

# Modbus Installation and Instruction Manual

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#### Modbus Communication Set-up and Installation

#### I. Background

Modbus, developed in 1979, is a serial communications protocol to be used with programmable logic controllers (PLCs) to read or write digital messages sent over the network. It is perhaps one of the most widely used communication protocols as it is free to use, easy to program and maintain, and was developed specifically for industrial use. Using a master/slave network, it can transmit data in real time giving it an advantage over other networks. Modbus can support up to 247 devices and is used to define both the physical layer (electrical connections) and the application layer (way in which to communicate). All devices on the network must have the same physical configuration consisting of the data format and baud rate.

Before setting up/installing the Modbus communication network onto Hydro Instruments equipment, familiarize yourself with the information contained in this packet. If you have any questions please contact Hydro Instruments.

*Electrical Warning:* Programming these devices does include electrical shock risk. Take care to avoid electrical shocks and do not touch any part of the power line unless you are certain the power has been disconnected.

#### II. Definitions

*Physical Layer:* The physical layer is the actual hardware and electrical termination set-up used to connect the master and slaves together for Modbus communication. All Hydro Instruments equipment outlined in this document supports "Modbus RTU" on a 2-wire RS-485 network.

Baud Rate: The baud rate is the modulation of the signal between devices.

*Node:* The node is the programmed number given to the slave so that the master can communicate specifically with that unit when requested. Thus, each unit should have its own unique node number.

*Application Layer:* This is the layer closest to the end user. It interacts with the software application to display information in a human-recognizable format.

*Master:* The master is the main controller of the network (some programmers may be more familiar with the "server"). There can only be one master per network which is the only device that can read and write information to the other devices (or slaves). The master may be a computer or any type of SCADA system.

*Slave:* The slave, or "client", is any PLC connected to the master. Each slave will have a specific node which will be used by the master to communicate to that specific PLC.

*Function Code:* The function code tells the slave what type of information is being requested by the master. This information may either be to read or write bits, or to read or write registers. The function code is an integer from 1 to 127 and that number is interpreted by the slave as to what information is requested. Thus, the same function code may serve two different purposes on two different instruments.

*Data Address:* The data address in decimal format is an indexing integer uniquely identifying each variable stored by the selected device.

*Data Quantity:* The data quantity tells the slave how many bits or registers of data are going to the data address.

## III. Support Types (Physical/Electrical Standards)

#### **1.** *RS-485*

The RS-485 network is supported by Hydro Instruments equipment and is the most commonly used physical layer. It allows for connection to multiple slaves (up to 247), has excellent noise immunity, high speed (up to 35Mbps), and cables can be used up to 4,000 feet. The RS-485 version of Modbus is commonly referred to as Modbus RTU. Aside from the physical connections, the user must define the baud rate and the data format so that both the master and the slave have the same format. The data formats and baud rates that are supported can be seen in Table 1.

2. Address Data Format - The published Modbus addresses are decimal addresses and use the standard notation prefix for decimal (no prefix).

Data Format	Baud Rates
8/N/1	2400
8/N/2	4800
8/E/1	9600
8/O/1	19200
	38400
	57600
	115200
	250000

#### Table 1. Data Formats and Baud Rates Supported by Hydro Instruments

Hydro Instruments uses a half-duplex (2 wire) interface type. Hydro Instruments also recommends that the slaves be "daisy chained" together so that only one connection to the master is required. Cat 5 cable is the recommended cable to use and the wiring should be installed according to Table 2.

Table 2.	Wiring	connections for	Modbus RTU
----------	--------	-----------------	------------

CAT 5 Cable	RS-485 Terminal	Equipment Terminal
Brown & white	V+	
Blue &white	A	A
Blue	В	В
Brown	V-(GND)	GND

The RS-485 network requires a "termination resistor" installed at either end of the network when using very long cable runs (>300 feet) at high baud rates (> 19200). Contact Hydro Instruments for more information.

## **3.** *TCP/IP*

This network architectural model can be used to communicate through Ethernet or WiFi and has the advantage of being able to control Modbus devices over the internet. This version is referred to as Modbus TCP/IP. Hydro Instruments does not currently sell the devices for this communication and recommends using an intermediate hub which can connect to the RS-485 terminal. The user can then communicate to the hub using the configuration outlined in Section III.1, and then communicate to this hub over the internet. Contact your supplier for installation information.

### **IV.** Programming Equipment onto the Network:

#### 1. Programing Omni-Valves (OV-110 and OV-1000)

Programming Omni-valves (slaves) should be performed after the physical layer has been installed (Section III). Omni-valves purchased after October 2013 will be standard equipped to communicate with Modbus. If purchased before said date, contact Hydro Instruments.

- **I.** Determine the baud rate and data format of the master controller.
- **II.** From the main screen, press the "down" key until the password screen appears. Enter the password, "110" (OV-110) or "1000" (OV-1000) using the "plus" and "minus" keys.
- **III.** Once the correct password appears on the screen, continue to press the down key until the text "ADCAL" is blinking, then press the plus key.
- **IV.** Press the down key once so that "Yes" is blinking. Press and hold the "down" key for approximately 5-10 seconds.
- **V.** A new set of screens should appear. Go down two screens using the "down" key until the "Modbus" screen appears.
- **VI.** Use the "plus" key to select the baud rate.
- **VII.** Press the "down" key once. Then enter the node number using the "plus" key. Save this number to program the master controller and to ensure the same number is not given to two units.
- **VIII.** Press the "down" key once. Then enter the data format using the "plus" key.
  - **IX.** Cycle the power to save the information.

### 2. Programming Vaporizers (VPH-10000)

Programming Vaporizers should be performed after the physical layer has been installed (Section III). Refer to the steps below to configure the VPH-10000 vaporizer baud rate, node number and data format to communicate with the network.

- **I.** Determine the baud rate and data format of the master controller.
- **II.** From the main screen, press the "down" key until the password screen appears. Enter the password "100" using the "plus" and "minus" keys.
- **III.** Once the correct password is blinking continue to press the down key until the Modbus screen appears.
- **IV.** Using the "plus" and "minus" keys, enter the baud rate that matches the master/server.
- V. Press the "down" key so that the node number is blinking and enter the node number using the "plus" and "minus" keys. Save this number and make sure it does not match with any other equipment on the network.
- **VI.** Press the "down" key so that the data format is blinking. Enter the data format that matches the master/server.
- **VII.** Cycle the power to save the information.

### 3. Programming GA-180 Gas Leak Detectors

Programming the GA-180 Gas Detectors should be performed after the physical layer has been installed (Section III). Refer to steps below (and GA-180 O&M Manual Figure 8) to configure the GA-180 baud rate, node number, and data format to communicate with the network.

- I. Determine the baud rate and data format of the master controller.
- II. From the main screen, press the "down" key until the password screen appears. Enter the password "180" using the "plus" and "minus" keys.
- III. Once the correct password is blinking press the down arrow key. Then with "Sensor" blinking, press and hold the "minus" key until the Modbus setup screen appears.
- IV. Using the "plus" and "minus" keys, enter the baud rate that matches the master/server.
- V. Press the "down" key so that the node number is blinking and enter the node number using the "plus" and "minus" keys. Save this number and make sure it does not match with any other equipment on the network.
- VI. Press the "down" key so that the data format is blinking. Enter the data format that matches the master/server.
- VII. Cycle the power to save the information.

## 4. Programming CS-110 Automatic Changeover Controller

Programming the CS-110 Automatic Changeover controllers should be performed after the physical layer has been installed (Section III). Refer to steps below (and CS-110 O&M Manual) to configure the CS-110 baud rate, node number, and data format to communicate with the network.

- I. Determine the baud rate and data format of the master controller.
- II. From the main screen, press the "down" key until the password screen appears. Enter the password "110" using the "plus" and "minus" keys.
- III. Once the correct password is blinking press the down arrow key. Then continue to press the "down" key until the Modbus setup screen appears.
- IV. Using the "plus" and "minus" keys, enter the baud rate that matches the master/server.
- V. Press the "down" key so that the node number is blinking and enter the node number using the "plus" and "minus" keys. Save this number and make sure it does not match with any other equipment on the network.
- VI. Press the "down" key so that the data format is blinking. Enter the data format that matches the master/server.
- VII. Cycle the power to save the information.

## 5. Programming RAH-210, RPH-250, RPH-260, RAH-280, and WQM-100 Analyzers

Programming the Residual Analyzers should be performed after the physical layer has been installed (Section III). Refer to steps below (and O&M Manuals) to configure the residual analyzer baud rate, node number, and data format to communicate with the network.

- I. Determine the baud rate and data format of the master controller.
- II. From the main screen, press and hold the "down" key for at least 5 seconds until the first hidden screen appears. Use the "down" key to navigate to the 12<sup>th</sup> hidden screen which is the Modbus setup screen.
- III. Using the "plus" and "minus" keys, enter the baud rate that matches the master/server.
- IV. Press the "down" key so that the node number is blinking and enter the node number using the "plus" and "minus" keys. Save this number and make sure it does not match with any other equipment on the network.
- V. Press the "down" key so that the data format is blinking. Enter the data format that matches the master/server.
- VI. Cycle the power to save the information.

### 6. Programming TH-4000 Turbidimeter, GA-171 Gas Detector, HC-220 PID Controller

Programming the TH-4000 Turbidimeter, GA-171 Gas Detector, or HC-220 PID Controller should be performed after the physical layer has been installed (Section III). Refer to steps below to configure the baud rate, node number, and data format to communicate with the network.

