Modbus Technical Manual

Rev	Date	Who	Changes
1.0		CAP	Original
1.1	12/12/06	CAP	Changes required for release
1.2	14/02/07	MFB	Added Connection Diagram and amended Table of Contents
1.3	09/03/2007	KRJ	Added support for 2.6.x firmware • Removed all Inhibitor Water Meter references • Added upgraded Inhibitor points for water meter mode • Added Water Usage Meter points • Added Flow Control alarm mode • Added pH, pH220 and ORP lockout points • Minor formatting changes
1.4	11/04/2007	KRJ	Additional support for 2.6.x firmware • Changed Dispersant Pump Size and Dose Rate to 32-bit values • Changed Corrosion readings to 32-bit values • Changed corrosion Set Point and Alarm Level to 32-bit values • Minor textual changes
1.5	19/04/2007	KRJ	Additional support for revised 4-20mA module
1.6	29/05/2007	KRJ	Gramatical/Spelling revisions for release

Table of Contents

1 Scope

This document's purpose is to describe the user interface for the Aquarius Modbus protocol. It outlines the mapping for all the variables to the respective registers locations.

This document does not outline the modbus protocol which is well documented and available at http://www.modbus.org. This web site is supported by the modbus organisation and outlines all details of the modbus protocol.

2 Software Versions

This document revision describes the MODBUS points supported by the 2.06.XX series of controller firmware. Other revisions of this document should be consulted when interfacing with controllers featuring other firmware versions, as detailed in the following table.

Firmware Version	Document Version
2.05.XX	1.2
2.06.XX	1.6

3 Connection Diagram

3.1 RS 485 Protocol (Recommended)

Connect Gnd, RS485+ and RS485- on Communications PCB to BMS.
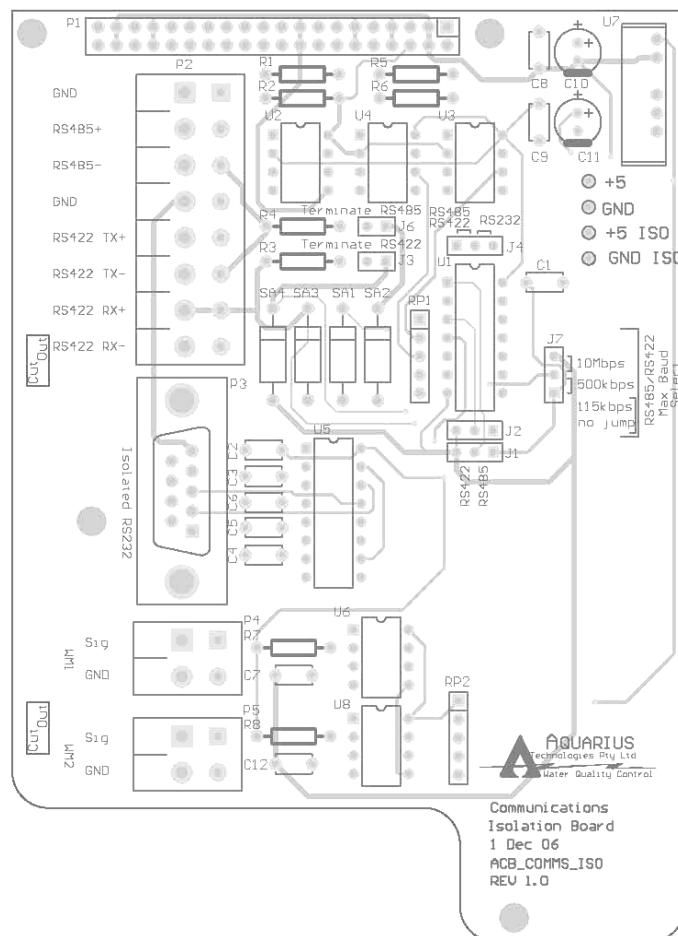Set jumpers J1, J2 and J4 to RS 485.

3.2 RS 422 Protocol

Connect Gnd, RS422 T+. RS422 T-, RS422 R+, RS422 R- to BMS
Set jumpers J1, J2 and J4 to RS422.

3.3 RS 232

Connect DB9 plug to Isolated RS232 socket.
Set jumper J4 to RS232.

3.4 Baud Rate

The baud rate is fixed at 115200 for all three protocols. J7 should remain open at all times.

4 Data Format

Modbus uses a 'big-endian' representation for addresses and data items. This means that when a numerical quantity larger than a single byte is transmitted, the MOST significant byte is sent first. The following sub-topics describe the different types of encoding and show how the data is encoded as it is within the Modbus packet. Most client drivers will extract the data from the packet in the correct format for use/display within the client environment.

4.1 16 Bit word Format

A 16-bit word item is transmitted with the MOST significant byte first. Each of these data items will fit within one register that is read.

	value	1_{st}	2_{nd}
	0x1234	0x12	0x34

4.2 32 Bit word Format

A 32-bit word item is transmitted with the MOST significant byte first, then the next MOST significant, until all bytes are transmitted.
Two registers are required to read each 32-bit data item. The two registers must be read from or written to sequentially within the same MODBUS packet.

