Introduction

Instrumentation Northwest now offers an easy-to-read Modbus version for several of their popular AquiStar® Smart Sensors. These sensors communicate via Modbus RTU and directly return measurement readings, without any further math on the part of the host system.

The purpose of this document is to give details for communicating with these sensors for use by PLCs, SCADA systems, and any other applications that use Modbus RTU protocol.

Table of Contents

Installing Aqua4Plus Software 1
Direct Read General Information 2
- Communication Settings 2
- Register Addressing 2
- Data Format 3

Sensor Specific Information 3
- PT2X, LevelSCOUT, BaroSCOUT Pressure/Temperature Sensors 3
- PT12 Pressure/Temperature Sensors 7
- CT2X Conductivity/Temperature/Pressure Sensors 12
- GDL General Dataloggers 16
- TempHion pH/ORP/ISE Sensors 21
- Turbo Turbidity Sensors 26
- DO2 Dissolved Oxygen Sensors 29

Appendix – Power On Function 33

Installing Aqua4Plus Software

INW Smart Sensors come with the Aqua4Plus host software to be installed on your PC or laptop. If you will mainly be reading your sensor with another control program, you may still want to install the Aqua4Plus software package This software is used to set sensor options, such as the Modbus address, to program the datalogger for background recording, to retrieve data from the logger, to view collected data, and to export data to external files for use with spreadsheets or databases. Refer to the Aqua4Plus software manual for details on installing and using Aqua4Plus.

Note: in most places in this document any references to Aqua4Plus also apply to Aqua4Plus Lite, with the exception of changing the baud rate. You must use the standard Aqua4Plus program to change baud rates.

Direct Read General Information

Communication Settings

Your sensor comes configured to communicate at 38,400 baud, with 8 data bits, one stop bit, and no parity. The sensor can also be set to 19,200 or 9600 baud, if needed for your application. (Note: The LevelSCOUT and BaroSCOUT operate only at 38,400 baud.) You must use the standard version of Aqua4Plus to change baud rates.

Setting the Baud Rate in the Sensor (if needed)

If needed, set your sensor to the desired baud rate as follows:

- Connect your sensor to your computer. (Refer to the Aqua4Plus or sensor instruction manual for information on connecting your sensor to your computer.)
- Run Aqua4Plus version 1.9.1 or later.
- Scan for and click on your sensor.
- If your sensor contains any data you want to keep, upload that data now.
- Erase all sessions.
- Click on the Configure menu, and then select Advanced.
- From the flyout menu, select Sensor Baud Rate. (You may be asked for a password. The password is admin.) If you do not see the baud rate option, contact INW to be sure you have the correct firmware.
- On the popup box, click the down-arrow and select the baud rate you need, and then click OK.

Once you have changed the baud rate on the sensor, you will not be able to talk to it with Aqua4Plus until you change the baud rate for Aqua4Plus, as follows:

Click the Options menu, and then select Baud Rate.

On the popup box, click the down-arrow, select the baud rate you need, and then click OK.

The current baud rate is displayed in the lower right corner of the main Aqua4Plus window.

Register Addressing

The physical register addresses on AquiStar smart sensors start numbering from zero – the first address is 0, the second is 1, etc. On the other hand, Modbus protocol considers the first logical address to be 1, the second logical address to be 2, etc. For example, to take a pressure reading you have to read the physical address 62592.

Some programs and equipment when asked to read address 62592 will read that physical address. Others however will read that logical address, which is actually the physical address 62591. With these programs and equipment you must add a one to the address – thus in this example you would request a read at address 62593.

Still other programs and equipment require the addition of 400,000 to the address to indicate reading holding registers. These may or may not require the addition of one to the physical address. Check with your program and/or equipment documentation to determine what style of register addressing is required.

All readings are obtained using Modbus function 03-Read Holding Registers.

Data Format

The data is returned as a 32-bit IEEE floating-point value, high word first, also referred to as big-endian, float inverse, or Float AB CD.

Sensor Specific Information

PT2X, LevelSCOUT, and BaroSCOUT Pressure/Temperature Sensors

Firmware Requirements

In order to use the direct read Modbus capability, your sensor must have firmware version 1.5 or later. If you are unsure of your firmware version, you can determine the version as follows:

- Connect your sensor directly to your computer. (Refer to the Aqua4Plus or the sensor instruction manual for information on connecting your sensor to your computer.)
- Run Aqua4Plus and scan to locate your sensor. If more than one sensor is connected, be sure to highlight the correct one.
- Click on the button in the upper right corner of the sensor window. The firmware version will display in the drop down information box.

Firmware Version Summary

Firmware Version	Direct read supported	Can select units for direct read	Comments
Earlier than 1.0	No	No	Cannot be upgraded in field – must get new circuit board.
1.0 – 1.3	No	No	Contact INW to download firmware 1.5 for direct read support.
1.5	Yes	No	Cannot be upgraded in the field to support selecting units – must get new circuit board.
2.1	Yes	No	Contact INW to download 2.3 for selecting units
2.2 and above	Yes	Yes	

Selecting Units for Direct Read

These sensors by default use the following units:

- Temperature Degrees Celsius
- Pressure PSI

If you have firmware 2.2 or later, you can select from a variety of units. If you want to change to different units, for example, degrees Fahrenheit for temperature or meters of water for pressure, set these units using Aqua4Plus, as shown below:

- Connect your sensor to your computer.
- Run Aqua4Plus (Be sure that you have Aqua4Plus version 1.8.5 or later (1.9.2 or later recommended, 1.9.8 or later for BaroSCOUT or LevelSCOUT). Also, be sure you have the correct sensor firmware version, as described above.)
- Scan for and click on your sensor.
- Click on the Configure menu, and then select Advanced.
- From the flyout menu, select Direct Read Units. If you do not see this option, be sure your sensor is running the correct firmware.
- On the popup box, click the down-arrows next to the channel type you want to change, and then select the units you want to. (Note, this does not affect the units used on the Aqua4Plus display. Refer to the Aqua4Plus software manual for details on using Aqua4Plus.)
- Click OK

Register Addresses

With Firmware 1.5				
To read:	**Specified Address**	**+ 1**	**+ 400,000**	**+ 400,001**
Pressure	62592	62593	462592	462593
Temperature	62594	62955	462594	462595
Sample Programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital meters
With Firmware 2.1 or above				
To read:	**Specified Address**	**+ 1**	**+ 400,000**	**+ 400,001**
Temperature	62592	62593	462592	462593
Pressure	62594	62955	462594	462595
Sample Programs or equipment	Visual Basic,Modbus Poll	Modpoll		Precision Digital meters

Power Consideration

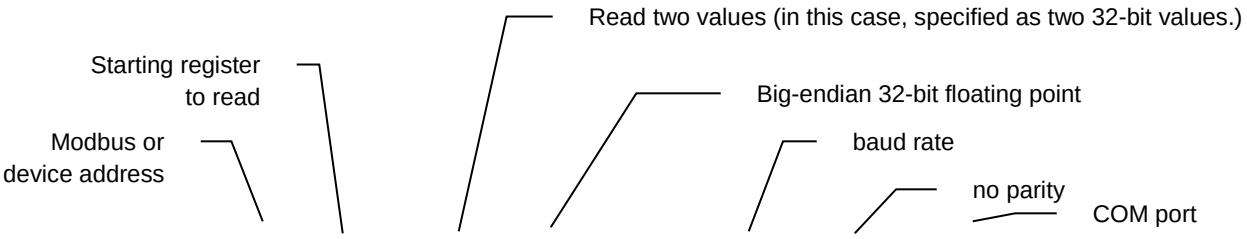
If your sensor is not powered continuously by internal batteries or an auxiliary power supply, then you must turn power on to the sensor at least two seconds before a reading is to be taken to allow the sensor to warm up.

Sample Readings

Sample Readings from Modpoll

Modpoll is a free FieldTalk™ Modbus Polling Utility, Copyright (c) 2002-2006 FOCUS Software Engineering Pty Ltd. A copy can be downloaded from: http://www.modbusdriver.com.

Following is the command line in Modpoll to take a pressure and temperature reading from a sensor on Modbus address seven. This sensor was connected to com port 4 on a PC.




```
C:\>modpoll -a7 -r62593 -c2 -t4:float -f -b38400 -pnone COM4
```

Results:

```
Polling slave (Ctrl-C to stop) ...
[62593]: 23.137499
[62595]: 0.123077
```

Temperature value

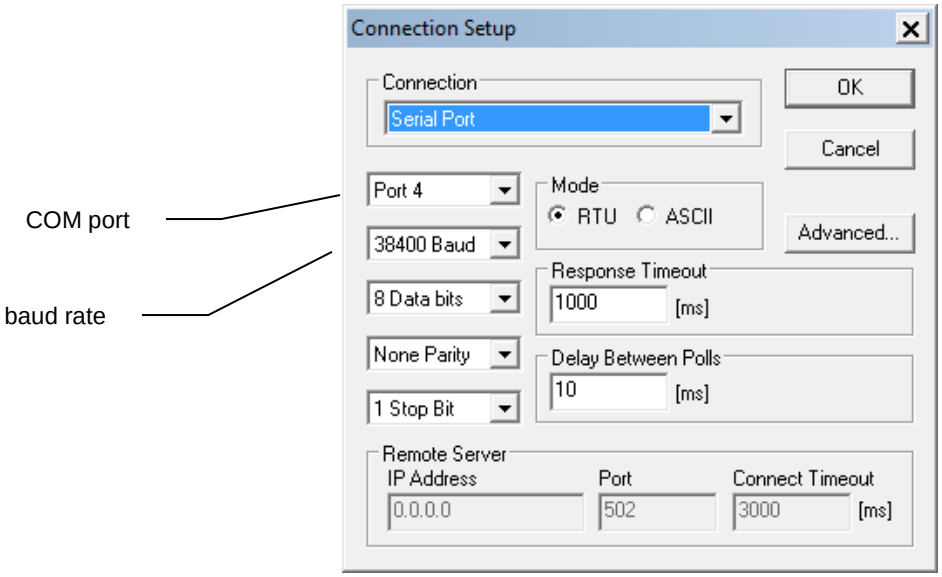
Pressure value

Note that the register address used is the specified address plus one. This command requested two floating point values. The program returned two16-bit registers for temperature (62593-4) and two for pressure (62595-6), interpreting both sets as 32-bit floating point values.