- I. Determine the baud rate and data format of the master controller.
- II. From the main screen, press and hold the "down" key for at least 5 seconds until the Modbus setup screen appears.
- III. Using the "plus" and "minus" keys, enter the baud rate that matches the master/server.
- IV. Press the "down" key so that the node number is blinking and enter the node number using the "plus" and "minus" keys. Save this number and make sure it does not match with any other equipment on the network.
- V. Press the "down" key so that the data format is blinking. Enter the data format that matches the master/server.
- VI. Cycle the power to save the information.

### V. Programming Masters:

Be sure that the electrical terminations are complete and accurate. Also confirm that the baud rate and data format are the same on the master as they are on the slaves. Different software may have different ways of displaying and programming information on the device, however the function code and addresses for the specified equipment will be the same regardless of the software being used. Refer to the tables below for setting the equipment parameters on the master/server.

#### **Function Code Designations:**

Function Code	Function Name	Description	Request Packet Size	Response Packet Size
01	read coils	read 1 to 2000 bits	8	5 or 6 + N/8
02	read discrete inputs	read 1 to 2000 bits	8	5 or 6 + N/8
03	read hold registers	read 1 to 125 registers	8	5 + 2N
04	read input registers	read 1 to 125 registers	8	5 + 2N
05	write a single coil	write 1 bit	8	8
06	write a single register	write 1 register	8	8
15	write multiple coils	write 1 to 2000 bits	9 or 10 + N/8	8
16	write multiple registers	write 1 to 123 registers	9 + 2N	8

#### Table 3. Description of Function Codes for Hydro Instruments Equipment

#### VARIABLE ADDRESSES AND REGISTER VALUES

\*Values are read only and cannot be edited by the user.

**\*\***The decimal positions can be read but should not be written over Modbus since they can only be changed on the display.

The variable type defines whether or not the data stored in the register is a real time value/number (float/floating point) or if the number will correspond to a feature or command (integer). In the case of integers, values have been developed so that the Omni-valve can change and display features like units, the control type, or control alarms and relays over the Modbus network. The following definitions for integer type values can be seen in table 5.

The Omni-valve integer type values correspond to Modbus registers. The Omni-valve float values correspond to two Modbus registers in which the float data is in the IEEE 754 format (32 bit). Using this format the first address reads/writes the most significant 16 bits, whereas the second address reads/writes the least significant 16 bits.

Name	Туре	Address	Register Value	Feature
			0	Automatic
Run Mode	Integer	0	1	Manual
			2	Check Valve Position
			0	Normal
			1	Flow Signal Loss
			2	Low Flow
Alarm Status	Intogor	1	3	Res/ORP Loss
Alarm Status	Integer	1	4	Low Residual
			5	High Residual
			6	Flow + Resl Loss
			7	Dose Signal Loss
	Integer		0	Flow Pacing
			1	Residual/ORP
Control Method		2	2	Compound Loop
			3	Step Feed
			4	Dual Input Feed Fwd
			0	%
			1	GPM
			2	MGD
Process Variable 1 Units	Integer	3	3	LPM
			4	MLD
			5	GPD
			6	m³/hr
			0	ppm
Process Variable 2 Units	Integer	4	1	mg/l
			2	mV

## Table 4. Modbus OV-110 and OV-1000 Omni-valveVariable Addresses, Register Values, and Features

			3	рН
			4	GPD
			0	%
			1	PPD
			2	a/hr
			3	kg/hr
Process Output 1 Units	Integer	5	4	GPH
•	5		5	GPM
			6	GPD
			7	LPM
			8	LPH
*PV1	Float	6/7		
PV1 Dosage	Float	8/9		
PV1 Span	Float	10/11		
PV1 Low Set	Float	12/13		
*PV2	Float	14/15		
PV2 Set Point	Float	16/17		
PV2 Span	Float	18/19		
PV2 Integral	Float	20/21		
PV2 Low Set	Float	22/23		
PV2 High set	Float	24/25		
*PO1	Float	26/27		
PO1 Span	Float	28/29		
PO1 Manual	Float	30/31		
*PV3	Float	32/33		
PV3 Set Point	Float	34/35		
PV3 Span	Float	36/37		
PV3 Integral	Float	38/39		
PV1 Enable	Integer	51	0 = Mc	odbus, 1 = 4-20mA input
PV2 Enable	Integer	52	0 = Mo	odbus, 1 = 4-20mA input
PV3 Enable	Integer	53	0 = Mc	odbus, 1 = 4-20mA input
PV2 Lag Time Mode	Integer	54	0 = fixed,	1 = single point, 2 = 2 point
PV2 F1	Integer	55		
PV2 T1	Integer	56		Time in Seconds
PV2 F2	Integer	57		
PV2 T2	Integer	58		Time in Seconds
PV3 Lag Time Mode	Integer	59	0 = fixed,	1 = single point, 2 = 2 point
PV3 F1	Integer	60		
PV3 T1	Integer	61		Time in Seconds
PV3 F2	Integer	62		
PV3 T2	Integer	63		Time in Seconds
PO1 GFM	Integer	64		In PO1 Units
PO1 GFM Span	Integer	65		In PO1 Units
PO1 GFM Error	Integer	66		10% to 100%

\*Values are read only and cannot be edited by the user. However, PV1, PV2, and PV3 can each be selected to either be read at the analog input channels or set over Modbus.

## Table 5. Modbus VPH-10000 VaporizerVariable Addresses, Register Values, and Features

Name	Туре	Address	Register Value	Feature
*Gas Temperature	Integer	1		
*Gas Pressure	Integer	2		
Gas Pressure Span	Integer	3		
High Pressure Alarm Level	Integer	4		
*Superheat Temperature	Integer	5		
Superheat Alarm Set Point	Integer	6		
*Control Water Temperature	Integer	7		
Water Temperature Set Point	Integer	8		
High Temperature Alarm Set Point	Integer	9		
Low Temperature Alarm Set Point	Integer	10		
*Aux Water Temperature	Integer	11		
			0	Normal
*Water Level	Intogor	12	1	High
	Integer	12	2	Low
			3	Low Low
*Heater Power Output (kW)	Integer	13	-	
*Heater Power Output (%)	Integer	14	-	
*Heater Element Temperature	Integer	15		
Temperature Units	Integer	16	0	Celsius
	Integer	10	1	Fahrenheit
Pressure   Inits	Integer	17	0	PSI
	Integer	17	1	Bar
			0	Normal
			2	Low Water Temperature
			3	High Water Temperature
			4	Heater Over Temperature
			5	Superheat Alarm
*Alarm Status	Integer	18	6	High Water Alarm
			7	Low Water Alarm
			8	PRV Burst Disc
			0	EXP Burst Disc High
			3	Pressure
			10	High Pressure

\*Values are read only and cannot be edited by the user.

Table 6. Modbus GA-180 Gas DetectorVariable Addresses, Register Values, and Features

Name	Туре	Address	Description				
*SensorLive(1 through 16)	Array of Integers	1 through 16	Array holds all 16 live sensor values (ppm or %)	For example 75 = 7.5ppm			
SensorType(1 through 16)	Array of Integer Bit Fields	17 through 32	Array holds the sensor co sensors. Each integer val following fields: b23-b16 = Filter Time b15-b8 = Alarm Delay Tin b6 = Engineering Units (f b5 = Latch Enable b4 = Fail Safe Enable b3-b0 = Gas Type	onfiguration for all 16 ue is a bit field, with the me D=ppm, 1=%)			

b23 b22



1 0 0 1 = 9  $\rightarrow$  H<sub>2</sub>S (Hydrogen sulfide)

SensorSpan(1 through 16)	Array of Integers	33 through 48	Array holds a sensor span v	ll 16 alues	Fc 100	or example ) = 10.0ppm
				Intege	r Value	Status
		40	Arrov bolds all	(	)	Off
*ConcorStatuc(1 through 16)	Array of	49 through 64	Array noius air		L	Normal
"Sensor Status (1 through 10)	Integers		64 status values	-	2	Danger
					3	Alarm
				4	1	Error
LowAlarm(1 through 16)	Array of Integers	65 through 80	Array holds a sensor low alarm	ray holds all 16 r low alarm values		or example ) = 1.0ppm
HighAlarm(1 through 16)	Array of	81	Array holds a	ll 16	or example	

	Integers	through 96	sensor high a values	larm	20 = 2.0ppm		
*Temperature	Integer	97	Live temperatur thermocour (C or F)	re from ple	Fo	or example 75 = 75F	
	Integer		Tomporaturo	Intege	r Value	<i>Status</i>	
*TempStatus		98	status	1	L	High Temp	
				2	2	Error	
TempSetup	Integer Bit Field	99, 100, 101	A bit field which holds the temperature configuration: b16 = Temp Units (0=C, 1=F) b15-b8 = Alarm Delay Time b7-b0 = High Alarm Temp (C or F)				



b16	b15	b14	b13	b12	b11	b10	6q	b8	b7	9q	b5	b4	٤q	2q	b1	0q
Alarm Delay Time						High Alarm Temp										

↓ Temp Units

RemoteAck	Integer	102	Remote acknowledg	ge	Set to 1 to remote acknowledge alarm	
*Anyl owAlarm	Integer	103	Indicates any	Intege	r Value	Status No Alarm
	AnyLowAlam Integer 103			1		Any Alarm
		104	Indicates any	Intege	r Value	Status
*AnyHighAlarm	Integer		sensor high	(	)	No Alarm
			alarm	1		Any Alarm
			Indicates any	Intege	r Value	Status
*AnyFailAlarm	Integer	105	sensor fail	0		No Alarm
			alarm	1		Any Alarm

\*Values are read only and cannot be edited by the user.