	1_{st} register		2_{nd} register	
Value	1_{st}	2_{nd}	1_{st}	2_{nd}
0x12345678	0x56	0x78	0x12	0x34

4.3 String Format

A string is a group of 8-bit data items having a fixed length. The first character of a string is transmitted first, followed by the remaining characters. A single register contains two characters of the string. To simply string storage/transfer, each string should be of an even-byte length.
1_{st} register 2_{nd} register 3_{rd} register 4_{th} register

	register 1		register 2		register 3		register 4		register 5	
value	1_{st}	2_{nd}	1_{st}	2_{nd}	1_{st}	2_{nd}	1_{st}	2_{nd}	1_{st}	2_{nd}
	char1	char2	char3	char4	char5	char6	char7	char8	char9	char10
'Aquarius'	'A'	'q'	'u'	'a'	'r'	'i'	'u'	's'	0x0	0x0

Note a 0x0 is used to indicate the last character in the string and must always be sent at the end of the last valid char. Ie if you can send 10 bytes for a name and you only send 2 characters the 3rd must be a 0.

5 Poll Rate

Polling the controller to quickly will slow the controller right down. It is recommended to only poll once every 30sec minimum

6 Software Series and Modules

The following table details which modules are featured in the different controller models.

	AT	CT	SP	TW	HP	KPI	PHS	PHD	ORP	CON
Data Logger	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ORP		Yes	Yes	Yes	Yes	Yes			Yes	
pH		Yes	Yes		Yes	Yes	Yes			
pH220				Yes				Yes		
Conductivity	Yes	Yes	Yes	Yes	Yes	Yes				Yes
Dispersant	Yes	Yes				Yes				
Inhibitor	Yes	Yes				Yes				Yes
Timers	2	2				2				
Super Chlorination		Yes	Yes		Yes	Yes				
LSI		Yes	Yes		Yes	Yes				
FAH		Yes	Yes		Yes	Yes				
Flow Ctrl						Yes				
Flow Rate						Yes				
Corrosion						Yes				
Water Usage Meter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

7 Module Options

The following software modules are options and may not be supported on your model of controller.
- 4-20mA input

8 Timers

The following timer numbers are allocated as follows for each software series defined.

	Timer 1	Timer 2	Timer 3	Timer 4
AT	Biocide A	Biocide B	None	None
CT	ORP Timer	Biocide B	None	None
KPI	ORP Timer	Biocide B	None	None

9 Binary Inputs

These are the binary inputs (read-only digital tags) supported at present:

Addr	Module	Tag Name	Description/Notes
10001	Alarm	alarm_relay	True if the alarm relay is closed.
10002	Tank	tank_low	True if the tank is low
10003	Flow	flow_on	True if there is flow
10004	Temp	temp_probe_invalid	True if the temperature is out of range
10005	Corr	corr_alarm_on	True if the corrosion alarm is on

Addr	Module	Tag Name	Description/Notes
10006	Cond	cond_alarm_on	True if the conductivity level is out of range
10007	Cond	cond_pump_on	True if the conductivity pump is on
10008	ORP	orp_pump_on	True if oxidant or reducing agent is being added
10009	ORP	orp_alarm_on	True if the ORP level is out of range
10010	pH	ph_pump_on	True if acid (or base) is being added
10011	pH	ph_alarm_on	True if the pH level is out of range
10012	pH220	ph220_acid_pump_on	True if the ph220 acid pump is on
10013	pH220	ph220_base_pump_on	True if the ph220 base pump is on
10014	pH220	ph220_alarm_on	True if the ph220 level is out of range
10015	Inhib	inhib_pump_on	True if the inhibitor pump is on
10016			Reserved – Used in firmware version 2.5.x
10017	Disp	disp_pump_on	True if the dispersion pump is on
10018	Tmr1	tmr1_relay_on	True if the timer dose relay is on
10019	Tmr1	tmr1_prebleed_on	
10020	Tmr1	tmr1_lockout_on	
10021	Tmr2	tmr2_relay_on	True if the timer dose relay is on
10022	Tmr2	tmr2_prebleed_on	
10023	Tmr2	tmr2_lockout_on	
10024	Tmr3	tmr3_relay_on	True if the timer dose relay is on
10025	Tmr3	tmr3_prebleed_on	
10026	Tmr3	tmr3_lockout_on	
10027	Tmr4	tmr4_relay_on	True if the timer dose relay is on
10028	Tmr4	tmr4_prebleed_on	
10039	Tmr4	tmr4_lockout_on	
10030			Reserved
10031			Reserved
10032	Flow	flow_ctrl_alarm_on	True if the flow control alarm is active. Only used when in auto mode
10033	Flow	flow_valve_fully_on	True if the control valve is fully open
10034	Super CL	super_cl_on	True if super chlorination is running
10035			Reserved
10036			Reserved
10037			Reserved
10038			Reserved
10039			Reserved
10040			Reserved
10041			Reserved
10042	Tank	tank_enabled	Indicates the tank monitoring module is enabled
10043	Flow	flow_ctrl_enabled	Indicates the flow ctrl module is enabled
10044	Flow	flow_on_off_enabled	Indicates the flow on_off module is enabled
10045	Flow	flow_rate_enabled	Indicates the flow rate module is enabled
10046	Temp	temp_enabled	Indicates the temperature module is enabled
10047	Corr	corrosion_enabled	Indicates the corrosion module is enabled
10048	Cond	cond_enabled	Indicates the conductivity module is enabled
10049	pH220	ph220_enabled	Indicates the ph220 module is enabled
10050	Inhib	inhib_enabled	Indicates the inhibitor module is enabled
10051			Reserved – Used in firmware version 2.5.x

Addr	Module	Tag Name	Description/Notes
10052	Disp	disp_enabled	Indicates the dispersant module is enabled
10053	4-20	4_20_enabled	Indicates the 4-20mA input module is enabled
10054	Super Cl	super_cl_enabled	Indicates the super chlorination module is enabled
10055	FAH	fah_enabled	Indicates the FAH (Free available Halogen) module is enabled
10056	LSI	lsi_enabled	Indicates the LSI module is enabled
10057			Reserved
10058			Reserved
10059			Reserved
10060			Reserved
10061	pH	ph_lockout	True if the pH pump has been locked out
10062	pH220	ph220_lockout	True if the pH220 pump has been locked out
10063	ORP	orp_lockout	True if the ORP pump has been locked out
10064	4-20	4_20_alarm_on	True if the 4-20mA input is out of range

10 Analogue Inputs

These are the analog inputs (read-only integer tags) supported at present. Each value is a signed 16 bit integer.

