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Modbus User's Programming Manual for Protocol 3™

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SERVICE AND TECHNICAL SUPPORT

service parts: 1-800-473-7373

international service/main: 1-952-469-8230

service fax: 1-952-469-8193

service@despatch.com

GLOBAL HEADQUARTERS

phone: 1-888-DESPATCH (1-888-337-7282)

international/main: 1-952-469-5424

fax: 1-952-469-4513

sales@despatch.com

www.despatch.com

8860 207th Street West
Minneapolis, MN 55044 USA

Despatch
INDUSTRIES

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Revision History

Revision	Date	Author	Description
1	6/2012	Livingston	Original Release - Revised for Protocol 3 and formatting
2	7/2012	Livingston	Updated Register tables for new Protocol 3 Firmware release 2.0

Table of Contents

1.	About This Manual.....	5
1.1.	Important User Information.....	5
1.2.	Manufacturer & Service	5
1.3.	Organization of this Manual	6
1.3.1.	Reference Documents.....	6
1.4.	Serial Communications	6
1.4.1.	Supported Protocols.....	6
1.4.2.	RS485 Configuration.....	6
1.4.3.	RS485 Device Addressing.....	7
1.4.4.	Ethernet Configuration	7
1.4.5.	Link Layer	8
1.4.6.	Supported Modbus Functions.....	9
1.4.7.	Function Descriptions.....	9
1.4.8.	Data Formats	12
2.	Modbus Address List.....	13
2.1.	Input Parameters.....	13
2.1.1.	Process Input Parameters.....	13
2.1.2.	High Limit Input Parameters	14
2.1.3.	Digital Inputs	16
2.2.	Output Parameters	16
2.2.1.	Relay Output 1 Parameters	16
2.2.2.	Relay Output 2 Parameters	17
2.2.3.	Relay Output 3 Parameters	18
2.2.4.	Relay Output 4 Parameters	18
2.2.5.	Relay Output 5 Parameters	19
2.2.6.	Linear Output Parameters	20
2.3.	Setpoint Parameters	21
2.4.	Control Parameters	22
2.5.	Alarm Parameters	24
2.5.1.	Alarm 1.....	24
2.5.2.	Alarm 2.....	24
2.5.3.	Alarm 3.....	25
2.5.4.	Alarm 4.....	25
2.5.5.	Alarm 5.....	26
2.5.6.	High Limit Alarm Parameters	26
2.6.	Logger parameters (Data Logger)	28
2.6.1.	Data Recorder.....	28
2.6.2.	Real Time Clock.....	28
2.7.	Display Parameters	29
2.7.1.	Keys.....	29
2.7.2.	LEDs.....	29
2.7.3.	HMI	29
2.7.4.	System Data.....	30
2.8.	Mode Controls	32
2.8.1.	General Mode Control.....	32
2.8.2.	Manual Mode Parameters.....	32

- 2.8.3. Timer Mode Parameters 33
- 2.8.4. Profile Mode Parameters 34
- 2.9. Uploading and Downloading of Profiles 35
 - 2.9.1. Instruction Sequence to create a profile at the next available position..... 36
 - 2.9.2. Instruction Sequence to create a profile at a specified profile position 36
 - 2.9.3. Instruction Sequence to edit an existing Profile Header..... 37
 - 2.9.4. Instruction Sequence to read a profile 37
 - 2.9.5. Profile Command Code Descriptions 37
 - 2.9.5.1. Creating a profile header (Command Code CP)..... 37
 - 2.9.5.2. Editing/Creating a profile header at a location (Command Code EP or WP) 39
 - 2.9.5.3. Creating a Segment (Command Code WS) 40
 - 2.9.5.4. Editing or Inserting a Segment (Command Codes IS and ES) 41
 - 2.9.5.5. Segment Info A, B Information 42
 - 2.9.5.6. Deleting Profiles (Command Code DP and DA)..... 43
 - 2.9.5.7. Deleting a Segment (Command Code DS)..... 44
 - 2.9.5.8. Getting the Number of Segments Remaining (Command Code SR) 44
 - 2.9.5.9. Edit Response Message 45
 - 2.9.5.10. Reading a Profile Header (Command Code RP) 46
 - 2.9.5.11. Read a Segment (Command Code RS)..... 47
 - 2.9.5.12. Read a profile Name (Command Code PN) 49
 - 2.9.5.13. Read Profile Memory Status (Command Code PS) 51

Figures

- Figure 1. Modbus Link Layer..... 8

1. About This Manual

1.1. Important User Information

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Global Headquarters	Contact	Service & Technical Support
Despatch Industries 8860 207th Street Lakeville, MN 55044 USA	International/Main: 1-952-469-5424 US toll free: 1-888-337-7282 Fax: 1-952-469-4513 info@despatch.com www.despatch.com	Service: 1-952-469-8230 US toll free: 1-800-473-7373 Service @despatch.com

1.3. Organization of this Manual

This document provides all application-specific information necessary for developing a Modbus Master application program for interfacing with the Protocol 3™ slave controller.

1.3.1. Reference Documents

The following Modbus Protocol documents should also be helpful and relevant:
 For a complete description of the Modbus protocol refer to the description provided at <http://www.modicon.com/> or <http://www.modbus.org/>.

	<p><i>This programming manual assumes an intermediate understanding of the Modbus Protocol. Only limited information is presented here regarding the Modbus Protocol specifications.</i></p>
---	--

1.4. Serial Communications

1.4.1. Supported Protocols

The unit supports two communication interfaces Modbus RTU and Modbus TCP. Modbus RTU is supported through the RS485 interface and Modbus TCP is supported through the optional Ethernet Module.

For a complete description of the Modbus protocol refer to the description provided at <http://www.modbus.org/>.

1.4.2. RS485 Configuration

The RS485 address, bit rate and character format are configured via the front panel from the Comms Configuration menu.

Physical layer configuration settings possible are:

Data rate: 4800, 9600, 19200, 38400, 57600 or 115200 bps
 Parity: None (default), Even, Odd

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Character format: Always 8 bits per character.
Device Address: *See below.*

1.4.3. RS485 Device Addressing

The instrument must be assigned a unique device address in the range 1 to 255. This address is used to recognize Modbus Queries intended for this instrument. With the exception of globally addressed broadcast messages, the instrument ignores Modbus Queries that do not match the address that has been assigned to it.

The instrument will accept broadcast messages (global queries) using device address 0 no matter what device address is assigned. No response messages are returned for globally addressed Queries.

1.4.4. Ethernet Configuration

For Modbus TCP communications (Modbus over Ethernet), the IP address can either be assigned by a Dynamic Host Configuration Protocol (DHCP), BootP or AutoIP server on the network, or manually assigned using the IP address allocation software tool.

The supported data rates 10/100BASE-T (10 or 100 Mbps) are automatically detected.

1.4.5. Link Layer

A Query (or command) is transmitted from the Modbus Master to the Modbus Slave. The slave instrument assembles the reply to the master (see Figure 1).

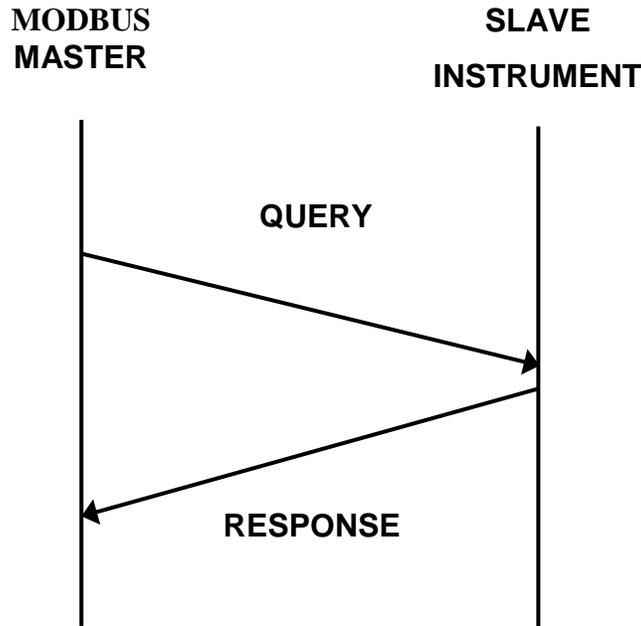


Figure 1. Modbus Link Layer.

A message for either a QUERY or RESPONSE is made up of an inter-message gap followed by a sequence of data characters. The inter-message gap is at least 3.5 data character times - the transmitter must not start transmission until 3 character times have elapsed since reception of the last character in a message, and must release the transmission line within 3 character times of the last character in a message.

Note:

Three character times is approximately 0.25ms at 115200 bps, 0.51ms at 57600 bps, 0.75ms at 38400 bps, 1.5ms at 19200 bps, 3ms at 9600 bps and 6ms at 4800bps.

Data is encoded for each character as binary data, transmitted LSB first.

For a QUERY the address field contains the address of the slave destination. The slave address is given together with the Function and Data fields by the Application layer. The CRC is generated from the given address, function and data characters.

For a RESPONSE the address field contains the address of the responding slave. The Function and Data fields are generated by the slave application. The CRC is generated from the address, function and data characters.

The standard MODBUS RTU CRC-16 calculation employing the polynomial $2^{16}+2^{15}+2^2+1$ is used.

Inter-message gap	Address 1 character	Function 1 character	Data <i>n</i> characters	CRC Check 2 characters
-------------------	------------------------	-------------------------	-----------------------------	---------------------------

1.4.6. Supported Modbus Functions

Modbus defines several function types. The following types are supported by this instrument:

Function Code (decimal)	Modbus Meaning	Description
03 / 04	Read Holding/Input registers	Read current binary value of specified number of parameters at given address. Up to 64 parameters can be accessed with one Query.
06	Write Single Register	Writes two bytes to a specified word address.
08	Diagnostics	Used for loopback test only.
16 (0x10 hex)	Write Multiple Registers	Writes up to 253 bytes of data to the specified address range.
23 (0x17 hex)	Read/Write Multiple Registers	Reads and Writes 253 bytes of data to the specified address ranges.

1.4.7. Function Descriptions

The following is interpreted from the Modbus Protocol Description obtainable from <http://www.modbus.org/>. Refer to that document if clarification is required.

In the function descriptions below, the preceding device address value is assumed, as is the correctly formed two-byte CRC value at the end of the QUERY and RESPONSE frames.

Function 03 / 04 - Read Holding/Input Registers

Reads current binary value of data at the specified word addresses.

QUERY

Function	Address of 1 st Word		Number of Words	
03 / 04	HI	LO	HI	LO

RESPONSE

Function	Number of Bytes	First Word		Last Word	
03 / 04		HI	LO	HI	LO

In the response the “Number of Bytes” indicates the number of data bytes read from the instrument. E.g. if 5 words are read, the count will be 10 (A hex). The maximum number of words that can be read is 64. If a parameter does not exist at one of the addresses read, then a value of 0000h is returned for that word.

Function 06 - Write Single Register

Writes two bytes to a specified word address.

QUERY

Function	Address of Word		Value to write	
06	HI	LO	HI	LO

RESPONSE

Function	Address of Word		Value written	
06	HI	LO	HI	LO

Note:

The Response normally returns the same data as the Query.