#### Table 7. Modbus CS-110 Automatic Changeover Controller Variable Addresses, Register Values, and Features

Name	Туре	Address	Description					
			Integer Value	State				
*\/16+>+o	Integer	1	0	Off				
visiale	Integer	T	1	On				
			2	Empty				
V1RunMins	Integer	2	Run time in minutes					
*V1Scale	Float	3,4	Scale reading (e.g., 868 kg)					
V1ScaleSpan	Float	5,6	Scale span value (e.g., 1,000 kg)					
			Integer Value	State				
*\/26+>+o	Intogor	11	0	Off				
vzstate	Integer	11	1	On				
			2	Empty				
V2RunMins	Integer	12	Run time i	n minutes				
*V2Scale	Float	13,14	Scale reading (e.g., 868 kg)					

V2ScaleSpan	Float	15,16	Scale span value (e.g., 1,000 kg)					
			Int	eger Value	Setting			
ScaleUnits	Testa e a u	20		0	Off			
(Enable / Scale Units)	Integer	20		1	Kg (kilograms)			
				2	Pd (pounds)			
OnDelayTime	Integer	21		Valve turn on dela	y time in seconds			
BomotoAck	Integor	22	Bomot	o ocknowlodgo	Set to 1 to remote			
RemoteAck	Integer	22	Keniou		acknowledge alarm			
			Remote	Integer Value	Behavior			
***DomotoCtrl	Integor	22	control	0	Turn OFF both valves			
RemoteCtri	Integer	23	for	1	Turn ON valve 1			
			valves	2	Turn ON valve 2			

**\*\*\***Value is not persistent, and the command is ignored when tanks are empty.

## Table 8. Modbus RAH-210 and RPH-250 Residual AnalyzersVariable Addresses, Register Values, and Features

Name	Туре	Address	Description						
*Temp	Integer	1	Temperature (C o	live disp r F)	layed	Fo		r example 74 = 74F	
TempManual	Integer	2	Temp r (Kelvin	nanual x 10)		For example 2555 = 255.5K, dis still shows C or 1		r example 255.5K, display shows C or F	
					Intege	r Value	е	Setting	
TempMode	Integer	3	Temp mod	e	(	)		Auto	
					1			Manual	
				_	Intege	r Value	е	Setting	
TempUnits	Integer	4	Temp unit	s	0			C (Celsius)	
					-	1		F (Fahrenheit)	
*Ph	Integer	10	pH live calib	rated va	alue		Fo	r example	
	incegei	10	(pH x 100)			4	425	5 = 4.25 pH	
				I		r Value	е	Setting	
		11	pH mode		(	)		Auto	
PhMode	Integer				1			Manual	
					2			Monitor	
		12			<u></u>	3		None	
PhFilterTime	Integer	12	pH	average	e filter tir	ne in s	ie in seconds		
PhManual	Integer	13	pH manu		5		10	r example	
			(pH x	100)		4	425	<u>e = 4.25 pH</u>	
PhLow	Integer	14	pH low ala	arm vait	le		ר0 ⊿רג	r example	
			(µ⊓ x n⊎ high al	<u>100)</u>		•	423 Eo	<u> </u>	
PhHigh	Integer	15	pH nigh alarm value			4	425	= 4.25  nH	
			(pri x	Hexad	lecimal V	'alue	Fle	oat Scale Factor	
	Flow		Flow	110/100	0x50	urue		x 1	
**FlowDP	Hex	20	decimal		0x31			x 10	
					0x22			x 100	
					0x13			x 1000	

Flow	Integer	21			Flow live		
FlowSpan	Integer	22			Flow span		
FlowThreshold	Integer	23		Flow thr	eshold for PC	)1Flo	w
FlowMinCLC	Integer	24	Flov	v min to	stop Resl in	CLC	mode
FlowStop	Integer	25	Percent of Flo which	wSpan stop	below	F 10 =	or example = 10% of span
FlowLow	Integer	26	F	low low	alarm value	(0=0	Off)
			Intege	r Value			Setting
				0			%
				1			GPM
Floud Inite	Tutonov	77		2			MGD
FlowUnits	Integer	27	3				LPM
			4	4			MLD
				5			GPD
						m <sup>3</sup> /hour	
FlowDosade	Integer	28	Flow dos	age valı	le	F	or example
Tiowbosage	Integer	20	(% x	100)		12	25 = 1.25%
FlowFilterTime	Integer	29	Flov	v averag	je filter time i	n se	econds
				Hexad	decimal Value	ŀ	Float Scale Factor
			Turb1		0x50		x 1
**Turb1DP	Hex	30	decimal		0x31		x 10
			position		0x22		x 100
¥ <b>T</b>	Tutonov	21		<b>T</b>	0x13		x 1000
^1urb1	Integer	31		Turb	1 live (turbid	ty) (	Catting
Turk 1 Mada	Intogor	22	Turk 1 maa	4~	Integer va	ue	Setting
TUIDIMOUE	Integer	32			0		OII
Turb1Spap	Intogor	22	Turb1 or				UII
Turb1Span	Integer	34		Turh1	high alarm v	مارام	3
Tubingn	Integer	J_		Hexa	decimal Value		Float Scale Factor
			Turh2	0x50		- '	x 1
**Turb2DP	Hex	40	decimal		0x31		x 10
TUIDEDI	i iex	10	position		0x22		x 100
					0x13		x 1000
*Turb2	Integer	41		Turb	2 live (turbid	ty)	
					Integer Va	lue	Setting
Turb2Mode	Integer	42	Turb2 mod	de	0		Off
					1		On
Turb2Span	Integer	43			Turb2 span		
Turb2High	Integer	44		Turb2	high alarm v	alue	9
				Нехас	decimal Value	ŀ	Float Scale Factor
			Residual		0x50		x 1
**ResIDP	Hex	50	decimal		0x31		x 10
			position		0x22		x 100
	<b>.</b> .				0x13	_	x 1000
	Integer	51	K R				alue
ResiSetPoint	Integer	52	K		set point for		
ResiLOW	Integer	53 F4	Residual low alarm value (0=Off)				
Resinign Rocknon	Integer	54		Residua		valu	le
ResiDidi	Integer	55	Residual cor	r Neor	Integer 1/2	lue	Satting
ICSII IUUC	Integer	50		1301	Incyci Va	uc	Juliy

						mode		0			mV cell
								1		2	4/20mA sensor
								Integer	Value	9	Setting
ReslUnits	Inte	aer	5	7	I	Residual un	its	0			PPM
		5-						1			MG/L
			_	-		Residual int	egral v	alue		For	example
ReslIntegral	Inte	eger	5	8	-	(%)	22		225	= 22.5%	
ReslFilterTime	Inte	ger	5	9		Residu	ual aver	age filter t	ime i	n seo	conds
					Hexad		decimal Value		Floa	at Scale Factor	
						PO1		0x50			x 1
**PO1DP	He	ex	6	0	d	lecimal		0x31			x 10
					р	osition		0x22			x 100
								0x13			x 1000
PO1		Inte	eger	6	1		PO1	final calib	rated	l valu	ue
PO1Manual		Inte	eger	6	2			PO1 ma	anual		
PO1Span		Int	eger	6	3			PO1 s	ban		
								Integer	Value	e	Setting
								0			%
								1			PPD
DO 1 Unito		Test		c	4	DO1	nita	2			GR/H
POTOINIS		1110	eger	0	+	POIU	nits	3			KG/H
								4			GPH
								5			GPM
								6			GPD
								Integer	Value	e,	Setting
PO1GasType In		Int	eger	6	5	PO1 gas	type	1			Cl <sub>2</sub>
								-1			SO <sub>2</sub>
								Flag Bit		Alar	rm Condition
								b0		High	n Turbidity 1
										High	n Turbidity 2
								b2	T	urbid	1 1 Signal Loss
								b3	Т	urbid	d 2 Signal Loss
								b4		L	Low Flow
						Alarm c	tatuc	b5		Flow	v Signal Loss
AlarmStatus		Int	eger	7	0	flag h	ite	b6		Dat	ta Log Error
						nag L	11.5	b7	1	Therr	mistor Failure
								b8		Hig	gh Residual
								b9		Lov	w Residual
								b10	Re	es/Ol	RP Signal Loss
								b11			High pH
								b12			Low pH
								b13	I/	O No	ode COM Error
						Alarm r	node	Integer	Value	9	Setting
AlarmMode		Int	eger	7	1	settii	าต	0			No Latch
						5000	.я	1			Latch
AlarmTime		Int	eger	7	2		Alarn	n delay tim	e in s	secol	nds
							Inte	eger Value			Setting
						Relay		0		Resl	I High Alarm
Relay1Mode		Int	Integer	8	0	mode		1		Res	I Low Alarm
						setting		2	T	urbid	1 1 High Alarm
								3	T	urbid	1 2 High Alarm