Sample Readings from Modbus Poll

Modbus Poll is a PC based polling program by Witte Software and is available from www.modbustools.com.
Below are the relevant windows from Modbus Poll, reading the same sensor as was read in the example above.

Connection Setup Window



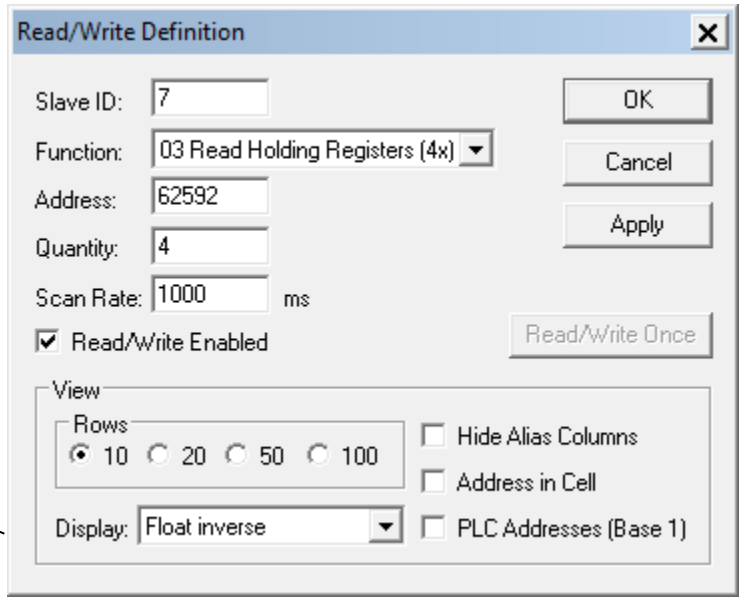
Read Request Window

Modbus or device address

Starting register to read – note this uses the specified address without adding 1.

Number of registers to read – in this case specified as four registers

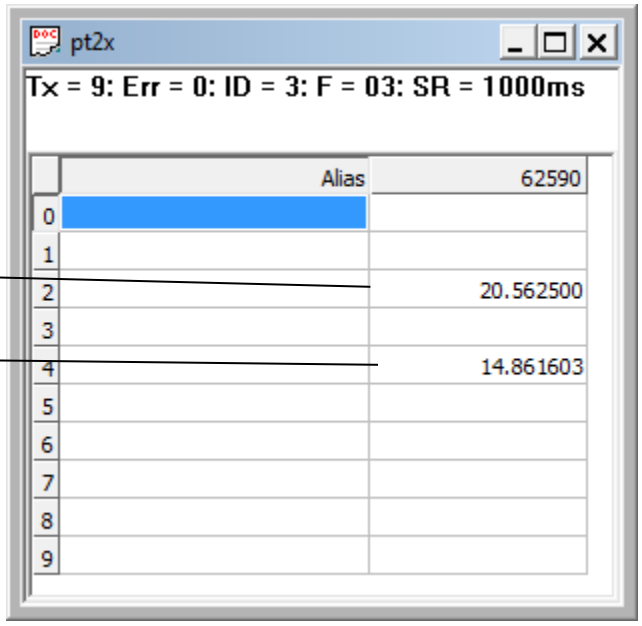
Big-endian 32-bit float (May say “Float Inverse” or “Float AB CD”)



Results Window

Temperature value

Pressure value



PT12 Pressure/Temperature Sensor

Power Consideration

If your sensor is not powered continuously by an auxiliary power supply, then you must turn power on to the sensor at least two seconds before a reading is to be taken to allow the sensor to warm up.

Register Definitions

Communication settings and Modbus® functions

The PT12 is configured to communicate with 8 data bits, one stop bit, and no parity. Default baud rate is 19200.

A Word about Register Addressing on a PT12

The physical register addresses on the PT12 start numbering from zero – the first address is 0, the second is 1, etc. On the other hand, Modbus protocol considers the first logical address to be 1, the second logical address to be 2, etc. For example, to take a pressure reading you have to read the physical address 0.

Some programs and equipment when asked to read address 0 will read that physical address. Others however will read that logical address, which is actually the physical address -1 (which does not exist). With these programs and equipment you must add a one to the address – thus in this example you would request a read at address 1.

Still other programs and equipment require the addition of 40,000 or 400,000 to the address to indicate reading holding registers. These usually also require the addition of one to the physical address. Check with your program and/or equipment documentation to determine what style of register addressing is required.

Like many common Modbus devices the PT12 returns readings starting at register address 0 (or 1 if using one-based addressing). For compatibility with other INW Smart Sensor equipment, the PT12 also returns these same readings starting at a register address 62592 (or 62593 if using one-based addressing).

Parameter Registers Using Standard Addressing				
	Zero-Based	**One-Based**	**+40,001**	**+400,001**
Pressure	0	1	40001	400001
Temperature	2	3	40003	400003
Power Supply Voltage	4	5	40005	400005
Averaged Pressure*	6	7	40007	400007
Maximum Pressure*	8	9	40009	400009
Minimum Pressure*	10	11	40011	400011
Averaged Temperature*	12	13	40013	400013
Sample programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital Meters

* See the *PT12 Instruction Manual* for details on setting the averaging window

Parameter Registers Using High Addressing *(to Match INW Smart Sensors - Available with firmware 0.13 and higher)*				
	Zero-Based	**One-Based**	**+40,001**	**+40,0001**
Pressure	62592	62593	N/A	462593
Temperature	62594	62595	N/A	462595
Power Supply Voltage	62596	62597	N/A	462597
Averaged Pressure*	62598	62599	N/A	462599
Maximum Pressure*	62600	62601	N/A	462601
Minimum Pressure*	62602	62603	N/A	462603
Averaged Temperature*	62604	62605	N/A	462605
Sample programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital Meters

* See the *PT12 Instruction Manual* for details on setting the averaging window

Readings and the Auto-Enable Setting

The PT12 is equipped with an Auto-Enable setting that controls how long the sensor is awake after taking a reading. (See the *PT12 Instruction Manual* for details on setting this value.) When a reading is requested, four things happen:

1. The sensor wakes up.
2. The current value in the register is returned.
3. The sensor turns on the analog portion, begins sampling, and begins putting the new values in the registers.

4a. If auto-enable is set to a positive value *w*, the sensor stays awake for *w* seconds, sampling and moving values into the registers all the while, and then goes to sleep.

4b. If auto-enable is set to zero, the sensor immediately goes to sleep after putting the reading in the register.

If your read frequency is less than the auto-enable value, the sensor will stay on continuously, and your readings will always be fresh, with the exception of the very first reading.

If your read frequency is greater than the auto-enable value, the following reading sequence is recommended:

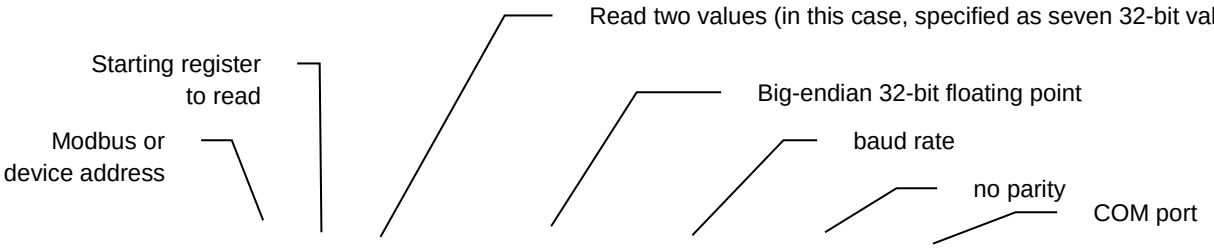
1. Request a reading. This begins the wakeup process on the sensor and returns the value currently in the register, which will be old data. Throw this value away.
2. Wait one second, then take another reading. This reading will have fresh data. Record this reading.

Sample Readings

Sample Readings from Modpoll

Modpoll is a free FieldTalk™ Modbus Polling Utility, Copyright (c) 2002-2006 FOCUS Software Engineering Pty Ltd. A copy can be downloaded from: http://www.modbusdriver.com.

