WALCHEM

IWAKI America Inc.

Web Master® WIND

Modbus TCP/IP Option Instruction Manual

s825, s826, s827, or s829v022 and higher

Five Boynton Road Hopping Brook Park Holliston, MA 01746 USA

TEL: 508-429-1110 FAX: 508-429-7433 WEB: www.walchem.com

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1.0 SCOPE

This document is a User Interface Specification for the WebMaster® Modbus/TCP product feature. This is a mapping of the various dynamic variables to their Modbus/TCP register locations.

This document supports the Modbus feature in the following controller software versions:

S825v022, s826v022, s827v022, s829v022

2.0 INTRODUCTION

The WebMaster® product supports TCP/IP communications on 3 different network interfaces (USB, modem, and Ethernet). All configurations of set points are accomplished with a computer running a browser (such as Microsoft Internet Explorer) connected to the WebMaster® over one of these interfaces.

The Modbus/TCP option allows the WebMaster® to communicate with PC-based applications such as WonderWare and Intellution HMI/SCADA programs, Building Energy Management systems, Distributed Control Systems (DCS), as well as stand-alone HMI devices.

The WebMaster® is a Modbus Server, meaning that it is capable of responding to requests from the HMI device. The WebMaster® cannot initiate the flow of information, for example, it will not immediately send a new alarm message. It will wait until the HMI device requests the current data contained in specific register locations.

In version 10 or higher, the HMI software can be used to change WebMaster® set points. This manual is divided into two sections, Modbus Read and Modbus Writes.

If the HMI device does not directly support Modbus/TCP protocol, then a protocol translation gateway may be required to convert from Modbus/TCP to a protocol that the device supports. Please note that Modbus/RTU requires a serial interface, not Ethernet, and therefore is not directly compatible with the WebMaster®.

3.0 OVERVIEW

Modbus/TCP is a form of Modbus that uses the TCP/IP layers as a base layer for controlling the communications between different devices.

The Modbus/TCP protocol supports multiple types of data transactions, from reading single bits per transaction, to advanced object-oriented operations. However, to ensure the most compatible system available, the simplest function set is to be made available.

The Modbus/TCP protocol has each transaction type classified in to conformance classes, to ensure consistency and interoperability. Class 0 is the simplest, and allows for reading and writing of multiple 16-bit registers. The Modbus/TCP feature of the WebMaster® will support reading and writing of these 16-bit registers, which allows the WebMaster® to establish a block of data which contains all the process variables, set points, alarms and input/output statuses that are to be made public to a Modbus/TCP client. This block of data is packaged so that it can be read in 16-bit chunks (or registers) at a time, regardless of the type of data within it. In the following sections, the formatting, storing, and reading of this data are described.

4.0 MODBUS/TCP DRIVER

4.1 MODBUS PROTOCOL

The Modbus protocol, as well as the TCP extension, is well documented in the specifications which are available at http://www.modbus.org, a website established by the Modbus Organization for supporting and organizing the Modbus protocol. Only the use of the protocol is documented here.

4.1.1 TCP

The Modbus/TCP extension includes 7 additional bytes to the original Modbus protocol, which allows for transport over the TCP/IP layers.

The MBAP Header (Modbus Application Protocol Header) consists of 7 bytes of information:

Transaction Identifier	2 bytes	identification of Request/Response transaction – copied from request to response
Protocol Identifier	2 bytes	0 = Modbus protocol
Length	2 bytes	number of following bytes – includes the unit identifier
Unit Identifier	1 byte	identification of remote slave, can be used for broadcasting (not supported)

The Unit Identifier has a special consideration in the WebMaster® implementation. If the value is 0, then the request is considered to be a broadcast message; therefore the packet will be processed, and no response will be generated. If the value is anything else, the packet will be processed and a response will be generated.

Normally the Slave ID will be set in the HMI client software to 1.

The broadcast Unit Identifier address is not supported as of this release, as the only function code supported is Read Holding Registers; therefore, a response is required at all times.

4.1.2 Function Codes

The Modbus/TCP Server feature supports the following function codes:

- Function Code 3 (FC3), Read Multiple Registers, which allows the reading of up to 125 16-bit registers, or quantities, within a single request/response cycle.
- Function Code 16 (FC16), Write Multiple Registers, which allows the writing of up to 125 16-bit registers, or quantities, within a single request/response cycle.
- Function Code 6 (FC6), Write Single Registers, which allows the writing of a single 16-bit register within a single request/response cycle.

FC3 and FC16 have a 125-register limitation, which was established for the Modbus/TCP standard to maintain consistency with the original Modbus protocol standard, even though a TCP/IP packet can support more data.

Request

Function Code	1 byte	0x03
Starting Address	2 bytes	0x0000 to 0xFFFF
Quantity of Registers	2 bytes	1 to 125 (0x01 to 0x7D)

Response

Function Code	1 byte	0x03
Byte Count	1 byte	2 x N*
Register Values	N* x 2 bytes	

*N = quantity of registers

Error

Function Code	1 byte	0x03
Exception Code	1 byte	

Any unsupported Function Code request will be returned with an error response. The error response is also applied to a request for too much data, or data at a register address that is not present.

4.2 TCP/IP INTERFACE

The Modbus/TCP interface is attached to the TCP/IP stack that is implemented within the WebMaster® product, and will listen to all communications that come in on Modbus/TCP registered port 502.

Up to 10 connections/sockets are possible at one time. If there are 10 active connections, any attempt at any more connections is ignored.

Once a connection has been established, it will be closed after 1 minute of inactivity.

4.3 DATA REFRESH

To ensure that the Modbus/TCP client has the most recent data available to it, the Modbus/TCP periodically refreshes the data by reading the selected data and storing it in the specific locations within the tables.

The refresh is performed every four seconds, so the client application should not request data more frequently than once every 4000 msec.

4.4 DATA ENCODING

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/TCP packet. Most client drivers will extract the data from the packet in the correct format for use/display within the client environment.

4.4.1 Binary

Binary data is used for digital input or alarm states that can be represented as a 1 or a 0. A binary item is represented as a single bit within a data word. All binary data is packed in to 16-bit data words, therefore a single register contains 16 bits of binary data, each having a specific meaning.

value	1st	2nd
0xAA55 (101010100101)	0xAA (10101010)	0x55 (01010101)

4.4.2 16-Bit Word (short)

A 16-bit word item is transmitted with the MOST significant byte first. FC3 reads 16-bit items at a time; therefore, each of these data items will fit within one register that is read.

value	1st	2nd
0x1234	0x12	0x34

4.4.3 32-Bit Word (Integer)

Integer data is used for encoding the status message, input or output state, relay control mode, and relay output mode. A 32-bit word item is transmitted with the MOST significant byte first, then the next MOST significant, until all bytes are transmitted. FC3 reads 16-bit items at a time; therefore, two registers are required to read each 32-bit data item.

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

4.4.4 Float Inverse

Float Inverse data is used to represent sensor input and control output dynamic data.