				4	pН	High/Low Alarm		
				5		Any Alarm		
				Integer Value		Setting		
				0	Re	esl High Alarm		
			Relav	1	R	esl Low Alarm		
Relav2Mode	Integer	81	mode	2	Turt	oid 1 High Alarm		
		-	setting	3	Turt	pid 2 High Alarm		
			5	4	рН	pH High/Low Alarm		
				5	P	Any Alarm		
	1			Integer Value		Settina		
				0	Re	esl High Alarm		
			Relay	1	R	esl Low Alarm		
Relav3Mode	Integer	82	mode	2	Tur	pid 1 High Alarm		
		-	setting	3	Tur	pid 2 High Alarm		
			5	4	pH	High/Low Alarm		
				5	F	Any Alarm		
				Integer Value		Settina		
				0	Re	esl High Alarm		
			Relay	1	R	esl Low Alarm		
Relav4Mode	Integer	83	mode	2	Turł	oid 1 High Alarm		
			setting	3	Tur	pid 2 High Alarm		
			5	4	bH	High/Low Alarm		
				5	F	Any Alarm		
Relay1	Integer	84		Relay 1 st		/		
Relay2	Integer	85		Relay 2	state			
Relay3	Integer	86		Relay 3	state			
Relay4	Integer	87	Relav 4 st		state			
DataLogEnb	Integer	90		Data log	enable			
DataLogTime	Integer	91	Da	ata log time inte	rval in s	seconds		
				Integer	Value	Setting		
				0		Resl		
			A01 ma	1		Temp		
AO1Mode	Integer	100	AUI mo	<sup>2</sup> 2		pН		
	_		setting	3		Turb 1		
				4		Turb 2		
				5		PO1		
				Integer	Value	Setting		
				0		Resl		
			402 mo	1		Temp		
AO2Mode	Integer	101	AO2 mo	2		pН		
			Setting	3		Turb 1		
				4		Turb 2		
				5		PO1		
				Integer	Value	Setting		
				0		Resl		
			A03 ma	10 1		Temp		
AO3Mode	Integer	102	Cotting	2		pH		
			security	3		Turb 1		
				4		Turb 2		
				5		PO1		
AO4Mode	Integer	103	AO4 mo	de <i>Integer</i>	Value	Setting		

			setting	0	Resl
				1	Temp
				2	pН
				3	Turb 1
				4	Turb 2
				5	PO1
		110	Dup modo	Integer Value	Setting
RunMode	Integer		cotting	0	Auto
			setting	1	Manual
				Integer Value	Setting
				0	Off
CtrlMode	Integer	111	Control mode	1	Flow
				2	Resl
				3	Compound

\*\*The decimal positions can be read but should not be written over Modbus since they can only be changed on the display.

## Table 9. Modbus TH-4000 TurbidimeterVariable Addresses, Register Values, and Features

Name	Туре	Address		D	escription	1	
				Hexad	decimal Value	e /	Float Scale Factor
			Turb1		0x50		x 1
**Turb1DP	Hex	1	decimal		0x31		x 10
			position		0x22		x 100
					0x13		x 1000
*Turb1	Integer	2			Turb1 live		
Turb1Mode	Integer	3		Turb1	mode (on o	r off)	
Turb1Span	Integer	4		Tu	rb1 span lev	el	
Turb1High	Integer	5		Turb1	high alarm	level	
Turb1AvgTime	Integer	6	Turb	1 avera	ge filter time	in se	econds
				Hexad	decimal Value	e P	Float Scale Factor
			Turb2		0x50		x 1
**Turb2DP	Hex	11	decimal		0x31		x 10
			position	position			x 100
					0x13		x 1000
*Turb2	Integer	12			Turb2 live		
Turb2Mode	Integer	13		Turb2	mode (on o	r off)	
Turb2Span	Integer	14		Tu	rb2 span lev	el	
Turb2High	Integer	15		Turb2	2 high alarm	level	
Turb2AvgTime	Integer	16	Turb	2 avera	ge filter time	in se	econds
					Flag Bit	A	larm Condition
					b0	Н	igh Turbidity 1
					b1	Н	igh Turbidity 2
AlarmStatus	Integer	20	Alarm status flag bits		b2	Tur	bid 1 Signal Loss
					b3	Turl	bid 2 Signal Loss
					b4	D	Data Log Error
					b5	I/O	Node COM Error
AlarmMode	Integer	21	Alarm mode s	etting	Integer Va	lue	Setting

				0	No Latch			
				1	Latch			
AlarmTime	Integer	22	Alarm delay time in seconds (set by user)					
Relay1	Integer	30	Relay 1 state					
Relay2	Integer	31	Relay 2 state					
DataLogEnb	Integer	40	Data log enable					
DataLogTime	Integer	41	Data log time interval in seconds					

**\*\*** The decimal positions can be read but should not be written over Modbus since they can only be changed on the display.

Name	Туре	Address			De	escrip	otion		
*C1	Intogor	1		S1 live				For example	
	Integer	L		(ppm x 10	))		3	32 = 3.2ppm	
S1Snan	Integer	2		S1 span				For example	
	Integer	2		(ppm x 10	))			32 = 3.2ppm	
				Integer V	/alue	Se	etting		
				0		Chan	nel OFF	-	
				1		NH <sub>3</sub>		Ammonia	
				2			O <sub>2</sub>	Oxygen	
			S1	3			O3	Ozone	
S1GasType	Integer	3	gas	4			SO2	Sulfur dioxide	
			type	5			Cl <sub>2</sub>	Chlorine	
				6		(	CIO2	Chlorine dioxide	
				7			CO	Carbon monoxide	
				8	8		H <sub>2</sub>	Hydrogen	
				9	-		H <sub>2</sub> S	Hydrogen sulfide	
					In	teger	Value	Setting	
S1AlarmMode	Integer	4	S1 alarm mode			0		No Latch	
						1		Latch	
S1Highl aval	Integer	5	S1 h	nigh alarm l	level		F	or example	
STRIGHEEVEL	Integer	5		(ppm x 10)	)		32 = 3.2ppm		
S1AlarmTime	Integer	6		S1 ala	arm de	elay tii	me in sec	onds	
S1FilterTime	Integer	7		S1 ave	raging	filter	time in se	econds	
*\$7	Integer	11		S2 live		For example			
52	Integer			(ppm x 10	))		3	32 = 3.2ppm	
S2Snan	Integer	12		S2 span				For example	
	incegei	12		(ppm x 10	))			32 = 3.2ppm	
				Integer V	/alue	Se	etting		
				0		Chan	nel OFF	-	
				1			NH3	Ammonia	
			S2	2			O <sub>2</sub>	Oxygen	
S2GasType	Integer	13	gas	3			O <sub>3</sub>	Ozone	
			type	4			SO <sub>2</sub>	Sulfur dioxide	
				5			Cl <sub>2</sub>	Chlorine	
				6		(	CIO2	Chlorine dioxide	
				7			CO	Carbon monoxide	

## Table 10. Modbus GA-171 Gas DetectorVariable Addresses, Register Values, and Features

				8		H <sub>2</sub>	Hydrogen	
				9		H <sub>2</sub> S	Hydrogen sulfide	
					Int	teger Value	Setting	
S2AlarmMode	Integer	14	S2 alarm mode		S2 alarm mode		No Latch	
						1	Latch	
	Intogor	15	S2 ł	nigh alarm	level		For example	
SZHIGHLEVEI	Integer	15	(ppm x 10)			' (ppm x 10)		32 = 3.2ppm
S2AlarmTime	Integer	16		S2 ala	arm de	elay time in	seconds	
S2FilterTime	Integer	17		S2 ave	raging	filter time i	n seconds	
						Flag Bit	Alarm Condition	
						b0	S1 High Alarm	
AlarmStatus	Intogor	20	Alarma	tatus flag	hita	b1	S2 High Alarm	
Aldinistatus	Integer	20	AldITT	status nag i	DILS	b2	S1 Loss Alarm	
						b3	S2 Loss Alarm	
						b4	I/O Node COM Error	

## Table 11. Modbus HC-220 PID ControllerVariable Addresses, Register Values, and Features

Name	Туре	Address	Description				
				Hexa	decimal Value	Float Scale Factor	
			PV1		0x50	x 1	
**PV1DP	Hex	1	decimal		0x31	x 10	
			position		0x22	x 100	
					0x13	x 1000	
PV1	Integer	2			PV1 live		
PV1Select	Integer	3	PV1 inp	ut selectio	on (0=Modbus, 1 4=AI4)	=AI1, 2=AI2, 3=AI3,	
					Integer Value	Setting	
					0	PV1	
PV1Name	Integer	4	4 PV1 r	name	1	H2O	
					2	PRO	
					3	FLO	
					Integer Value	Setting	
					0	%	
				1		GPM	
D\/11 Inite	Intogor	F	D\/1	unito	2	MGD	
PVIONICS	Integer	5	PVI	units	3	LPM	
					4	MLD	
					5	GPD	
					6	m <sup>3</sup> /hour	
D\/1Docade	Integer	6	PV1 do	osage	For	example	
r v i Dosage	Integer	0	(dosage	x 100)	12	5 = 1.25	
PV1Span	Integer	7			PV1 span		
PV1MinCLC	Integer	8	PV	1 flow mir	n in compound lo	op control mode	
			PV1 per	cent of	For	evamnle	
PV1Stop	Integer	9	spa	an	3025	= 30 25%	
			below	which	5025	- 55.2570	