Following is the command line in Modpoll to take a pressure and temperature reading from a sensor on Modbus address seven. This sensor was connected to com port 4 on a PC.




```
C:\>modpoll -a7 –r1 –c7 -t4:float -f –b19200 -pnone COM4
```

If using the high addresses, the **–r1** value would have been: **–r62593**
Results:

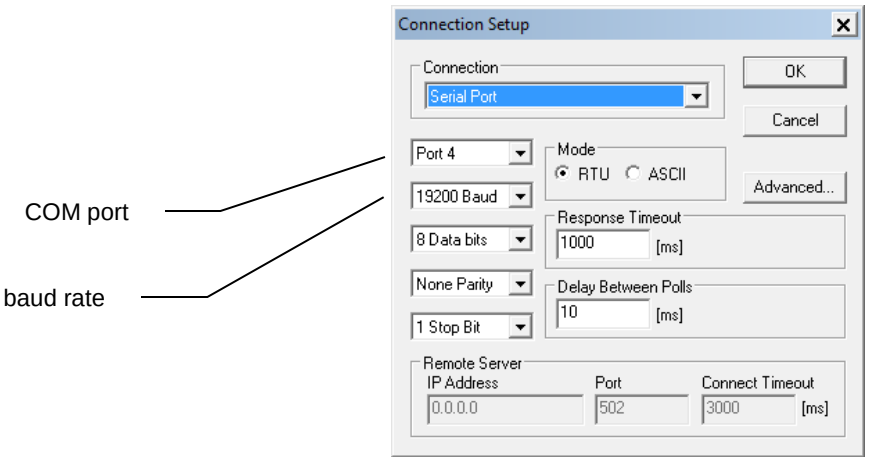
```
Polling slave (Ctrl-C to stop) ...
[1]:  14.883077   — Pressure value
[3]:  21.567499   — Temperature value
[5]:  11.723368   — Power supply voltage
[7]:  14.882629   — Averaged pressure
[9]:  14.892629   — Maximum pressure
[11]: 14.878765   — Minimum pressure
[13]: 21.645987   — Averaged temperature
```

Note that the register address used is the specified address plus one. This command requested two floating point values. The program returned two16-bit registers for pressure (1-2) and two for temperature (3-4), interpreting both sets as 32-bit floating point values.

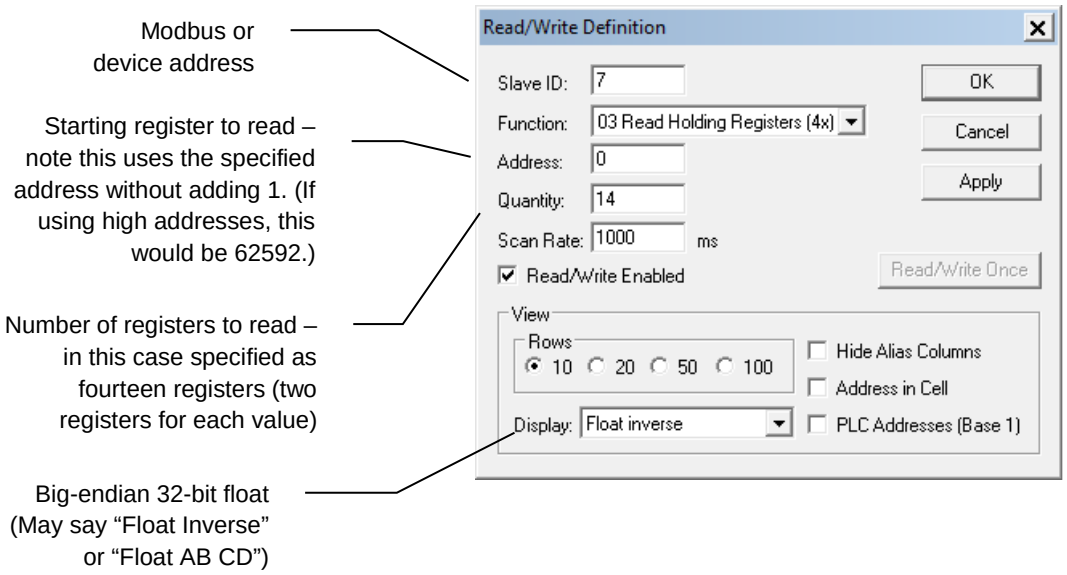
Sample Readings from Modbus Poll

Modbus Poll is a PC based polling program by Witte Software and is available from www.modbustools.com. Below are the relevant windows from Modbus Poll, reading the same sensor as was read in the example above.

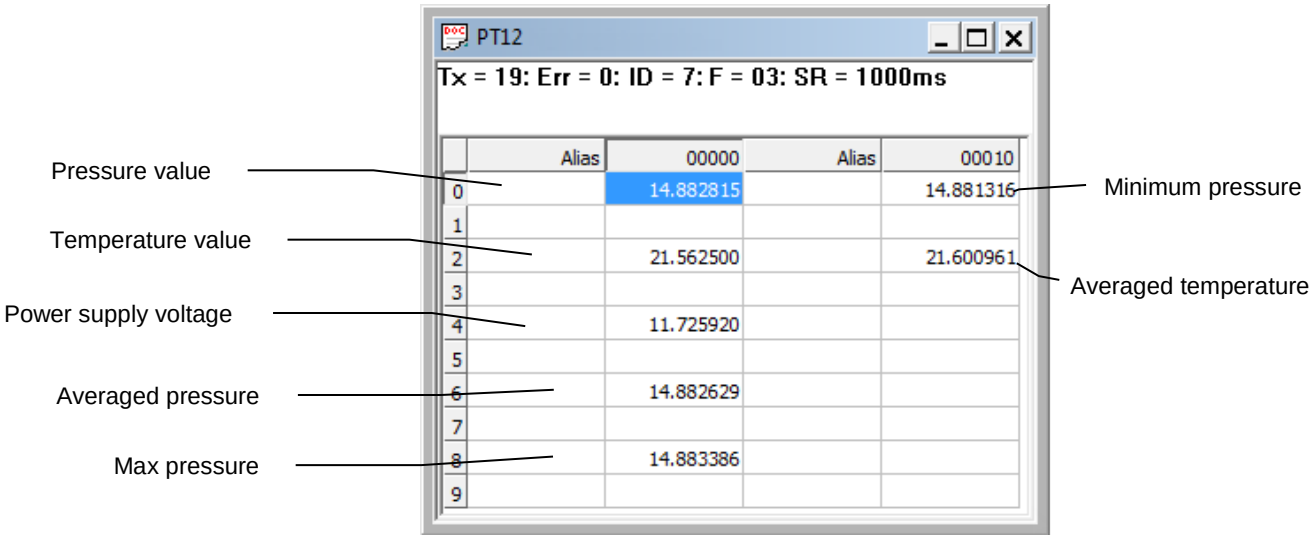
Connection Setup Window



Read Request Window



Results Window



CT2X Conductivity/Temperature/Pressure Sensor

Firmware Requirements for the CT2X

In order to use the direct read Modbus capability, your CT2X must have firmware version 1.5 or later. If you are unsure of your firmware version, you can determine the version as follows:

- Connect your sensor directly to your computer. (Refer to the Aqua4Plus or CT2X Instruction manual for information on connecting your sensor to your computer.)
- Run Aqua4Plus and scan to locate your sensor. If more than one sensor is connected, be sure to highlight the correct one.
- Click on the button in the upper right corner of the sensor window. The firmware version will display in the drop down information box.

Firmware Version Summary

Firmware Version	Direct read supported	Can select units for direct read	Comments
Earlier than 1.0	No	No	Cannot be upgraded in field – must get new circuit board.
1.5	Yes	No	Cannot be upgraded in the field to support selecting units – must get new circuit board.
2.0	Yes	No	Contact INW to download 2.3 for selecting units
2.1	Yes	No	Contact INW to download 2.3 for selecting units
2.2 – 2.7	Yes	Yes	Units can be set for temperature and pressure only
2.8 and above	Yes	Yes	Salinity and TDS added

Selecting Units for Direct Read

The CT2X by default uses the following units:

- Temperature Degrees Celsius
- Conductivity µS/cm
- Pressure PSI
- Salinity PSU
- TDS mg/L

If you have firmware 2.2 or later, you can select from a variety of units. If you want to change to different units, for example, degrees Fahrenheit for temperature or meters of water for pressure, set these units using Aqua4Plus, as shown below. Note: Conductivity is always returned in µS/cm. Salinity is always returned in PSU; TDS is always returned in mg/L.

- Connect your sensor to your computer.
- Run Aqua4Plus (Be sure that you have Aqua4Plus version 1.8.5 or later (1.9.2 or later recommended). Also, be sure you have the correct sensor firmware version, as described above.)
- Scan for and click on your sensor.
- Click on the Configure menu, and then select Advanced.
- From the flyout menu, select Direct Read Units. If you do not see this option, be sure your sensor is running the correct firmware.
- On the popup box, click the down-arrows next to the channel type you want to change, and then select the units you want to. (Note, this does not affect the units used on the Aqua4Plus display. Refer to the Aqua4Plus software manual for details on using Aqua4Plus.)
- Click OK

Register Addresses

To read:	Specified Address	+ 1	+ 400,000	+ 400,001
Temperature	62592	62593	462592	462593
Conductivity - Linear	62594	62595	462594	462595
Conductivity - nLFn	62596	62597	462596	462597
Pressure	62598	62599	462598	462599
Salinity	62600	62601	462600	462601
TDS	62602	62603	462602	462603
Sample Programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital meters

Power Consideration

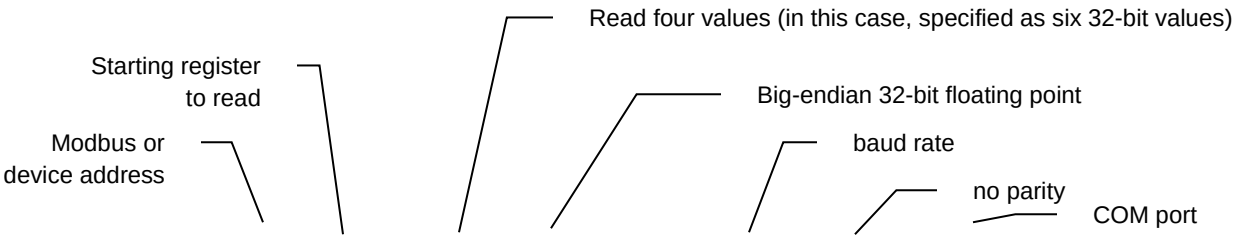
If your sensor is not powered continuously by internal batteries or an auxiliary power supply, then you must turn power on to the sensor at least five seconds before a reading is to be taken to allow the sensor to warm up.