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Places	Description/Notes
30001-2	2	Time	time_t (32 bits)	secs	1		Number of seconds since 1970
30003	1	Time	time_week	weeks	1		From 1 to 4
30004	1	Flow	flow_velocity	m/sec	100		
30005	1	Temp	temp_reading	°C	10		
30006							Used in firmware 2.5.x
30007							Used in firmware 2.5.x
30008							Used in firmware 2.5.x
30009							Used in firmware 2.5.x
30010	1	Cond	cond_reading	mS	1000		gm/l in saltwater
30011-12	2	Orp	orp_reading	mV	100		From 0 to 99900
30013-14	2	pH	ph_reading	pH	1000		From 0 to 14000
30015-16	2	pH220	ph220_reading	pH	1000		From 0 to 14000
30017							Used in firmware 2.5.x
30018							Used in firmware 2.5.x
30019	1	LSI	LSI_reading	-	1000		A number from -9.900 to 9.900
30020	1	FAH	FAH_reading	mg/l	100		
30021							Reserved – Used in firmware version 2.5.x
30022							Reserved
30023							Reserved
30024							Reserved
30025							Reserved
30026	1	Alarm	alarm_time_on	secs	1		Resets to 0 at end of data logging interval
30027	1	Tank	tank_empty_on_time	secs	1		Resets to 0 at end of data logging interval
30028	1	Flow	flow_on_time	secs	1		Resets to 0 at end of data logging interval
30029	1	Cond	cond_pump_on_time	secs	1		Resets to 0 at end of data logging interval
30030	1	ORP	orp_pump_on_time	secs	1		Resets to 0 at end of data logging interval
30031	1	pH	ph_pump_on_time	secs	1		Resets to 0 at end of data logging interval
30032	1	pH220	ph220_acid_pump_on_time	secs	1		Resets to 0 at end of data logging interval
30033	1	pH220	ph220_base_pump_on_time	secs	1		Resets to 0 at end of data logging interval
30034	1	Inhib	inhib_pump_on_time	secs	1		Resets to 0 at end of data logging interval
30035							Reserved – Used in firmware version 2.5.x

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Places	Description/Notes
30036	1	Disp	disp_pump_on_time	secs	1		Resets to 0 at end of data logging interval
30037	1	Tmr1	tmr1_relay_on_time	secs	1		Resets to 0 at end of data logging interval
30038	1	Tmr2	tmr2_relay_on_time	secs	1		Resets to 0 at end of data logging interval
30039	1	Tmr3	tmr3_relay_on_time	secs	1		Resets to 0 at end of data logging interval
30040	1	Tmr4	tmr4_relay_on_time	secs	1		Resets to 0 at end of data logging interval
30041							Reserved
30042							Reserved
30043							Reserved
30044							Reserved
30045-46	2	Alarm	alarm_last_sent (32 bits)	secs	1		Number of seconds since 1970
30047	1	Alarm	alarm_num_sent	-	1		Number of times an alarm has been sent
30048	1						Reserved
30049	1						Reserved
30050	1	Flow	flow_output	%	10		Output level from -100.0% to 100.0%
30051-52	2	Flow	flow_err	m/sec	100		Measure system response from the setpoint
30053-54	2	Flow	flow_err_rate	m/sec^2	100		Measure system response change from the setpoint
30055	1	Flow	flow_ctrl_valve		1		10000 valve fully open
30056	1	Corr	corr_output				
30057-58	2	Corr	corr_err				
30059-60	2	Corr	corr_err_rate				
30061	1						reserved
30062	1	ORP	orp_output	%	10		Output level from 0 to 100%
30063-64	2	ORP	orp_err	mV	100		Measure system response from the setpoint
30065-66	2	ORP	orp_err_rate	mV/min	100		Measure system response change from the setpoint
30067							Reserved
30068	1	pH	ph_output	%	10		Output level from 0 to 100%
30069-70	2	pH	ph_err	pH	1000		Measure system response from the setpoint
30071-72	2	pH	ph_err_rate	pH/min	1000		Measure system response change from the setpoint
30073							reserved
30074	1	pH220	ph220_acid_output	%	10		Output level from 0 to 100%
30075-76	2	pH220	ph220_acid_err	pH	1000		Measure system response from the setpoint
30077-78	2	pH220	ph220_acid_err_rate	pH/min	1000		Measure system response change from the setpoint
30079							Reserved
30080	1	pH220	ph220_base_output	%	10		Output level from 0 to 100%
30081-82	2	pH220	ph220_base_err	pH	1000		Measure system response from the setpoint
30083-84	2	pH220	ph220_base_err_rate	pH/min	1000		Measure system response change from the setpoint
30085	1						Reserved
30086	1						Reserved
30087	1						Reserved
30088	1						Reserved
30089	1	pH	ph_num_instances	-	1		Number of pH instances
30090	1	ORP	orp_num_instances	-	1		Number of ORP instances
30091	1	Tmr	tmr_num_timers	-	1		Number of timers
30092	1						Reserved
30093	1						Reserved
30094	1						Reserved
30095	1						Reserved
30096	1						Reserved
30097	1						Reserved