			stop			
DV/1Thus shald	Tutorov	10	(% X 100)	DV (1. thus shald		
PV1Inreshold	Integer	10		PV1 threshold	aaaanda	
PV1Filler1ime	Integer	11	PVI dVe			
PVILOW	Integer	12		PVI low alarm leve		
	Integer	13			of PV1/PV2	
PVIVarLagTimeK2	Integer	14	PV1 FIOV	v at variable lag tim	e for PV3	
MaxLagTime1	Integer	15	PVI		time	
LagTimeK1	Integer	16		PV1 user set lag tim	e	
MaxLagTime2	Integer	17	PV2	max calculated lag	time	
LagTimeK2	Integer	18	112	PV2 user set lag tim	<u>е е е е е е е е е е е е е е е е е е е </u>	
PV2DP	Integer	20		PV2 Decimal position	n	
PV2	Integer	21		PV2 live = residual		
PV2Select	Integer	22	PV2 input selection	on (0=Modbus, 1=A 4=AI4)	I1, 2=AI2, 3=AI3,	
PV2Name	Integer	23	PV2 name	0 = PV2, 1 = RES, 2 4=Ch1, 5=SCM, 6	2 =ORP, 3=pH, =TDS, 7=DO,	
				Integer Value	Setting	
					DDM	
				1	MG/I	
				2	mV	
PV2Units	Integer	24	PV1 units	3	nH	
				4	рп NTП	
				5	%	
			5 78			
PV2SetPoint	Integer	25	PV2 set p	oint for example 22!	5 = 22.5%	
PV2Span	Integer	26		PV2 span		
PV2Zero	Integer	27		PV2 zero		
PV2FilterTime	Integer	28	PV2 ave	eraging filter time in	seconds	
PV2DeadBand	Integer	29	P۱	/2 set point dead ba	ind	
PV2Integral	Integer	30		PV2 integral (% x 10	))	
PV2Low	Integer	31		PV2 low alarm leve	ĺ	
PV2High	Integer	32		PV2 high alarm leve		
PV2LagTimeMode	Integer	33	PV2 Lag time	mode (0=fixed, 1=s	slope, 2=point)	
PV3	Integer	40	P	V3 filtered and scale	ed	
PV3 Select	Integer	41	PV3 input selection	on (0=Modbus, 1=A 4=AI4)	I1, 2=AI2, 3=AI3,	
PV3SetPoint	Integer	42	PV3 set p	oint used when PV3	Mode = 3	
PV3Span	Integer	43		PV3 span		
PV3Integral	Integer	44		PV3 integral (% x 10	))	
PV3Mode	Integer	45	PV3 Mode (0=Fl	ow, 1=Res, 2=CLC,	3=Feed forward)	
PV3LagTimeMode	Integer	46	PV3 Lag time	mode (0=fixed, 1=s	slope, 2=point)	
	-			. ,		
PO1DP	Integer	60		PO1 decimal position	n	
PO1	Integer	61		PO1 live		
PO1Manual	Integer	62	PO	1 value in manual m	node	
PO1Units	Integer	63	PO1 units	0	%	
				1	PPD	

					2		GR/H
					3		KG/H
					4		GPH
					5		GPM
					6		GPD
					7		LPM
					8		LPH
PO1Span	Integer	64			PO1 S	Span	
PO1CacTypo	Intogor	65		、	1		Cl <sub>2</sub>
POIGastype	Integer	60	FOI gas type	POI gas type			SO <sub>2</sub>
					b1	P	V1 low alarm
		66	Alarm status flag bits		b2	P	V1 loss alarm
					b3	P	V2 low alarm
AlarmStatus	Intogor				b4	P	V2 loss alarm
Aldinistatus	Integer				b5	P١	/2 high alarm
					B6 P		V3 loss alarm
					B7 Nod		e 1 comm error
					B8 Nod		e 2 comm error
AlarmTime	Integer	67	Alarm dela	y tir	ne (secs) -	- delay ti	me set by user
					0		Flow
CtrlModo	Intogor	68	control modo		1		Resl
Cumoue	Integer	00			2		Compound
					3		Feed forward
BunMada	Intoger	60	run modo		0		Auto
KullMode	megel	60	Turrmode		1		Manual
D\/v/ ees	Integer	70	PV1/PV2		0		Maintain Valve
PVXLOSS	PVxLoss Integer		input loss action		1		Close Valve

Table 12. Modbus WQM-100 Water Quality MonitorVariable Addresses, Register Values, and Features

Name	Туре	Address		Descript	ion	
				Hexadecimal V	alue	Float Scale Factor
			Flow	0x50		x 1
**FlowDP	Hex	20	decimal	0x31		x 10
			position	0x22		x 100
				0x13		x 1000
Flow	Integer	21		Flow live	е	
FlowSpan	Integer	22	Flow span			
FlowThreshold	Integer	23	Flow threshold for PO1Flow			
FlowMinCLC	Integer	24	Flov	v min to stop Res	l in Cl	_C mode
FlowStop	Integor	25	Percent of FlowSpan below			For example
Flowstop	Integer	25	which	n stop	10	) = 10% of span
FlowLow	Integer	26	F	low low alarm va	lue (0	=Off)
			Integer Value			Setting
FlowUnits	Integer	72		0		%
	integer 27	2/	1			GPM
		-		2		MGD

3LPM4MLD5GPD6m²/hourFlowDosageInteger28FlowFilterTimeInteger29Pb1PhIntInteger29Pb1PhIntInteger30Pb1PhIntInteger30Pb1PhIntInteger31Pb1CondIntInteger31Pb1CondIntInteger32Cond Live Calibrated ValueFor example S35 = 53.5 mVPb1CondIntInteger32Pb1ProbeTypeInteger33Pb1ProbeTypeInteger34Pb1ProbeTypeInteger34Pb1LowInteger34Pb1LowInteger35Pb1LowInteger36Pb1HighInteger36Pb1HighInteger36Pb1HighInteger40Pb2PhIntIntegerPb2PhIntIntegerPb2ProbeTypeInteger41mV live valueFor example S35 = 33.5 mVPb2CondIntInteger41Pb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeIntegerPb2ProbeTypeInteger <th></th> <th>I</th> <th></th> <th></th> <th></th> <th></th> <th></th>		I						
4MLD5GPD6m²/hourFlowDosageInteger28Flow dosage value ( $\% \times 100$ )For example 125 = 1.25%FlowFilterTimeInteger29Flow average filter time in secondsPb1PhIntInteger30pH live calibrated value (pH × 100)For example 225 = 7.25 pHPb1VoltsInteger31mV live valueFor example 3035 = 30.35 mS/cmPb1CondIntInteger32Cond Live Calibrated Value $3035 = 30.35 mS/cm$ Pb1ProbeTypeInteger33Probe TypeInteger ValuePb1FilterTimeInteger34pH average filter time in secondsPb1LowInteger35(PH tow alarm value (PH × 100)For example $2 = 0.000$ Pb1LowInteger36(PH value)For example $2 = 0.000$ Pb1HighInteger36(PH value)For example $2 = 0.25$ pHPb1LowInteger36(PH value)For example $2 = 0.25$ pHPb1HighInteger40pH live calibrated value (pH × 100)For example $2 = 0.25$ pHPb2PhIntInteger41mV live valueFor example $3035 = 30.35$ mS/cmPb2CondIntInteger43Probe TypeInteger ValuePb2ProbeTypeInteger43Probe TypeInteger ValuePb2ProbeTypeInteger44pH average filter time in secondsPb2ProbeTypeInteger45Ph live calibrated value (PH × 100)25 = 7.25 pH				3		LPM		
SGDFlow DosageInteger28Flow dosage value (% x 100)For example 125 = 1.25%FlowFilterTimeInteger29Flow average filter time in secondsPb1PhIntInteger30pH live calibrated value (pH x 100)For example 225 = 7.25 pHPb1PhIntInteger31mV live valueFor example 335 = 53.5 mVPb1CondIntInteger32Cond Live Calibrated Value 3035 = 30.35 mS/cmFor example 3035 = 30.35 mS/cmPb1ProbeTypeInteger33Probe TypeInteger 2Off 2Pb1FriterTimeInteger34pH average filter time in secondsPb1LowInteger36pH live alibrated value 3035 = 30.35 mS/cmPb1EviterTimeInteger36pH low alarm value (pH x 100)For example 422 = 4.25 pHPb1HighInteger36pH live calibrated value (pH x 100)For example 425 = 4.25 pHPb1HighInteger36pH live calibrated value (pH x 100)For example 425 = 4.25 pHPb2PhIntInteger40pH live calibrated value (pH x 100)For example 43 = 53.5 mVPb2CondIntInteger41mV live valueFor example 3035 = 30.35 mS/cmPb2ProbeTypeInteger43Probe TypeInteger 3 = ConductivityPb2ProbeTypeInteger43Probe TypeInteger 3 = ConductivityPb2ProbeTypeInteger43Probe TypeInteger 3 = ConductivityPb2ProbeTypeIn				4		MLD		
6m²/hourFlowDosageInteger28Flow dosage valueFor example (% x 100)125 = 1.25%FlowFilterTimeInteger29Flow average filter time in secondsPb1PhIntInteger30PH live calibrated value (pH x 100)For example 725 = 7.25 pHPb1CondIntInteger31mV live valueS35 = 53.5 mVPb1CondIntInteger32Cond Live Calibrated ValueFor example 333 = 30.35 mS/cmPb1ProbeTypeInteger33Probe TypeInteger ValueSetting 0Pb1FilterTimeInteger34pH average filter time in secondsOffPb1FilterTimeInteger35(pH x 100)425 = 4.25 pHPb1LowInteger36pH low alarm value (pH x 100)For example 3 ConductivityPb1FilterTimeInteger36pH low alarm value (pH x 100)For example 4.25 = 4.25 pHPb1LowInteger36pH live calibrated value (pH x 100)For example 725 = 7.25 pHPb2PhIntInteger40pH live calibrated value (pH x 100)For example 725 = 7.25 pHPb2CondIntInteger41mV live valueSat so my 73 = 53.5 mVPb2ProbeTypeInteger43Probe TypeInteger 1Pb2ProbeTypeInteger43Probe TypeSat so my 70Pb2ProbeTypeInteger44pH average filter time in seconds 335 = 33.5 mVPb2ProbeTypeInteger45pH low alarm value 				5			GPD	
FlowDosageInteger28Flow dosage value (% x 100)For example 125 = 1.25%FlowFilterTimeInteger29Flow average filter time in secondsPb1PhIntInteger30pH live calibrated value (pH x 100)For example 725 = 7.25 pHPb1VoltsInteger31mV live valueFor example 303 = 53.5 mVPb1CondIntInteger32Cond Live Calibrated Value $303 = 30.35$ ms/cmFor example 303 = 30.35 ms/cmPb1ProbeTypeInteger33Probe TypeInteger ValueSetting 0Pb1FilterTimeInteger34pH average filter time in seconds (pH x 100)Por example 3Pb1LowInteger36pH high alarm value (pH x 100)For example 425 = 4.25 pHPb1HighInteger36pH live calibrated value (pH x 100)For example 425 = 3.25 mVPb2PhIntInteger40pH live calibrated value (pH x 100)For example 425 = 7.25 pHPb2PvltsInteger41mV live valueFor example 53 = 53.5 mVPb2ProbeTypeInteger42Cond Live Calibrated Value (pH x 100)For example 725 = 7.25 pHPb2ProbeTypeInteger43Probe TypeInteger ValueSas = 30.35 mS/cmPb2ProbeTypeInteger44pH average filter time in seconds 0.035 = 30.35 mS/cmPb2ProbeTypeInteger45pH live calibrated value (pH x 100)For example 22 0.026Pb2ProbeTypeInteger46pH live calibrated value <br< td=""><td></td><td></td><td></td><td>6</td><td></td><td></td><td>m<sup>3</sup>/hour</td></br<>				6			m <sup>3</sup> /hour	
FlowFilterTimeInteger29Flow average filter time in secondsPb1PhIntInteger30pH live calibrated value (pH x 100)For example 725 = 7.25 pHPb1VoltsInteger31mV live valueFor example 535 = 33.5 mVPb1CondIntInteger32Cond Live Calibrated ValueFor example 3035 = 30.35 mS/cmPb1ProbeTypeInteger33Probe Type $\overline{I}$ $\overline{PH}$ Pb1ProbeTypeInteger34pH average filter time in seconds $\overline{O}$ $\overline{Off}$ Pb1FilterTimeInteger35pH low alarm value (pH x 100)For example 42 = 4.25 pH $\overline{O}$ $\overline{Off}$ Pb1HighInteger36pH live calibrated value (pH x 100)For example 42 = 4.25 pH $\overline{O}$ $\overline{Off}$ Pb2PhIntInteger40pH live calibrated value (pH x 100)For example 725 = 7.25 pH $\overline{O}$ $\overline{Off}$ Pb2PohIntInteger41mV live valueFor example 335 = 33.35 mS/cm $\overline{Off}$ Pb2PobeTypeInteger42Cond Live Calibrated Value (pH x 100)For example 725 = 7.25 pHPb2PobeTypeInteger43Probe Type $\overline{I}$ $\overline{Off}$ Pb2PobeTypeInteger44pH average filter time in secondsFor example 335 = 33.35 mS/cmPb2LowInteger44pH average filter time in secondsFor example 335 = 33.55 mS/cmPb2FilterTimeInteger44pH average filter time in secondsFor example 335 = 33.55 mS/cm <td>FlowDosage</td> <td>Integer</td> <td>28</td> <td>Flow dosage valu (% x 100)</td> <td>Je</td> <td>Fc 12</td> <td>or example <math>5 = 1.25\%</math></td>	FlowDosage	Integer	28	Flow dosage valu (% x 100)	Je	Fc 12	or example $5 = 1.25\%$	
Pb1PhIntInteger30PH live calibrated value (pH x 100)For example 725 = 7.25 pHPb1VoltsInteger31mV live value535 = 53.5 mVPb1CondIntInteger32Cond Live Calibrated Value3035 = 30.35 mS/cmPb1ProbeTypeInteger33Probe TypeInteger ValueSettingPb1ProbeTypeInteger34pH average filter time in secondsOffPb1Integer1pH average filter time in secondsConductivityPb1FilterTimeInteger36pH low alarm valueFor example 2Pb1LowInteger36pH low alarm valueFor example 2Pb1HighInteger36pH live calibrated value (pH x 100)For example 425 = 4.25 pHPb1PinterTimeInteger36pH live calibrated value 	FlowFilterTime	Integer	29	Flow average	e filter ti	ime in sea	conds	
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Pb3Volts Integer 51 mV live value For example 535 = 53.5 mV   Pb3CondInt Integer 52 Cond Live Calibrated Value For example 3035 = 30.35 mS/cm   Pb3ProbeType Integer 53 Probe Type Integer Value Setting	Pb3PhInt	Integer	50	(nH x 100)	uluc	72	5 = 7.25  nH	
Pb3VoltsInteger51mV live value1 of examplePb3CondIntInteger52Cond Live Calibrated Value535 = 53.5 mVPb3ProbeTypeInteger53Probe TypeInteger ValueSetting			51			Fr	or example	
Pb3CondIntInteger52Cond Live Calibrated ValueFor example 3035 = 30.35 mS/cmPb3ProbeTypeInteger53Probe TypeInteger ValueSetting	Pb3Volts	Integer		mV live value		535	5 = 53.5  mV	
Pb3ProbeType Integer 53 Probe Type Integer Value Setting	Pb3CondInt	Integer	52	Cond Live Calibrated	Value	Fc 3035 =	or example = 30.35 mS/cm	
	Pb3ProbeType	Integer	53	Probe Type	Intege	er Value	Setting	

