

MAP Modbus Implementation Guide

Rev. 0.90

The M1500 with Modbus supports the following functions:

Function Code	Description	Address range	Note
01	Read Coil Status	0 to 1	Analog Output only
03	Read Holding Registers	0 to $(10x(n) - 1)$ or 40000 to $49999 + 10x(n)$ ^{Note 1}	10 per MAP card
04	Read Input Registers	0 to $(10x(n) - 1)$ or 30000 to $29999 + 24x(n)$ ^{Note 1}	24 per MAP card exc. comm cards
05	Force Single Coil	0 to 1	Analog Output only
06	Preset Single Register	0 to $(10x(n) - 1)$ or 40000 to $49999 + 10x(n)$ ^{Note 1}	10 per MAP card
08	Diagnostics	N/A	Sub functions 1,2
15	Force Multiple Coils	0 to 1	Analog Output only
17	Report Slave ID	N/A	

Note 1: Addressing may be zero based or may use “Modicon convention” offsets, i.e 0 = Coils, 1 = Discrete Inputs, 3 = Input Registers, and 4 = Holding Registers.

Defaults:

Slave ID: 247, 0xF7

Baud rate: 19200

Data bits: 8

Parity: None

Stop bits: 1

Address Map:

Coils		
Address	Description	Read / Write
0	Opto alarm output 1 ^{Note 2}	R/W
1	Opto alarm output 2 ^{Note 2}	R/W

Note 2: Analog output option only.

Input Registers			
Address ^{Note 3}	Description	Data type	Read / Write
0, 30000	Primary process variable value	IEEE-754 float	R
2, 30002	Primary process variable min.	IEEE-754 float	R
4, 30004	Primary process variable max.	IEEE-754 float	R
6, 30006	Primary process variable raw ADC	Buffered 16-bit	R
8, 30008	Secondary process variable value	IEEE-754 float	R
10, 30010	Secondary process variable min.	IEEE-754 float	R
12, 30012	Secondary process variable max.	IEEE-754 float	R
14, 30014	Secondary process variable raw ADC	Buffered 16-bit	R
16, 30016	Internal temperature value	IEEE-754 float	R
18, 30018	Internal temperature min.	IEEE-754 float	R
20, 30020	Internal temperature max.	IEEE-754 float	R
22, 30022	Internal temperature raw ADC	Buffered 16-bit	R

Note 3: Odd addresses are invalid

IEEE-754 floating point input register values are transmitted in big-endian format.

Example:

Poll: <F7><04><00 00><00 02><65 5D>

Response: <F7><04><04><BE A8 C7 49><5B 85>

The data value $0xBEA8C747 = -0.32965$.

Raw ADC values are transmitted as a buffered 16-bit value, i.e. a data value of <00 00 2A A8> => $0x2AA8 = 10920_{10}$.

Holding Registers			
<i>Address</i>	<i>Description</i>	<i>Valid values</i>	<i>Read / Write</i>
0, 40000	Modbus node ID	1 – 247	R/W
1, 40001	<baud> <protocol>	See note 4	R/W
2, 40002	<N/A> <# of daughter cards>	0 – <i>n</i>	R
3, 40003	<gen. status> <board address>	See note 4	R
4, 40004	<class> <type>	See note 4	R
5 – 9	Future use		
10, 40010	<Pri. EU> <Sec. EU>	See note 5	R/W
11, 40011	<N/A> <Int. temp. EU>	See note 5	R/W
12, 40012	Recalibration control	See note 6	W
13, 40013	<status> <board address>	See note 4	R
14, 40014	<class> <type>	See note 4	R
15 – 19	Future use		

Values written as <XX><YY> are the high and low bytes, respectively, of the word data value returned by the register.

Note 4:

Serial baud rate	
<i>Value (hex)</i>	<i>Baud rate</i>
04	9600
05	19,200
06	38,400
07	57,600
08	115,200

Serial Protocol	
<i>Value (hex)</i>	<i>Protocol</i>
00	Meriam
01	Meriam (override)
10	Modbus RTU

Changes to baud rate and protocol do not take effect until a device reset (function code 08, sub code 01) is issued.

Status Codes (General)	
<i>Value (hex)</i>	<i>Status</i>
0x00	good
0x01	instrument busy, message discarded
0x02	message CRC invalid, message discarded
0x03	message incomplete after timeout, message discarded
0x10	command1 not supported or invalid
0x11	command2 not supported or invalid
0x12	command3 not supported or invalid
0x13	command1 not supported in current mode
0x14	command2 not supported in current mode
0x15	command3 not supported in current mode
0xF0	POST (power on self test) failed - general
0xF1	hardware missing/incomplete/failed
0xF2	main program not loaded, bootloader only
0xF3	memory map blank/not loaded
0xF4	memory map type/version unsupported

Status Codes (Individual)	
<i>Value (hex)</i>	<i>Status</i>
0x00	Good
0x01	Engineering unit invalid
0x02	Memory/data location invalid
0x03	Sensor not present or invalid
0x04	Memory/data get/set failed
0x05	Cmd1/2/3 not supported for this channel
0x0F	A general catch-all status
0x10	Cannot find calibration cell, m too low
0x11	Cannot find calibration cell, m too high
0x12	Cannot find calibration cell, n too low
0x13	Cannot find calibration cell, n too high
0x14	Calibration expired
0x20	Measurement soft over range
0x21	Measurement hard over range
0x22	Temperature soft over range
0x23	Temperature hard over range
0x30	Simulation value too low
0x31	Simulation value too high
0x40	Field recal not allowed