A float is 32-bits within the WebMaster product; therefore is transmitted just as a 32-bit word item is. FC3 reads 16-bit items at a time; therefore, two registers are required to read each float data item.

Hexadecimal Representation of a 32-bit Floating Point Number

1st Word		**2nd Word**	
1st Byte	2nd Byte	1st Byte	2nd Byte
0x12	0x34	0x56	0x78

Since the “Float Inverse” convention is used in MODBUS, this means that the high and low order "words" are actually swapped.

Therefore, the HMI must perform the word swap of the register contents in order to convert and express the floating point number properly in normal decimal notation.

32-bit Float Inverse Hexadecimal Representation of a Floating Point Number

1st Word		2nd Word	
1st Byte	2nd Byte	1st Byte	2nd Byte
0x56	0x78	0x12	0x34

Example:

5,000.00 decimal is 0x459C4000 hexadecimal float and 0x4000459C hexadecimal inverse float.

4.4.5 Strings

Strings are used for the System Summary page header data, custom names, and units of measure. 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. Modbus reads 16-bit items at a time; therefore, a single register contains two characters of the string. To simplify string storage/transfer, each string should be of an even-byte length.

	1st register		2nd register		3rd register		4th register	
value	1st	2nd	1st	2nd	1st	2nd	1st	2nd
'Walchem'	'W'	'a'	'l'	'c'	'h'	'e'	'm'	?

Strings are read by the client application as Hex and decoded into ASCII.

Example:

"Level 2"

Address	Hex value	ASCII
6001	0x4C65	"LE"
6003	0x7665	"VE"
6005	0x6c20	"L "
6007	0x3200	"2 "

4.5 DATA DICTIONARY - READS

The following tables detail the Modbus addresses required to access each item of the public data.

4.5.1 Addressing (0- or 1-Based)

The addressing within the Modbus/TCP protocol (that is, the data within the physical packet) is 0-based, meaning the first element/item to be accessed is referenced by address 0. The Modbus standard for handling and displaying the data is 1-based, meaning the first element/data item to be access is referenced by address 1.

Most client applications handle this by having the user enter the 1-based number, and then subtract 1 to revert to the 0-based addressing required at the protocol level.

Some client applications allow the user to enter the 0-based number, or a combination, depending on how it is configured.

The addresses defined within the following table are 1-based, as the majority of the client applications work with this method.

4.5.2 Header Data, Custom Names and Units of Measure

Header data consists of strings to display the name and location programmed in the product. Custom names of inputs and outputs describe the purpose of the device connected. Units of measure changes made in the controller can be automatically be updated on the HMI. Refer to section **4.4.5 Strings** for the method to extract the string data.

For example, to read the Controller Name, a Read Holding Register request is generated with address 40001 and a register quantity of 16.

Controller Details

Parameter	Register Quantity	Item Size (bytes)	Register Addresses
Controller Name	16	32	0001
Controller Location	16	32	0017

Custom Names and Units of Measure

			HARDWARE CHANNELS														
Parameter	Size (Words)	Register Quantity/Channel	1	2	3	4	5	6	7	8	A	B	C	D	E	F	
Analog Input Custom Name	16	16	6001	6017	6033	6049	6065	6081	6097	6113	--	--	--	--	--	--	Register Addresses
Sensor Input Custom Name	16	8	6257	6273	6289	6305	--	--	--	--	--	--	--	--	--	--	
Digital Input Custom Name	16	16	6385	6401	6417	6433	6449	6465	--	--	6481	6497	6513	6529	6545	6561	
Relay Output Custom Name	16	12	6641	6657	6673	6689	6705	6721	6737	6753	--	--	--	--	--	--	
Analog Output Custom Name	16	8	6833	6849	6865	6881	--	--	--	--	--	--	--	--	--	--	
Analog Input Units	16	16	6961	6977	6993	7009	7025	7041	7057	7073	--	--	--	--	--	--	
Sensor Input Units	16	8	7217	7233	7249	7265	--	--	--	--	--	--	--	--	--	--	
Digital Input Units	16	16	7345	7361	7377	7393	7409	7425	--	--	7441	7457	7473	7489	7505	7521	
Relay Output Units	16	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Analog Output Units	16	8	7793	7809	7825	7841	--	--	--	--	--	--	--	--	--	--	

4.5.3 Alarm Data

Alarm states are bit-based (Binary), with up to 16 alarms encoded within each register. To access an individual alarm state, the register is read and the specific bit of the register is checked. Refer to section **4.4.2 16-Bit Word (short)** for the method to properly extract the data.

For example, to check the Modem Failure Alarm, a Read Holding Register is generated with address 41001 and a register quantity of 1. When the data is returned, and is extracted, it is bit-or'ed with 2 to determine the state.

Legend:

--	Bit not defined or used
XY_#	Hardware channel for that register address and bit number
M	Modem Card
E	Ethernet Hardware
A	Analog Input Card
D	Digital Input Card
S	Slave Controllers on a Subnetwork
AO_#	Analog Output Cards
SI_#	Sensor Input Cards
DI_#	Digital Input Channels
AI_#	Analog Input Channels
R_#	Relay Output Channels

Example: Set Modbus to display data in Binary. If Modbus reports back the following for word 1002, this means Sensor Error on sensor inputs channels 1 and 2.

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	<---- *Bit #*
0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	

Alarm Message	Register Addresses	Relay Output Alarms																
		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	<---- *Bit #*
Timer Skipped Alarm	1035	--	--	--	--	--	--	--	--	R_8	R_7	R_6	R_5	R_4	R_3	R_2	R_1	HARDWARE
Output Timeout Alarm	1037	--	--	--	--	--	--	--	--	R_8	R_7	R_6	R_5	R_4	R_3	R_2	R_1	CHANNEL