					0	Off		
					1	pН		
					2	ORP		
					3	Conductivity		
Pb3FilterTime	Integer	54	pH average	e filter tir	ne in sec	onds		
	 -		pH low alarm val	ue	Fo	or example		
Pb3Low	Integer	55	(pH x 100)		425	5 = 4.25  pH		
	<b>.</b> .		pH high alarm val	ue	Fo	or example		
Pb3High	Integer	56	(pH x 100)		925	5 = 9.25 pH		
			pH live calibrated v	alue	Fc	or example		
Pb4PhInt	Integer	60	(pH x 100)		725	5 = 7.25  pH		
		61			Fc	or example		
Pb4Volts	Integer	•-	mV live value		535	5 = 53.5  mV		
					Fc	or example		
Pb4CondInt	Integer	62	Cond Live Calibrated	Value	3035 =	= 30.35 mS/cm		
				Inteae	r Value	Settina		
					0	Off		
Pb4ProbeType	Integer	63	Probe Type		1	nH		
i b ii tobet ype	incegei	05	i i obe i ype		2	ORP		
						Conductivity		
Pb4FilterTime	Integer	64	nH average	nH average filter tin		filter time in seconds		onds
	integer		nH low alarm val		Fr	onus or evample		
Pb4Low	Integer	65	$(nH \times 100)$	uc	421	5 - 4.25  nH		
			nH high alarm val			or evample		
Pb4High	Integer	66	(pH x 100)		92	5 = 9.25  nH		
			(011 × 100)		52.	5 – 5.25 pm		
					Fr	or example		
Temp	Integer	70	Temperature		2555 =	255 5K display		
remp	integer	70	(Kelvin x 10)		still	still shows C or F		
			Temp active sensor	node	5011			
Temp Node	Integer	71	number (where to re	ad T)	1,	, 2, 3, or 4		
				Interre	r Value	Settina		
TemnMode	Integer	72	Temp mode	incege	<u>ו אמועכ</u> ו	Auto		
rempriode	inceger	72	remp mode		<u>,</u> 1	Manual		
				Intege	r Value	Settina		
Templ Inits	Integer	73	Temp units	incege	<u>ו אמומכ</u> ו	C (Celsius)		
remponits	integer	/5	remp units		1	F (Fahrenheit)		
					L			
			PO1 final calibrated					
PO1	Integer	90	value					
PO1Span	Integer	Q1		Full	scale vali	e for display		
POILInits	Integer	92	PO1 units	1 un	<u>ع % م</u>	tc		
10101113	Integer	52		Interre	r Value	Sottina		
PO1PunMode	Integer	03	Pun Mode	incge	<u>י ימומכ</u> ר	Manual		
FOIRUIIMOUE	Integel	22			J 1			
	Intogor	0/	Manual Value		Llear ad	justablo		
FUIMAINA	Integer	דע			USEI du	านรเฉมเซ		
	Integra	05	DID Control mode	Into -	r \/al	Catting		
PIDCTIMOde	Integer	95	PID Control mode	Intege	r value	Setting		

			0	Off
			1	Flow
			2	Set Point
			2	Compound
			5	Loop
Integer	96	PID set point based	Soloct 1	2 3 or 4
Integer	30	on which channel	Jelett 1,	2, 3, 01 4
Integer	97	PID Set Point	User selec	ted value
Integer	98	PID Dead Band	User selec	ted value
Integer	99	PID Integral Value	Ex. 200 =	= 20.0 %
Integer	100	AO1 Mode		
Integer	101	AO2 Mode	0=PO1, 1=Prob	e 1, 2=Probe 2,
Integer	102	AO3 Mode	3=Probe 3, 4=P	robe 4, 5=Temp
Integer	103	AO4 Mode		
Integer	104	Alarm Status	b0:DataLogAlm, b2:Pb1HighAlm, b4:Pb2HighAlm, b5:Pb3LowAlm,b b7:Pb4LowAlm,b b9:TempAlm, b b11:FlowLossAlm	b1:Pb1LowAlm, b3:Pb2LowAlm, 6:Pb3HighAlm, 8:Pb4HighAlm, 10:FlowLowAlm, n, b12:ComError
				•
Integer	105	Alarm Mode	0=nonlatching	, 1 = latching
Integer	110	Relay 1 mode	0=Ch1 Low, 1=Ch1	High, 2=Ch2 Low,
Integer	111	Relay 2 mode	3=Ch2 High, 4=Ch3 Low, 5=Ch3 High 6=Ch4 Low, 7=Ch4 High, 8=Flow Lo	
Integer	112	Relay 3 mode		
Integer	113	Relay 4 mode	9=Any	Alarm
Integer	114	Relay 1 State		
Integer	115	Relay 2 State		1 - 01
Integer	116	Relay 3 State	$U = UFF_{i}$	T = ON
Integer	117	Relay 4 State		
	Integer Integer	Integer96Integer97Integer98Integer98Integer99Integer100Integer101Integer102Integer103Integer103Integer104Integer105Integer110Integer111Integer112Integer113Integer113Integer114Integer115Integer116Integer117	Integer96PID set point based on which channelInteger97PID Set PointInteger98PID Dead BandInteger99PID Integral ValueInteger100AO1 ModeInteger101AO2 ModeInteger102AO3 ModeInteger103AO4 ModeInteger103AO4 ModeInteger104Alarm StatusInteger105Alarm ModeInteger110Relay 1 modeInteger111Relay 2 modeInteger112Relay 3 modeInteger113Relay 4 modeInteger114Relay 1 StateInteger115Relay 3 StateInteger116Relay 3 StateInteger117Relay 4 State	Integer96PID set point based on which channelSelect 1,Integer97PID Set PointUser selectInteger98PID Dead BandUser selectInteger99PID Integral ValueEx. 200 =Integer100AO1 Mode0=PO1, 1=ProbInteger102AO3 Mode3=Probe 3, 4=PtInteger103AO4 Mode0=PO1, 1=ProbInteger103AO4 Mode0=PO1, 1=ProbInteger104Alarm Statusb0:DataLogAlm, b5:Pb3LowAlm, b b7:Pb4LowAlm, b b9:TempAlm, b1 b11:FlowLossAlmInteger105Alarm Mode0=nonlatchingInteger110Relay 1 mode 0=Ch1 Low, 1=Ch1 3=Ch2 High, 4=Ch2 3=Ch2 High, 4=Ch2 <br< td=""></br<>