Sample Readings

Sample Readings from Modpoll

Modpoll is a free FieldTalk™ Modbus Polling Utility, Copyright (c) 2002-2006 FOCUS Software Engineering Pty Ltd. A copy can be downloaded from: http://www.modbusdriver.com.

Following is the command line in Modpoll to take temperature, conductivity, and pressure readings from a sensor on Modbus address two. This sensor was connected to com port 4 on a PC.




```
C:\>modpoll -a2 -r62593 -c4 –t6:float -f -b38400 -pnone COM4

Polling slave (Ctrl-C to stop) ...
```

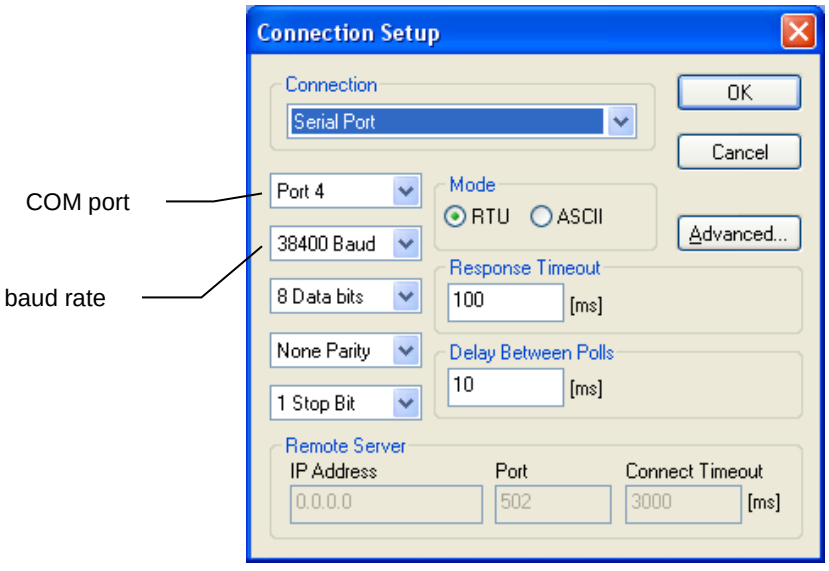
[62593]: 39.096756 — Temperature (degrees C)
[62595]: 2297.144775 — Conductivity – Linear (µS/cm)
[62597]: 2274.558105 — Conductivity – nLFn (µS/cm)
[62599]: 10.049695 — Pressure (PSI)
[62601]: 0.198327 — Salinity (PSU)
[62603]: 206.375214 — TDS (mg/L)

Note that the register address used is the specified address plus one. This command requested four floating point values. The program returned two16-bit registers for temperature (62593-4), and two for linear conductivity (62595-6), two for non-linear conductivity (62597-8), and two for pressure (62599-600), interpreting each set as a 32-bit floating point value.

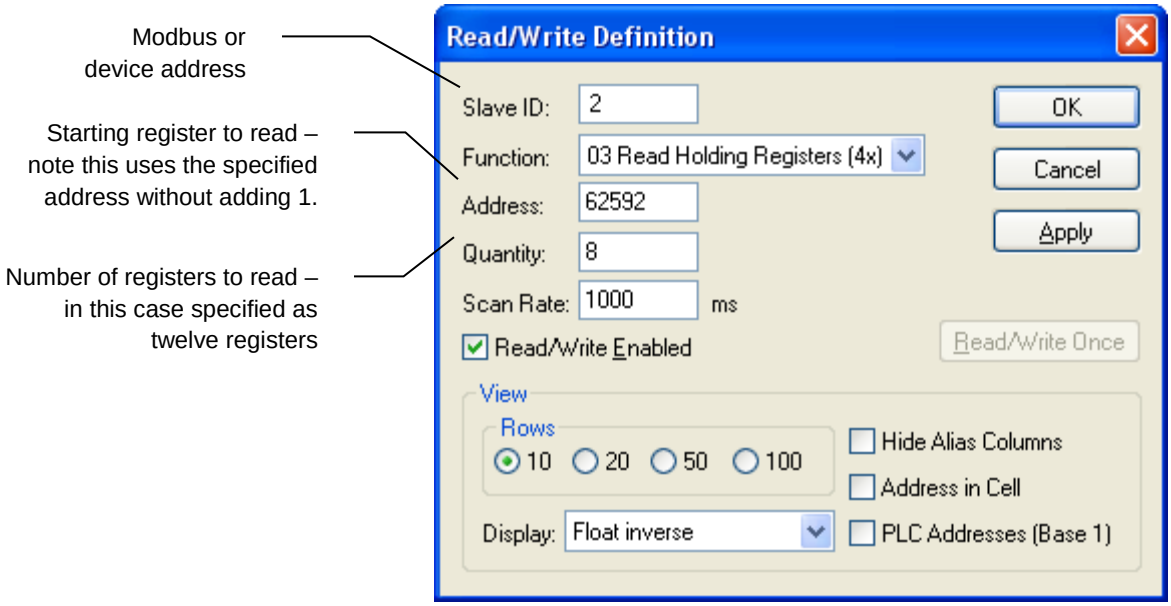
Sample Readings from Modbus Poll

Modbus Poll is a PC based polling program by Witte Software and is available from www.modbustools.com.
Below are the relevant windows from Modbus Poll, reading the same sensor as was read in the example above.

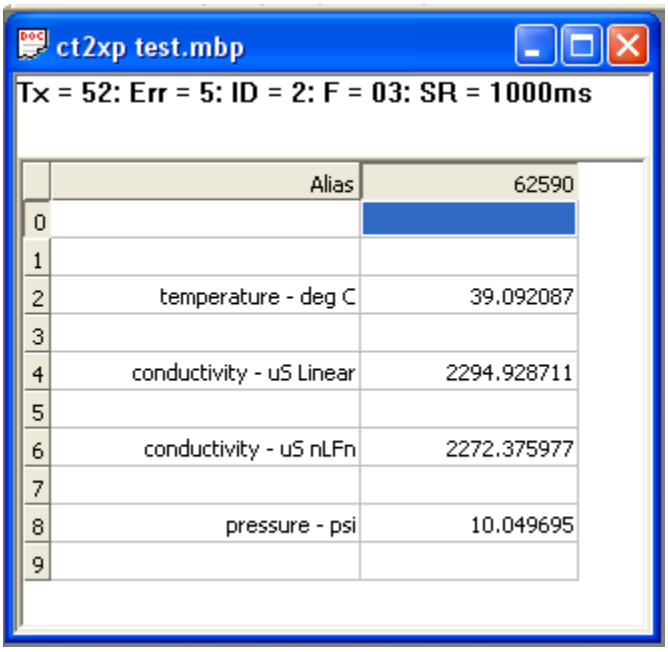
Connection Setup Window



Read Request Window



Results Window



	Alias	62590
0		
1		
2	temperature - deg C	39.092087
3		
4	conductivity - uS Linear	2294.928711
5		
6	conductivity - uS nLFn	2272.375977
7		
8	pressure - psi	10.049695
9		

GDL General Datalogger

NOTE: See Power ON information in the Appendix.

Firmware Requirements for the GDL

In order to use the direct read Modbus capability, your GDL must have firmware version 2.5 or later. If you are unsure of your firmware version, you can determine the version as follows:

- Connect your sensor directly to your computer. (Refer to the Aqua4Plus or GDL Instruction manual for information on connecting your sensor to your computer.)
- Run Aqua4Plus and scan to locate your sensor. If more than one sensor is connected, be sure to highlight the correct one.
- Click on the button in the upper right corner of the sensor window. The firmware version will display in the drop down information box.

Firmware Version Summary

Firmware Version	Direct read supported	Can select units for direct read	Comments
Earlier than 2.5	No	No	Cannot be upgraded in field – must get new circuit board.
2.5 or later	Yes	Yes	

Selecting Units for Direct Read

The GDL by default uses the following units:

- Temperature Degrees Celsius
- mV mV
- Voltage Volts
- 4-20 mA mA

You can select from a variety of units. If you want to change to different units, for example, degrees Fahrenheit for temperature or or mV for voltage, set these units using Aqua4Plus, as shown below.

- Connect your sensor to your computer.
- Run Aqua4Plus (Be sure that you have Aqua4Plus version 1.8.509 or later (1.9.2 or later recommended). Also, be sure you have the correct sensor firmware version, as described above.)
- Scan for and click on your sensor.
- Click on the Configure menu, and then select Advanced.
- From the flyout menu, select Direct Read Units. If you do not see this option, be sure your sensor is running the correct firmware.
- On the popup box, click the down-arrows next to the channel type you want to change, and then select the units you want to. (Note, this does not affect the units used on the Aqua4Plus display. Refer to the Aqua4Plus software manual for details on using Aqua4Plus.)
- Click OK

Register Addresses

Standard GDL Channels				
To read:	**Specified Address**	**+ 1**	**+ 400,000**	**+ 400,001**
Temperature 1	62592	62593	462592	462593
Temperature 2	62594	62595	462594	462595
mV	62596	62597	462596	462597
Voltage 1	62598	62599	462598	462599
Voltage 2	62600	62601	462600	462601
4-20 mA 1	62602	62603	462602	462603
4-20 mA 2	62604	62605	462604	462605
Sample Programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital meters

Digital GDL Channels				
To read:	**Specified Address**	**+ 1**	**+ 400,000**	**+ 400,001**
If Configured for Dissolved Oxygen				
DO 1	62606	62607	462606	462607
DO Temperature 1	62608	62609	462608	462609
DO 2	62610	62611	462610	462611
DO Temperature 2	62612	62613	462612	462613
DO 3	62614	62615	462614	462615
DO Temperature 3	62616	62617	462616	462617
DO 4	62618	62619	462618	462619
DO Temperature 4	62620	62621	462620	462621
If Configured Heart Rate Monitor				
Heart Rate	62606	62607	462606	462607
If Configured for Tipping Bucket Rain Gauge				
Rainfall	62606	62607	462606	462607