Alarm Message	Register Addresses	Digital Input Alarms																
		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	<---- Bit #
Digital Level Switch Low Alarm	1016	--	--	--	--	--	--	--	--	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	HARDWARE CHANNEL
	1017	--	--	--	--	--	--	--	--	--	--	--	--	DI_F	DI_E	DI_D	DI_6	
Generic Counter Rate High Alarm	1018	--	--	--	--	--	--	--	--	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	
	1019	--	--	--	--	--	--	--	--	--	--	--	--	DI_F	DI_E	DI_D	DI_6	
	1020	--	--	--	--	--	--	--	--	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	
	1021	--	--	--	--	--	--	--	--	--	--	--	--	DI_F	DI_E	DI_D	DI_6	
Generic Counter Total Alarm	1022	--	--	--	--	--	--	--	--	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	
	1023	--	--	--	--	--	--	--	--	--	--	--	--	DI_F	DI_E	DI_D	DI_6	
Generic Input Alarm	1024	--	--	--	--	--	--	--	--	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	
	1025	--	--	--	--	--	--	--	--	--	--	--	--	DI_F	DI_E	DI_D	DI_6	
Flow Meter Total Alarm	1026	--	--	DI_D	--	--	DI_A	--	--	--	--	--	--	--	--	--	--	
	1027	--	--	--	--	--	DI_C	--	--	--	--	--	--	--	DI_B	--	--	
	1028	--	--	--	--	--	DI_2	--	--	--	--	--	--	--	DI_1	--	--	
	1029	--	--	--	--	--	DI_4	--	--	--	--	--	--	--	DI_2	--	--	
	1030	--	--	--	--	--	DI_6	--	--	--	--	--	--	--	DI_3	--	--	
Flow Meter Rate High Alarm	1026	--	--	--	--	DI_D	--	--	DI_A	--	--	--	--	--	--	--	--	
	1027	--	--	--	--	--	--	--	DI_C	--	--	--	--	--	--	--	DI_B	
	1028	--	--	--	--	--	--	--	DI_2	--	--	--	--	--	--	--	DI_1	
	1029	--	--	--	--	--	--	--	DI_4	--	--	--	--	--	--	--	DI_3	
	1030	--	--	--	--	--	--	--	DI_6	--	--	--	--	--	--	--	DI_5	
Flow Meter Rate Low Alarm	1026	--	--	--	DI_D	--	--	DI_A	--	--	--	--	--	--	--	--	--	
	1027	--	--	--	--	--	--	DI_C	--	--	--	--	--	--	--	DI_B	--	
	1028	--	--	--	--	--	--	DI_2	--	--	--	--	--	--	--	DI_1	--	
	1029	--	--	--	--	--	--	DI_4	--	--	--	--	--	--	--	DI_3	--	
	1030	--	--	--	--	--	--	DI_6	--	--	--	--	--	--	--	DI_5	--	
Flow Meter Deviation Alarm	1026	DI_A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	1027	DI_C	DI_B	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	1028	DI_2	DI_1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	1029	DI_4	DI_3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	1030	DI_6	DI_5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Feed Verification Pump Failure	1031	--	--	--	--	DI_F	DI_E	DI_D	DI_6	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	
Interlock Alarm	1032	--	--	--	--	DI_F	DI_E	DI_D	DI_6	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	
Low Low Alarm	1056	--	--	--	--	DI_F	DI_E	DI_D	DI_6	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	
High High Alarm	1057	--	--	--	--	DI_F	DI_E	DI_D	DI_6	DI_5	DI_4	DI_3	DI_2	DI_1	DI_C	DI_B	DI_A	
Deviated Sensor Alarm	1058	--	--	--	--	--	--	--	--	--	--	--	--	--	DI_F	DI_E	DI_D	

Alarm Message	Register Addresses	Analog Input Alarms																
		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	<---- Bit #
Level Low Alarm	1004	--	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	
	1005	--	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	
	1006	--	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	
	1007	--	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	
Level Sensor Error	1004	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	
	1005	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	
	1006	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	
	1007	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	
Generic Low Alarm	1008	--	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	
	1009	--	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	
	1010	--	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	
	1011	--	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	
Generic High Alarm	1008	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	
	1009	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	
	1010	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	
	1011	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	
Generic Sensor Error	1008	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	--	
	1009	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	--	
	1010	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	--	
	1011	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	--	
Flow Meter Sensor Error	1012	--	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	
	1013	--	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	
	1014	--	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	
	1015	--	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	
Flow Meter High Alarm	1012	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	
	1013	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	
	1014	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	
	1015	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	
Flow Meter Low Alarm	1012	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	--	
	1013	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	--	
	1014	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	--	
	1015	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	--	
Flow Meter Total Alarm	1012	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	--	--	
	1013	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	--	--	
	1014	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	--	--	
	1015	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	--	--	
Level Low Low Alarm	1044	--	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	
	1045	--	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	
	1046	--	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	
	1047	--	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	
Level High Alarm	1044	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	
	1045	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	
	1046	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	
	1047	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	
Level High High Alarm	1044	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	--	
	1045	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	--	
	1046	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	--	
	1047	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	--	
Level Deviation Alarm	1044	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	--	--	
	1045	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	--	--	
	1046	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	--	--	
	1047	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	--	--	
Generic Low Low Alarm	1048	--	--	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	
	1049	--	--	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	
	1050	--	--	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	
	1051	--	--	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	
Generic High High Alarm	1048	--	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	--	
	1049	--	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	--	
	1050	--	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	--	
	1051	--	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	--	
Generic Deviation Alarm	1048	--	--	--	--	AI_2	--	--	--	--	--	--	--	AI_1	--	--	--	
	1049	--	--	--	--	AI_4	--	--	--	--	--	--	--	AI_3	--	--	--	
	1050	--	--	--	--	AI_6	--	--	--	--	--	--	--	AI_5	--	--	--	
	1051	--	--	--	--	AI_8	--	--	--	--	--	--	--	AI_7	--	--	--	
Flow Meter Low Low Alarm	1052	--	--	--	--	--	--	--	*2*	--	--	--	--	--	--	--	*1*	
	1053	--	--	--	--	--	--	--	*4*	--	--	--	--	--	--	--	*3*	
	1054	--	--	--	--	--	--	--	*6*	--	--	--	--	--	--	--	*5*	
	1055	--	--	--	--	--	--	--	*8*	--	--	--	--	--	--	--	*7*	
Flow Meter HIgh High Alarm	1052	--	--	--	--	--	--	*2*	--	--	--	--	--	--	--	*1*	--	
	1053	--	--	--	--	--	--	*4*	--	--	--	--	--	--	--	*3*	--	
	1054	--	--	--	--	--	--	*6*	--	--	--	--	--	--	--	*5*	--	

HARDWARE CHANNEL

4.5.4 Status Data

Status data consists of 32-bit Word (Integer). Refer to section **4.5.3 32-Bit Word (int)** for the method to properly extract the data. The following rules indicate the format of the table:

Address defines the starting address to read to access the item

Register Count (Item) defines the number of registers to read to access the item

For example, to check the Analog Input Status for hardware channel 2, a Read Holding Register is generated with address 42036 and a register quantity of 1.