0x41	Too far from zero to zero
0x42	Recal point outside valid range
0x43	Recal point error beyond limit
0x44	General recal script error
0x45	General recal point library error
0x46	Recal command out of sequence

MAP Module Identification		
<i>Class</i>	<i>Type</i>	<i>Description</i>
00		Measurement / Simulation
	00	Embedded Pressure Instrument
	01	Embedded Voltage Instrument
	02	Embedded Current Output
01		Communications Bridge
	00	RS232 / RS485
	01	USB
02		Repository / Datalogging
	00	Repository
03		Control / User Interface
	00	M4 Control
	01	M4 Graphics
04		Power Supply
	00	M4 Main
	01	VMA

Note 5:

Engineering Units	
<i>Code (dec.)</i>	<i>Units</i>
<i>Pressure</i>	
0	PSI
1	inW20C
2	inW4C
3	inW60
4	ftW20C
5	ftW4C
6	ftW60F
7	mmW20C
8	mmW4C
9	mmW60F
10	cmW20C
11	cmW4C
12	cmW60F

13	mW20C
14	mW4C
15	mW60F
16	inHg0C
17	mHg0C
18	cmHg0C
19	mmHg0C
20	torr
21	kg/cm2
22	kg/m2
23	Pa
24	hPa
25	kPa
26	MPa
27	Bar
28	mBar
29	ATM
30	oz/in2
31	lb/ft2
32	User 1
33	User 2
Temperature	
0	°F
1	°C
2	K
3	°R
Voltage / Current	
0	mA
1	Volts

Note 6:

Field recalibration of the M1500 via Modbus is accomplished by writing to holding register 12. The value written is a bit-masked word. The procedure is given below, with example commands. Values shown as 0xNNNN or in angle brackets < > are hexadecimal.

Control word map:

MSb

-	-	CH 2 SEL	CH 1 SEL	-	-	-	-
-	-	-	-	-	DEFAULTS	SPAN	ZERO

LSb

On 2-sensor models, only 1 sensor may be calibrated at a time.

- 1) Isolate the M1500 from the process in accordance with { ? } and attach the calibration pressure source.
- 2) Establish ZERO pressure value on process port.
- 3) Write value 0x1001 (Sensor 1) or 0x2001 (Sensor 2, if equipped) to holding register 12. Example command for Sensor 1:

Poll: <F7><06><00 0C><10 01><91 5F>
 Response: <F7><06><00 0C><10 01><91 5F> (echo)

- 4) Establish SPAN pressure value on process port.
- 5) Write value 0x1002 (Sensor 1) or 0x2002 (Sensor 2, if equipped) to holding register 12. Example command for Sensor 1:

Poll: <F7><06><00 0C><10 02><D1 5E>
 Response: <F7><06><00 0C><10 02><D1 5E> (echo)

- 6) Calibration is complete. Remove the calibration pressure source and return the M1500 to service in accordance with { ? }
- 7) Factory calibration values may be restored by writing value 0x1004 (Sensor 1) or 0x2004 (Sensor 2, if equipped) to holding register 12. Example command for Sensor 1:

Poll: <F7><06><00 0C><10 04><51 5C>
 Response: <F7><06><00 0C><10 04><51 5C> (echo)

Diagnostic functions

The Diagnostic command (0x08) supports sub-functions 1 (Restart Communications) and 2 (Return Diagnostic Register). Examples are shown below.

Restart Communication

This function performs a power-on reset of the M1500. Communication logging is not supported in the M1500, so Data Field values <00 00> and <FF 00> yield identical results.

Poll: <F7><08><00 01><FF 00><E4 AD>
 Response: <F7><08><00 01><FF 00><E4 AD> (echo)

The response is echoed before reset.

Return Diagnostic Register

The diagnostic register is a 16-bit word composed of 2 8-bit status bytes from the M1500s internal communication. The high byte is the General Status and the low byte is the Individual Status. See Note 4 above for status codes.

Poll: <F7><08><00 02><00 00><55 5D>
Response: <F7><08><00 02><00 00><55 5D>

(Note that the response is NOT an echo, <00 00> is the actual diagnostic register value.

Enumerate Daughter Cards

This is not part of the Modbus Diagnostic command, but may provide useful information for setup and debugging. The M1500 internal architecture consists of one communications interface (“comm. card”) and one or more Embedded Instruments. On power-up, the comm. card polls the internal bus to find all attached Embedded Instruments. The resultant count from this operation is available in Holding Register 2. On the M1500, the value returned will normally be 0x0001.

Poll: <F7><03><00 02><00 01><31 5C>
Response: <F7><03><02><00 01><B1 91>

Since there is 1 daughter card in the M1500, the valid range of input register addresses is 0 through 22 (24 registers per EI card). The valid range of holding registers is 0 through 19. Note that many of these registers are reserved for future use and will return 00 values.