Function 08 - Loopback Diagnostic Test

QUERY

Function	Diagnostic Code		Value	
08	HI=00	LO=00	HI	LO

RESPONSE

Function	Sub-function		Value	
08	HI=00	LO=00	HI	LO

Note:

The Response normally returns the same data as the loopback Query. Other Diagnostic Codes are not supported.

Function 16 - Write Multiple Registers (0x10 Hex)

Writes consecutive word (two-byte) values starting at the specified address.

QUERY

Function	1 st Write Address		Number of Words to Write		Number of Query Bytes	1 st Query Byte	2 nd Query Byte	etc	Last Query Byte
10	HI	LO	HI	LO				→	

RESPONSE

Function	1 st Word Address		Number of Words	
10	HI	LO	HI	LO

Note:

The number of data bytes that can be written in one message is 253 bytes.

Function 23 Hex - Read / Write Multiple Registers (0x17 hex)

Reads and writes the requested number of consecutive words (two-bytes) starting at the specified addresses.

QUERY

Function	1 st Read Address		Number of Words to Read		1 st Write Address		Number of Words to Write		Values to Write						
	HI	LO	HI	LO	HI	LO	HI	LO	1 st Word		2 nd Word		etc	Last Word	
17	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	→	HI	LO

RESPONSE

Function	Number of Bytes	Read Data						
		1 st Word		2 nd Word		etc	Last Word	
17		HI	LO	HI	LO	→	HI	LO

Note:

The number of data bytes that can be read and written in one message is 253 bytes.

Exception Responses

When a QUERY is sent that the instrument cannot interpret, an Exception RESPONSE is returned. Possible exception responses are:

Exception Code	Error Condition	Interpretation
00	Unused	None.
01	Illegal function	Function number out of range.
02	Illegal Data Address	Write functions: Parameter number out of range or not supported. (for write functions only). Read Functions: Start parameter does not exist or end parameter greater than 65536.
03	Illegal Data Value	Attempt to write invalid data / required action not executed.

The format of an exception response is:

RESPONSE

Function	Exception Code
Original Function code with its Most Significant Bit (MSB) set.	<i>as detailed above</i>

Note:

In the case of multiple exception codes for a single QUERY the Exception code returned is the one corresponding to the first parameter in error.

The Modbus parameter register addresses are detailed in the following sections.
The Access column indicates if a parameter is read only (RO) or if it can also be written to (R/W).

Note:

Some parameters that do not apply for a particular configuration will accept reads and writes. Read only parameters will return an exception if an attempt is made to write values to them.

1.4.8. Data Formats

Data can be read or written in three formats: Integer Only, Integer with 1 Decimal Place and Floating Point Number.

The Modbus Address column shows the register address for each parameter in integer format. Other formats can be calculated from the Integer Only address.

When working in Hexadecimal, the format calculations are:

Address for Integer with 1 Decimal Place = Integer address plus 0x4000

Address for Floating Point = Integer address multiplied by 2, plus 0x8000

When working in Decimal, the format calculations are:

Address for Integer with 1 Decimal Place = Integer address plus 16384

Address for Floating Point = Integer address multiplied by 2, plus 32768

Example Register Address Calculations

Calculating Parameter Register Addresses				
		<i>Integer Only</i>	<i>Integer+1</i>	<i>Floating Point</i>
Register Address Calculation	<i>(hex)</i>	Address	Address + 0x4000	Address x 2 + 0x8000
	<i>(dec)</i>	Address	Address + 16384	Address x 2 + 32768
Address Example: (For Process Variable)	<i>(hex)</i>	0x0407	0x4407	0x880E
	<i>(dec)</i>	1031	17415	34830
<i>Data Value Returned: If actual Value = 23.9 decimal</i>	<i>(hex)</i>	<i>0x00, 0x17</i>	<i>0x00, 0xEF</i>	<i>0x41, 0xBF, 0x33, 0x33</i>
	<i>(dec)</i>	<i>23</i>	<i>239</i>	<i>23.9 as floating decimal</i>
Address Example: (For Selected Setpoint)	<i>(hex)</i>	0x101F	0x501F	0xA03E
	<i>(dec)</i>	4127	20511	41022
<i>Data Value Returned: If Value = 1 (Alternative SP)</i>	<i>(hex)</i>	<i>0x00, 0x01</i>	<i>0x00, 0x0A</i>	<i>0x3F, 0x80, 0x00, 0x00</i>
	<i>(dec)</i>	<i>1</i>	<i>10</i>	<i>1.0 as floating decimal</i>

2. Modbus Address List

2.1. Input Parameters

2.1.1. Process Input Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes	
Input Range	1024	0x0400	R/W	Value	
				0	B TC
				2	C TC
				4	D TC
				6	E TC
				8	J TC
				10	K TC
				12	L TC
				14	N TC
				16	R TC
				18	S TC
				20	T TC
				22	P24
				24	Pt100
				26	NI120
				28	0_20mA
				29	4_20mA
				30	0_50mV
31	10_50mV				
32	0_5V				
33	1_5V				
34	0_10V				
35	2_10V				
Engineering units	1025	0x0401	R/W	0 = None 1 = Degrees C 2 = Degrees F	
Decimal Place	1026	0x0402	R/W	0 = 1234 1 = 123.4 2 = 12.34 3 = 1.234	
Process Input Range Minimum	1027	0x0403	R/W		
Process Input Range Maximum	1028	0x0404	R/W		
Process Input Process variable offset	1029	0x0405	R/W	Span of the input range	
Process Input	1030	0x0406	R/W	Any value between 0.0 and 512.0	

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Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Filter time constant				
Process Input Process Variable	1031	0x0407	R	
Process Input Sensor Break Flag	1032	0x0408	R	0 = Inactive 1 = Active
Process Input Under Range Flag	1033	0x0409	R	0 = Inactive 1 = Active
Process Input Over Range Flag	1034	0x040A	R	0 = Inactive 1 = Active
Process Input CJC Enable	1035	0x040B	R/W	0 = Enable 1 = Disabled
Process Input User Calibration Type	1085	0x043D	R/W	0 = No User Calibration 1 = Single Point Calibration 2 = Two Point Calibration
Process Input Low Temperature Calibration Point	1086	0x043E	R/W	
Process Input Low Calibration Offset	1087	0x043F	R/W	
Process Input High Temperature Calibration Point	1088	0x0440	R/W	
Process Input High Calibration Offset	1089	0x0441	R/W	

2.1.2. High Limit Input Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
High Limit Input Range	9000	0x2328	R/W	Value
				0
				2
				4
				6
				10
				14
				18
				20

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Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes																								
				<table border="1"> <tr><td>22</td><td>S TC</td></tr> <tr><td>24</td><td>T TC</td></tr> <tr><td>28</td><td>P24</td></tr> <tr><td>30</td><td>Pt100 RTD</td></tr> <tr><td>34</td><td>0_20mA</td></tr> <tr><td>35</td><td>4_20mA</td></tr> <tr><td>36</td><td>0_50mV</td></tr> <tr><td>37</td><td>10_50mV</td></tr> <tr><td>38</td><td>0_5V</td></tr> <tr><td>39</td><td>1_5V</td></tr> <tr><td>40</td><td>0_10V</td></tr> <tr><td>41</td><td>2_10V</td></tr> </table>	22	S TC	24	T TC	28	P24	30	Pt100 RTD	34	0_20mA	35	4_20mA	36	0_50mV	37	10_50mV	38	0_5V	39	1_5V	40	0_10V	41	2_10V
22	S TC																											
24	T TC																											
28	P24																											
30	Pt100 RTD																											
34	0_20mA																											
35	4_20mA																											
36	0_50mV																											
37	10_50mV																											
38	0_5V																											
39	1_5V																											
40	0_10V																											
41	2_10V																											
High Limit Input Engineering units	9001	0x2329	R/W	0 = None 1 = Degrees C 2 = Degrees F																								
High Limit Input Decimal Place	9002	0x232C	R/W	0 = 1234 1 = 123.4 2 = 12.34 3 = 1.234																								
High Limit Input Range Minimum	9003	0x232A	R/W																									
High Limit Input Range Maximum	9004	0x232B	R/W																									
High Limit User Calibration Type	9008	0x2330	R/W	0 = No User Calibration 1 = Single Point Calibration 2 = Two Point Calibration																								
High Limit Input Process variable offset	9009	0x2331	R/W	Span of the input range																								
Process Input Low Calibration Offset	9010	0x2332	R/W																									
Process Input Low Temperature Calibration Point	9011	0x2333	R/W																									
Process Input High Calibration Offset	9012	0x2334	R/W																									
Process Input High Temperature Calibration Point	9013	0x2335	R/W																									
High Limit Input Process Variable	9006	0x232E	R																									
High Limit Input	9007	0x232F	R	Bit 0 = OPEN																								

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Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
status				Bit 1 = Low Bit 2 = High

2.1.3. Digital Inputs

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes										
Digital input states	2001	0x7D1	R	<table border="1"> <thead> <tr> <th>Bit Position</th> <th>Digital input</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>2</td> </tr> <tr> <td>2</td> <td>3</td> </tr> <tr> <td>3</td> <td>4</td> </tr> </tbody> </table>	Bit Position	Digital input	0	1	1	2	2	3	3	4
Bit Position	Digital input													
0	1													
1	2													
2	3													
3	4													

2.2. Output Parameters

2.2.1. Relay Output 1 Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes																																
Usage	2146	0x0862	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Usage</th> </tr> </thead> <tbody> <tr><td>0</td><td>None</td></tr> <tr><td>1</td><td>Alarm 1</td></tr> <tr><td>2</td><td>Alarm 2</td></tr> <tr><td>3</td><td>Alarm 3</td></tr> <tr><td>4</td><td>Alarm 4</td></tr> <tr><td>5</td><td>Alarm 5</td></tr> <tr><td>6</td><td>Event 1</td></tr> <tr><td>7</td><td>Event 2</td></tr> <tr><td>8</td><td>Event 3</td></tr> <tr><td>9</td><td>Event 4</td></tr> <tr><td>10</td><td>Event 5</td></tr> <tr><td>11</td><td>Cycle Complete</td></tr> <tr><td>12</td><td>Profile Running</td></tr> <tr><td>13</td><td>Or of Alarms</td></tr> <tr><td>14</td><td>Alarm and Events</td></tr> </tbody> </table>	Value	Usage	0	None	1	Alarm 1	2	Alarm 2	3	Alarm 3	4	Alarm 4	5	Alarm 5	6	Event 1	7	Event 2	8	Event 3	9	Event 4	10	Event 5	11	Cycle Complete	12	Profile Running	13	Or of Alarms	14	Alarm and Events
Value	Usage																																			
0	None																																			
1	Alarm 1																																			
2	Alarm 2																																			
3	Alarm 3																																			
4	Alarm 4																																			
5	Alarm 5																																			
6	Event 1																																			
7	Event 2																																			
8	Event 3																																			
9	Event 4																																			
10	Event 5																																			
11	Cycle Complete																																			
12	Profile Running																																			
13	Or of Alarms																																			
14	Alarm and Events																																			
Alarm Selection	2148	0x0864	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr><td>0</td><td>Alarm 1 or Alarm 2</td></tr> <tr><td>1</td><td>Alarm 1 or Alarm 2 or Alarm 3</td></tr> <tr><td>2</td><td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4</td></tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Alarm 2	1	Alarm 1 or Alarm 2 or Alarm 3	2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4																								
Value	Selection																																			
0	Alarm 1 or Alarm 2																																			
1	Alarm 1 or Alarm 2 or Alarm 3																																			
2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4																																			