			HARDWARE CHANNELS														
Parameter	**Size (Words)**	**Data Type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**A**	**B**	**C**	**D**	**E**	**F**	
Sensor Input Status	1	Integer	2002	2004	2006	2008	--	--	--	--	--	--	--	--	--	--	**Register Addresses**
Sensor Input Temperature Status	1	Integer	2014	2016	2018	2020	--	--	--	--	--	--	--	--	--	--	
Analog Input Status	1	Integer	2034	2036	2038	2040	2042	2044	2046	2048	--	--	--	--	--	--	
Digital Input Status	1	Integer	2060	2062	2064	2066	2068	2070	--	--	2054	2056	2058	2072	2074	2076	
Analog Output Status	1	Integer	2098	2100	2102	2104	--	--	--	--	--	--	--	--	--	--	
Relay Hand-Off-Auto Mode (0=Hand, 1=Off, 2=Auto)	1	Integer	2114	2116	2118	2120	2122	2124	2126	2128	--	--	--	--	--	--	
Relay Output State (0=Off, 256=On)	1	Integer	2137	2138	2139	2140	2141	2142	2143	2144							

The data is encoded using the following values:

Digital, Analog and Sensor Input Status Codes

Code	Message
0	" "
1	Normal
2	Off
3	On
4	OK
5	Self Test
6	Wait
7	Sampling
8	Hold
9	Sensor Error
10	High Alarm
11	Low Alarm
12	Calibration Time
13	Board Failure
14	Pump Failure
15	Total Alarm
16	Probe wash
17	High High Alarm
18	Low Low Alarm
19	Sensor Deviation

4.5.4 Dynamic Data

Dynamic data generally consists of 16-bit words (Binary), 32-bit word (Integer) or float inverse. To access an individual Dynamic Data item, 1 or 2 registers are required to be read. Refer to sections **4.5.2 16-Bit Word (short), 4.5.3 32-Bit Word (Integer)** and **4.5.4 Float Inverse** for the methods to properly extract the data. The following rules indicate the format of the table:

Address	defines the starting address to read to access the item
Register Count (Item)	defines the number of registers to read to access the item

For example, to check the item Sensor Calibrated Reading for hardware channel 1, a Read Holding Register is generated with address 43001 and a register quantity of 2.

Dynamic Data			**HARDWARE CHANNELS**														
Parameter	**Size (Words)**	**Data Type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**A**	**B**	**C**	**D**	**E**	**F**	
Direct Sensors																	
Sensor Input Calibrated Value	2	Float Inverse	3001	3003	3005	3007	--	--	--	--	--	--	--	--	--	--	
Sensor Input Uncalibrated Value	2	Float Inverse	3017	3019	3021	3023	--	--	--	--	--	--	--	--	--	--	
Sensor Input mV	2	Float Inverse	3033	3035	3037	3039	--	--	--	--	--	--	--	--	--	--	
Sensor Input Temperature Calibrated Value	2	Float Inverse	3049	3051	3053	3055	--	--	--	--	--	--	--	--	--	--	
Sensor Input Temperature Uncalibrated Value	2	Float Inverse	3065	3067	3069	3071	--	--	--	--	--	--	--	--	--	--	
Sensor Input Temperature mV	2	Float Inverse	3081	3083	3085	3087	--	--	--	--	--	--	--	--	--	--	
Analog (4-20 mA) Inputs																	
Analog Input Scaled Value	2	Float Inverse	3097	3099	3101	3103	3105	3107	3109	3111	--	--	--	--	--	--	**Register Addresses/ Bit Number**
Analog Input mA Value	2	Float Inverse	3129	3131	3133	3135	3137	3139	3141	3143	--	--	--	--	--	--	
Analog Input Total (Flow Type Only)	2	Float Inverse	3161	3163	3165	3167	3169	3171	3173	3175	--	--	--	--	--	--	
Digital Inputs																	
Digital Input Rate (Paddlewheel and Counter Types Only)	2	Float Inverse	3335	3337	3339	3341	3343	3345	--	--	3329	3331	3333	3347	3349	3351	
Digital Input Total (Flowmeter, Feed Verification and Counter Types Only)	2	Float Inverse	3367	3369	3371	3373	3375	3377	--	--	3361	3363	3365	3379	3381	3383	
Digital Input State (0=Open, 1=Closed)	1 Bit	Binary	3322/1	3323/9	3323/1	3324/9	3324/1	3325/9	--	--	3321/9	3321/1	3322/9	3325/1	3326/9	3326/1	
Analog (4-20 mA) Outputs																	
Analog Output % Output	2	Float Inverse	3681	3683	3685	3687	--	--	--	--	--	--	--	--	--	--	
Analog Output mA Value	2	Float Inverse	3697	3699	3701	3703	--	--	--	--	--	--	--	--	--	--	

4.6 DATA DICTIONARY - WRITES

The following tables detail the Modbus addresses required to modify each item of the public data.

4.6.1 Addressing (0- or 1-Based)

The addressing within the Modbus/TCP protocol (that is, the data within the physical packet) is 0-based, meaning the first element/item to be accessed is referenced by address 0. The Modbus standard for handling and displaying the data is 1-based, meaning the first element/data item to be access is referenced by address 1.

Most client applications handle this by having the user enter the 1-based number, and then subtract 1 to revert to the 0-based addressing required at the protocol level.

Some client applications allow the user to enter the 0-based number, or a combination, depending on how it is configured.

The addresses defined within the following table are 1-based, as the majority of the client applications work with this method.

4.6.2 Dynamic Data - Writes

Dynamic data for Modbus writes are float inverse. To modify an individual Set Point, 2 registers are required to be written to. Set points with (int) shown will be rounded to an integer if not entered as one. Refer to section **4.5.4 Float Inverse** for the methods to properly modify the data. All writable registers may also be read.

For example, to modify the Low-low alarm set point on sensor input hardware channel 1, a Write Holding Register is generated with address 20641 and a size of 2. The second chart below indicates the range of allowable set points for each type of sensor.

Direct Sensor Input Read/Write Parameters

		Direct Sensor Channel				
When Configured As	Available Setpoints	SI_1	SI_2	SI_3	SI_4	
Any Sensor TYPE	Low Low alarm	20641	20671	20701	20731	Register Addresses
	Low alarm	20643	20673	20703	20733	
	High alarm	20645	20675	20705	20735	
	High High alarm	20647	20677	20707	20737	
	Manual Temp	20649	20679	20709	20739	
	Temp Hi Alarm	20651	20681	20711	20741	
	Temp Lo Alarm	20653	20683	20713	20743	
	Alarm Deadband	20655	20685	20715	20745	
	Damping	20657	20687	20717	20747	
	Deviation From Primary Sensor	20659	20689	20719	20749	

Allowable Setpoint Value Ranges: Based on Configured Sensor TYPE

	When Direct Sensors Configured As:						
Available Setpoints	**Contacting Cond**	**Electrodeless Cond(0 to 1000uS)**	**Electrodeless Cond(0 to 10,000uS)**	**Electrodeless Cond(0 to 100mS)**	**Electrodeless Cond(0 to 1,000mS)**	**pH**	**ORP**
Low Low alarm limit	0 to 30,000	0 to 3,000	0 to 30,000	0 to 300	0 to 3,000	-2 to + 16	-1400 to +1400
Low alarm limit	0 to 30,000	0 to 3,000	0 to 30,000	0 to 300	0 to 3,000	-2 to + 16	-1400 to +1400
High alarm limit	0 to 30,000	0 to 3,000	0 to 30,000	0 to 300	0 to 3,000	-2 to + 16	-1400 to +1400
High High alarm limit	0 to 30,000	0 to 3,000	0 to 30,000	0 to 300	0 to 3,000	-2 to + 16	-1400 to +1400
Manual Temp							
If Configured as Deg C	-5 to 88	-5 to 88	-5 to 88	-5 to 88	-5 to 88	-5 to 150	-5 to 88
If Configured as Deg F	23 to 190	23 to 190	23 to 190	23 to 190	23 to 190	23 to 302	23 to 190
Alarm Deadband	0 to 30,000	0 to 3,000	0 to 30,000	0 to 300	0 to 3,000	-2 to + 16	-1400 to +1400
Damping	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60
Deviation From Primary Sensor	0 to 30,000	0 to 3,000	0 to 30,000	0 to 300	0 to 3,000	-2 to + 16	-1400 to +1400