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Places	Description/Notes
30098	1						Reserved
30099-100	2	Temp	temp_last_cal	Secs	1		Number of seconds since 1970
30101-102	2	Corr	corr_last_cal	Secs	1		Number of seconds since 1970
30103-104	2	Cond	cond_last_cal	Secs	1		Number of seconds since 1970
30105-106	2	ORP	orp_last_cal	Secs	1		Number of seconds since 1970
300107-108	2	pH	ph_last_cal	Secs	1		Number of seconds since 1970
30109	1						Reserved
30110	1						Reserved
30111	1						Reserved
30112							Reserved
30113	1	HW	Model	-			1 = CT Series 2 = SP Series 4 = AT Series 8 = TW Series 16 = HP Series 32 = PH Series 64 = KPI Series
30114	1	HW	dom_day		1		Date of manufacture day (1-31)
30115	1	HW	dom_month		1		Date of manufacture month (1-12)
30116	1	HW	dom_year		1		Date of manufacture year (2000-)
30117-118	2	HW	serial_no (32 bits)	-	1		The controller's serial number
30119	1				1		Reserved
30120	1	SW	sw_ver_major	-	1		Software Code Version Major
30121	1	SW	sw_ver minor	-	1		Software Code Version Minor
30122	1	SW	sw_ver build	-	1		Software Code Version Build
30123	1	HW	bl_ver major		1		Bootloader version major
30124	1	HW	bl_ver minor		1		Bootloader version minor
30125	1	HW	bl_ver build		1		Bootloader version build
30126	1						Reserved
30127-28	2	HW	Option Flags 1	-	1		Aquarius Internal Use
30129-30	2	HW	Option Flags 2	-1	1		Reserved
30131	1	HW	Country	-	1		Aquarius Internal Use
30132	1	HW	Customer	-	1		Aquarius Internal Use
30133-34	2	SW	Checksum	-	1		Software Checksum
30135							Reserved
30136							Reserved
30137							Reserved
30138							Reserved
30139							Reserved
30140							Reserved
30141-42	2	WUM	wum_makeup_log	1	1		Resets to 0 at end of data logging interval
30143-44	2	WUM	wum_makeup_mtd	1	1		Month to date – resets to 0 at start of month
30145-46	2	WUM	wum_makeup_ytd	1	1		Year to date – resets to 0 at start of year
30147-48	2	WUM	wum_bleed_log	1	1		Resets to 0 at end of data logging interval
30149-50	2	WUM	wum_bleed_mtd	1	1		Month to date – resets to 0 at start of month
30151-52	2	WUM	wum_bleed_ytd	1	1		Year to date – resets to 0 at start of year
30153-54	2	WUM	wum_backwash_log	1	1		Resets to 0 at end of data logging interval
30155-56	2	WUM	wum_backwash_mtd	1	1		Month to date – resets to 0 at start of month

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Places	Description/Notes
30157-58	2	WUM	wum_backwash_ytd	l	1		Year to date – resets to 0 at start of year
30159-60	2	WUM	wum_makeup_total	l	1		Wraps around at 999,999,999,999
30161-62	2	WUM	wum_bleed_backwash_total	l	1		Wraps around at 999,999,999,999
30163-64	2	WUM	wum_total_difference	l	1		wum_makeup_total – wum_bleed_backwash_total Wraps around at 999,999,999,999
30165-66	2	WUM	wum_total_reset_time	sec	1		Number of seconds since 1970 when the totals were last reset
30167							Reserved
30168							Reserved
30169							Reserved
30170							Reserved
30171-2	2	Corr	corr_probe1_mpy	µm/year	1000		
30173-4	2	Corr	corr_probe 1_pitting		1000		
30175-6	2	Corr	corr_probe 2_mpy	µm/year	1000		
30177-8	2	Corr	corr_probe 2_pitting		1000		
30179							Reserved
30180							Reserved
30181							Reserved
30182							Reserved
30183-4	2	4-20	4_20_mA	mA	100		4-20mA input reading in mA
30185-6	2	4-20	4_20_engineering		100		4-20mA input scaled to engineering units

11 Binary Outputs

These are the binary outputs (writable digital tags) supported at present:

Addr	Module	Tag Name	Description/Notes	True	False	Factory
00001	Protocol	protocol	set to 'false' to use the aquaguard protocol	modbus	Aquaguard	
00002	Flow	flow_ctrl_mode		auto	manual	
00003	pH	ph_dose	Indicates if acid or base dosing. This point is only used on the following models **CT, KPI, SP, PH**	base	acid	
00004	ORP	orp_dose	Indicates if oxidising or reducing agent is being used. This point is only used on the following model **TW.**	oxidise	reduce	
00005			Reserved – Used in firmware version 2.5.x			
00006	Alarm	factory_default	set to true if controller has been set to factory defaults. Write a 0 to it to clear it. Can only be written once, any other writes will be ignored.	factory defaults	been configured	
00007	Alarm	alarm_ignore_flow	set to 'true' to ignore flow when alarming	on	off	