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes												
				3 Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5												
Event Alarm Selection	2150	0x0866	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Alarm 1 or Event 1</td> </tr> <tr> <td>1</td> <td>Alarm 2 or Event 2</td> </tr> <tr> <td>2</td> <td>Alarm 3 or Event 3</td> </tr> <tr> <td>3</td> <td>Alarm 4 or Event 4</td> </tr> <tr> <td>4</td> <td>Alarm 5 or Event 5</td> </tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Event 1	1	Alarm 2 or Event 2	2	Alarm 3 or Event 3	3	Alarm 4 or Event 4	4	Alarm 5 or Event 5
Value	Selection															
0	Alarm 1 or Event 1															
1	Alarm 2 or Event 2															
2	Alarm 3 or Event 3															
3	Alarm 4 or Event 4															
4	Alarm 5 or Event 5															

2.2.2. Relay Output 2 Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes																																
Usage	2176	0x0880	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Usage</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>None</td> </tr> <tr> <td>1</td> <td>Alarm 1</td> </tr> <tr> <td>2</td> <td>Alarm 2</td> </tr> <tr> <td>3</td> <td>Alarm 3</td> </tr> <tr> <td>4</td> <td>Alarm 4</td> </tr> <tr> <td>5</td> <td>Alarm 5</td> </tr> <tr> <td>6</td> <td>Event 1</td> </tr> <tr> <td>7</td> <td>Event 2</td> </tr> <tr> <td>8</td> <td>Event 3</td> </tr> <tr> <td>9</td> <td>Event 4</td> </tr> <tr> <td>10</td> <td>Event 5</td> </tr> <tr> <td>11</td> <td>Cycle Complete</td> </tr> <tr> <td>12</td> <td>Profile Running</td> </tr> <tr> <td>13</td> <td>Or of Alarms</td> </tr> <tr> <td>14</td> <td>Alarm and Events</td> </tr> </tbody> </table>	Value	Usage	0	None	1	Alarm 1	2	Alarm 2	3	Alarm 3	4	Alarm 4	5	Alarm 5	6	Event 1	7	Event 2	8	Event 3	9	Event 4	10	Event 5	11	Cycle Complete	12	Profile Running	13	Or of Alarms	14	Alarm and Events
Value	Usage																																			
0	None																																			
1	Alarm 1																																			
2	Alarm 2																																			
3	Alarm 3																																			
4	Alarm 4																																			
5	Alarm 5																																			
6	Event 1																																			
7	Event 2																																			
8	Event 3																																			
9	Event 4																																			
10	Event 5																																			
11	Cycle Complete																																			
12	Profile Running																																			
13	Or of Alarms																																			
14	Alarm and Events																																			
Alarm Selection	2178	0x0882	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Alarm 1 or Alarm 2</td> </tr> <tr> <td>1</td> <td>Alarm 1 or Alarm 2 or Alarm 3</td> </tr> <tr> <td>2</td> <td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4</td> </tr> <tr> <td>3</td> <td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5</td> </tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Alarm 2	1	Alarm 1 or Alarm 2 or Alarm 3	2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4	3	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5																						
Value	Selection																																			
0	Alarm 1 or Alarm 2																																			
1	Alarm 1 or Alarm 2 or Alarm 3																																			
2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4																																			
3	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5																																			
Event Alarm Selection	2180	0x0884	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Alarm 1 or Event 1</td> </tr> <tr> <td>1</td> <td>Alarm 2 or Event 2</td> </tr> <tr> <td>2</td> <td>Alarm 3 or Event 3</td> </tr> <tr> <td>3</td> <td>Alarm 4 or Event 4</td> </tr> <tr> <td>4</td> <td>Alarm 5 or Event 5</td> </tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Event 1	1	Alarm 2 or Event 2	2	Alarm 3 or Event 3	3	Alarm 4 or Event 4	4	Alarm 5 or Event 5																				
Value	Selection																																			
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2	Alarm 3 or Event 3																																			
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4	Alarm 5 or Event 5																																			

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2.2.3. Relay Output 3 Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes																																
Usage	2186	0x088A	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Usage</th> </tr> </thead> <tbody> <tr><td>0</td><td>None</td></tr> <tr><td>1</td><td>Alarm 1</td></tr> <tr><td>2</td><td>Alarm 2</td></tr> <tr><td>3</td><td>Alarm 3</td></tr> <tr><td>4</td><td>Alarm 4</td></tr> <tr><td>5</td><td>Alarm 5</td></tr> <tr><td>6</td><td>Event 1</td></tr> <tr><td>7</td><td>Event 2</td></tr> <tr><td>8</td><td>Event 3</td></tr> <tr><td>9</td><td>Event 4</td></tr> <tr><td>10</td><td>Event 5</td></tr> <tr><td>11</td><td>Cycle Complete</td></tr> <tr><td>12</td><td>Profile Running</td></tr> <tr><td>13</td><td>Or of Alarms</td></tr> <tr><td>14</td><td>Alarm and Events</td></tr> </tbody> </table>	Value	Usage	0	None	1	Alarm 1	2	Alarm 2	3	Alarm 3	4	Alarm 4	5	Alarm 5	6	Event 1	7	Event 2	8	Event 3	9	Event 4	10	Event 5	11	Cycle Complete	12	Profile Running	13	Or of Alarms	14	Alarm and Events
Value	Usage																																			
0	None																																			
1	Alarm 1																																			
2	Alarm 2																																			
3	Alarm 3																																			
4	Alarm 4																																			
5	Alarm 5																																			
6	Event 1																																			
7	Event 2																																			
8	Event 3																																			
9	Event 4																																			
10	Event 5																																			
11	Cycle Complete																																			
12	Profile Running																																			
13	Or of Alarms																																			
14	Alarm and Events																																			
Alarm Selection	2188	0x088C	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr><td>0</td><td>Alarm 1 or Alarm 2</td></tr> <tr><td>1</td><td>Alarm 1 or Alarm 2 or Alarm 3</td></tr> <tr><td>2</td><td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4</td></tr> <tr><td>3</td><td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5</td></tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Alarm 2	1	Alarm 1 or Alarm 2 or Alarm 3	2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4	3	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5																						
Value	Selection																																			
0	Alarm 1 or Alarm 2																																			
1	Alarm 1 or Alarm 2 or Alarm 3																																			
2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4																																			
3	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5																																			
Event Alarm Selection	2190	0x088E	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr><td>0</td><td>Alarm 1 or Event 1</td></tr> <tr><td>1</td><td>Alarm 2 or Event 2</td></tr> <tr><td>2</td><td>Alarm 3 or Event 3</td></tr> <tr><td>3</td><td>Alarm 4 or Event 4</td></tr> <tr><td>4</td><td>Alarm 5 or Event 5</td></tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Event 1	1	Alarm 2 or Event 2	2	Alarm 3 or Event 3	3	Alarm 4 or Event 4	4	Alarm 5 or Event 5																				
Value	Selection																																			
0	Alarm 1 or Event 1																																			
1	Alarm 2 or Event 2																																			
2	Alarm 3 or Event 3																																			
3	Alarm 4 or Event 4																																			
4	Alarm 5 or Event 5																																			

2.2.4. Relay Output 4 Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes				
Usage	2205	0x89D	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Usage</th> </tr> </thead> <tbody> <tr><td>0</td><td>None</td></tr> </tbody> </table>	Value	Usage	0	None
Value	Usage							
0	None							

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes																												
				<table border="1"> <tr><td>1</td><td>Alarm 1</td></tr> <tr><td>2</td><td>Alarm 2</td></tr> <tr><td>3</td><td>Alarm 3</td></tr> <tr><td>4</td><td>Alarm 4</td></tr> <tr><td>5</td><td>Alarm 5</td></tr> <tr><td>6</td><td>Event 1</td></tr> <tr><td>7</td><td>Event 2</td></tr> <tr><td>8</td><td>Event 3</td></tr> <tr><td>9</td><td>Event 4</td></tr> <tr><td>10</td><td>Event 5</td></tr> <tr><td>11</td><td>Cycle Complete</td></tr> <tr><td>12</td><td>Profile Running</td></tr> <tr><td>13</td><td>Or of Alarms</td></tr> <tr><td>14</td><td>Alarm and Events</td></tr> </table>	1	Alarm 1	2	Alarm 2	3	Alarm 3	4	Alarm 4	5	Alarm 5	6	Event 1	7	Event 2	8	Event 3	9	Event 4	10	Event 5	11	Cycle Complete	12	Profile Running	13	Or of Alarms	14	Alarm and Events
1	Alarm 1																															
2	Alarm 2																															
3	Alarm 3																															
4	Alarm 4																															
5	Alarm 5																															
6	Event 1																															
7	Event 2																															
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10	Event 5																															
11	Cycle Complete																															
12	Profile Running																															
13	Or of Alarms																															
14	Alarm and Events																															
Alarm Selection	2207	0x089F	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr><td>0</td><td>Alarm 1 or Alarm 2</td></tr> <tr><td>1</td><td>Alarm 1 or Alarm 2 or Alarm 3</td></tr> <tr><td>2</td><td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4</td></tr> <tr><td>3</td><td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5</td></tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Alarm 2	1	Alarm 1 or Alarm 2 or Alarm 3	2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4	3	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5																		
Value	Selection																															
0	Alarm 1 or Alarm 2																															
1	Alarm 1 or Alarm 2 or Alarm 3																															
2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4																															
3	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5																															
Event Alarm Selection	2209	0x08A1	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr><td>0</td><td>Alarm 1 or Event 1</td></tr> <tr><td>1</td><td>Alarm 2 or Event 2</td></tr> <tr><td>2</td><td>Alarm 3 or Event 3</td></tr> <tr><td>3</td><td>Alarm 4 or Event 4</td></tr> <tr><td>4</td><td>Alarm 5 or Event 5</td></tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Event 1	1	Alarm 2 or Event 2	2	Alarm 3 or Event 3	3	Alarm 4 or Event 4	4	Alarm 5 or Event 5																
Value	Selection																															
0	Alarm 1 or Event 1																															
1	Alarm 2 or Event 2																															
2	Alarm 3 or Event 3																															
3	Alarm 4 or Event 4																															
4	Alarm 5 or Event 5																															

2.2.5. Relay Output 5 Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes																								
Usage	2216	0x08A8	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Usage</th> </tr> </thead> <tbody> <tr><td>0</td><td>None</td></tr> <tr><td>1</td><td>Alarm 1</td></tr> <tr><td>2</td><td>Alarm 2</td></tr> <tr><td>3</td><td>Alarm 3</td></tr> <tr><td>4</td><td>Alarm 4</td></tr> <tr><td>5</td><td>Alarm 5</td></tr> <tr><td>6</td><td>Event 1</td></tr> <tr><td>7</td><td>Event 2</td></tr> <tr><td>8</td><td>Event 3</td></tr> <tr><td>9</td><td>Event 4</td></tr> <tr><td>10</td><td>Event 5</td></tr> </tbody> </table>	Value	Usage	0	None	1	Alarm 1	2	Alarm 2	3	Alarm 3	4	Alarm 4	5	Alarm 5	6	Event 1	7	Event 2	8	Event 3	9	Event 4	10	Event 5
Value	Usage																											
0	None																											
1	Alarm 1																											
2	Alarm 2																											
3	Alarm 3																											
4	Alarm 4																											
5	Alarm 5																											
6	Event 1																											
7	Event 2																											
8	Event 3																											
9	Event 4																											
10	Event 5																											