If Configured for Generic Digital Channels				
Digital 1	62606	62607	462606	462607
Digital 2	62608	62609	462608	462609
Digital 3	62610	62611	462610	462611
Digital 4	62612	62613	462612	462613
Digital 5	62614	62615	462614	462615
Sample Programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital meters

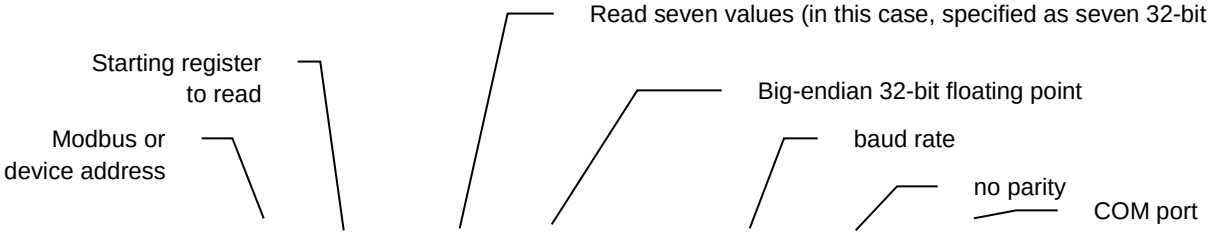
Sample Readings

Sample Readings from Modpoll

Modpoll is a free FieldTalk™ Modbus Polling Utility, Copyright (c) 2002-2006 FOCUS Software Engineering Pty Ltd. A copy can be downloaded from: http://www.modbusdriver.com.

Specify the number of values you want to read and the starting address. For example, to read the seven standard channels, specify 7 values starting at 62593. To read only the first dissolved oxygen and DO temperature channels, specify 2 values starting at 62607.

Following is the command line in Modpoll to take readings from the seven standard channels from a sensor on Modbus address two. This sensor was connected to com port 4 on a PC.




```
C:\>modpoll -a2 -r62593 –c7 -t4:float -f -b38400 -pnone COM4

Polling slave (Ctrl-C to stop) ...
```

[62593]: 24.254608 — Temperature (degrees C)
[62595]: 21.458041 — Temperature (degrees C)
[62597]: 138.24154 — mV channel (mV)
[62599]: 1.5868882 — Voltage (volts)
[62601]: 3.6587415 — Voltage (volts)
[62603]: 10.049695 — 4-20 mA (mA)
[62605]: 15.624782 — 4-20 mA (mA)

Note that the register address used is the specified address plus one. This command requested seven floating point values. The program returned two16-bit registers for each channel, interpreting each set as a 32-bit floating point value.

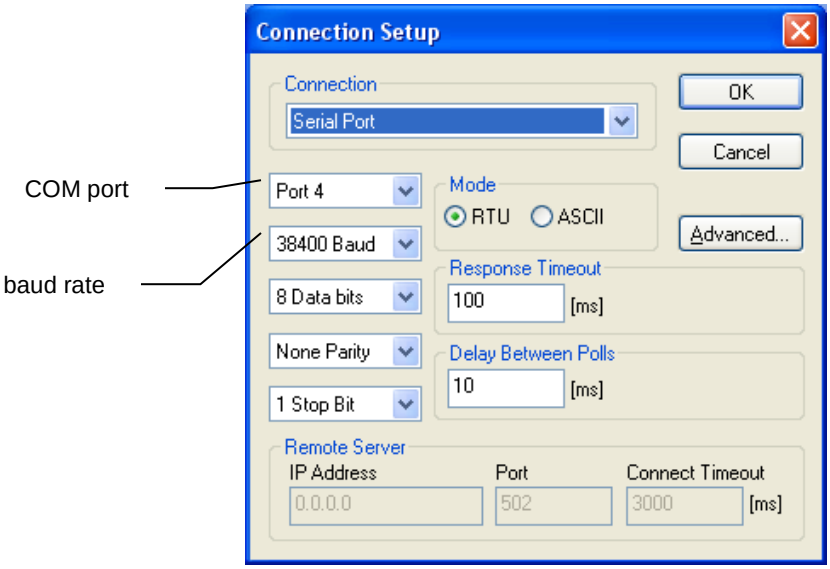
Sample Readings from Modbus Poll

Modbus Poll is a PC based polling program by Witte Software and is available from www.modbustools.com.

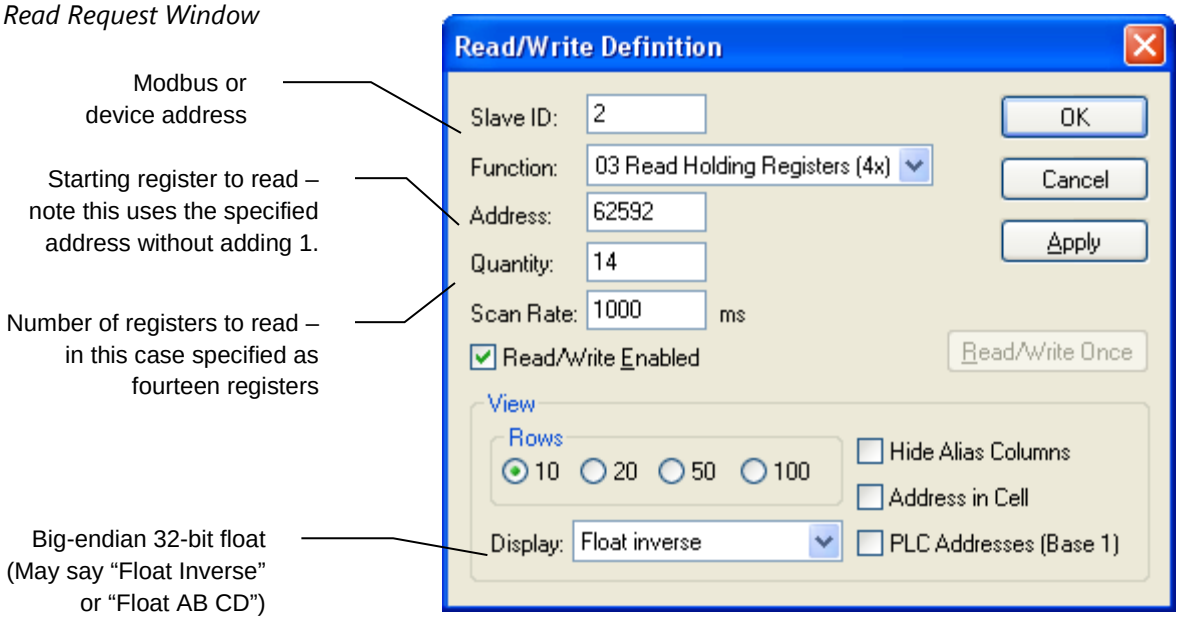
Specify **twice** the number of values you want to read and the starting address. For example, to read the seven standard channels, specify 14 values starting at 62592. To read only the first dissolved oxygen and DO temperature channels, specify 4 values starting at 62606.

Below are the relevant windows from Modbus Poll, reading the same sensor as was read in the example above.

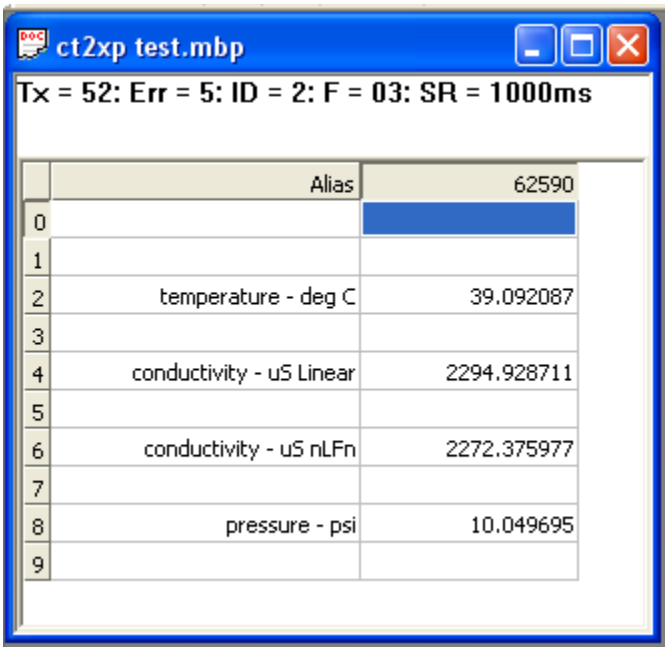
Connection Setup Window



Read Request Window



Results Window



	Alias	62590
0		
1		
2	temperature - deg C	39.092087
3		
4	conductivity - uS Linear	2294.928711
5		
6	conductivity - uS nLFn	2272.375977
7		
8	pressure - psi	10.049695
9		

TempHion pH/ISE/Redox (ORP) Sensors

Firmware Requirements for the TempHion

In order to use the direct read Modbus capability, your TempHion must have firmware version 1.1 or later. If you are unsure of your firmware version, you can determine the version as follows:

- Connect your sensor directly to your computer. (Refer to the Aqua4Plus or TempHion Instruction manual for information on connecting your sensor to your computer.)
- Run Aqua4Plus and scan to locate your sensor. If more than one sensor is connected, be sure to highlight the correct one.
- Click on the button in the upper right corner of the sensor window. The firmware version will display in the drop down information box.