Addr	Module	Tag Name	Description/Notes	True	False	Factory
00008	Alarm	alarm_ignore_cal	set to 'true' to ignore calibration alarms	on	off	
00009			Reserved			
00010			Reserved			
00011			Reserved			
00012			Reserved			
00013			Reserved			
00014	Tmr1	tmr1_week1		timer	none	
00015	Tmr1	tmr1_week2		timer	none	
00016	Tmr1	tmr1_week3		timer	none	
00017	Tmr1	tmr1_week4		timer	none	
00018	Tmr2	tmr2_week1		timer	none	
00019	Tmr2	tmr2_week2		timer	none	
00020	Tmr2	tmr2_week3		timer	none	
00021	Tmr2	tmr2_week4		timer	none	
00022	Tmr3	tmr3_week1		timer	none	
00023	Tmr3	tmr3_week2		timer	none	
00024	Tmr3	tmr3_week3		timer	none	
00025	Tmr3	tmr3_week4		timer	none	
00026	Tmr4	tmr4_week1		timer	none	
00027	Tmr4	tmr4_week2		timer	none	
00028	Tmr4	tmr4_week3		timer	none	
00029	Tmr4	tmr4_week4		timer	none	

12 Analogue Outputs

These are the analog outputs (writeable integer tags) supported at present. Each value is a signed 16–bit or 32-bit integer.

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40001	1	Time	time_day	days	1	0	1	31		
40002	1	Time	time_month	months	1	0	1	12		
40003	1	Time	time_year	years	1	0	1970	-		
40004	1	Time	time_hour	hours	1	0	0	23		
40005	1	Time	time_min	mins	1	0	0	59		
40006	1	Time	time_sec	sec	1	0	0	59		
40007	1	Alarm	alarm repeat	-	1	0	0	3	0=Never, 1=Once, 2=4hrs, 3=morning	
40008	1	Flow	flow_ctrl_setpoint	l/min	1000					

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40009	1	Corr	corr_probe1	-	1	0	0	16	0=AL1 1=AL2 2=BS1 3=BS2 4=BS3 5=CS1 6=CS2 7=CU1 8=CU2 9=CU3 10=NI1 11=NI2 12=SS1 13=SS2 14=SS3 15=SS4 16=TI1	
40010	1	Corr	corr_probe2	-	1	0	0	16	0=AL1 1=AL2 2=BS1 3=BS2 4=BS3 5=CS1 6=CS2 7=CU1 8=CU2 9=CU3 10=NI1 11=NI2 12=SS1 13=SS2 14=SS3 15=SS4 16=TI1	
40011	1	Corr	corr_probesel		1	0	1	2	1 = probe 1 2 = probe 2	
40012	1	Corr	corr_mode	-	1	0	0	3	0=off, 1=mpy, 2=pit, 3=M+P	
40013									Used in firmware 2.5.x	
40014									Used in firmware 2.5.x	
40015-16	2	Corr	corr_error_center		10	1	1	999.0	Increase to reduce system sensitivity – or reduce to increase it.	F
40017-18	2	Corr	corr_error_dot_center		10	1	1	999.0	Increase to reduce system sensitivity to change – or reduce to increase it.	F
40019	1	Corr	corr_shoulder_factor		1	0	1	100		F
40020	1	Cond	cond_setpoint	mS	1000	2	0	9990		
40021	1	Cond	cond_mode	-	1		0	3	0=flow, 1=continuous, 2=off, 3=timer	
40022	1	Cond	cond_alarm	mS	1		0	6	0=0.2, 1=0.4, 2=0.8, 3=1.0, 4=1.5,5=2.0, 6=0.1	
40023	1	Cond	cond_alarm_mode	-	1		0	3	0=+/-, 1=+, 2=-, 3=off	
40024									reserved	
40025-26	2	ORP	orp_setpoint	mV	10		0	9990		

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40027	1	ORP	orp_mode	-	1		0	3	0=flow, 1=continuous, 2=off, 3=timer, 4=timer&flow **Note** Timer and Timer&Flow should only be used if ORP timer installed and working	
40028	1	ORP	orp_alarm_mode	-	1		0	3	0=+/-, 1=+, 2=-, 3=off	
40029	1	ORP	orp_alarm	mV	1		0	6	0=150, 1=200, 2=300, 3=400, 4=25, 5=50, 6=100	
40030	1	ORP	orp_lockout_delay	mins	1		0	990		
40031	1	ORP	orp_pump_duty	%	1		1	100		
40032									Reserved	
40033-34	2	ORP	orp_error_center	mV	100		1	10000	Increase to reduce system sensitivity – or reduce to increase it.	F
40035-36	2	ORP	orp_error_dot_center	mV/min	100		1	99900	Increase to reduce system sensitivity to change – or reduce to increase it.	F
40037	1	ORP	orp_fuzzy_shoulder	-	1		1	10	fuzzy logic control	F
40038									reserved	
40039-40	2	pH	ph_setpoint	pH	1000		0	14000		
40041	1	pH	ph_mode	-	1		0	2	0=flow, 1=continuous, 2=off	
40042	1	pH	ph_alarm	pH	1		0	5	0=2.0, 1=3.0, 2=3.5, 3=0.5, 4=1.0, 5=1.5	
40043	1	pH	ph_alarm_mode	-	1		0	3	0=+/-, 1=+, 2=-, 3=off	
40044	1	pH	ph_lockout_delay	mins	1		0	990		
40045	1	pH	ph_pump_duty	%	1		1	100		
40046									reserved	
40047-48	2	pH	ph_error_center	pH	1000		1	14000	Increase to reduce system sensitivity – or reduce to increase it.	F
40049-50	2	pH	ph_error_dot_center	pH/min	1000		1	99000	Increase to reduce system sensitivity to change – or reduce to increase it.	F
40051	1	pH	ph_fuzzy_shoulder	-	1		1	100	fuzzy logic control	F
40052									reserved	
40053-54	2	pH220	ph220_acid_setpoint	pH	1000		0	14000	3 decimals allowed./ Only use 2	
40055-56	2	pH220	ph220_base_setpoint	pH	1000		0	14000	3 decimals allowed./ Only use 2	