Table 13. Modbus RPH-260 Residual AnalyzerVariable Addresses, Register Values, and Features

Variable / laar ebbeb/ (legister Valaes/ and Features							
Name	Туре	Address	Description				
Res1DP	Integer	10	Resl 1 decimal position				
Res1	Integer	11	Resl 1 final calibrated value				
Res1Low	Integer	12	Resl 1 low alarm value (0=off)				
Resl1High	Integer	13	Resl 1 High Alarm value				
Resl1FlowStopEnb	Integer	14	Resl 1 sample water flow stop alarm enable				
Res1Span	Integer	15	Resl 1 span				
Resl1Units	Integer	16	Resl 1 engineering units (0=PPM, 1=mg/l)				
Resl1FilterTime	Integer	17	Resl 1 Avg filter time (seconds)				
Resl1ProbeType	Integer	18	Resl 1 probe type (0=off, 1=F1, 2=F2, 3=T1, 4=F3)				
Resl1pHProbe	Integer	19	Resl 1 pH probe used for compensation (1 or 2)				

Resl1FlowStop	Integer	92	Resl 1 sample water flow (0=ok, 1=stopped)			
Res2DP	Integer	20	Resl 2	Resl 2 decimal position		
Res2	Integer	21	Resl 2 fi	nal calibi	ated valu	Je
Res2Low	Integer	22	Resl 2 lov	v alarm v	alue (0=	off)
Resl2High	Integer	23	Resl 2	High Ala	rm value	1
Resl2FlowStopEnb	Integer	24	Resl 2 sample w	ater flow	stop ala	rm enable
Res2Span	Integer	25		Resl 2 sp	an	
Resl2Units	Integer	26	Resl 2 engineer	ing units	(0=PPM	, 1=mg/l)
Resl2FilterTime	Integer	27	Resl 2 Ave	g filter tir	ne (secor	nds)
Resl2ProbeType	Integer	28	Resl 2 probe type (0=off, 1=F		F1, 2=F2	, 3=T1, 4=F3)
Resl2pHProbe	Integer	29	Resl 2 pH probe u	sed for c	ompensa	tion (1 or 2)
Resi2FlowStop	Integer	93	Resl 2 sample wa	ater flow	(0=ok. 1	=stopped)
		50				(accepted)
			nH 1 live calibrated	valuo	Ec	or ovamplo
Ph1PhInt	Integer	30	$(nH \times 100)$	value	72	5 - 7.25  nH
			(prix 100)	Intege	r Value	Settina
				incege	n n	Off
Ph1ProheType	Integer	31	Prohe 1 Type		1	nH
ППТОВетуре	incegei	51	Пореттурс		2	OPD
					2	UNI
					0=	off 1=auto
pH1CompMode	Integer	32	pH 1 Comp mode			2=manual
PH1FilterTime	Inteaer	33	pH 1 average filter time in seconds			conds
pH1Manual	Integer	34	pH 1 manual value			
pH1Low	Integer	35	nH 1 low alarm value			
pH1Ligh	Integer	36	nH 1 High Alarm Value			
p						
	<b>.</b> .	10	pH 2 live calibrated	value	Fo	or example
Ph2PhInt	Integer	40	(pH x 100)		725	5 = 7.25 pH
				Intege	r Value	Setting
					0	Off
Ph2ProbeType	Integer	41	Probe 2 Type		1	рН
	_				2	ORP
nH2ComnModo	Integer	40	nH 2 Comp mod		0=0	off, 1=auto,
phzcompilioue	Integer	42		le	2	2=manual
PH2FilterTime	Integer	43	pH 2 average	ge filter ti	me in se	conds
pH2Manual	Integer	44	pH	2 manua	l value	
pH2Low	Integer	45	pH 2	low alar	m value	
pH2High	Integer	46	pH 2	High Alar	m Value	
			Temperature 1 For exam		or example	
Temp1Show	Integer	50			2555 =	255.5K, display
				1	still	shows C or F
				Intege	r Value	Setting
Temn1Mode	Integer	51	Temp 1 mode	(	)	Off
	Inceger	51			1	Auto
					2	Manual
Temp1Units	Integer	52	Temp 1 units	Intege	r Value	Setting

				0		C (Celsius)
				1		F (Fahrenheit)
						· · ·
			T		Fc	r example
Temp2Show	Integer	53	Temperature 2		2555 =	255.5K, display
	5		(Keivin x 10)		still :	shows C or F
				Integer Value		Setting
Tana 204 ada	Tuto and	Γ4	Tana 2 made	0		Off
Tempz™ode	Integer	54	Temp 2 mode	1		Auto
				2		Manual
				Integer	Value	Setting
Temp2Units	Integer	55	Temp 2 units	0		C (Celsius)
	5			1		F (Fahrenheit)
AO1Mode	Integer	60	AO1 Mode	0=Res1	. 1=Res	2, 2=pH/ORP1.
AO2Mode	Integer	61	AO2 Mode	3=p	, H/ORP2	, 4=Temp1,
AO3Mode	Integer	62	AO3 Mode	5=Tem	, 1p2, 6=0	Cond, 7=Press,
AO4Mode	Integer	63	AO4 Mode		8=PO1,	9=PO2
			alarm status flag bits ( b2:Res1HighAlm, b3 b5:Res2HighAlm, b6 b8:pH1HighAlm, b9	b0:DataLoss :Res1Loss :Res2Loss :pH2LowA	ogAlm, b Alm, b4 Alm, b7 Im, b10	01:Res1LowAlm, :Res2LowAlm, ':pH1LowAlm, :pH2HighAlm,
AlarmStatus	Integer	70	b11:Temp1Alm, b12:Temp2Alm, b13:Res1FlowStopAlm, b14:Res2FlowStopAlm, b15:CondHighAlm, b16:CondLowAlm, b17:PressHighAlm,			Alm, pwStopAlm, ghAlm,
			b18:PressLov	vAlm, b19	:PressLc	ssAlm,
	<b>.</b>		b20	:ComErroi	rAlm)	4 1 1 1 1
AlarmMode	Integer	/1	Alarm Mode	0=non	0=nonlatching, 1 = latching	
Alarm I Ime	Integer	/2	Alarm Delay Time		secc	nas
				0_Dec 1		1-Doc 1 High Alm
Relay1Mode	Integer	80	Relay 1 mode	2 = Res  1	Low Alm.	3 = Res 1 High Alm,
Relay2Mode	Integer	81	Relay 2 mode		4=pH/ORI	P 1 Alarm,
Relay3Mode Relay4Mode	Integer	82	Relay 3 mode	/5=pH 7=Flow 1 Ala 10=Cond I	ORP 2 Ala L Stop Ala Irm, 9=Co High Alm,	rm, 6=Any Alarm, m, 8=Flow 2 Stop nd Low Alm, 11=Press Low Alm,
Delevit	Tutogov	0.4	Delay 1 Chata		12=Press	High Alm
Relay1	Integer	84	Relay 1 State			
Relay2	Integer	85	Relay 2 State	0	$) = OFF_{i}$	1 = ON
Relay3	Integer	86	Relay 3 State		,	
Relay4	Integer	87	Relay 4 State			
DataLogEnb	Integer	90		(	J=0ff, 1	enable
DataLogTime	Integer	91	Interval		Seco	onds
	<u> </u>	400				
CondEnb	Integer	100	Conductivity Enable			
Cond	Integer	101	Conductivity Live	(mS x 1	00, ex.	125 = 1.25 mS)
CondLow	Integer	102	Conducti	vity Low a	larm val	ue
CondHigh	Integer	103	Conductivity high alarm value			