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Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes												
				<table border="1"> <tr><td>11</td><td>Cycle Complete</td></tr> <tr><td>12</td><td>Profile Running</td></tr> <tr><td>13</td><td>Or of Alarms</td></tr> <tr><td>14</td><td>Alarm and Events</td></tr> </table>	11	Cycle Complete	12	Profile Running	13	Or of Alarms	14	Alarm and Events				
11	Cycle Complete															
12	Profile Running															
13	Or of Alarms															
14	Alarm and Events															
Alarm Selection	2218	0x08AA	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr><td>0</td><td>Alarm 1 or Alarm 2</td></tr> <tr><td>1</td><td>Alarm 1 or Alarm 2 or Alarm 3</td></tr> <tr><td>2</td><td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4</td></tr> <tr><td>3</td><td>Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5</td></tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Alarm 2	1	Alarm 1 or Alarm 2 or Alarm 3	2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4	3	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5		
Value	Selection															
0	Alarm 1 or Alarm 2															
1	Alarm 1 or Alarm 2 or Alarm 3															
2	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4															
3	Alarm 1 or Alarm 2 or Alarm 3 or Alarm 4 or Alarm 5															
Event Alarm Selection	2220	0x08AC	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Selection</th> </tr> </thead> <tbody> <tr><td>0</td><td>Alarm 1 or Event 1</td></tr> <tr><td>1</td><td>Alarm 2 or Event 2</td></tr> <tr><td>2</td><td>Alarm 3 or Event 3</td></tr> <tr><td>3</td><td>Alarm 4 or Event 4</td></tr> <tr><td>4</td><td>Alarm 5 or Event 5</td></tr> </tbody> </table>	Value	Selection	0	Alarm 1 or Event 1	1	Alarm 2 or Event 2	2	Alarm 3 or Event 3	3	Alarm 4 or Event 4	4	Alarm 5 or Event 5
Value	Selection															
0	Alarm 1 or Event 1															
1	Alarm 2 or Event 2															
2	Alarm 3 or Event 3															
3	Alarm 4 or Event 4															
4	Alarm 5 or Event 5															

2.2.6. Linear Output Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes												
Linear Output Usage	2144	0x0860	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Usage</th> </tr> </thead> <tbody> <tr><td>0</td><td>None</td></tr> <tr><td>1</td><td>Retransmit PV</td></tr> <tr><td>2</td><td>Retransmit SP</td></tr> <tr><td>3</td><td>Primary (Heat) Control Power</td></tr> <tr><td>4</td><td>Cool Control Power (Only available on Heat Cool model)</td></tr> </tbody> </table>	Value	Usage	0	None	1	Retransmit PV	2	Retransmit SP	3	Primary (Heat) Control Power	4	Cool Control Power (Only available on Heat Cool model)
Value	Usage															
0	None															
1	Retransmit PV															
2	Retransmit SP															
3	Primary (Heat) Control Power															
4	Cool Control Power (Only available on Heat Cool model)															
Linear output range	2223	0x08AF	R/W	<table border="1"> <thead> <tr> <th>Value</th> <th>Range</th> </tr> </thead> <tbody> <tr><td>0</td><td>0 – 5V</td></tr> <tr><td>1</td><td>0 – 10V</td></tr> <tr><td>2</td><td>2 – 10V</td></tr> <tr><td>3</td><td>0 – 20mA</td></tr> <tr><td>4</td><td>4 – 20mA</td></tr> </tbody> </table>	Value	Range	0	0 – 5V	1	0 – 10V	2	2 – 10V	3	0 – 20mA	4	4 – 20mA
Value	Range															
0	0 – 5V															
1	0 – 10V															
2	2 – 10V															
3	0 – 20mA															
4	4 – 20mA															
Retransmit Minimum	2152	0x0868	R/W													
Retransmit Maximum	2153	0x0869	R/W													

2.3. *Setpoint Parameters*

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Setpoint Minimum	3944	0x0F68	R/W	Limited by input range maximum/minimum
Setpoint Maximum	3945	0x0F69	R/W	Limited by input range maximum/minimum
Manual/Timer Mode Setpoint Value	3960	0x0F78	R/W	Limited by Setpoint maximum/minimum

2.4. Control Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Cycle time	4301	0x10CD	R/W	0.5 to 512.0
Control Type	4310	0x10D6	R/W	0 = Single (Heat Only) 1 = Dual (Heat/Cool) (Only available on Heat Cool Variant)
Control Action	4311	0x10D7	R/W	0 = Direct 1 = Reverse
Proportional Band 1	4312	0x10D8	R/W	0.0 to 999.9
Secondary (Cool) Proportional Band	4313	0x10D9	R/W	0.0 to 999.9 (Only available on Heat Cool Variant)
Integral/Reset	4314	0x10DA	R/W	0.0 to 5999
Derivative/Rate	4315	0x10DB	R/W	0.0 to 5999
Bias	4316	0x10DC	R/W	For single control 0 to 100, for Dual control -100 to 100
Overlap/DeadBand	4317	0x10DD	R/W	20% of the proportional band (Only available on Heat Cool Variant)
On/Off Differential	4320	0x10E0	R/W	0.1 to 100
Heat/Primary Power Upper limit	4321	0x10E1	R/W	10 to 100% Can not be made smaller than Heat/Primary Lower limit + 10
Heat/Primary Power Lower limit	4322	0x10E2	R/W	0 to 90% Can not be made larger than Heat/Primary Upper limit – 10
Cool/Secondary Power Upper limit	4323	0x10E3	R/W	10 to 100% Can not be made smaller than Cool/Secondary Lower limit + 10
Cool/Secondary Power Lower limit	4324	0x10E4	R/W	0 to 90% Can not be made larger than Cool/Secondary Upper limit – 10
Pretune Enable	4325	0x10E5	R/W	0 = Disabled 1 = Enabled
Self tune Enable	4326	0x10E6	R/W	0 = Disabled 1 = Enabled
Loop Alarm Type	4327	0x10E7	R/W	1 = Time 2 = Auto
Loop Alarm time	4328	0x10E8	R/W	1 to 5999
Primary Power	4329	0x10E9	R	0 to 100%
Pretune Status	4332	0x10EC	R	0 = Inactive 1 = Active
Self tune Status	4333	0x10ED	R	0 = Inactive 1 = Active
Loop Alarm status	4334	0x10EE	R	0 = Inactive 1 = Active
Preset Power	4335	0x10EF	R/W	0% to 100%

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Auto Pre-tune	4336	0x10F0	R/W	0 = Disabled 1 = Enabled

2.5. Alarm Parameters

2.5.1. Alarm 1

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Alarm Type	6144	0x1800	R/W	0 = High Alarm 1 = Low Alarm 2 = Deviation Alarm 3 = Band Alarm 4 = Loop Alarm 5 = Sensor Break Alarm
Alarm Value	6145	0x1801	R/W	Limited by the input range maximum and minimum for Alarm types 0 and 1. Limited by the span of the input range for alarm types 2 and 3. Not used for alarms 4 and 5.
Alarm Hysteresis	6146	0x1802	R/W	Limited by the span of the input range
Alarm inhibit	6147	0x1803	R/W	0 = Disabled 1 = Enabled
Alarm status	6148	0x1804	R	0 = Inactive 1 = Active
Alarm inhibit status	6149	0x1805	R	0 = Not inhibited 1 = Inhibited
Rate Minimum Time Alarm Value	6150	0x1806	R/W	

2.5.2. Alarm 2

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Alarm Type	6160	0x1810	R/W	0 = High Alarm 1 = Low Alarm 2 = Deviation Alarm 3 = Band Alarm 4 = Loop Alarm 5 = Sensor Break Alarm
Alarm Value	6161	0x1811	R/W	Limited by the input range maximum and minimum for Alarm types 0 and 1. Limited by the span of the input range for alarm types 2 and 3. Not used for alarms 4 and 5.
Alarm Hysteresis	6162	0x1812	R/W	Limited by the span of the input range
Alarm inhibit	6163	0x1813	R/W	0 = Disabled 1 = Enabled
Alarm status	6164	0x1814	R	0 = Inactive 1 = Active

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Alarm inhibit status	6165	0x1815	R	0 = Not inhibited 1 = Inhibited
Rate Minimum Time Alarm Value	6166			

2.5.3. Alarm 3

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Alarm Type	6176	0x1820	R/W	0 = High Alarm 1 = Low Alarm 2 = Deviation Alarm 3 = Band Alarm 4 = Loop Alarm 5 = Sensor Break Alarm
Alarm Value	6177	0x1821	R/W	Limited by the input range maximum and minimum for Alarm types 0 and 1. Limited by the span of the input range for alarm types 2 and 3. Not used for alarms 4 and 5.
Alarm Hysteresis	6178	0x1822	R/W	Limited by the span of the input range
Alarm inhibit	6179	0x1823	R/W	0 = Disabled 1 = Enabled
Alarm status	6180	0x1824	R	0 = Inactive 1 = Active
Alarm inhibit status	6181	0x1825	R	0 = Not inhibited 1 = Inhibited
Rate Minimum Time Alarm Value	6182	0x1826	R/W	

2.5.4. Alarm 4

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Alarm Type	6192	0x1830	R/W	0 = High Alarm 1 = Low Alarm 2 = Deviation Alarm 3 = Band Alarm 4 = Loop Alarm 5 = Sensor Break Alarm
Alarm Value	6193	0x1831	R/W	Limited by the input range maximum and minimum for Alarm types 0 and 1. Limited by the span of the input range for alarm types 2 and 3. Not used for

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Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
				alarms 4 and 5.
Alarm Hysteresis	6194	0x1832	R/W	Limited by the span of the input range
Alarm inhibit	6195	0x1833	R/W	0 = Disabled 1 = Enabled
Alarm status	6196	0x1834	R	0 = Inactive 1 = Active
Alarm inhibit status	6197	0x1835	R	0 = Not inhibited 1 = Inhibited
Rate Minimum Time Alarm Value	6198	0x1836	R/W	

2.5.5. Alarm 5

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Alarm Type	6208	0x1840	R/W	0 = High Alarm 1 = Low Alarm 2 = Deviation Alarm 3 = Band Alarm 4 = Loop Alarm 5 = Sensor Break Alarm
Alarm Value	6209	0x1841	R/W	Limited by the input range maximum and minimum for Alarm types 0 and 1. Limited by the span of the input range for alarm types 2 and 3. Not used for alarms 4 and 5.
Alarm Hysteresis	6210	0x1842	R/W	Limited by the span of the input range
Alarm inhibit	6211	0x1843	R/W	0 = Disabled 1 = Enabled
Alarm status	6212	0x1844	R	0 = Inactive 1 = Active
Alarm inhibit status	6213	0x1845	R	0 = Not inhibited 1 = Inhibited
Rate Minimum Time Alarm Value	6214	0x1846	R/W	

2.5.6. High Limit Alarm Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Alarm Value	9022	0x233E	R/W	

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Alarm Hysteresis	9023	0x233F	R/W	Limited by the span of the input range
Alarm status	9007	0x232F	R	0 = Inactive 1 = Active