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40057	1	pH220	ph220_mode	-	1		0	3	0=flow, 1=continuous, 2=off, 3=timer	
40058	1	pH220	ph220_alarm_mode	-	1		-2	-1	0=on, 1=off	
40059	1	pH220	ph220_alarm	pH	1		0	5	0=2, 1=3, 2=3.5, 3=0.5, 4=1, 5=1.5	
40060	1	pH220	ph220_lockout_delay	mins	1		0	990		
40061	1	pH220	ph220_pump_duty	%	1		1	100		
40062									reserved	
40063-64	2	pH220	ph220_error_center	pH	1000		1	14000	Increase to reduce system sensitivity – or reduce to increase it.	F
40065-66	2	pH220	ph220_error_dot_center	pH/min	1000		1	99000	Increase to reduce system sensitivity to change – or reduce to increase it.	F
40067	1	pH220	ph220_fuzzy_shoulder	-	1		1	100	fuzzy logic control	F
40068									Reserved	
40069									Reserved	
40070									Reserved – Used in firmware version 2.5.x	
40071									Reserved – Used in firmware version 2.5.x	
40072									Reserved – Used in firmware version 2.5.x	
40073									Reserved	
40074									Reserved – Used in firmware version 2.5.x	
40075									Reserved – Used in firmware version 2.5.x	
40076									Reserved – Used in firmware version 2.5.x	
40077									Reserved	
40078									Used in firmware 2.5.x	
40079									Used in firmware 2.5.x	
40080	1	Disp	disp_mode	-	1		0	5	0=off 1=bleed 2=continuous 3=Flow 4=inhibitor 5=ORP if orp enabled	
40081									Reserved	
40082	1	SuperCL	super_cl_start_min	min	1		0	59		
40083	1	SuperCL	super_cl_start_hour	hrs	1		0	23		

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40084	1	SuperCL	super_cl_start_day	days	1		0	6	0=Off, 1=Sun ... 7=Sat	
40085	1	SuperCL	super_cl_duration	hrs	1		1	24		
40086	1	SuperCL	super_cl_repeat	wks	1		1	12		
40087-88	2	SuperCL	super_cl_orp	mV	100		6000	90000	ORP setting	
40089-90	2	SuperCL	super_cl_next_run	seconds since 1970					time for next run seconds since 1970	
40091	1	FAH	fah_cyanurate_acid	mg/l	1		0	95	note steps in 5	
40092	1	LSI	lsi_calcium_hardness	mg/l	1		100	600	steps of 10	
40093	1	Tmr1	tmr1_duty	%	1		1	100		
40094	1	Tmr1	tmr1_mode	%	1		1	3	0=off 1=timer 2=timer&flow	
40095	1	Tmr1							Reserved	
40096	1	Tmr1	tmr1_bleed_predelay	hrs	10		0	99		
40097	1	Tmr1	tmr1_bleed_lockout	hrs	10		0	99		
40098	1	Tmr1	tmr1_on_day0	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40099	1	Tmr1	tmr1_on_hr0	hrs	1		0	23		
40100	1	Tmr1	tmr1_on_min0	min	1		0	59		
40101	1	Tmr1	tmr1_duration0	hrs	10		0	99		
40102	1	Tmr1	tmr1_on_day1	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40103	1	Tmr1	tmr11_on_hr1	hrs	1		0	23		
40104	1	Tmr1	tmr11_on_min1	min	1		0	59		
40105	1	Tmr1	tmr11_duration1	hrs	10		0	99		
40106	1	Tmr1	tmr1_on_day2	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40107	1	Tmr1	tmr1_on_hr2	hrs	1		0	23		
40108	1	Tmr1	tmr1_on_min2	min	1		0	59		
40109	1	Tmr1	tmr1_duration2	hrs	10		0	99		
40110	1	Tmr1	tmr1_on_day3	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40111	1	Tmr1	tmr1_on_hr3	hrs	1		0	23		
40112	1	Tmr1	tmr1_on_min3	min	1		0	59		
40113	1	Tmr1	tmr1_duration3	hrs	10		0	99		
40114	1	Tmr1	tmr1_on_day4	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri,	
40115	1	Tmr1	tmr1_on_hr4	hrs	1		0	23		
40116	1	Tmr1	tmr1_on_min4	min	1		0	59		
40117	1	Tmr1	tmr1_duration4	hrs	10		0	99		
40118	1	Tmr1	tmr1_on_day5	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40119	1	Tmr1	tmr1_on_hr5	hr	1		0	23		
40120	1	Tmr1	tmr1_on_min5	min	1		0	59		
40121	1	Tmr1	tmr1_duration5	hrs	10		0	99		

