

# MantaPlus Integrated SDI-12 and MODBUS Output Operating Manual

28 May 2020

## 1) Introduction

In March of 2020, Eureka introduced integrated SDI-12 and RS-422 MODBUS data outputs for the Manta water-quality multiprobe product line (which includes the Trimeter). This optional feature replaces the external converter units previously required for those output formats.

The new feature is called “Multi-Protocol Interface Board”, or MIB. One adapter cable provides MODBUS output, and a different adapter cable provides SDI-12 output.

The MIB is normally built into the Manta at the time of the Manta’s manufacture; it cannot be seen from outside the instrument, and does not alter the Manta’s size or appearance. The photo below shows a Manta, Underwater Cable, and at the top of the photo, the short SDI-12 Adapter Cable. The SDI-12 master is attached to the three bare wires on one end of the Adapter Cable. The MODBUS Adapter Cable works the same way.



If you wish to retrofit a Manta with the MIB option, please contact Eureka. If you wish to build your own MODBUS or SDI-12 converter cable, or convert your Underwater Cable into a converter cable, use the wiring diagrams in Appendices One and Two.

Note that Manta Data Cables (the short cables used for tasks such as calibration) will communicate with a PC or laptop, but do not support MODBUS or SDI-12 operation.

A MIB-equipped Manta can communicate with a PC and other RS-232 devices as usual (this is the “transparent” mode). Most MIB-equipped Mantas can be operated with USB power as usual. However, some of the larger Mantas and/or longer cables may require the USB Converter’s 12V adapter to communicate with that Manta. The photo at right shows a “wall wart” that provides 12 volts to the USB Adapter that connects an Underwater Cable or Data Cable to the USB port on a PC or laptop. You can use a 12-volt battery as well.



Note also that early Manta Data Cables will work only in transparent mode; the Modbus and SDI-12 features work only with an Underwater Cable.

## 2) MODBUS Operation

### a) How It Works

For MODBUS communication, simply connect the MODBUS Adapter Cable to the nine-pin connector on the Underwater Cable attached to your MIB-equipped Manta. The Adapter Cable gives you the wires you need to connect the Manta to a MODBUS device, and is wired to inform the Manta that you wish to communicate in the MODBUS format instead of the usual RS-232.

Note that the MODBUS interface can use either half-duplex differential RS-485 or full-duplex RS-232 (separate transmit and receive).

### b) The MODBUS Technical Details

A MIB-equipped Manta uses MODBUS protocol over RS-485 or RS-232 to read the parameters processed by the Manta.

The upstream communication functions either as a full-duplex RS-232 standard interface, or as a half-duplex, RS-485 standard interface. Data format is 8-bits with no parity, one stop bit. Baud rate is 19,200.

The MODBUS interface provides measurement values, beginning at holding register 40001 (see Table 1), for all enabled Manta parameters, with each measurement value occupying 2 MODBUS registers. Values are formatted in IEEE-754 32-bit floating point representation.

<b>Table 1: Mapping MODBUS Parameter Measurement Values</b>			
<b>MODBUS Holding Register</b>	<b>Bus Address</b>	<b>Read Value</b>	<b>Format</b>
<b>40001</b>	<b>0</b>	<b>Parameter 1 MSW</b>	<b>IEEE32</b>
<b>40002</b>	<b>1</b>	<b>Parameter 1 LSW</b>	
<b>40003</b>	<b>2</b>	<b>Parameter 2 MSW</b>	<b>IEEE32</b>
<b>40004</b>	<b>3</b>	<b>Parameter 2 LSW</b>	
<b>..</b>	<b>..</b>		
<b>40035</b>	<b>34</b>	<b>Parameter 18 MSW</b>	<b>IEEE32</b>
<b>40036</b>	<b>35</b>	<b>Parameter 18 LSW</b>	

In RS-485 operation, two communication lines to the MIB are used for the differential lines Data+ and Data- (see Appendix 1). In RS-232 operation, the Data+ line is connected to the Manta Rx line and the Data- line is connected to Manta TX line. A negative voltage on the Manta Rx signals the MIB that the Tx line from an RS-232 host is connected, so that the MIB operates in MODBUS/RS-232 format; otherwise, RS-485 format is assumed. The data format is 8-bits with no parity and one stop bit. The MIB normally operates at 19,200 baud. If you wish to change that rate, please see Table 2.

The MIB provides store/update read-only registers and read/write settings for communicating with common SCADA systems, PLC interfaces, or other data collection platforms. A built-in MODBUS map provides aggregated sensor readings and other equipment information.