2.6. Logger parameters (Data Logger)

2.6.1. Data Recorder

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Log Interval	7550	0x1D7E	R/W	0 = Every second 1 = Every 2 seconds 2 = Every 5 seconds 3 = Every 10 seconds 4 = Every 15 seconds 5 = Every 30 seconds 6 = Every Minute 7 = Every 2 Minutes 8 = Every 5 Minutes 9 = Every 10 Minutes 10 = Every 15 Minutes 11 = Every 30 Minutes 12 = Every 60 Minutes
Log Mode	7551	0x1D7F	R/W	0 = Record until memory used 1 = Continues FIFO
Memory Remaining	7554	0x1D82	R	In Bytes
Time Remaining	7555	0x1D83	R	In seconds

2.6.2. Real Time Clock

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Date format	7868	0x1EBC	R	0 = dd/mm/yyyy (European Default) 1 = mm/dd/yyyy (USA Default)
Time	7869	0x1EBD	R/W	In seconds from midnight
Date	7870	0x1EBE	R/W	
Day of the week	7872	0x1EC0	R/W	1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday 7 = Sunday

2.7. Display Parameters

2.7.1. Keys

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Key State	7669	0x1DF5	R	Current state of the keys
Key Debounce	7670	0x1DF6	R/W	Not currently supported

2.7.2. LEDs

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
LED 1 Label	7660	0x1DEC	R/W	
LED 2 Label	7661	0x1DED	R/W	
LED 3 Label	7662	0x1DEE	R/W	
LED 4 Label	7663	0x1DEF	R/W	
Backlight Colour	7668	0x1DF4	R/W	0 = Green to Red on Alarm 1 = Red to Green on Alarm 2 = Green 3 = Red

2.7.3. HMI

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Language	7675	0x1DFB	R/W	0 = Downloaded Language 1 = English
LCD Contrast	7676	0x1DFC	R/W	0 to 100
Invert LCD	7677	0x1DFD	R/W	0 = Normal 1 = Inverted
Setup Lock Code	7678	0x1DFE	R/W	Default 10
Configuration Lock Code	7679	0x1DFF	R/W	Default 10
Tune Lock Code	7680	0x1E00	R/W	Default 10
USB Lock Code	7683	0x1E03	R/W	Default 10
Recorder Lock Code	7684	0x1E04	R/W	Default 10
Profile Lock Code	7682	0x1E02	R/W	Default 10

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2.7.4. System Data

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Serial number hi	210	0x00D2	R	Can only be set through diagnostics mode, Refer to document ENG2491
Serial number lo	211	0x00D3	R	Can only be set through diagnostics mode, Refer to document ENG2491
Serial number line	212	0x00D4	R	Can only be set through diagnostics mode, Refer to document ENG2491
Serial number qty	213	0x00D5	R	Can only be set through diagnostics mode, Refer to document ENG2491
Date of manufacture (Day)	370	0x0172	R	Can only be set through diagnostics mode, Refer to document ENG2491
Date of manufacture (Month)	371	0x0173	R	Can only be set through diagnostics mode, Refer to document ENG2491
Date of manufacture (Year)	372	0x0174	R	Can only be set through diagnostics mode, Refer to document ENG2491
Software PRL	208	0x00D0	R	Can only be set through diagnostics mode, Refer to document ENG2491
Hardware PRL	207	0x00CF	R	Can only be set through diagnostics mode, Refer to document ENG2491
Software version	201	0x00C9	R	Can only be set through diagnostics mode, Refer to document ENG2491
Hardware option	200	0x00C8	R	Can only be set through diagnostics mode, Refer to document ENG2491
Manufactures ID	216	0x00D8	R	Can only be set through diagnostics mode, Refer to document ENG2491
Unit ID	203	0x00CB	R	Should never be set by automatic test equipment
Version Major	217	0x00D9	R	Should never be set by automatic test equipment
Version Minor	218	0x00DA	R	Should never be set by automatic test equipment
OP Version	202	0x00CA	R	Should never be set by automatic test equipment
Sub Version	204	0x00CC	R	Should never be set by automatic test equipment
Software type	206	0x00CE	R	Should never be set by automatic test equipment
OEM Code hi	373	0x0175	R	Should never be set by automatic test equipment
OEM Code lo	374	0x0176	R	Should never be set by automatic test

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
				equipment
Contact Details line 1	400	0x0190	R/W	26 characters of text
Contact Details line 2	401	0x0191	R/W	26 characters of text
Contact Details line 3	402	0x0192	R/W	26 characters of text
Contact Details line 4	403	0x0193	R/W	26 characters of text
Contact Details line 5	404	0x0194	R/W	26 characters of text
Contact Details line 6	405	0x0195	R/W	26 characters of text
Contact Details line 7	406	0x0196	R/W	26 characters of text
Communications Address	413	0x019D	R/W	
Communications Baud rate	414	0x019E	R/W	
Communications Parity	415	0x019F	R/W	

2.8. Mode Controls

2.8.1. General Mode Control

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Mode Selection	8285	0x205D	R/W	0 = Do Nothing 1 = Manual Mode 2 = Timer Mode 3 = Profile Mode 4 = Mode Selection
Digital input Profile Selection control Enable	8273	0x2051	R/W	0 = HMI or Comms selection 1 = Digital input profile selection
Current Mode Selected	8280	0x2058	RO	0 = Mode Selection 1 = Configuration 2 = Manual 3 = Timer 4 = Profile

2.8.2. Manual Mode Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Manual Mode Recovery	8278	0x2056	R/W	0 = Control Off 1 = Recover to Mode
Manual Mode recovery Time	8279	0x2057	R/W	Value in seconds
Manual Mode Status	8281	0x2059	RO	0 = Mode Stopped 1 = Mode Running
Manual Mode Relay Status	2170	0x087A	RO	Bit 0 = Relay 1 Bit 1 = Relay 2 Bit 2 = Relay 3 Bit 3 = Relay 4 Bit 4 = Relay 5
Manual Mode Control	8283	0x205B	R/W	0 = Stop Manual Mode 1 = Start Manual Mode 3 = Waiting for Command
Manual Mode Control Setpoint	3960	0x0F78	R/W	
Manual Mode Relay 1	8249	0x2039	R/W	0 = Off 1 = On
Manual Mode Relay 2	8250	0x203A	R/W	0 = Off 1 = On
Manual Mode Relay 3	8251	0x203B	R/W	0 = Off 1 = On

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Manual Mode Relay 4	8252	0x203C	R/W	0 = Off 1 = On

2.8.3. Timer Mode Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Timer Mode Recovery	8275	0x2053	R/W	0 = Control Off 1 = Restart Timer 2 = Continue Timer
Timer Mode Recovery Time	8276	0x2054	R/W	Value in seconds
Timer Mode Auto Hold Value	8272	0x2050	R/W	
Timer Mode Status	8282	0x205A	RO	0 = Mode Stopped 1 = Mode Running
Timer Mode Relay Status	2170	0x087A	RO	Bit 0 = Relay 1 Bit 1 = Relay 2 Bit 2 = Relay 3 Bit 3 = Relay 4 Bit 4 = Relay 5
Timer Mode Control	8284	0x205C	R/W	0 = Stop Timer 1 = Start Timer 3 = Waiting for Command
Timer Time	8270	0x204E	R/W	Time in seconds
Current Remaining Time of timer	8238	0x202E	RO	Value in seconds. The amount of time remaining for the active segment.
Timer Mode Control Setpoint	3960	0x0F78	R/W	
Timer Mode Relay 1	8249	0x2039	R/W	0 = Off 1 = On
Timer Mode Relay 2	8250	0x203A	R/W	0 = Off 1 = On
Timer Mode Relay 3	8251	0x203B	R/W	0 = Off 1 = On
Timer Mode Relay 4	8252	0x203C	R/W	0 = Off 1 = On

2.8.4. Profile Mode Parameters

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Currently Selected Profile	8243	0x2033	R/W	Value between 0 and 63
Currently Active Segment	8244	0x2034	RO	Value between 0 and 255
Current Setpoint	8256	0x2040	RO	
Currently Running Segment Type	8258	0x2042	RO	0 = None 1 = Ramp Up 2 = Step 3 = Dwell 4 = Hold 5 = Loop 6 = Join 7 = End 8 = Ramp Down
Start Delay Time	8233	0x2029	RO	Value in seconds. The current start delay time remaining
Current Time of the active segment	8237	0x202D	RO	Value in seconds. The amount of time the segment has been running
Current Remaining Time of segment	8238	0x202E	RO	Value in seconds. The amount of time remaining for the active segment.
Current Time of the running Profile	8235	0x202B	RO	Value in seconds. The amount of time the profile has been running.
Current Remaining Profile Time	8236	0x202C	RO	Value in seconds. The amount of time remaining for the complete profile.
Total Hold Time	8239	0x202F	RO	Value in seconds. The total amount of time the profile has been held for.
Profile Mode Relay Status	2170	0x087A	RO	Bit 0 = Relay 1 Bit 1 = Relay 2 Bit 2 = Relay 3 Bit 3 = Relay 4 Bit 4 = Relay 5
Event 1 Status	8249	0x2039	RO	0 = Inactive 1 = Active
Event 2 Status	8250	0x203A	RO	0 = Inactive 1 = Active
Event 3 Status	8251	0x203B	RO	0 = Inactive 1 = Active
Event 4 Status	8252	0x203C	RO	0 = Inactive 1 = Active
Profile Selection	8243	0x2033	R/W	Value between 0 and 63 to select the profile to run

Parameter Name	Modbus Address (Dec)	Modbus Address (Hex)	Access R/W	Notes
Profile Control	8245	0x2035	R/W	0 = Do Nothing 1 = Run the selected profile 2 = Hold the currently running profile 3 = Abort the currently running profile 4 = Jump to the next segment 5 = Release a held profile 6 = Exit the profile control once the profile has completed and is holding the last setpoint
Active Profile Name	8259	0x2043	R	The currently selected profile name
Profile Status	8241	0x2031	R	0 = Stopped 1 = Running 2 = Held 3 = Delayed 4 = Error 5 = Aborted 6 = Ended

2.9. Uploading and Downloading of Profiles

The information in this section is intended for advanced users writing their own software code. Most users will create or edit profiles using the instrument keypad or via BlueControl. Either method allows quick and easy editing of profiles.

Advanced users can setup or edit profiles by writing to the Profile Configuration parameter at address 8198 (0x2006). This can only be accessed by using Modbus function code 23 (0x17). The instrument replies with a status message.

When creating a new profile the steps below must be followed exactly, either to create a profile at the next available position, or at a position that you specify.

Each message in the sequence includes a 2 byte Command Code that tells the instrument the purpose of the message, and therefore the meaning of the data contained in it.

The command codes support by this instrument are:

Command Code	Value Decimal	Value Hex	Function
CP	17232	0x4350	Create Profile
EP	17744	0x4550	Edit Profile
WP	22352	0x5750	Write Profile
WS	22355	0x5753	Create Segment
IS	18771	0x4953	Insert Segment
ES	17747	0x4553	Edit a Segment
DP	17488	0x4450	Delete a Profile
DA	17473	0x4441	Delete all profiles
DS	17491	0x4453	Delete a Segment
SR	21330	0x5352	Get the number of segments remaining
RP	21072	0x5250	Read Profile Header

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Command Code	Value Decimal	Value Hex	Function
RS	21075	0x5253	Read Segment
PN	20558	0x504E	Read Profile Name
PS	20563	0x5053	Read the profiler memory status

The following rules apply when creating a profile over communications:

- Profiles must always be terminated with an end segment.
- Segments cannot be added after an end segment has been added.
- All changes made to the selected profile are immediately saved in the instrument.