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40122										
40123	1	Tmr2	tmr2_duty	%	1		1	100		
40124	1	Tmr2	tmr2_mode	%	1		1	3	0=off 1=timer 2=timer&flow	
40125	1	Tmr2							Reserved	
40126	1	Tmr2	tmr2_bleed_predelay	hrs	10		0	99		
40127	1	Tmr2	tmr2_bleed_lockout	hrs	10		0	99		
40128	1	Tmr2	tmr2_on_day0	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40129	1	Tmr2	tmr2_on_hr0	hrs	1		0	23		
40130	1	Tmr2	tmr2_on_min0	min	1		0	59		
40131	1	Tmr2	tmr2_duration0	hrs	10		0	99		
40132	1	Tmr2	tmr2_on_day1	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40133	1	Tmr2	tmr2_on_hr1	hrs	1		0	23		
40134	1	Tmr2	tmr2_on_min1	min	1		0	59		
40135	1	Tmr2	tmr2_duration1	hrs	10		0	99		
40136	1	Tmr2	tmr2_on_day2	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40137	1	Tmr2	tmr2_on_hr2	hrs	1		0	23		
40138	1	Tmr2	tmr2_on_min2	min	1		0	59		
40139	1	Tmr2	tmr2_duration2	hrs	10		0	99		
40140	1	Tmr2	tmr2_on_day3	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40141	1	Tmr2	tmr2_on_hr3	hrs	1		0	23		
40142	1	Tmr2	tmr2_on_min3	min	1		0	59		
40143	1	Tmr2	tmr2_duration3	hrs	10		0	99		
40144	1	Tmr2	tmr2_on_day4	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri,	
40145	1	Tmr2	tmr2_on_hr4	hrs	1		0	23		
40146	1	Tmr2	tmr2_on_min4	min	1		0	59		
40147	1	Tmr2	tmr2_duration4	hrs	10		0	99		
40148	1	Tmr2	tmr2_on_day5	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40149	1	Tmr2	tmr2_on_hr5	hr	1		0	23		
40150	1	Tmr2	tmr2_on_min5	min	1		0	59		
40151	1	Tmr2	tmr2_duration5	hrs	10		0	99		
40152									Reserved	
40153	1	Tmr3	tmr3_duty	%	1		1	100		
40154	1	Tmr3	tmr3_mode	%	1		1	3	0=off 1=timer 2=timer&flow	
40155	1	Tmr3							Reserved	
40156	1	Tmr3	tmr3_bleed_predelay	hrs	10		0	99		
40157	1	Tmr3	tmr3_bleed_lockout	hrs	10		0	99		

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40158	1	Tmr3	tmr3_on_day0	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40159	1	Tmr3	tmr3_on_hr0	hrs	1		0	23		
40160	1	Tmr3	tmr3_on_min0	min	1		0	59		
40161	1	Tmr3	tmr3_duration0	hrs	10		0	99		
40162	1	Tmr3	tmr3_on_day1	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40163	1	Tmr3	tmr3_on_hr1	hrs	1		0	23		
40164	1	Tmr3	tmr3_on_min1	min	1		0	59		
40165	1	Tmr3	tmr3_duration1	hrs	10		0	99		
40166	1	Tmr3	tmr3_on_day2	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40167	1	Tmr3	tmr3_on_hr2	hrs	1		0	23		
40168	1	Tmr3	tmr3_on_min2	min	1		0	59		
40169	1	Tmr3	tmr3_duration2	hrs	10		0	99		
40170	1	Tmr3	tmr3_on_day3	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40171	1	Tmr3	tmr3_on_hr3	hrs	1		0	23		
40172	1	Tmr3	tmr3_on_min3	min	1		0	59		
40173	1	Tmr3	tmr3_duration3	hrs	10		0	99		
40174	1	Tmr3	tmr3_on_day4	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri,	
40175	1	Tmr3	tmr3_on_hr4	hrs	1		0	23		
40176	1	Tmr3	tmr3_on_min4	min	1		0	59		
40177	1	Tmr3	tmr3_duration4	hrs	10		0	99		
40178	1	Tmr3	tmr3_on_day5	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40179	1	Tmr3	tmr3_on_hr5	hr	1		0	23		
40180	1	Tmr3	tmr3_on_min5	min	1		0	59		
40181	1	Tmr3	tmr3_duration5	hrs	10		0	99		
40182									Reserved	
40183	1	Tmr4	tmr4_duty	%	1		1	100		
40184	1	Tmr4	tmr4_mode	%	1		1	3	0=off 1=timer 2=timer&flow	
40185	1	Tmr4							Reserved	
40186	1	Tmr4	tmr4_bleed_predelay	hrs	10		0	99		
40187	1	Tmr4	tmr4_bleed_lockout	hrs	10		0	99		
40188	1	Tmr4	tmr4_on_day0	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40189	1	Tmr4	tmr4_on_hr0	hrs	1		0	23		
40190	1	Tmr4	tmr4_on_min0	min	1		0	59		
40191	1	Tmr4	tmr4_duration0	hrs	10		0	99		
40192	1	Tmr4	tmr4_on_day1	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40193	1	Tmr4	tmr4_on_hr1	hrs	1		0	23		
40194	1	Tmr4	tmr4_on_min1	min	1		0	59		
40195	1	Tmr4	tmr4_duration1	hrs	10		0	99		
40196	1	Tmr4	tmr4_on_day2	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40197	1	Tmr4	tmr4_on_hr2	hrs	1		0	23		
40198	1	Tmr4	tmr4_on_min2	min	1		0	59		
40199	1	Tmr4	tmr4_duration2	hrs	10		0	99		
40200	1	Tmr4	tmr4_on_day3	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40201	1	Tmr4	tmr4_on_hr3	hrs	1		0	23		
40202	1	Tmr4	tmr4_on_min3	min	1		0	59		
40203	1	Tmr4	tmr4_duration3	hrs	10		0	99		
40204	1	Tmr4	tmr4_on_day4	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri,	
40205	1	Tmr4	tmr4_on_hr4	hrs	1		0	23		
40206	1	Tmr4	tmr4_on_min4	min	1		0	59		
40207	1	Tmr4	tmr4_duration4	hrs	10		0	99		
40208	1	Tmr4	tmr4_on_day5	day	1		0	10	0=off, 1-7=Sun-Sat 8=all, 9=Mon-Fri, 10=Mon+Wed+Fri	
40209	1	Tmr4	tmr4_on_hr5	hr	1		0	23		
40210	1	Tmr4	tmr4_on_min5	min	1		0	59		
40211	1	Tmr4	tmr4_duration5	hrs	10		0	99		
40212	1								Reserved	
40213	1								Reserved	
40214	1								Reserved	
40215	1	SW	Designator[0..1]						Name of the controller	
40216	1	SW	Designator[2..3]							
40217	1	SW	Designator[4..5]							
40218	1	SW	Designator[6..7]							
40219	1	SW	Designator[8..9]							
40220	1	SW	Designator[10..11]							
40221	1	SW	Designator[12..13]							
40222	1	SW	Designator[14..15]							
40223	1	SW	Designator[16..17]						16 is the last field and should always be sent as 0 to terminate the string	
40224									Reserved	
40225	1	DLogr	datalogger_interval	mins	1		1	240	0=1, 1=2, 2=5, 3=10, 4=15, 5=30, 6=60, 7=120, 8=240	
40226	1	Culture	culture_units		0		0	1	0= SI, 1=US Imperial	
40227									Reserved	
40228									Reserved	
40229									Reserved	
40230									Reserved	