PressEnb	Integer	110	Pressure enable		
Press	Integer	111	Pressure live	(0x30 = psi, 0x21=bar)	
PressMa	Integer	112	Pressure live	$(mA \times 100, ex. 425 = 4.25mA)$	
PressSpan	Integer	113	Pressure Span		
PressLow	Integer	114	Pressur	e low alarm value	
PressHigh	Integer	115	Pressur	e high alarm value	
PressUnits	Integer	116	Pressure units	(0=psi, 1=bar)	
FlowDP	Integer	120	Flow decimal position		
Flow	Integer	121	Flow Live		
Flow Span	Integer	122	Flow Span		
Flow Threshold	Integer	123	Flow threshold for PO1	Flow	
FlowMinCLC	Integer	124	Flow min to stop the R	esl in CLC mode	
FlowStop	Integer	125	Flow percent of FlowS	oan below which stop	
Flow Low	Integer	126	Flow low alarm value (	0=off)	
Flow Units	Integer	127	Flow engineering units	(0=%, 1=GPM, 2=MGD,	
		127	3=LPM, 4=MLD, 5=GP	PD, 6=M3/H)	
Flow Dosage	Integer	128	Flow dosage value (%)	)	
Flow Filter Time	Integer	129	Flow filter time (second	ds)	
PID1CtrlMode	Integer	130	PID1 Ctrl mode (0=Off	f, 1=Flow, 2=SP, 3=Compound)	
PID1Channel	Integer	131	PID1 Channel (0=Residual, 1=pH1, 2=ORP1, 3=Cond)		
PID1SetPOint	Integer	132	PID1 set point (Res or pH or ORP or Cond)		
PID1DeadBand	Integer	133	PID1 dead band (Res,	pH, ORP, or Cond)	
PID1 Integral	Integer	134	PID1 integral value (%		
				·	
PID2CtrlMode	Integer	135	PID2 Ctrl mode (0=0ff	f = Flow 2 = SP 3 = Compound)	
PID2Channel	Integer	136	PID2 Channel (0-Resid	$f_{\text{ual}} = 1 - pH_1 - 2 - OPP_1 - 3 - Cond$	
	Integer	127	PID2 cot point (Pos or	pH or OPP or Cond)	
PIDZSELFOIIIL	Integer	120	PID2 Set point (Res of		
	Integer	100	PID2 dead Dalid (Res,		
PID2 Integral	Integer	139	PID2 Integral Value (%	) 	
504		4.40			
P01	Integral	140	PO1 final calibrated	value	
PO1Span	Integral	141	PO1 span		
PO1Units	Integral	142	PO1 engineering units 3=KG/H, 4=GPH, 5=G	(0=%, 1=PPD, 2= GR/h, PM, 6=GPD)	
PO1Run Mode	Integral	143	PO1 run mode (1=Aut	o, 2=Manual)	
PO1Manual	Integral	144	PO1 Manual value		
PO2	Integral	150	PO2 final calibrated value		
PO2Snan	Integral	151	PO2 man		
	Integral	101	PO2 engineering unit	te $(0-\% 1-DDD 2-CD/b)$	
PO2Units	Integral	152		(0-70, 1-FFD, 2-GK/H, -CDM, 6-CDD)	
DODUn Mada	Integral	150	$3 - \frac{1}{10}, 1 + \frac{1}{10}$	$\frac{1}{2}$	
	Integral	153		uto, z=manuar)	
POzmanual	Integral	154	POZ Manual value		

Table 14. Modbus RAH-280 Residual AnalyzerVariable Addresses, Register Values, and Features

Name	Туре	Address	ss Description				
				Hexadecimal V	/alue	Float Scale Factor	
			Flow	0x50		x 1	
**FlowDP	Hex	20	decimal	0x31		x 10	
			position	0x22		x 100	
				0x13		x 1000	
Flow	Integer	21		Flow li	ve		
FlowSpan	Integer	22		Flow sp	ban		
FlowThreshold	Integer	23		Flow threshold f	or PO1	LFlow	
FlowMinCLC	Integer	24	Flov	w min to stop Re	esl in C	LC mode	
FlowStop	Integer	25	Percent of Flo	wSpan below		For example	
	Incoger	20	which	n stop	1	0 = 10% of span	
FlowLow	Integer	26	F	low low alarm v	alue ((	D=Off)	
			Intege	r Value	-	Setting	
			(	0		%	
				1	-	GPM	
FlowUnits	Integer	27		2		MGD	
	Incoger			3		LPM	
			4	4		MLD	
				5		GPD	
			(	5		m <sup>3</sup> /hour	
FlowDosage	Integer	28	Flow dosage value			For example	
Tionboodge	incegei	20	(% x 100)			125 = 1.25%	
FlowFilterTime	Integer	29	Flow average filter time in se		seconds		
ResIDP	Integer	30		Resl decimal	positio	on	
Resl	Integer	31		Resl final calibr	ated v	l value	
ReslLow	Integer	32		Resl low alarm v	alue (0=off)		
ReslHigh	Integer	33	F	Resl high alarm v	alue (0=off)		
ReslFlowStop	Integer	34	Resl sa	mple water flow	(0=ok	, 1=stopped)	
ReslSpan	Integer	35		Resl sp	an		
ReslUnits	Integer	36	Resl er	ngineering units	<u>(0=PP</u>	M, 1=MG/L)	
ReslFilterTime	Integer	37		Resl filter time	(secor	nds)	
					1		
PhInt	Integer	40	pH live calib	brated value		For example	
			(рн х	(100)	<u> </u>	725 = 7.25  pH	
PhMode	Integer	41	pH mode (	0=off, 1=auto, 2	2=mar	iual, 3=monitor)	
pHFilterTime	Integer	42	рH	l average filter ti	<u>me in</u>	seconds	
pHManual	Integer	43		Manual v	alue		
Pb1Low	Integer	44	pH low al (pH x	arm value		For example $425 = 4.25 \text{ pH}$	
Dh1Ulat	Tabers	45	pH high alarm value			For example	
PDIHigh	Integer	45	(pH x 100)		925 = 9.25 pH		
			¥			•	
OrpEnb	Integer	50	ORP 6	enable			
ORPVolts	Integer	51	ORP live v	value (mV)			

ORPFilterTime	Integer	52	ORP filter time wo	orking seconds			
ORPLow	Integer	53	ORF	ORP Low Alarm Value			
ORPHigh	Integer	54	ORP High Alarm Value				
CondEnb	Integer	60	Conductivity enable				
COndInt	Integer	61	Conductivity live calibrated value in mS				
CondLow	Integer	63	Conductivity Low Alarm Value				
CondHigh	Integer	64	Conductivity High Alarm Value				
Temp	Integer	70	Temperature (Kelvin x 10)	erature F n x 10) stil		or example 255.5K, display shows C or F	
Temp Node	Integer	71	Temp active sensor number (where to re	node ead T) 1		, 2, 3, or 4	
	Integer		Temp mode	Intege	r Value	Setting	
TempMode		72		0	)	Auto	
-				1	L	Manual	
	Integer	73	Temp units	Integer Value		Setting	
TempUnits				0		C (Celsius)	
				1		F (Fahrenheit)	
PO1	Integer	90	PO1 final calibrated value				
PO1Span	Integer	91	PO1 span	Full scale value for display		ue for display	
PO1Units	Integer	92	PO1 units	% etc		etc	
PO1RunMode	Integer	93	Run Mode	Intege	r Value	Setting	
				0	)	Manual	
				1	L	Auto	
PO1Manual	Integer	94	Manual Value	User adjustable		justable	
	Integer	95	PID Control mode	Integer	r Value	Setting	
PIDCtrlMode				0	)	Off	
				1	L	Flow	
				2	2	Set Point	
				3	}	Compound	
PIDChannel	Integer	96	PID set point based on which channel	Select 1, 2, 3, or 4			
PIDSetPoint	Integer	97	PID Set Point	User selected value		cted value	
PIDDeadBand	Integer	98	PID Dead Band	User selected value		cted value	
PIDIntegral	Integer	99	PID Integral Value	Ex. 200 = 20.0 %		= 20.0 %	
AO1Mode	Integer	100	AO1 Mode				
AO2Mode	Integer	101	AO2 Mode	0=PO1, 1=Resl, 2=pH, 3=ORP,			
AO3Mode	Integer	102	AO3 Mode	4=Cond, 5=Temp			
AO4Mode	Integer	103	AO4 Mode				
AlarmStatus	Integer	104	Alarm Status	b0:DataLogAlm, b1:ReslLowAlm, b2:ReslHighAlm, b3:PHLowAlm, b4:PHHighAlm, b5:ORPLowAlm,b6:ORPHighAlm,			

				b7:CondLowAlm,b8:CondHighAlm, b9:FlowLowalm, b10:FlowLossAlm, b11:TempAlm, b12:FlowStopAlm, b13:ComError	
AlarmMode	Integer	105	Alarm Mode	0=nonlatching, 1 = latching	
Relay1Mode	Integer	110	Relay 1 mode	0=Ch1 Low, 1=Ch1 High, 2=Ch2 Low, 3=Ch2 High, 4=Ch3 Low, 5=Ch3 High,	
Relay2Mode	Integer	111	Relay 2 mode		
Relay3Mode	Integer	112	Relay 3 mode	6=Ch4 Low, 7=Ch4 High, 8=Flow Low,	
Relay4Mode	Integer	113	Relay 4 mode	9=Any Alarm	
Relay1	Integer	114	Relay 1 State	0 = OFF, 1 = ON	
Relay2	Integer	115	Relay 2 State		
Relay3	Integer	116	Relay 3 State		
Relay4	Integer	117	Relay 4 State		

#### VI. Troubleshooting

#### Consider the following points if having difficulty establishing communication:

- 1.) The master can request several addresses in one packet request, but the addresses have to be sequential.
- 2.) When the master requests data the slave node may not respond instantly because its running the program loop.
  - a. The SCADA has a parameter that can be set which is how long to wait for a response.
  - b. Another parameter is the polling interval- how often does the SCADA request data. If its too fast the slave node may not be ready.
  - c. You could try to increase those times and also only request 1 address in the packet from one of the addresses which is not working to see if the address can be read properly.
- 3.) Another issue is that there is very specific timing required for Modbus regarding the data packet and the interval timing between packets which nodes on the network use to determine when a packet ends and when a new packet begins.
  - a. Windows and Linux are not real time operating systems. So there is no way to ensure this timing in a Windows or Linux application program.
  - b. The solution is the interface hardware between the computer and the RS-485 network must handle this timing.
  - c. Good SCADA software accounts for this. Keep this in mind.