The MODBUS interface provides measurement values, beginning at holding register 40001 (see Table 3), for all enabled Manta parameters, with each measurement value occupying two MODBUS registers. Values are formatted in IEEE-754 32-bit floating-point representation.

The MIB's address is register-programmable (the default value is 1). The MIB will always respond to MODBUS address 0 if you don't know the real address.

<b>Table 2: MODBUS Baud Rate Indices</b>	
<b>Index</b>	<b>BaudRate</b>
0	9600
1	19200 (default)
2	38400
3	57600
4	115200

<b>Table 3: MODBUS Control Register Mapping</b>			
<b>MODBUS Holding Register</b>	<b>Bus Address</b>	<b>Read/Write Value</b>	<b>Format</b>
40201	200	Baud Rate - Upstream	Fixed at 19,200 baud
40202	201	MODBUS Device Address	Integer 1-250. Default=1
40203	202	Baud Rate - Downstream	Integer index, 0-4
40204	203	SDI-12 address	Integer 0-9, A-Z, a-z
40205	204	Power switch delay	Integer 0-60
40206	205	Manta+ Wipe interval	Integer 0-1440 (minutes)
40207	206	Manta+ Wipe Freeze Time	Integer 0-60 (seconds)

### c) MIB Commands for MODBUS

A MIB-equipped Manta can be connected to a host PC or laptop to send commands directly to the Manta CPU, as well as special commands (see Table 4) to the MIB itself. This mode of communication - using the Manta's normal RS-232 output and not MODBUS - is called the "transparent mode".

When a terminal emulator, such as TeraTerm or Hyperterminal, is used to talk to the Manta in this transparent mode, the MIB recognizes and responds to certain ASCII commands to allow the programming/verifying of some parameters, as shown below. The format of these MIB command is "\$ccxxx<cr>", where:

'\$' indicates a MIB command

cc is a two-character MIB command identifier

xxx is a parameter values specific to the command

Table 4: Special MIB Commands			
Command	Description	Parameters	Response
\$AMxxx<cr>	Set MODBUS Address	xxx ; 001 to 250	OK<cr>
\$AM?<cr>	Read MODBUS Address	none; default = 1	xxx<cr> ; 001 to 250
\$WPxxxx<cr>	Write Manta+ wiper interval	xxxx ; 0000 to 1440 minutes, default = 0	OK<cr>
\$WP?<cr>	Read Manta+ wiper interval	none	xxxx<cr> ; 0000 to 1440 minutes
\$WFxx<cr>	Write wipe data freeze time	xx ; 0 to 60 seconds, default = 15	OK<cr>
\$WF?<cr>	Read Manta+ wipe data freeze time	None	xx<cr> ; 0 to 60 seconds
\$FV?<cr>	Read IB firmware revision	None	IB Firmware revision

#### d) MODBUS Automatic Wiper Operation

Some Manta models include a sensor-cleaning wiper built into the turbidity sensor. The wiper clears debris, foulants, and bubbles from the sensors' active faces when the Manta is first powered-up, and when a WIPE command is sent to the Manta. If your Manta is continuously powered during MODBUS operation, you may wish to periodically initiate wipe cycles using MIB commands (see Table 4). The Wipe Interval is the number of minutes between wipe cycles. Note that setting the Wipe Interval to 0 disables automatic wiping.

Some parameter values are invalid during normal wiper cycles because of the movement of the wiper. When the cycle ends, the data resume their real-time format. But if your MODBUS controller may create an alarm on account of the invalid data during the wipe cycle, you can use MIB WIPE commands (see Table 4) to "freeze" all sensor data while the wiper is cycling. That means that all data coming from the Manta during the wiper cycle is the same data sent in the last data transmission before the wipe cycle started, i.e. the readings stay the same during the wiper cycle. This programmable freeze time sets the number of seconds (default is 15 seconds) that the data are frozen after the Manta is given a WIPE command. The data resume their real-time format after that number of seconds has passed.

### 3) Using the MIB for SDI-12 Communication

#### a) How It Works

For SDI-12 communication, simply connect the SDI-12 Adapter Cable to the nine-pin connector on the Data Cable or Underwater Cable attached to your MIB-equipped Manta. The Adapter Cable gives you the wires you need to connect the Manta to an SDI-12 device, and is wired to inform the Manta that you wish to communicate in the SDI-12 format instead of the usual RS-232 format (i.e. transparent mode).

Appendix One shows the wire assignments by color.