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40231	1	Flow	flow_ctrl_alarm_mode	-	1		0	3	0=Off, 1=±10%, 2=±15%, 3=±20%	
40232									Reserved	
40233									Reserved	
40234									Reserved	
40235-36	2	Inhib	inhib_pump_size	l/h	1000		100	20000	Used when not in WM mode	
40237-38	2	Inhib	inhib_dose_rate	l/h	1000				Used when not in WM mode Only values from 0.5% to 100% of the pump size will be accepted	
40239-40	2	Inhib	inhib_pump_size_wm	l/h	1000		100	20000	Used when in WM mode	
40241	1	Inhib	inhib_ppm	Ppm	1		1	999	Used when in WM mode	
40242	1	Inhib	inhib_mode	-	1		0	5	0=off, 1=bleed, 2=continuous, 3=flow, 4=water meter, 5=corrosion flow **Note** Corrosion flow mode whould only be set if corr_enabled is TRUE **Note** The WUM Makeup meter is used to control the Inhibitor in WM mode (see point 40247).	
40243									Reserved	
40244									Reserved	
40245									Reserved	
40246									Reserved	
40247-48	2	WUM	wum_makeup_vol_per_pulse	L	1000		0	1000000	Litres of makeup for each pulse 0 disables input.	
40249-50	2	WUM	wum_bleed_vol_per_pulse	L	1000		0	1000000	Litres of bleed for each pulse 0 disables input,	
40251-52	2	WUM	wum_backwash_vol_per_pulse	L	1000		0	1000000	Litres of backwash for each pulse 0 disables input.	
40253									Reserved	
40254									Reserved	
40255									Reserved	
40256									Reserved	
40257-58	2	Disp	disp_pump_size	l/hr	1000		100	20000		

Address	Reg	Module	Tag name	Units	Scale	Display Decimal Place	Min	Max	Description/Notes	Factory
40259-60	2	Disp	disp_dose_rate	l/hr	1000		1	20000	Only values from 0.5% to 100% of the pump size will be accepted	
40261-62	2	Corr	corr_setpoint		1000		1000	999000		
40263-64	2	Corr	corr_alset		1000		0	500000	0 disables alarm	
40265										
40266										
40267										
40268										
40269										
40270										
40271										
40272										
40273-4	2	4-20	4_20_engineering_min		100		-1e7	1e7	Value in engineering units represented by 4mA	
40275-6	2	4-20	4_20_engineering_max		100		-1e7	1e7	Value in engineering units represented by 20mA	
40277	1	4-20	4_20_alarm_mode				0	3	0=±, 1=+, 2=-, 3=OFF	
40278									Reserved	
40279-80	2	4-20	4_20_alarm_centre		100		-1e7	1e7	Desired value of 4-20mA input	
40281-82	2	4-20	4_20_alarm_range		100		1	1e7	Width of alarm window	
40283	1	4-20	4_20_name[0..1]						Name of the 4-20mA signal.	
40284	1	4-20	4_20_name[2..3]							
40285	1	4-20	4_20_name[4..5]							
40286	1	4-20	4_20_name[6..7]							
40287	1	4-20	4_20_name[8..9]							
40288	1	4-20	4_20_name[10] and NULL							

13 Factory and Software Series

Any fields that have an * in the factory field are **NOT** to be modified.
Any model fields with an * in them are **NOT** to be used for this model.

14 Timer Naming

All software series that have timers, timer 1 is the first timer seen in the

Series	Num Timers	Timer	Timer Name
AT Series	2	1	Biocide-A
		2	Biocide-B
CT Series	2	1	ORP
		2	Biocide-B
SP	0		N/A
TW	0		
HP	0		N/A
KPI	2	1	ORP
		2	Biocide-B

15 Master Station Settings

This protocol has been tested using Citect v6.0 (www.citect.com) with the following Modbus specific settings:

[Modbus] LongDataType=3
Long data types use the formula: 65536*high register + low register. There is only register that uses this type (time_t) and is unlikely to be used by many master stations (and so can generally be ignored).

[Modbus] MaxBits=720
The maximum read size in one request. The controller has a limited packet size (around 100 bytes) that can be sent.