	When Direct Sensors Configured As:						
Available Setpoints	**Chlorine, Chlorine Dioxide (1 ppm)**	**Chlorine, Chlorine Dioxide, Ozone, (10 ppm)**	**Chlorine Dioxide, Hydrogen Peroxide (100 ppm)**	**Hydrogen Peroxide, Peracetic Acid (1000 ppm)**	**Hydrogen Peroxide, Peracetic Acid (10000 ppm)**	**Hi Temp Cond**	**Generic**
Low Low alarm limit	0 to 1	0 to 10	0 to 100	0 to 1000	0 to 10000	0 to 30,000	-100K to 100K
Low alarm limit	0 to 1	0 to 10	0 to 100	0 to 1000	0 to 10000	0 to 30,000	-100K to 100K
High alarm limit	0 to 1	0 to 10	0 to 100	0 to 1000	0 to 10000	0 to 30,000	-100K to 100K
High High alarm limit	0 to 1	0 to 10	0 to 100	0 to 1000	0 to 10000	0 to 30,000	-100K to 100K
Manual Temp							
If Configured as Deg C						0 to 200	
If Configured as Deg F						32 to 392	
Alarm Deadband	0 to 1	0 to 10	0 to 100	0 to 1000	0 to 10000	0 to 30,000	0 to 100,000
Damping	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60
Deviation From Primary Sensor	0 to 1	0 to 10	0 to 100	0 to 1000	0 to 10000	0 to 30,000	0 to 100,000

Digital Input Read/Write Parameters

When Configured As	Available Setpoints	Allowable Range	Digital Input Channel DI_A	DI_B	DI_C	DI_1	DI_2	DI_3	DI_4	DI_5	DI_6	DI_D	DI_E	DI_F	
INTERLOCK	None	N/A	--	--	--	--	--	--	--	--	--	--	--	--	Register Addresses
GENERIC INPUT			--	--	--	--	--	--	--	--	--	--	--	--	
LEVEL SWITCH			--	--	--	--	--	--	--	--	--	--	--	--	
POSI-FLOW	Vol Per Stroke	.001 to 10 ml	20881	20901	20921	20941	20961	20981	21001	21021	21041	21061	21081	21101	
	Alarm Time	.01 to 10 min	20885	20905	20925	20945	20965	20985	21005	21025	21045	21065	21085	21105	
GENERIC COUNTER	OneCount =	0 to 10000	20881	20901	20921	20941	20961	20981	21001	21021	21041	21061	21081	21101	
	Total Alarm Limit	0 to 1,000,000,000	20885	20905	20925	20945	20965	20985	21005	21025	21045	21065	21085	21105	
	Rate Low Alarm	0 to 1,000,000,000	20887	20907	20927	20947	20967	20987	21007	21027	21047	21067	21087	21107	
	Rate High Alarm	0 to 1,000,000,000	20889	20909	20929	20949	20969	20989	21009	21029	21049	21069	21089	21109	
CONTACTING FM	Vol per Contact	0 to 100,000	20883	20903	20923	20943	20963	20983	21003	21023	21043	21063	21083	21103	
	Total Alarm Limit	0 to 1,000,000,000	20885	20905	20925	20945	20965	20985	21005	21025	21045	21065	21085	21105	
PADDLEWHEEL FM	K factor	.001 to 20,000	20881	20901	20921	20941	20961	20981	21001	21021	21041	21061	21081	21101	
	Total alarm limit	0 to 1,000,000,000	20885	20905	20925	20945	20965	20985	21005	21025	21045	21065	21085	21105	
	Rate Low Low alarm	0 to 1,000,000,000	20887	20907	20927	20947	20967	20987	21007	21027	21047	21067	21087	21107	
	Rate Low alarm	0 to 1,000,000,000	20889	20909	20929	20949	20969	20989	21009	21029	21049	21069	21089	21109	
	Rate high alarm	0 to 1,000,000,000	20891	20911	20931	20951	20971	20991	21011	21031	21051	21071	21091	21111	
	Rate high high alarm	0 to 1,000,000,000	20893	20913	20933	20953	20973	20993	21013	21033	21053	21073	21093	21113	
	Alarm Deadband	0 to 1,000,000,000	20895	20915	20935	20955	20975	20995	21015	21035	21055	21075	21095	21115	
	Damping	0 to 60	20897	20917	20937	20957	20977	20997	21017	21037	21057	21077	21097	21117	

Analog Input Read/Write Parameters

When Configured As	Available Setpoints	Allowable Range	Analog Input Channel AI_1	AI_2	AI_3	AI_4	AI_5	AI_6	AI_7	AI_8	
LEVEL	Full Volume	0 to 1,000,000,000	20001	20041	20081	20121	20161	20201	20241	20281	Register Addresses
	mA when tank Empty	4 to 20	20003	20043	20083	20123	20163	20203	20243	20283	
	mA when tank Full	4 to 20	20005	20045	20085	20125	20165	20205	20245	20285	
	Low Low alarm	0 to "full volume"	20007	20047	20087	20127	20167	20207	20247	20287	
	Low alarm	0 to "full volume"	20009	20049	20089	20129	20169	20209	20249	20289	
	High alarm	0 to "full volume"	20011	20051	20091	20131	20171	20211	20251	20291	
	High High alarm	0 to "full volume"	20013	20053	20093	20133	20173	20213	20253	20293	
	Alarm Deadband	0 to 1,000,000,000	20017	20057	20097	20137	20177	20217	20257	20297	
	Damping	0 to 60	20019	20059	20099	20139	20179	20219	20259	20299	
	Deviation From Primary Sensor	0 to 1,000,000,000	20021	20061	20101	20141	20181	20221	20261	20301	
Generic	4mA=	-100,000 to 100,000	20001	20041	20081	20121	20161	20201	20241	20281	Register Addresses
	20mA=	-100,000 to 100,000	20003	20043	20083	20123	20163	20203	20243	20283	
	Low Low alarm	4mA= to 20mA=	20007	20047	20087	20127	20167	20207	20247	20287	
	Low alarm	4mA= to 20mA=	20009	20049	20089	20129	20169	20209	20249	20289	
	High alarm	4mA= to 20mA=	20011	20051	20091	20131	20171	20211	20251	20291	
	High High alarm	4mA= to 20mA=	20013	20053	20093	20133	20173	20213	20253	20293	
	Alarm Deadband	0 to 20mA=	20017	20057	20097	20137	20177	20217	20257	20297	
	Damping	0 to 60	20019	20059	20099	20139	20179	20219	20259	20299	
	Deviation From Primary Sensor	0 to 100,000	20021	20061	20101	20141	20181	20221	20261	20301	
Flowmeter	4mA=	0 to 100,000	20001	20041	20081	20121	20161	20201	20241	20281	Register Addresses
	20mA=	0 to 100,000	20003	20043	20083	20123	20163	20203	20243	20283	
	Deadband	0 to 0.5	20005	20045	20085	20125	20165	20205	20245	20285	
	Rate low low alarm	0 to 100,000	20007	20047	20087	20127	20167	20207	20247	20287	
	Rate low alarm	0 to 100,000	20009	20049	20089	20129	20169	20209	20249	20289	
	Rate high alarm	0 to 100,000	20011	20051	20091	20131	20171	20211	20251	20291	
	Rate high high alarm	0 to 100,000	20013	20053	20093	20133	20173	20213	20253	20293	
	Total Alarm Trigger	0 to 1,000,000,000	20015	20055	20095	20135	20175	20215	20255	20295	
	Alarm Deadband	0 to 100,000	20017	20057	20097	20137	20177	20217	20257	20297	
	Damping	0 to 60	20019	20059	20099	20139	20179	20219	20259	20299	
	Deviation From Primary Sensor	0 to 100,000	20021	20061	20101	20141	20181	20221	20261	20301	