#### b) The SDI-12 Technical Details

The host computer-to-Manta+ communication adheres to requirements of the SDI-12 Support Group, Version 1.3. Table 5 summarizes the implemented SDI-12 commands. If you are not familiar with the SDI-12 Protocol, the SDI-12 Support Group website ([www.sdi-12.org](http://www.sdi-12.org)) provides more detail.

<b>Table 5: MIB SDI-12 Commands</b> (a = SDI-12 address)		
a!	Empty command	
aA!	Change address	
aC!	Request a concurrent measurement	returns up to 20 values
aM!	Request a measurement	returns up to 9 values
aM1!	Request an additional measurement	returns up to 9 additional values
aM2!	Request an additional measurement	returns up to 2 additional values
aCC!	Request a concurrent measurement with CRC	
aMC!	Request a measurement with CRC	
aDn!	Read measurement results data	n = 0..2
aI!	Request device identification string	

**c) Special MIB Commands for SDI-12**

A MIB-equipped Manta can be connected to a host PC or laptop to send commands directly to the Manta CPU, as well as special commands to the MIB itself. Using the Manta’s normal RS-232 output and not SDI-12 output is called the “transparent mode”.

When a terminal emulator, such as TeraTerm or Hyperterminal, is used to talk to the Manta in this transparent mode, the MIB recognizes and responds to certain ASCII commands (see Table 6) to allow the programming/verifying some parameters, as shown below. The format of these MIB command is “\$ccxxx<cr>”, where:

‘\$’ indicates an MIB command

cc is a two-character MIB command identifier

xxx is a parameter values specific to the command

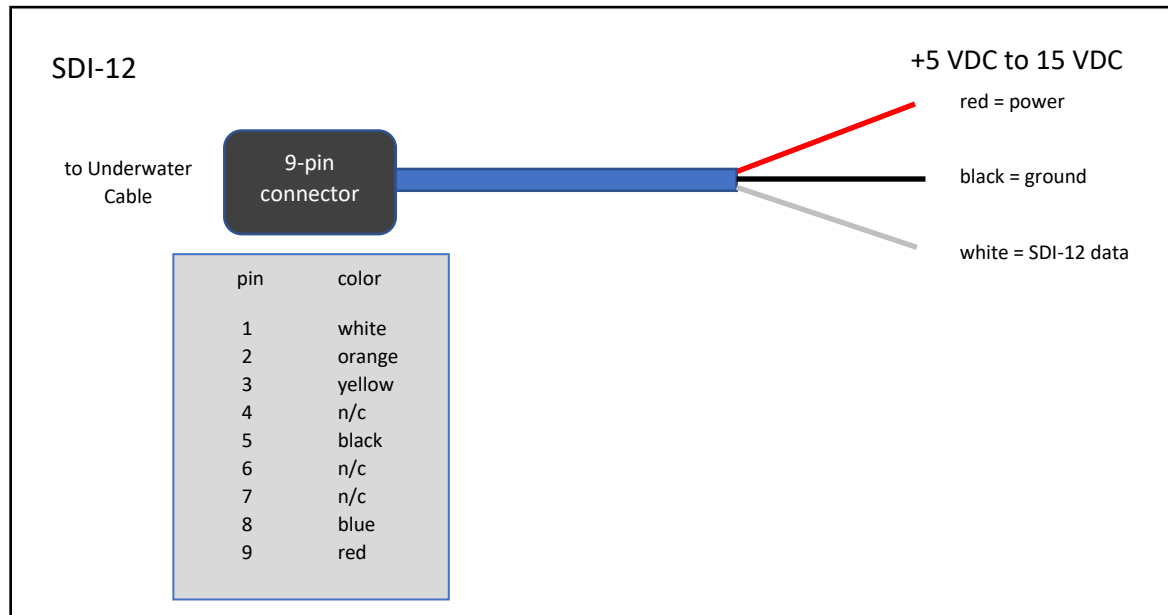
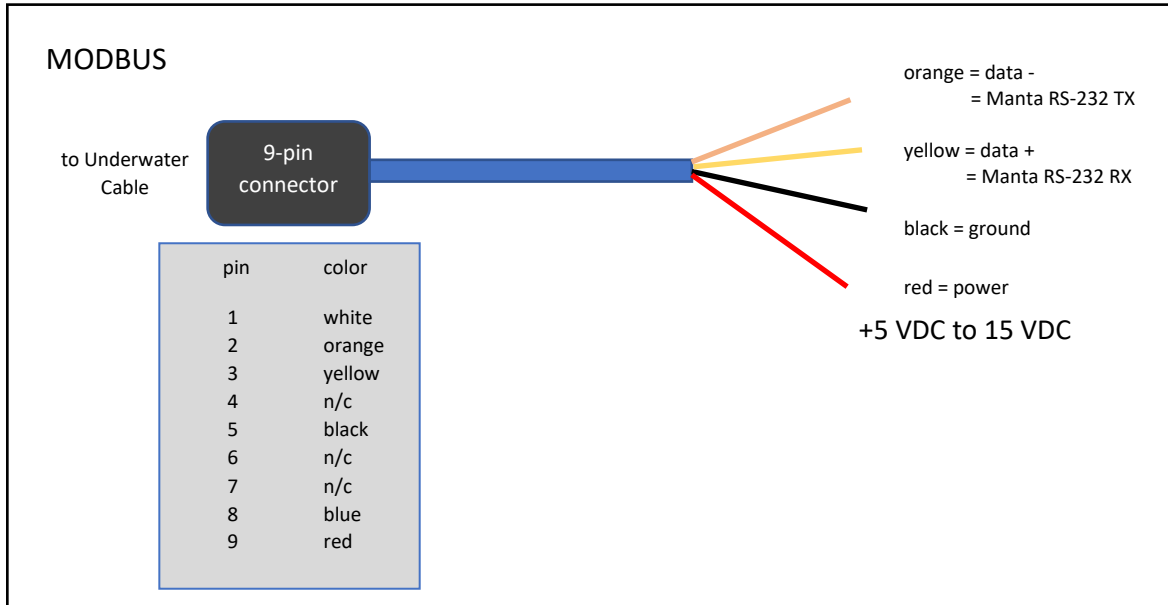
<b>Table 6: MIB Transparent-Mode Commands</b>			
Command	Description	Parameter(s)	Response
\$ASx<cr>	Set SDI-12 Address	x= 0-9,A-Z,a-z; default = 0	OK <cr>
\$AS?<cr>	Read SDI-12 Address	None	x<cr> ; x= 0 to 9, A to Z, and a to z
\$PDxx<cr>	Set power-off delay (extend Manta+ power ON-time from the last measure command)	xxx = 0 to 60 seconds; default is 30 seconds	OK<cr>
\$PD?<cr>	Read power-off delay	None	xxx<cr> ; x = 0 to 60 seconds
\$FV?<cr>	Read IB firmware revision	None	IB Firmware revision