2.9.1. *Instruction Sequence to create a profile at the next available position*

1. Create a profile by writing the profile header data using the Command Code value CP (0x43, 0x50). This starts the profile creation process by reserving a profile memory slot. The profile number is returned by the instrument in the Edit Response Message.
2. Write the first segment using the Command Code value Code WS (0x57, 0x53). This command will fill the next available segment position and link it to the profile created in step 1.
3. Write the second segment, again using Command Code WS. This fills the next available segment position and links it to the segment created in step 2.
4. Continue writing segments until the profile is complete (whilst remaining within the overall limit of 255 segments for all profiles combined). Each of these segments fills the next available position and links it to the previous segment specified.
5. The very last segment of the profile must be one of the end type segments. Thereafter, no more segments can be added to the specified profile. To add a segment to an existing profile the insert segment command must be used.

2.9.2. *Instruction Sequence to create a profile at a specified profile position*

CAUTION:

If this profile number is already in use then the profile header data is overwritten but the segments associated with it are kept.

1. Determine which profile positions are being used by using the Command Code value PS (0x50, 0x53). This command will return a list of all the profile positions currently being used.
2. Choose a location that is not being used and write the profile header data using the Command Code value WP (0x57, 0x50). The profile number is echoed back by the instrument in the Edit Response Message.
3. Write the first segment using the Command Code value Code WS (0x57, 0x53). This command will fill the next available segment position and link it to the profile created in step 1.
4. Write the second segment, again using Command Code WS. This fills the next available segment position and links it to the segment created in step 2.

5. Continue writing segments until the profile is complete (whilst remaining within the overall limit of 255 segments for all profiles combined). Each of these segments fills the next available position and links it to the previous segment specified.
6. The very last segment of the profile must be one of the end type segments. Thereafter, no more segments can be added to the specified profile. To add a segment to an existing profile the insert segment command must be used.

2.9.3. Instruction Sequence to edit an existing Profile Header

When a profile header is changed, the segments associated with it remain unchanged. They must be edited separately if required.

1. Determine the number of the profile to be edited. Use the Command Code value PS (0x50, 0x53) which returns a list of all profile positions/numbers currently in use.
2. Write a new profile header data using the Command Code value EP (0x45, 0x50).
The profile number is echoed back by the instrument in the Edit Response Message.

2.9.4. Instruction Sequence to read a profile

1. Use the command RP to read the profile header data
2. Use the command RS to read the 1st segment's data
3. Use the command RS to read the 2nd segment's data.
4. Repeat steps 2 and 3 until an end segment is reached.

2.9.5. Profile Command Code Descriptions

2.9.5.1. Creating a profile header (Command Code CP)

Creating A Profile Header - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument.
Function Code	23	17	Requires the multi read/write function.
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High Byte	00	00	
Read Quantity Of Registers Low Byte	01	01	
Write Start Address High Byte	32	20	
Write Start Address Low Byte	06	06	
Write Quantity Of Registers High Byte	00	00	
Write Quantity Of Registers Low Byte	20	14	
Byte Count	40	28	38dec / 0x26hex creating a profile at the next available location.
Command Code High Byte	67	43	Create Profile (CP) = 17232dec / 0x4350hex
Command Code Low Byte	80	50	
Profile Name Character 1	A/R	A/R	The ASCII codes equivalent to each of the
Profile Name Character 2	A/R	A/R	

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Creating A Profile Header - Request (to instrument)				
Field Name	Data		Comments	
	(Dec)	(Hex)		
Profile Name Character 3	A/R	A/R	16 characters of the profile name, e.g. : A = 65dec / 0x41, B = 66dec / 0x42 etc a = 97dec / 0x61, b = 98dec / 0x62 etc Note: Only valid characters from the instruments supported character set should be used	
Profile Name Character 4	A/R	A/R		
Profile Name Character 5	A/R	A/R		
Profile Name Character 6	A/R	A/R		
Profile Name Character 7	A/R	A/R		
Profile Name Character 8	A/R	A/R		
Profile Name Character 9	32	20		
Profile Name Character 10	32	20		
Profile Name Character 11	32	20		
Profile Name Character 12	32	20		
Profile Name Character 13	32	20		
Profile Name Character 14	32	20		
Profile Name Character 15	32	20		
Profile Name Character 16	32	20		
Profile Start Signal High Byte	00	00		0 = No delay, 1 = After delay, 2 = At Time/day
Profile Start Signal Low Byte	A/R	A/R		
Profile Start Time (Byte 4 - High)	Floating point number			
Profile Start Time (Byte 3)				
Profile Start Time (Byte 2)				
Profile Start Time (Byte 1 - Low)				
Profile Start Day High Byte	00	00	1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday, 6 = Saturday, 7 = Sunday, 8 = Monday to Friday, 9 = Monday to Saturday, 10 = Saturday And Sunday, 11= All Week	
Profile Start Day Low Byte	A/R	A/R		
Profile Starting Setpoint High	00	00	1 = Current Process Variable Value	
Profile Starting Setpoint Low	01	01		
Profile Recovery High Byte	00	00	0 = Control to off, 1 = Restart profile, 2 = Maintain last profile setpoint, 4 = Continue profile from where it was when power failed	
Profile Recovery Low Byte	A/R	A/R		
Profile Recovery Time (Byte 4 - high)	Floating point number			
Profile Recovery Time (Byte 3)				
Profile Recovery Time (Byte 2)				
Profile Recovery Time (Byte 1 - Low)				
Profile Abort action High Byte	00	00	0 = Control to off 1 = Maintain last profile setpoint	
Profile Abort Action Low Byte	A/R	A/R		
Profile Cycles High Byte	A/R	A/R	1 to 9999 or 10,000 for "Infinite"	
Profile Cycles Low Byte	A/R	A/R		
Profile Tracks High Byte	00	00	Always set to 1	
Profile Tracks Low Byte	01	01		
CRC High Byte	A/R	A/R		
CRC Low Byte	A/R	A/R		

The instrument replies to this message with an Edit Response Message Section 2.9.5.9.

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2.9.5.2. Editing/Creating a profile header at a location (Command Code EP or WP)

Creating Or Editing A Profile Header at a specific location - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument.
Function Code	23	17	Requires the multi read/write function.
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High Byte	00	00	
Read Quantity Of Registers Low Byte	01	01	
Write Start Address High Byte	32	20	
Write Start Address Low Byte	06	06	
Write Quantity Of Registers High Byte	00	00	
Write Quantity Of Registers Low Byte	21	15	
Byte Count	42	2A	42dec / 0x2Ahex if creating a profile at a specified location, or editing a profile.
Command Code High Byte	69 or 87	45 or 57	Edit Profile (EP) = 17744dec / 0x4550hex Write Profile (WP) = 23352dec / 0x5750hex
Command Code Low Byte	80	50	
Profile Number High Byte	A/R	A/R	The profile number can be anything between 0 and 64
Profile Number Low Byte	A/R	A/R	
Profile Name Character 1	A/R	A/R	<p>The ASCII codes equivalent to each of the 16 characters of the profile name, e.g. : A = 65dec / 0x41, B = 66dec / 0x42 etc a = 97dec / 0x61, b = 98dec / 0x62 etc</p> <p>Note: Only valid characters from the instruments supported character set should be used</p> <p>The space character (32dec / 0x20hex) is used to fill any unused characters at the end of the name</p> <p>Characters 9 to 16 are not supported and should be written to 32dec / 0x20hex</p>
Profile Name Character 2	A/R	A/R	
Profile Name Character 3	A/R	A/R	
Profile Name Character 4	A/R	A/R	
Profile Name Character 5	A/R	A/R	
Profile Name Character 6	A/R	A/R	
Profile Name Character 7	A/R	A/R	
Profile Name Character 8	A/R	A/R	
Profile Name Character 9	32	20	
Profile Name Character 10	32	20	
Profile Name Character 11	32	20	
Profile Name Character 12	32	20	
Profile Name Character 13	32	20	
Profile Name Character 14	32	20	
Profile Name Character 15	32	20	
Profile Name Character 16	32	20	
Profile Start Signal High Byte	00	00	0 = No delay, 1 = After delay, 2 = At Time/day
Profile Start Signal Low Byte	A/R	A/R	
Profile Start Time (Byte 4 - High)	Floating point number		
Profile Start Time (Byte 3)			
Profile Start Time (Byte 2)			
Profile Start Time (Byte 1 - Low)			
Profile Start Day High Byte	00	00	1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday, 6 = Saturday, 7 = Sunday, 8 = Monday to Friday, 9 = Monday to Saturday, 10 = Saturday And Sunday, 11= All Week
Profile Start Day Low Byte	A/R	A/R	
Profile Starting Setpoint High	00	00	1 = Current Process Variable Value

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Creating Or Editing A Profile Header at a specific location - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Profile Starting Setpoint Low	01	01	
Profile Recovery High Byte	00	00	0 = Control to off, 1 = Restart profile, 2 = Maintain last profile setpoint, 4 = Continue profile from where it was when power failed
Profile Recovery Low Byte	A/R	A/R	
Profile Recovery Time (Byte 4 - high)	Floating point number		
Profile Recovery Time (Byte 3)			
Profile Recovery Time (Byte 2)			
Profile Recovery Time (Byte 1 - Low)			
Profile Abort action High Byte	00	00	0 = Control to off 1 = Maintain last profile setpoint
Profile Abort Action Low Byte	A/R	A/R	
Profile Cycles High Byte	A/R	A/R	1 to 9999 or 10,000 for "Infinite"
Profile Cycles Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to this message with an Edit Response Message Section 2.9.5.9.

2.9.5.3. Creating a Segment (Command Code WS)

Creating new segments is only possible when a new profile is being created (see above for instruction for creating a profile at the next available position, or at a position that you specify). An error is returned if the correct sequence is not followed.