Analog Output Read/Write Parameters

			Analog Output				
When Configured As	**Available Setpoints**	**Allowable Range**	**AI_1**	**AI_2**	**AI_3**	**AI_4**	
RETRANSMIT	**4mA =**	full scale of assigned input	23613	23653	23693	23733	**Register Addresses**
	20mA =	full scale of assigned input	23615	23655	23695	23735	
PROPORTIONAL	HOA Mode (int)	0 to 2	23601	23641	23681	23721	**Register Addresses**
	Output Time Limit (int)	1 to 1440	23603	23643	23683	23723	
	Hand Time Limit (int)	1 to 1440	23605	23645	23685	23725	
	Input fault Value	0 to 100	23607	23647	23687	23727	
	Interlock Value	0 to 100	23609	23649	23689	23729	
	HAND value	0 to 100	23611	23651	23691	23731	
	Set Point	full scale of assigned input	23613	23653	23693	23733	
	Min Output Allowed	0 to 100	23615	23655	23695	23735	
	Max Output Allowed	0 to 100	23617	23657	23697	23737	
	Input value when output is Max	full scale of assigned input	23621	23661	23701	23741	
	Damping	0 to 60	23623	23663	23703	23743	
PID	HOA MODE (int)	0 to 2	23601	23641	23681	23721	**Register Addresses**
	Output Time Limit (int)	1 to 1440	23603	23643	23683	23723	
	Hand Time Limit (int)	0 to 1440	23605	23645	23685	23725	
	Input fault Value	0 to 100	23607	23647	23687	23727	
	Interlock Value	0 to 100	23609	23649	23689	23729	
	HAND value	0 to 100	23611	23651	23691	23731	
	Set Point	full scale of assigned input	23613	23653	23693	23733	
	Proportional Gain	-99 to 99	23615	23655	23695	23735	
	Integral Gain	-50 to 50	23617	23657	23697	23737	
	Derivative gain	-10 to 10	23619	23659	23699	23739	
	Max Output Allowed	0 to 100	23627	23667	23707	23747	
	Min Output Allowed	0 to 100	23629	23669	23709	23749	

HOA Mode: 0 = Hand, 1 = Off, 2 = Auto

Relay Read/Write Parameters

When Configured As	Available Setpoints	Allowable Range	Relay Output Channel								
			RI_1	RI_2	RI_3	RI_4	RI_5	RI_6	RI_7	RI_8	
ON/OFF SET POINT	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	On Delay (int)	0, 10 sec to 1440 min	21207	21407	21607	21807	22007	22207	22407	22607	
	Off Delay (int)	0, 10 sec to 1440 min	21209	21409	21609	21809	22009	22209	22409	22609	
	Set Point	full scale of assigned input	21211	21411	21611	21811	22011	22211	22411	22611	
	Deadband	full scale of assigned input	21213	21413	21613	21813	22013	22213	22413	22613	
TIME PROPORTIONAL	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Set Point	full scale of assigned input	21211	21411	21611	21811	22011	22211	22411	22611	
	Proportional band	full scale of assigned input	21213	21413	21613	21813	22013	22213	22413	22613	
	Sample Period	1 to 1440	21215	21415	21615	21815	22015	22215	22415	22615	
FLOW BASED CONTROL	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Unit Vol. to Trigger Output	1,000,000,000	21211	21411	21611	21811	22011	22211	22411	22611	
	Output On Time per unit vol.	1 sec to 1440 min	21213	21413	21613	21813	22013	22213	22413	22613	
ACTIVATE WITH ANOTHER RELAY	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
ACTIVATE AFTER ANOTHER RELAY (%)	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	% Relay to Activate	0 to 100	21211	21411	21611	21811	22011	22211	22411	22611	
ACTIVATE AFTER ANOTHER RELAY (FIXED TIME)	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Fixed Time to Activate	1 sec to 1440 min	21211	21411	21611	21811	22011	22211	22411	22611	
ACTIVATE AS % OF TIME	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	% Period to Activate	0.1 to 100	21211	21411	21611	21811	22011	22211	22411	22611	
	Time Period	1 to 1440	21213	21413	21613	21813	22013	22213	22413	22613	
24 HOUR TIMER	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Addition A On Time (int)	1 sec to 1440 min	21225	21425	21625	21825	22025	22225	22425	22625	
	Addition B On Time (int)	1 sec to 1440 min	21227	21427	21627	21827	22027	22227	22427	22627	
	Addition C On Time (int)	1 sec to 1440 min	21229	21429	21629	21829	22029	22229	22429	22629	
	Addition D On Time (int)	1 sec to 1440 min	21231	21431	21631	21831	22031	22231	22431	22631	
	Addition E On Time (int)	1 sec to 1440 min	21233	21433	21633	21833	22033	22233	22433	22633	
	Addition F On Time (int)	1 sec to 1440 min	21235	21435	21635	21835	22035	22235	22435	22635	
	Addition G On Time (int)	1 sec to 1440 min	21237	21437	21637	21837	22037	22237	22437	22637	
	Addition H On Time (int)	1 sec to 1440 min	21239	21439	21639	21839	22039	22239	22439	22639	
	Addition I On Time (int)	1 sec to 1440 min	21241	21441	21641	21841	22041	22241	22441	22641	
	Addition J On Time (int)	1 sec to 1440 min	21243	21443	21643	21843	22043	22243	22443	22643	
	Addition K On Time (int)	1 sec to 1440 min	21245	21445	21645	21845	22045	22245	22445	22645	
	Addition L On Time (int)	1 sec to 1440 min	21247	21447	21647	21847	22047	22247	22447	22647	
	Addition M On Time (int)	1 sec to 1440 min	21249	21449	21649	21849	22049	22249	22449	22649	
	Addition N On Time (int)	1 sec to 1440 min	21251	21451	21651	21851	22051	22251	22451	22651	
	Addition O On Time (int)	1 sec to 1440 min	21253	21453	21653	21853	22053	22253	22453	22653	
	Addition P On Time (int)	1 sec to 1440 min	21255	21455	21655	21855	22055	22255	22455	22655	
	Addition Q On Time (int)	1 sec to 1440 min	21257	21457	21657	21857	22057	22257	22457	22657	
	Addition R On Time (int)	1 sec to 1440 min	21259	21459	21659	21859	22059	22259	22459	22659	
	Addition S On Time (int)	1 sec to 1440 min	21261	21461	21661	21861	22061	22261	22461	22661	
	Addition T On Time (int)	1 sec to 1440 min	21263	21463	21663	21863	22063	22263	22463	22663	
1 WEEK TIMER	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Wk1D1 On Time (int)	1 sec to 1440 min	21225	21425	21625	21825	22025	22225	22425	22625	
	Wk1D2 On Time (int)	1 sec to 1440 min	21227	21427	21627	21827	22027	22227	22427	22627	
	Wk1D3 On Time (int)	1 sec to 1440 min	21229	21429	21629	21829	22029	22229	22429	22629	
	Wk1D4 On Time (int)	1 sec to 1440 min	21231	21431	21631	21831	22031	22231	22431	22631	
	Wk1D5 On Time (int)	1 sec to 1440 min	21233	21433	21633	21833	22033	22233	22433	22633	
	Wk1D6 On Time (int)	1 sec to 1440 min	21235	21435	21635	21835	22035	22235	22435	22635	
	Wk1D7 On Time (int)	1 sec to 1440 min	21237	21437	21637	21837	22037	22237	22437	22637	