Firmware Version Summary

Firmware Version	Direct read supported	Can select units for direct read	Comments
Earlier than 1.0	No	No	Cannot be upgraded in field – must get new circuit board.
1.0	No	No	Can be upgraded
1.1	Yes	Yes	Cannot be upgraded in the field
2.0 or higher	Yes	Yes	

Selecting Units for Direct Read

The TempHion has up to five data channels. The first channel is always temperature and returns a value in one direct read location. The Temperature channel by default uses degrees Celsius. If you want to change to different units, for example, degrees Fahrenheit, set these units using Aqua4Plus, as shown below.

- Connect your sensor to your computer.
- Run Aqua4Plus (Be sure that you have Aqua4Plus version 1.8.511 or later (1.9.2 or later recommended). Also, be sure you have the correct sensor firmware version, as described above.)
- Scan for and click on your sensor.
- Click on the Configure menu, and then select Advanced.
- From the flyout menu, select Direct Read Units. If you do not see this option, be sure your sensor is running the correct firmware.
- On the popup box, click the down-arrows next to Temperature, and then select the units you want to. (Note, this does not affect the units used on the Aqua4Plus display. Refer to the Aqua4Plus software manual for details on using Aqua4Plus.)
- Click OK

The remaining channels are mV channels and are configured at the factory as pH, ISE, or ORP channels. Each of the mV channels returns two direct read values, a mV value and a fully calibrated pH, ISE, or ORP value.

Register Addresses

For firmware 2.5 or higher:

Sample Addresses and Programs/Equipment				
To read:	**Specified Address**	**+ 1**	**+ 400,000**	**+ 400,001**
Temperature	62592	62593	462592	462593
pH in pH units	62594	62595	462594	462595
ISE in ppm	62596	62597	462596	462597
ORP in Eh	62598	62599	462598	462599
pH in mV	62600	62601	462600	462601
ISE in mV	62602	62603	462602	462603
ORP in mV	62604	62605	462604	462605
Sample Programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital meters

For firmware prior to 2.5:

Sample Addresses and Programs/Equipment				
To read:	**Specified Address**	**+ 1**	**+ 400,000**	**+ 400,001**
Temperature	62592	62593	462592	462593
pH in mV	62594	62595	462594	462595
ISE in mV	62596	62597	462596	462597
ORP in mV	62598	62599	462598	462599
pH in pH units	62600	62601	462600	462601
ISE in ppm	62602	62603	462602	462603
ORP in Eh	62604	62605	462604	462605
Sample Programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital meters

Power Consideration

If your sensor is not powered continuously by internal batteries or an auxiliary power supply, then you must turn power on to the sensor at least two seconds before a reading is to be taken to allow the sensor to warm up.

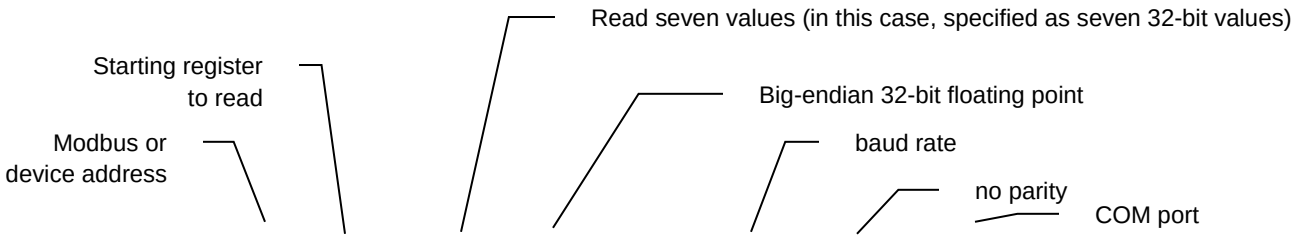
Sample Readings

Sample Readings from Modpoll

Modpoll is a free FieldTalk™ Modbus Polling Utility, Copyright (c) 2002-2006 FOCUS Software Engineering Pty Ltd. A copy can be downloaded from: http://www.modbusdriver.com.

Specify the number of values you want to read and the starting address. For example, assume you have a sensor with one temperature channel and the first mV channel configured for pH, the second as ISE, and the third as Redox. To read all values, specify 7 values starting at 62593.

Following is the command line in Modpoll to take as described above from a sensor on Modbus address two. This sensor was connected to com port 4 on a PC.




```
C:\>modpoll -a2 -r62593 –c7 -t4:float -f -b38400 -pnone COM4

Polling slave (Ctrl-C to stop) ...
```

```
[62593]: 26.456451   — Temperature (degrees C)
[62595]: 1.5830430   — pH in pH units
[62597]: 0.0124540   — ISE in ppm
[62599]: 0.0124540   — Redox in Eh
[62601]: 52.517487   — pH in mV
[62603]: 138.11003   — ISE in mV
[62605]: -0.000183   — Redox in mV
```

Sample values are for illustration purposes only – not intended to represent real readings.

Note that the register address used is the specified address plus one. This command requested three floating point values. The program returned two16-bit registers for each channel, interpreting each set as a 32-bit floating point value.

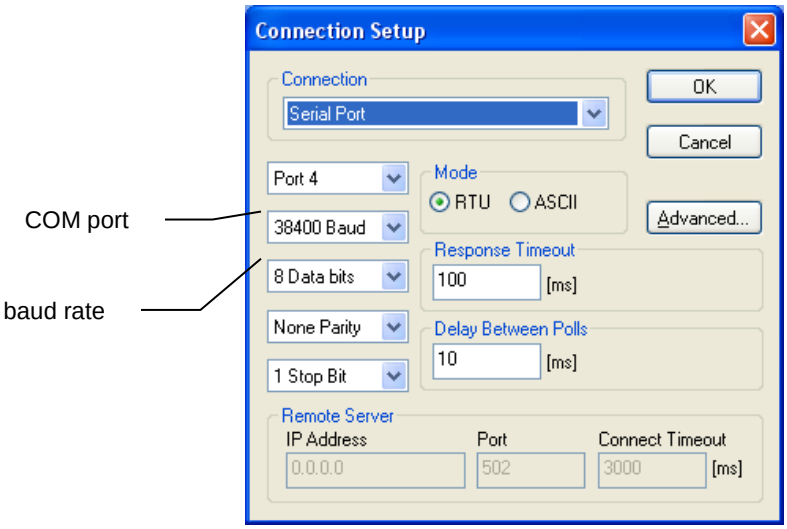
Sample Readings from Modbus Poll

Modbus Poll is a PC based polling program by Witte Software and is available from www.modbustools.com.

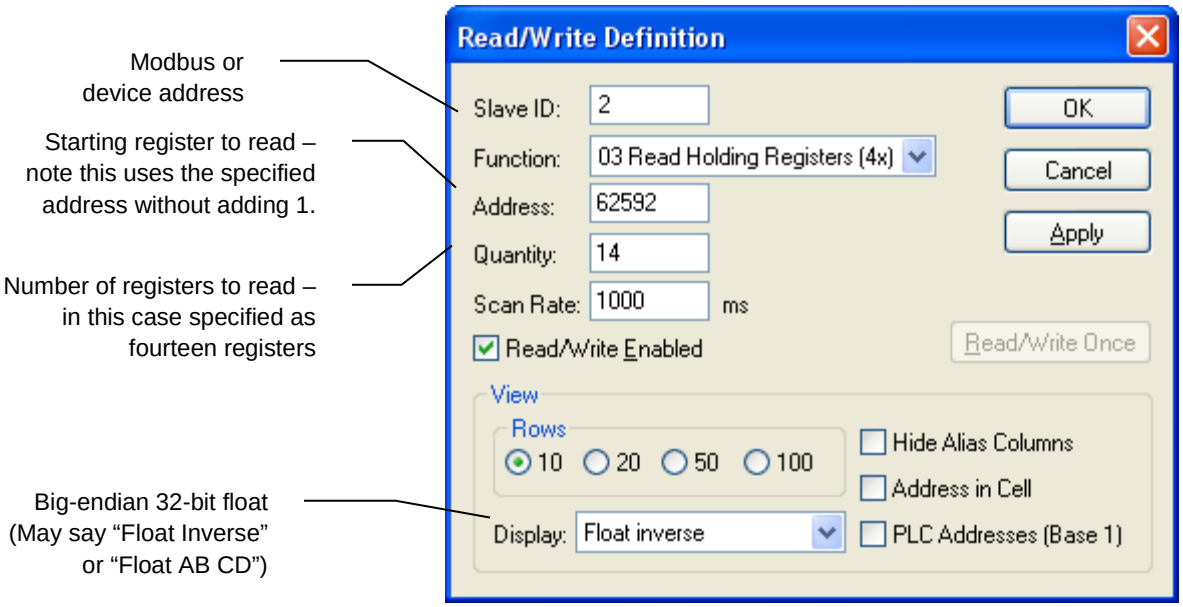
Specify **twice** the number of values you want to read and the starting address. For example, to read sensor shown in the above example, specify 14 values starting at 62592..

Below are the relevant windows from Modbus Poll, reading the same sensor as was read in the example above.

Connection Setup Window



Read Request Window



Results Window

	Alias	62590	Alias	62600
0			Ch2-mV	-127.149
1				
2	Ch1 - temp	20.1215	Ch3-mV	108.53
3				
4	Ch2 - pH	7.0764	Ch4-mV	39.4775
5				
6	Ch3 - ppm	0.0359909		
7				
8	Ch4 - Eh	413.843		
9				

Sample values are for illustration purposes only – not intended to represent real readings.

Turbo Turbidity Sensor

NOTE: See Power ON information in the Appendix.