Creating Segments - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument.
Function Code	23	17	Requires the multi read/write function.
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High	00	00	
Read Quantity Of Registers Low	01	01	
Write Start Address High	32	20	
Write Start Address Low	06	06	
Write Quantity Of Registers High	00	00	
Write Quantity Of Registers Low	11	0B	Create Segment (WS) = 11dec / 0x0Bhex
Byte Count	22	16	Create Segment (WS) = 22dec / 0x16hex
Command Code High Byte	87	57	Create Segment (WS) = 22355dec / 0x5753hex
Command Code Low Byte	83	53	
Profile Number High Byte	A/R	A/R	The profile number can be anything between 0 and 64
Profile Number Low Byte	A/R	A/R	
Segment Type High Byte	00	00	0 = Ramp Time, 1 = Ramp Rate, 2 = Step, 3 = Dwell, 4 = Hold, 5 = Loop 6 = Join, 7 = End, 8 = Repeat sequence then end
Segment Type Low Byte	A/R	A/R	
Segment Info A (Byte 4 - High)	Floating point number		The meaning of the data contained in Segment Info A depends on the type of segment it relates to. See section 12.5.5.
Segment Info A (Byte 3)			
Segment Info A (Byte 2)			

Creating Segments - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Segment Info A (Byte 1 - Low)			
Segment Info B (Byte 4 - High)			The meaning of the data contained in Segment Info B depends on the type of segment it relates to. See section 12.5.5.
Segment Info B (Byte 3)			
Segment Info B (Byte 2)			
Segment Info B (Byte 1 - Low)			
Auto Hold Type High Byte	A/R	A/R	
Auto Hold Type Low Byte	A/R	A/R	
Auto Hold Value (Byte 4 - High)			
Auto Hold Value (Byte 3)			
Auto Hold Value (Byte 2)			
Auto Hold Value (Byte 1 - Low)			
Events High Byte	00	00	The status of the five events are defined by the lowest 5 bits of the low byte. A bit value of 1 signifies the event is on. Bit 0 = event 1, bit 1 = event 2, bit 3 = event 4 and bit 5 = event 4.
Events Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to this message with an Edit Response Message Section 2.9.5.9.

2.9.5.4. Editing or Inserting a Segment (Command Codes IS and ES)

The Insert Segment command is used to add segments to an existing profile (one that already has an end segment). This inserts a new segment at the position specified. The Edit Segment command is used to alter segments of an existing profile. The segment number is in relation to the profile number, e.g. to edit or insert a segment at position 3 of profile 1 the segment number will be 3, and to edit or insert a segment at position 3 of profile 6 the segment number will also be 3.

Editing or Inserting Segments - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument.
Function Code	23	17	Requires the multi read/write function.
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High	00	00	
Read Quantity Of Registers Low	01	01	
Write Start Address High	32	20	
Write Start Address Low	06	06	
Write Quantity Of Registers High	00	00	
Write Quantity Of Registers Low	12	0C	
Byte Count	24	18	
Command Code High Byte	73 or 69	49 or 45	Insert Segment (IS) = 73dec / 0x4953hex Edit A Segment (ES) = 69dec / 0x4553hex
Command Code Low Byte	83	53	

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Editing or Inserting Segments - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Profile Number High Byte	A/R	A/R	The profile number can be anything between 0 and 64
Profile Number Low Byte	A/R	A/R	
Segment Position High Byte	A/R	A/R	The segment number to edit or insert at
Segment Position Low Byte	A/R	A/R	
Segment Type High Byte	00	00	0 = Ramp Time, 1 = Ramp Rate, 2 = Step, 3 = Dwell, 4 = Hold, 5 = Loop 6 = Join, 7 = End, 8 = Repeat sequence then end
Segment Type Low Byte	A/R	A/R	
Segment Info A (Byte 4 - High)	Floating point number		The meaning of the data contained in Segment Info A depends on the type of segment it relates to. See section 12.5.5.
Segment Info A (Byte 3)			
Segment Info A (Byte 2)			
Segment Info A (Byte 1 - Low)			
Segment Info B (Byte 4 - High)	Floating point number		The meaning of the data contained in Segment Info B depends on the type of segment it relates to. See section 12.5.5.
Segment Info B (Byte 3)			
Segment Info B (Byte 2)			
Segment Info B (Byte 1 - Low)			
Auto Hold Type High Byte	A/R	A/R	0 = Auto-Hold Off, 1 = Hold above SP, 2 = Hold below SP, 3 - Hold above and below SP
Auto Hold Type Low Byte	A/R	A/R	
Auto Hold Value (Byte 4 - High)	Floating point number		
Auto Hold Value (Byte 3)			
Auto Hold Value (Byte 2)			
Auto Hold Value (Byte 1 - Low)			
Events High Byte	00	00	The status of the five events are defined by the lowest 5 bits of the low byte. A bit value of 1 signifies the event is on. Bit 0 = event 1, bit 1 = event 2, bit 3 = event 4 and bit 5 = event 4.
Events Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to this message with an Edit Response Message Section 2.9.5.9.

2.9.5.5. Segment Info A, B Information

The Segment Data is included in the command message when creating, editing or inserting segments (see above). It is provided in two parts (Segment Info A and B). The meaning of the data contained in Segment Info A and B depends on the type of segment it relates to. *Null* is shown for unused data, these data values should be set to zero when writing the segment data.

Segment Type	Segment Info		Description
	A	B	
Ramp Time	Time (seconds)	Target setpoint	Ramp to the target setpoint "B" in the time "A"
Ramp Rate	Ramp rate	Target setpoint	Ramp to the target setpoint "B" at the ramp rate "A"
Step	<i>Null</i>	Target setpoint	Step to a target setpoint "B"
Dwell	Dwell time (seconds)	<i>Null</i>	Stay at the current setpoint for a period of time "A"
Hold	0 = Operator	<i>Null</i>	Wait for the operator to release the hold

Segment Type	Segment Info		Description
	A	B	
	1 = Time of day	Start Time	Wait until time of the day "B" in seconds since midnight.
Loop	Number of times to repeat 1 to 9999	Segment number	Loop to the specified segment number "B" from this point. Repeat this "A" times. Only segments below the current segment can be entered. Two loops must not cross each other.
Join	<i>Null</i>	Profile number	On completion of this profile jump run profile "B"
End	0 = Control off	<i>Null</i>	Turn off all control outputs.
	1 = Maintain profile setpoint	<i>Null</i>	Stay at the final setpoint of the profile
	2 = Control off with events	<i>Null</i>	Turn off the outputs but maintain the events.
Repeat Sequence Then End	0 = Outputs off	Number of times to repeat sequence	Repeat the profile sequence number "B" times, then turn off the control outputs
	1 = Maintain profile setpoint		Repeat the profile sequence number "B" times, then hold the last profile setpoint.
	2 = Control off with events		Turn off the outputs but maintain the events.

2.9.5.6. Deleting Profiles (Command Code DP and DA)

An individual profile can be deleted, or all profiles can be cleared with a single message. Deleting a profile removes the header of the specified profile and any segments associated with it. Delete all profiles wipes all profiles and segments from the instrument.

Delete Profiles - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument.
Function Code	23	17	Requires the multi read/write function
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High	00	00	
Read Quantity Of Registers Low	01	01	
Write Start Address High	32	20	
Write Start Address Low	06	06	
Write Quantity Of Registers High	00	00	
Write Quantity Of Registers Low	02 or 01	02 or 01	Delete A Profile (DP) = 02dec / 0x02hex Delete All Profiles (DA) = 01dec / 0x01hex
Byte Count	04 or 02	04 or 02	Delete A Profile (DP) = 04dec / 0x04hex Delete All Profiles (DA) = 02dec / 0x02hex
Command Code High Byte	68	44	Delete A Profile (DP) = 17488dec / 0x4450hex Delete All Profiles (DA) = 17473dec / 0x4441hex
Command Code Low Byte	80 or 65	50 or 41	
Profile Number High Byte	A/R	A/R	Note: The profile number is not included in the message when deleting all profiles.
Profile Number Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to this message with an Edit Response Message Section 2.9.5.9.

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2.9.5.7. Deleting a Segment (Command Code DS)

The delete segment command deletes the specified segment from the specified profile. The following segments are moved up one place in the profile (e.g. if segment 6 is deleted segment 7 now becomes segment 6).

Delete A Segment - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	Requires the multi read/write function
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High	00	00	
Read Quantity Of Registers Low	01	01	
Write Start Address High	32	20	
Write Start Address Low	06	06	
Write Quantity Of Registers High	00	00	
Write Quantity Of Registers Low	03	03	
Byte Count	06	06	
Command Code High Byte	68	44	
Command Code Low Byte	83	53	
Profile Number High Byte	A/R	A/R	Number of the profile that the segment wants to be deleted from
Profile Number Low Byte	A/R	A/R	
Segment Number High Byte	A/R	A/R	Number of the segment that wants to be deleted
Segment Number Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to this message with an Edit Response Message Section 2.9.5.9.

2.9.5.8. Getting the Number of Segments Remaining (Command Code SR)

Returns the number of unused segments remaining in the instrument. The number will be between 0 and 255, depending on how many have been used in the profiles so far created.

Get Segments Remaining - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument as required
Function Code	23	17	Requires the multi read/write function
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High	00	00	
Read Quantity Of Registers Low	01	01	
Write Start Address High	32	20	
Write Start Address Low	06	06	
Write Quantity Of Registers High	00	00	
Write Quantity Of Registers Low	01	01	
Byte Count	02	02	

Get Segments Remaining - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Command Code High Byte	83	53	
Command Code Low Byte	82	52	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

2.9.5.9. Edit Response Message

The instrument replies to each profile or segment creation, edit or delete message with an Edit Response Message. The same format is used when replying to the Get Segments Remaining request.

Edit Response Message - Response (from instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	The multi read/write function
Byte Count	02	02	
Command Response High Byte	A/R	A/R	Two data bytes containing the Command Response data (see below)
Command Response Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

Command Response Data

The data contained in the Edit Response Message returned after each profile or segment edit message is shown below. The data seen can be an error code, the number of unused segments or the profile number following a successful profile header creation/edit.

The error code shown will be as appropriate for the request message and instrument status.

Command Response Name	Two Byte Response		Description
	Low Byte	High Byte	
Profile Number	A/R	A/R	The number of the profile created or edited
Segments Remaining	A/R	A/R	The number of unused segments remaining
Command Successfully	0x4F	0x4B	The command requested executed without error
Command Not Recognized	0xFF	0xFF	The command is not recognized
Profile Number Invalid	0xF0	0x00	The profile number specified is not available.
Profile Name Invalid	0xF0	0x01	The profile name/characters are not valid
Start Signal Invalid	0xF0	0x02	The start signal is not recognized
Start Time Invalid	0xF0	0x03	The specified time is not within range
Start Day Invalid	0xF0	0x04	The specified day is not recognized
Starting Setpoint Invalid	0xF0	0x05	The specified starting setpoint is not recognized
Profile Recovery Invalid	0xF0	0x06	The profile recovery is not recognized
Recovery Time Invalid	0xF0	0x07	The recovery time is not within limits
Abort Action Invalid	0xF0	0x08	The abort action is not recognized
Profile Cycles Invalid	0xF0	0x09	The number of profile cycles is not within limits
Segment Number Invalid	0xF0	0x0A	The segment number is not valid for this profile
Segment Type Invalid	0xF0	0x0B	The segment type is not recognized
Segment Info A Invalid	0xF0	0x0C	The segment information A not valid for segment type defined
Segment Info B Invalid	0xF0	0x0D	The segment information B is not valid for the segment

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Command Response Name	Two Byte Response		Description
			type defined
Auto Hold Type Invalid	0xF0	0x0E	The auto hold type is not recognized
Auto Hold Value Invalid	0xF0	0x0F	The auto hold value is not within input span
Events Value Invalid	0xF0	0x10	The events are not within range
No Segments Remaining	0xF0	0x11	There are no more segments available
Write Length Invalid	0xF0	0x12	The number of parameters to be written are invalid for the function requested
Segment Setpoint Clamped	0xF0	0x13	The setpoint value entered was out of bounds. It has been clamped within the units setpoint limits.