Relay Read/Write Parameters

When Configured As	Available Setpoints	Allowable Range	Relay Output Channel RI_1	RI_2	RI_3	RI_4	RI_5	RI_6	RI_7	RI_8	
2 WEEK TIMER	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	**Register Addresses**
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Wk1D1 On Time (int)	1 sec to 1440 min	21225	21425	21625	21825	22025	22225	22425	22625	
	Wk1D2 On Time (int)	1 sec to 1440 min	21227	21427	21627	21827	22027	22227	22427	22627	
	Wk1D3 On Time (int)	1 sec to 1440 min	21229	21429	21629	21829	22029	22229	22429	22629	
	Wk1D4 On Time (int)	1 sec to 1440 min	21231	21431	21631	21831	22031	22231	22431	22631	
	Wk1D5 On Time (int)	1 sec to 1440 min	21233	21433	21633	21833	22033	22233	22433	22633	
	Wk1D6 On Time (int)	1 sec to 1440 min	21235	21435	21635	21835	22035	22235	22435	22635	
	Wk1D7 On Time (int)	1 sec to 1440 min	21237	21437	21637	21837	22037	22237	22437	22637	
	Wk2D1 On Time (int)	1 sec to 1440 min	21239	21439	21639	21839	22039	22239	22439	22639	
	Wk2D2 On Time (int)	1 sec to 1440 min	21241	21441	21641	21841	22041	22241	22441	22641	
	Wk2D3 On Time (int)	1 sec to 1440 min	21243	21443	21643	21843	22043	22243	22443	22643	
	Wk2D4 On Time (int)	1 sec to 1440 min	21245	21445	21645	21845	22045	22245	22445	22645	
	Wk2D5 On Time (int)	1 sec to 1440 min	21247	21447	21647	21847	22047	22247	22447	22647	
	Wk2D6 On Time (int)	1 sec to 1440 min	21249	21449	21649	21849	22049	22249	22449	22649	
	Wk2D7 On Time (int)	1 sec to 1440 min	21251	21451	21651	21851	22051	22251	22451	22651	
4 WEEK TIMER	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	**Register Addresses**
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Wk1D1 On Time (int)	1 sec to 1440 min	21225	21425	21625	21825	22025	22225	22425	22625	
	Wk1D2 On Time (int)	1 sec to 1440 min	21227	21427	21627	21827	22027	22227	22427	22627	
	Wk1D3 On Time (int)	1 sec to 1440 min	21229	21429	21629	21829	22029	22229	22429	22629	
	Wk1D4 On Time (int)	1 sec to 1440 min	21231	21431	21631	21831	22031	22231	22431	22631	
	Wk1D5 On Time (int)	1 sec to 1440 min	21233	21433	21633	21833	22033	22233	22433	22633	
	Wk1D6 On Time (int)	1 sec to 1440 min	21235	21435	21635	21835	22035	22235	22435	22635	
	Wk1D7 On Time (int)	1 sec to 1440 min	21237	21437	21637	21837	22037	22237	22437	22637	
	Wk2D1 On Time (int)	1 sec to 1440 min	21239	21439	21639	21839	22039	22239	22439	22639	
	Wk2D2 On Time (int)	1 sec to 1440 min	21241	21441	21641	21841	22041	22241	22441	22641	
	Wk2D3 On Time (int)	1 sec to 1440 min	21243	21443	21643	21843	22043	22243	22443	22643	
	Wk2D4 On Time (int)	1 sec to 1440 min	21245	21445	21645	21845	22045	22245	22445	22645	
	Wk2D5 On Time (int)	1 sec to 1440 min	21247	21447	21647	21847	22047	22247	22447	22647	
	Wk2D6 On Time (int)	1 sec to 1440 min	21249	21449	21649	21849	22049	22249	22449	22649	
	Wk2D7 On Time (int)	1 sec to 1440 min	21251	21451	21651	21851	22051	22251	22451	22651	
	Wk3D1 On Time (int)	1 sec to 1440 min	21253	21453	21653	21853	22053	22253	22453	22653	
	Wk3D2 On Time (int)	1 sec to 1440 min	21255	21455	21655	21855	22055	22255	22455	22655	
	Wk3D3 On Time (int)	1 sec to 1440 min	21257	21457	21657	21857	22057	22257	22457	22657	
	Wk3D4 On Time (int)	1 sec to 1440 min	21259	21459	21659	21859	22059	22259	22459	22659	
	Wk3D5 On Time (int)	1 sec to 1440 min	21261	21461	21661	21861	22061	22261	22461	22661	
	Wk3D6 On Time (int)	1 sec to 1440 min	21263	21463	21663	21863	22063	22263	22463	22663	
	Wk3D7 On Time (int)	1 sec to 1440 min	21265	21465	21665	21865	22065	22265	22465	22665	
	Wk4D1 On Time (int)	1 sec to 1440 min	21267	21467	21667	21867	22067	22267	22467	22667	
	Wk4D2 On Time (int)	1 sec to 1440 min	21269	21469	21669	21869	22069	22269	22469	22669	
	Wk4D3 On Time (int)	1 sec to 1440 min	21271	21471	21671	21871	22071	22271	22471	22671	
	Wk4D4 On Time (int)	1 sec to 1440 min	21273	21473	21673	21873	22073	22273	22473	22673	
	Wk4D5 On Time (int)	1 sec to 1440 min	21275	21475	21675	21875	22075	22275	22475	22675	
	Wk4D6 On Time (int)	1 sec to 1440 min	21277	21477	21677	21877	22077	22277	22477	22677	
	Wk4D7 On Time (int)	1 sec to 1440 min	21279	21479	21679	21879	22079	22279	22479	22679	
ACTIVATE ON A DI	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	**Register Addresses**
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	On Delay (int)	0, 10 sec to 1440 min	21207	21407	21607	21807	22007	22207	22407	22607	
	Off Delay (int)	0, 10 sec to 1440 min	21209	21409	21609	21809	22009	22209	22409	22609	
ALARM	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	**Register Addresses**
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	On Delay (int)	0, 10 sec to 1440 min	21207	21407	21607	21807	22007	22207	22407	22607	
	Power-Up Delay	0, 10 sec to 1440 min	21211	21411	21611	21811	22011	22211	22411	22611	
FLOW VOLUME BASED ON 2nd FLOW VOLUME	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	**Register Addresses**
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Controlled Volume per Input Volume	1,000,000,000	21211	21411	21611	21811	22011	22211	22411	22611	
	Input Volume to Trigger Control	1,000,000,000	21213	21413	21613	21813	22013	22213	22413	22613	
COUNTER BASED CONTROL	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	**Register Addresses**
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Quantity to Trigger Output	1 to 999,999,999	21211	21411	21611	21811	22011	22211	22411	22611	
	Output On Time per counts	1 sec to 1440 min	21213	21413	21613	21813	22013	22213	22413	22613	