Firmware Requirements for the Turbo

In order to use the direct read Modbus capability, your Turbo must have firmware version 2.0 or later. If you are unsure of your firmware version, you can determine the version as follows:

- Connect your sensor directly to your computer. (Refer to the Aqua4Plus Instruction manual for information on connecting your sensor to your computer.)
- Run Aqua4Plus and scan to locate your sensor. If more than one sensor is connected, be sure to highlight the correct one.
- Click on the button in the upper right corner of the sensor window. The firmware version will display in the drop down information box.

Units for Direct Read

The Turbo uses the following units:

- Temperature Degrees Celsius
- Turbidity NTU

Register Addresses

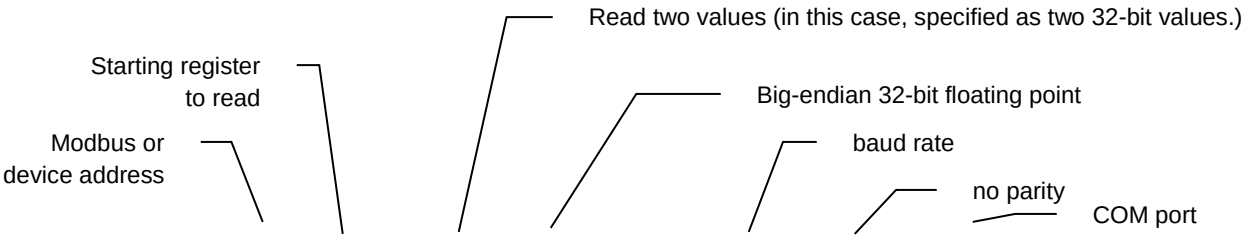
To read:	Specified Address	+ 1	+ 400,000	+ 400,001
Temperature	62592	62593	462592	462593
Turbidity	62594	62955	462594	462595
Sample Programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital meters

Sample Readings

Sample Readings from Modpoll

Modpoll is a free FieldTalk™ Modbus Polling Utility, Copyright (c) 2002-2006 FOCUS Software Engineering Pty Ltd. A copy can be downloaded from: http://www.modbusdriver.com.

Following is the command line in Modpoll to take a pressure and temperature reading from a sensor on Modbus address seven. This sensor was connected to com port 4 on a PC. (Note: This sample is on a sensor with firmware 1.5, which returns pressure and then temperature. If using a sensor with firmware 2.1 or above, temperature will be returned first, followed by pressure.)




```
C:\>modpoll –a1 -r62593 -c2 -t4:float -f -b38400 -pnone COM4
```

Results:

```
Polling slave (Ctrl-C to stop) ...
[62593]:  23.137499
[62595]: 498.982934
```

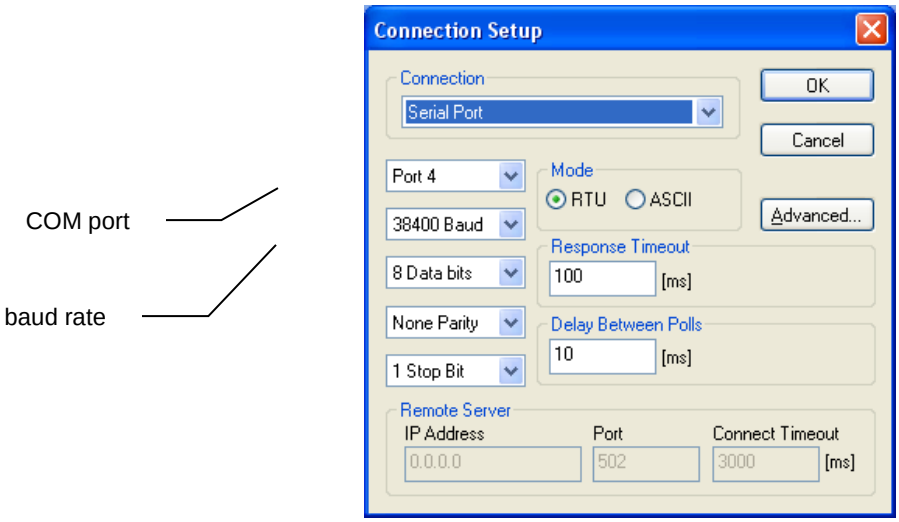
— Temperature value
— Turbidity value

Note that the register address used is the specified address plus one. This command requested two floating point values. The program returned two16-bit registers for temperature (62593-4) and two for turbidity (62595-6), interpreting both sets as 32-bit floating point values.

Sample Readings from Modbus Poll

Modbus Poll is a PC based polling program by Witte Software and is available from www.modbustools.com.
Below are the relevant windows from Modbus Poll, reading the same sensor as was read in the example above.

Connection Setup Window



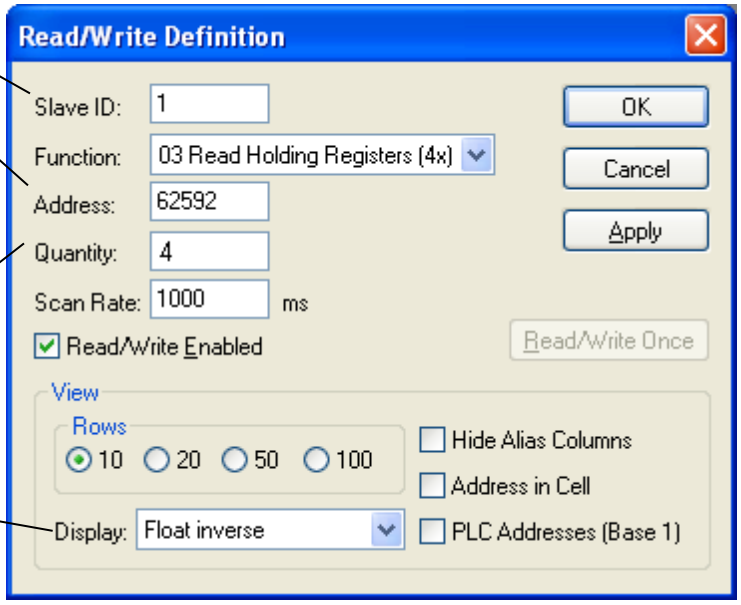
Read Request Window

Modbus or device address

Starting register to read – note this uses the specified address without adding 1.

Number of registers to read – in this case specified as four registers

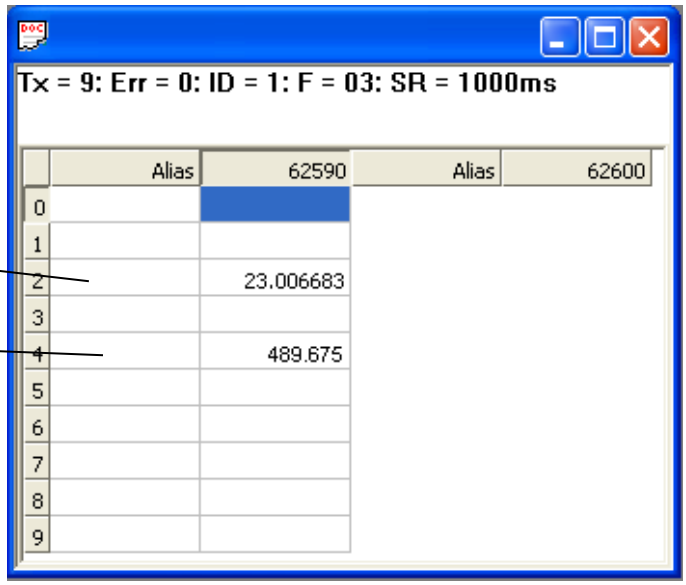
Big-endian 32-bit float (May say “Float Inverse” or “Float AB CD”)



Results Window

Temperature value

Turbidity value



DO2 Dissolved Oxygen Sensor

NOTE: See Power ON information in the Appendix.

Firmware Requirements for the DO2

In order to use the direct read Modbus capability, your DO2 must have firmware version 2.0 or later. If you are unsure of your firmware version, you can determine the version as follows:

- Connect your sensor directly to your computer. (Refer to the Aqua4Plus Instruction manual for information on connecting your sensor to your computer.)
- Run Aqua4Plus and scan to locate your sensor. If more than one sensor is connected, be sure to highlight the correct one.
- Click on the button in the upper right corner of the sensor window. The firmware version will display in the drop down information box.

Units for Direct Read

The DO2 uses the following units:

- Temperature (on board) Degrees Celsius
- Pressure PSI
- Power Volts
- Dissolved Oxygen ppm
- Temperature (on DO probe) Degrees Celsius

Register Addresses

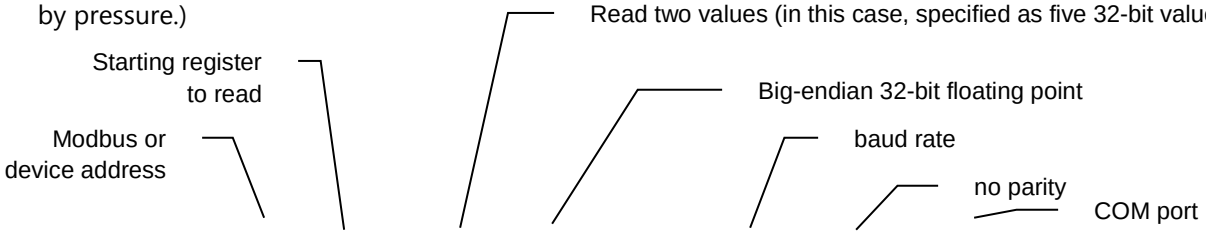
To read:	Specified Address	+ 1	+ 400,000	+ 400,001
Temperature (on board)	62592	62593	462592	462593
Pressure	62594	62955	462594	462595
Power	62596	62597	462596	462597
DO	62598	62599	462598	462599
Temperature (on DO probe)	62600	62601	4625600	462601
Sample Programs or equipment	Visual Basic, Modbus Poll	Modpoll		Precision Digital meters

Sample Readings

Sample Readings from Modpoll

Modpoll is a free FieldTalk™ Modbus Polling Utility, Copyright (c) 2002-2006 FOCUS Software Engineering Pty Ltd. A copy can be downloaded from: http://www.modbusdriver.com.