2.9.5.10. Reading a Profile Header (Command Code RP)

Read A Profile Header - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	Requires the multi read/write function
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High Byte	00	00	
Read Quantity Of Registers Low Byte	18	12	
Write Start Address High Byte	32	20	
Write Start Address Low Byte	06	06	
Write Quantity Of Registers High Byte	00	00	
Write Quantity Of Registers Low Byte	02	02	
Byte Count	04	04	
Command Code High Byte	82	52	
Command Code Low Byte	80	50	
Profile Number High Byte	A/R	A/R	Number of the profile to read
Profile Number Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to the Read A Profile Header request as follows:

Read Profile Header - Response (from instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	The multi read/write function
Byte Count	36	24	
Profile Name Character 1	A/R	A/R	The ASCII codes equivalent to each of the 16 characters of the profile name, e.g. : A = 65dec / 0x41, B = 66dec / 0x42 etc a = 97dec / 0x61, b = 98dec / 0x62 The space character (32dec / 0x20hex) is
Profile Name Character 2	A/R	A/R	
Profile Name Character 3	A/R	A/R	
Profile Name Character 4	A/R	A/R	
Profile Name Character 5	A/R	A/R	
Profile Name Character 6	A/R	A/R	

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Read Profile Header - Response (from instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Profile Name Character 7	A/R	A/R	used to fill any unused characters at the end of the name. Characters 9 to 16 are not used so can be ignored.
Profile Name Character 8	A/R	A/R	
Profile Name Character 9	32	20	
Profile Name Character 10	32	20	
Profile Name Character 11	32	20	
Profile Name Character 12	32	20	
Profile Name Character 13	32	20	
Profile Name Character 14	32	20	
Profile Name Character 15	32	20	
Profile Name Character 16	32	20	
Profile Start Signal High Byte	00	00	0 = No delay, 1 = After delay, 2 = At Time/day
Profile Start Signal Low Byte	A/R	A/R	
Profile Start Time (Byte 4 - High)	Floating point number		
Profile Start Time (Byte 3)			
Profile Start Time (Byte 2)			
Profile Start Time (Byte 1 - Low)			
Profile Start Day High Byte	00	00	1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday, 6 = Saturday, 7 = Sunday, 8 = Monday to Friday, 9 = Monday to Saturday, 10 = Saturday And Sunday, 11= All Week
Profile Start Day Low Byte	A/R	A/R	
Profile Starting Setpoint High	00	00	1 = Current Process Variable Value
Profile Starting Setpoint Low	A/R	A/R	
Profile Recovery High Byte	00	00	0 = Control to off, 1 = Restart profile, 2 = Maintain last profile setpoint, 4 = Continue profile from where it was when power failed
Profile Recovery Low Byte	A/R	A/R	
Profile Recovery Time (Byte 4 - high)	Floating point number		
Profile Recovery Time (Byte 3)			
Profile Recovery Time (Byte 2)			
Profile Recovery Time (Byte 1 - Low)			
Profile Abort action High Byte	00	00	0 = Control to off 1 = Maintain last profile setpoint
Profile Abort Action Low Byte	A/R	A/R	
Profile Cycles High Byte	A/R	A/R	1 to 9999 or 10,000 for "Infinite"
Profile Cycles Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

2.9.5.11. Read a Segment (Command Code RS)

Read A Segment - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	Requires the multi read/write function
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	

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Read A Segment - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Read Quantity Of Registers High Byte	00	00	
Read Quantity Of Registers Low Byte	11	0B	
Write Start Address High Byte	32	20	
Write Start Address Low Byte	06	06	
Write Quantity Of Registers High Byte	00	00	
Write Quantity Of Registers Low Byte	03	03	
Byte Count	06	06	
Command Code High Byte	82	52	
Command Code Low Byte	83	53	
Profile Number High Byte	A/R	A/R	Number of the profile to read
Profile Number Low Byte	A/R	A/R	
Segment Number High Byte	A/R	A/R	Number of the segment to read
Segment Number Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to the Read A Segment request as follows:

Read A Segment - Response (from instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	The multi read/write function
Byte Count	02	18	
Command Response High Byte	82	52	
Command Response Low Byte	83	53	
Profile Number High Byte	A/R	A/R	Echo of the profile number requested
Profile Number Low Byte	A/R	A/R	
Segment Number High Byte	A/R	A/R	Echo of the segment number requested
Segment Number Low Byte	A/R	A/R	
Segment Type High Byte	00	00	0 = Ramp Time, 1 = Ramp Rate, 2 = Step, 3 = Dwell, 4 = Hold, 5 = Loop 6 = Join, 7 = End, 8 = Repeat sequence then end
Segment Type Low Byte	A/R	A/R	
Segment Info A (Byte 4 - High)	Floating point number		The meaning of the data contained in Segment Info A depends on the type of segment it relates to. See below.
Segment Info A (Byte 3)			
Segment Info A (Byte 2)			
Segment Info A (Byte 1 - Low)			
Segment Info B (Byte 4 - High)	Floating point number		The meaning of the data contained in Segment Info B depends on the type of segment it relates to. See below.
Segment Info B (Byte 3)			
Segment Info B (Byte 2)			
Segment Info B (Byte 1 - Low)			
Auto Hold Type High Byte	A/R	A/R	0 = Auto-Hold Off, 1 = Hold above SP, 2 = Hold below SP, 3 - Hold above and below SP
Auto Hold Type Low Byte	A/R	A/R	

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Read A Segment - Response (from instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Auto Hold Value (Byte 4 - High)	Floating point number		
Auto Hold Value (Byte 3)			
Auto Hold Value (Byte 2)			
Auto Hold Value (Byte 1 - Low)			
Events High Byte	00	00	The status of the five events are defined by the lowest 5 bits of the low byte. A bit value of 1 signifies the event is on. Bit 0 = event 1, bit 1 = event 2, bit 3 = event 4 and bit 5 = event 4.
Events Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

Segment Data

The Segment Data is included in the response to a Read Segment request. It is provided in two parts (Segment Info A and B).

The meaning of the data contained in Segment Info A and B depends on the type of segment it relates to. *Null* is shown for unused data, this can be any value.

Segment Type	Segment Info		Description
	A	B	
Ramp Time	Time (in seconds)	Target setpoint	Ramp to the target setpoint "B" in the time "A"
Ramp Rate	Ramp rate	Target setpoint	Ramp to the target setpoint "B" at the ramp rate "A"
Step	Null	Target setpoint	Step to a target setpoint "B"
Dwell	Dwell time (in seconds)	Null	Stay at the current setpoint for a period of time "A"
Hold	0 = Operator	Null	Wait for the operator to release the hold
	1 = Time of day	Start Time	Wait until time of the day "B" in seconds since midnight.
Loop	Number of times to repeat 1 to 9999	Segment number	Loop to the specified segment number "B" from this point. Repeat this "A" times. Only segments below the current segment can be entered. Two loops must not cross each other.
Join	Null	Profile number	On completion of this profile jump run profile "B"
End	0 = Control off	Null	Turn off all control outputs.
	1 = Maintain profile setpoint	Null	Stay at the final setpoint of the profile
	2 = Control off with events	Null	Turn off the outputs but maintain the events.
Repeat Sequence Then End	0 = Outputs off	Number of times to repeat sequence	Repeat the profile sequence number "B" times, then turn off the control outputs
	1 = Maintain profile setpoint		Repeat the profile sequence number "B" times, then hold the last profile setpoint.
	2 = Control off with events		Turn off the outputs but maintain the events.

2.9.5.12. Read a profile Name (Command Code PN)

This command returns the name of the profile defined by the profile number requested.

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Read Profile Name - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	Requires the multi read/write function
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High Byte	00	00	
Read Quantity Of Registers Low Byte	08	08	
Write Start Address High Byte	32	20	
Write Start Address Low Byte	06	06	
Write Quantity Of Registers High Byte	00	00	
Write Quantity Of Registers Low Byte	02	02	
Byte Count	04	04	
Command Code High Byte	80	50	
Command Code Low Byte	78	4E	
Profile Number High Byte	A/R	A/R	Number of the profile to read
Profile Number Low Byte	A/R	A/R	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to the Read Profile Name request as follows:

Read Profile Name - Response (from instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	The multi read/write function
Byte Count	16	10	
Profile Name Character 1	A/R	A/R	The ASCII codes equivalent to each of the 16 characters of the profile name, e.g. : A = 65dec / 0x41, B = 66dec / 0x42 etc a = 97dec / 0x61, b = 98dec / 0x62 The space character (32dec / 0x20hex) is used to fill any unused characters at the end of the name. Characters 9 to 16 are not used so can be ignored.
Profile Name Character 2	A/R	A/R	
Profile Name Character 3	A/R	A/R	
Profile Name Character 4	A/R	A/R	
Profile Name Character 5	A/R	A/R	
Profile Name Character 6	A/R	A/R	
Profile Name Character 7	A/R	A/R	
Profile Name Character 8	A/R	A/R	
Profile Name Character 9	32	20	
Profile Name Character 10	32	20	
Profile Name Character 11	32	20	
Profile Name Character 12	32	20	
Profile Name Character 13	32	20	
Profile Name Character 14	32	20	
Profile Name Character 15	32	20	
Profile Name Character 16	32	20	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

2.9.5.13. Read Profile Memory Status (Command Code PS)

This command returns the status of the profile memory used. The response to this command is to return a table of all the profile numbers that are in use. A value of 0x00 indicates that the profile position is free and value of 0x01 indicates that the position is used by a profile. Using this command in conjunction with the read profile name command will give a directory of profile numbers to profile names.

Read Profile Memory Status - Request (to instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	Requires the multi read/write function
Read Start Address High Byte	32	20	
Read Start Address Low Byte	06	06	
Read Quantity Of Registers High Byte	00	00	
Read Quantity Of Registers Low Byte	32	20	
Write Start Address High Byte	32	20	
Write Start Address Low Byte	06	06	
Write Quantity Of Registers High Byte	00	00	
Write Quantity Of Registers Low Byte	01	01	
Byte Count	02	02	
Command Code High Byte	80	50	
Command Code Low Byte	83	53	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

The instrument replies to the Read Profile Memory Status request as follows:

Read Profile Memory Status - Response (from instrument)			
Field Name	Data		Comments
	(Dec)	(Hex)	
Unit Address	A/R	A/R	The ID address of the instrument
Function Code	23	17	The multi read/write function
Byte Count	64	40	
Profile 1 Position	0 or 1	0 or 1	For each of the 64 possible profile positions, a value of 0 is returned if the position is free, or 1 if the position is empty.
Profile 2 Position	0 or 1	0 or 1	
<i>etc.....</i>			
Profile 63 Position	0 or 1	0 or 1	
Profile 64 Position	0 or 1	0 or 1	
CRC High Byte	A/R	A/R	
CRC Low Byte	A/R	A/R	

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Service parts: 1-800-473-7373
International service/main: 1-952-469-8230
Service fax: 1-952-469-8193
service@despatch.com

GLOBAL OFFICES

Germany: +49 30 629 073 410 / europe@despatch.com
China: +86-21-62365868 / shanghai@despatch.com
Taiwan: +886-3-6588484 / taiwan@despatch.com

USA HEADQUARTERS

Phone: 1-952-469-5424
US toll free: 1-888-337-7282
Fax: 1-952-469-4513
info@despatch.com
service@despatch.com

www.despatch.com

8860 207th Street West
Minneapolis, MN 55044 USA

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