Relay Read/Write Parameters

When Configured As	Available Setpoints	Allowable Range	Relay Output Channel RI_1	RI_2	RI_3	RI_4	RI_5	RI_6	RI_7	RI_8	
PULSE PROPORTIONAL	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Set Point	full scale of assigned input	21211	21411	21611	21811	22011	22211	22411	22611	
	Control Direction	full scale of assigned input	21213	21413	21613	21813	22013	22213	22413	22613	
	Min Pump Speed	0 to 360	21215	21415	21615	21815	22015	22215	22415	22615	
	Max Pump Speed		21217	21417	21617	21817	22017	22217	22417	22617	
	Proportional Band	0 to 360	21219	21419	21619	21819	22019	22219	22419	22619	
PROBE WASH	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Hand Time Limit (int)	0 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Hold Time (int)	30 sec to 10 min	21211	21411	21611	21811	22011	22211	22411	22611	
	Event A On Time (int)	1 sec to 1440 min	21225	21425	21625	21825	22025	22225	22425	22625	
	Event B On Time (int)	1 sec to 1440 min	21227	21427	21627	21827	22027	22227	22427	22627	
	Event C On Time (int)	1 sec to 1440 min	21229	21429	21629	21829	22029	22229	22429	22629	
	Event D On Time (int)	1 sec to 1440 min	21231	21431	21631	21831	22031	22231	22431	22631	
	Event E On Time (int)	1 sec to 1440 min	21233	21433	21633	21833	22033	22233	22433	22633	
	Event F On Time (int)	1 sec to 1440 min	21235	21435	21635	21835	22035	22235	22435	22635	
	Event G On Time (int)	1 sec to 1440 min	21237	21437	21637	21837	22037	22237	22437	22637	
	Event H On Time (int)	1 sec to 1440 min	21239	21439	21639	21839	22039	22239	22439	22639	
	Event I On Time (int)	1 sec to 1440 min	21241	21441	21641	21841	22041	22241	22441	22641	
	Event J On Time (int)	1 sec to 1440 min	21243	21443	21643	21843	22043	22243	22443	22643	
	Event K On Time (int)	1 sec to 1440 min	21245	21445	21645	21845	22045	22245	22445	22645	
	Event L On Time (int)	1 sec to 1440 min	21247	21447	21647	21847	22047	22247	22447	22647	
	Event M On Time (int)	1 sec to 1440 min	21249	21449	21649	21849	22049	22249	22449	22649	
	Event N On Time (int)	1 sec to 1440 min	21251	21451	21651	21851	22051	22251	22451	22651	
	Event O On Time (int)	1 sec to 1440 min	21253	21453	21653	21853	22053	22253	22453	22653	
	Event P On Time (int)	1 sec to 1440 min	21255	21455	21655	21855	22055	22255	22455	22655	
	Event Q On Time (int)	1 sec to 1440 min	21257	21457	21657	21857	22057	22257	22457	22657	
	Event R On Time (int)	1 sec to 1440 min	21259	21459	21659	21859	22059	22259	22459	22659	
	Event S On Time (int)	1 sec to 1440 min	21261	21461	21661	21861	22061	22261	22461	22661	
	Event T On Time (int)	1 sec to 1440 min	21263	21463	21663	21863	22063	22263	22463	22663	
PID	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	Set Point	full scale of assigned input	21211	21411	21611	21811	22011	22211	22411	22611	
	Proportional Gain	-99 to 99	21213	21413	21613	21813	22013	22213	22413	22613	
	Integral Gain	50 to 50	21215	21415	21615	21815	22015	22215	22415	22615	
	Derivative gain	-10 to 10	21217	21417	21617	21817	22017	22217	22417	22617	
	Time Period	10 sec to 60 min	21219	21419	21619	21819	22019	22219	22419	22619	
IN/OUT OF RANGE	HOA Mode (int)	0 to 2	21201	21401	21601	21801	22001	22201	22401	22601	Register Addresses
	Output Time Limit (int)	0 to 1440	21203	21403	21603	21803	22003	22203	22403	22603	
	Hand Time Limit (int)	1 to 1440	21205	21405	21605	21805	22005	22205	22405	22605	
	High Set Point	full scale of assigned input	21211	21411	21611	21811	22011	22211	22411	22611	
	Low Set Point	full scale of assigned input	21213	21413	21613	21813	22013	22213	22413	22613	
	Deadband	full scale of assigned input	21215	21415	21615	21815	22015	22215	22415	22615	
	On Delay	0, 10 sec to 1440 min	21223	21423	21623	21823	22023	22223	22423	22623	
	Off Delay	0, 10 sec to 1440 min	21225	21425	21625	21825	22025	22225	22425	22625	

LSI/RSI Read/Write Parameters

Available Setpoints	Allowable Range	Index Channel IN_1	
Conductivity	0 to 30,000	23921	Register Addresses
Temperature		23923	
If Configured as Deg C	-5 to 88		
If Configured as Deg F	23 to 190		
Calcium Hardness	0 to 1500	23925	
Total Alkalinity	0 to 1000	23927	
pH	-2 to 16	23929	