Following is the command line in Modpoll to take a pressure and temperature reading from a sensor on Modbus address seven. This sensor was connected to com port 4 on a PC. (Note: This sample is on a sensor with firmware 1.5, which returns pressure and then temperature. If using a sensor with firmware 2.1 or above, temperature will be returned first, followed by pressure.)




```
C:\>modpoll –a1 -r62593 –c5 -t4:float -f -b38400 -pnone COM4
```

Results:

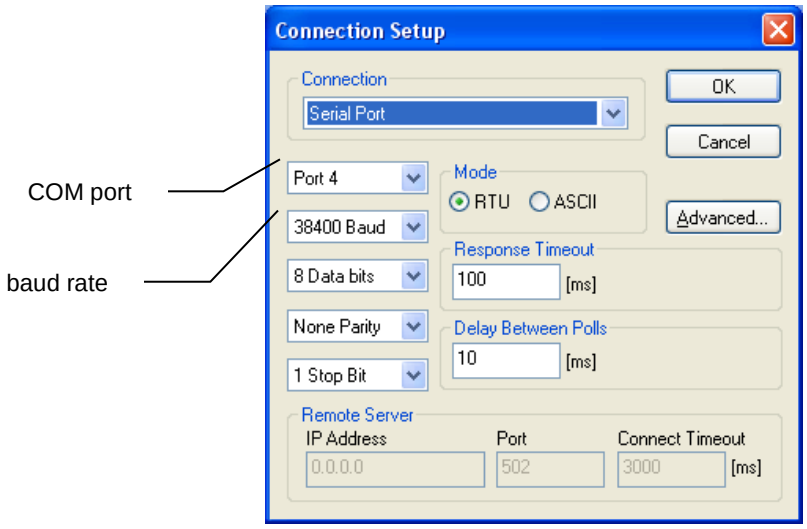
```
Polling slave (Ctrl-C to stop) ...
[62593]: 23.137499   — Temperature value (on board)
[62595]: 14.982934   — Pressure value
[62595]: 12.137499   — Power value
[62595]:  3.982934   — DO value
[62595]: 19.137499   — Temperature value (on DO probe)
```

Note that the register address used is the specified address plus one. This command requested five floating point values. The program returned ten16-bit registers, interpreting each set as a 32-bit floating point value.

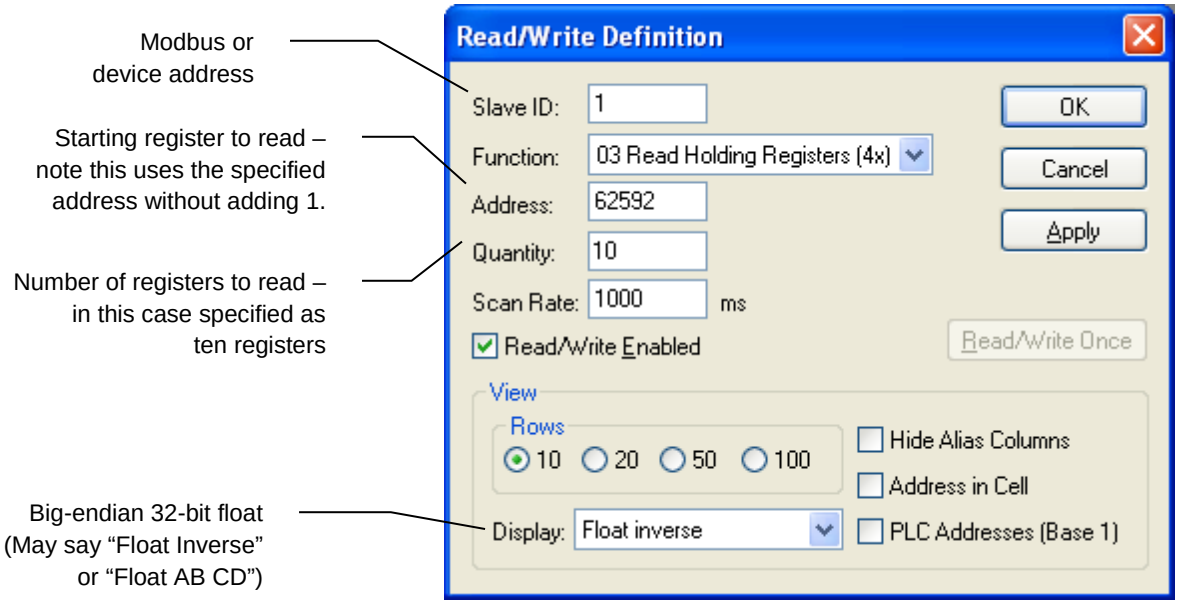
Sample Readings from Modbus Poll

Modbus Poll is a PC based polling program by Witte Software and is available from www.modbustools.com. Below are the relevant windows from Modbus Poll, reading the same sensor as was read in the example above.

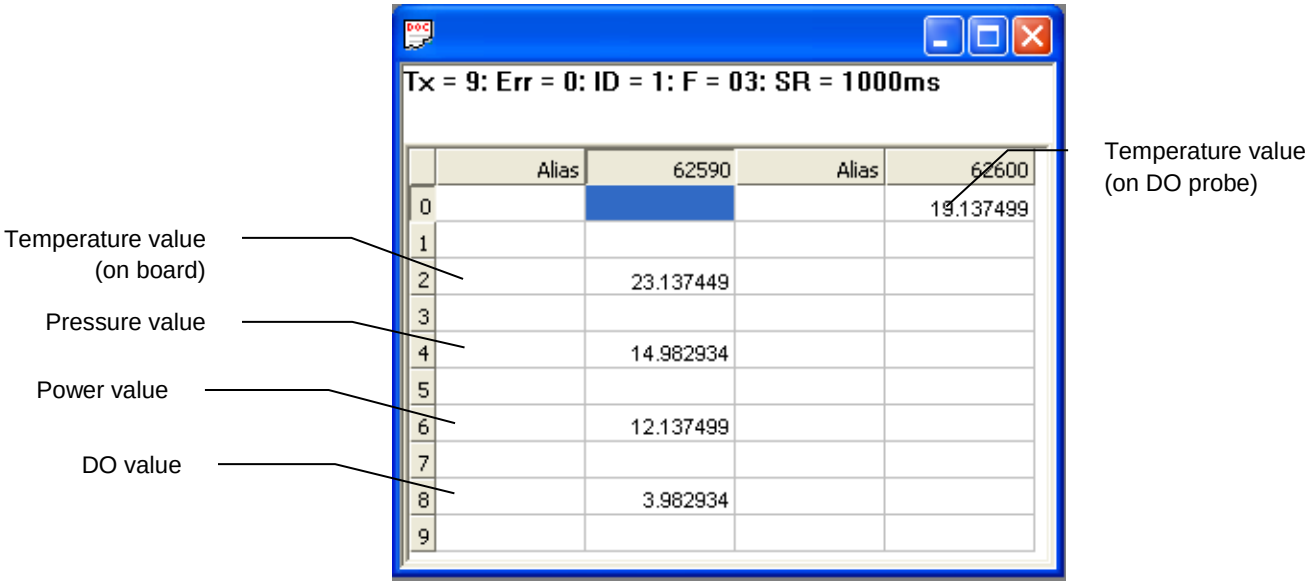
Connection Setup Window



Read Request Window



Results Window



Appendix: Power On Function – GLD, Turbo, and DO2

The GDL Datalogger has the ability to supply switched power to any connected sensors. To save power, this power remains off until a reading is requested. At that time the power is turned on. Similarly, the Turbo Sensor and the DO2 Sensor only supply power to the sensing elements when a reading is requested. The power then remains on for a certain time period, as listed below.

While this power is automatically turned on when a reading is requested, some devices require a warm-up or stabilization time after application of power before accurate readings can be taken. The Power On function provides a means to turn the power on prior to taking a reading to allow for stabilization. This same function allows you to specify how long the circuit remains on after a reading has been taken.

Basic functionality of the Power On Function

The Power On function is controlled by the value in the Power On register (register 62720 or 0xF500). When a positive value "n" is written to this register, the power is turned on to the sensing probe or connected sensors and remains on for n/4 seconds. When a reading is requested, the timer is reset and the sensing probe or connected sensors remain on for another n/4 seconds. To force the power off immediately after a reading, for power savings, write a zero to the register. If the power to the entire sensor is turned off, this value defaults as shown below:

GDL Datalogger: 30 (7.5 seconds)

Turbo Sensor: 48 (12 seconds)

DO2 Sensor: 30 (7.5 seconds)

Recommended method for best power savings

Write PowerOn value of N (N/4 seconds)

`Turns power on`

`Starts sampling about two times per second`

After warm up time*, request a reading

`Returns most recent reading`

`Resets PowerOn to N`

Write PowerOn value of 0

`Turns power off`

`Retains last reading`

* Warm-up/stabilization times vary depending on sensing elements. Adjust these values as needed for connected sensors on GDL units. Use default values, as listed above, for Turbo and DO2.

**Be sure to start your reading before n/4 seconds to ensure the sensing elements are still on.

If you cannot write the Power On value

If you are reading your device using a meter or other device that cannot write the Power On but simply takes readings on a specified schedule, be sure to set the polling interval to less than the defaults listed at the beginning of this appendix. That way the device is always powered up and readings should be fresh and stable. Note that the first reading when you turn on the device and meter will be old but will refresh very quickly.

Modbus is a registered trademark of Sneider Electric