Table 7 shows example SDI-12 commands and responses for a Manta for which 10 parameters have been selected for SDI-12 monitoring.

Table 7: Sample SDI-12 Commands and Responses for a Manta with 10 Parameters Selected	
Command	Response
0!	0<CR><LF>
0!	013EUREKA MANTA 711SN10162469<CR><LF>
0V!	00000<CR><LF>
0M!	00169<CR><LF>
0D0!	0+0+408.6999+4938.999+489.3999<CR><LF>
0D1!	0+4494.399+132.6000+3651.699+131.2000<CR><LF>
0D2!	0+2269.900<CR><LF>
0M1!	00031<CR><LF>
0D0!	0+11.70000<CR><LF>
0C!	000310<CR><LF>
0D0!	0+0+1.800000+2.100000+489.6999<CR><LF>
0D1!	0+4523.299+133.1000+3591.099+132.2000<CR><LF>
0D2!	0+2243.600+11.72000<CR><LF>
0MC!	00039<CR><LF>
0D0!	0+0+1.900000+2.100000+488.9999AD<CR><LF>
0D1!	0+4538.699+133.0000+3557.699+132.4000@Zy<CR><LF>
0D2!	0+2224.000NWS<CR><LF>
0MC1!	00031<CR><LF>
0D0!	0+11.68000BS_<CR><LF>
0CC!	000310<CR><LF>
0D0!	0+0+1.900000+2.000000+489.0999EHG<CR><LF>
0D1!	0+4546.699+133.1000+3540.199+132.6000O]X<CR><LF>
0D2!	0+2214.500+11.70000CSh<CR><LF>
<CR> denotes an ASCII carriage return; <LF> denotes an ASCII line feed	
In the return string of the "0!" command, "13" is the SDI-12 Version Number (1.3), "711" is the Manta CPU Firmware version (7.11), and the string following "SN", "10162469" is the Manta Serial Number.	



## Appendix One - MODBUS and SDI-12 Adapter Cable Wiring Assignments



## Appendix Two - Making Your Own MODBUS and SDI-12 Adapter Cables

