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Model 903

FMB-X-2.5 Diagnostics

Manual

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Document Revision History

Restrictions on Disclosure

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Document Revision	Details of Revision	Author	Date
Rev 1	Preliminary release for review.	AC	April 26, 2011
Rev 2	Added the Error Log section and updated the Mod Bus table	AC	Aug 8, 2011
Rev 3	- Updated Command Base Mode descriptions in Table 3. - Added section 3.2.1 on calibrating the optical diagnostics. - Error codes table labeled Table 4 - Added more information on Web Interface.	AC	Dec 20, 2011
Rev 3.1	- Updated section 3.2.1.2 on how to calibrate the optical RX readings.	AC	April 12, 2013

Reference Documents

Document Number	Document Title and Description
903-0611-00B	903-0611-00B Mux Software Manual
903-0406-00D	Model 903 Diagnostic Graphical User Interface (GUI) Software (1st Generation)
SFF-8472	SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transcievers Rev 10.2
903-0623-00	Standard 903 Manual (FMB-X-2.5 Version)

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Model 903 Second Generation Diagnostics

1.0 Introduction:

The Model 903 1st generation diagnostics provides a continuous output stream from the console serial port. This fixed diagnostics output contains diagnostics on both the remote and console units and an external PC software displays the data in a readable format.

The 2nd generation diagnostics expands on this 1st generation diagnostics by adding more information and the ability to access the diagnostics through an Ethernet port. The serial port by default will still provide 1st generation compatible diagnostics through the RS232 serial port, but when requested, will also provide additional diagnostics and configuration control through a command based protocol. The Ethernet port will also provide diagnostics through a ModBus TCP/IP protocol and web server interface, but have no configuration capability. Only the serial port will have the ability to configure the FMB-X-2.5.

The following document outlines how to access the diagnostics of the serial and the Ethernet interfaces of the FMB-X-2.5.

2.0 FMB-X Front Panel Interface

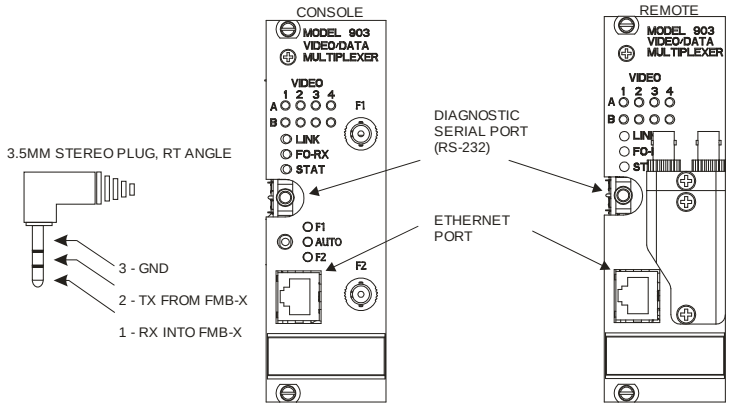

Figure 1: Front Panel Diagnostic Interface

The diagnostic serial port, shown in Figure 1, is a RS232 interface and is accessed using a 3.5mm stereo plug with the following UART settings:

9600Baud, 8 Data bits, 1 Stop bit, No Parity

The Ethernet port supports both 10Base-T and 100Base-Tx speeds, full and half duplex, auto crossover, and is default to auto negotiation. Use cables that meet CAT5E EIA/TIA-568A/B specifications.

3.0 Serial Interface

The serial port is a bi-directional RS232 interface that has two primary modes of operation as follows:

- Backwards compatibility mode (default on power up)

- Command base mode

3.1 Backwards compatibility mode

In this mode the console serial port will output diagnostics that has the same format as the 1st generation FMB/FMB-X (ref: 903-0611-00B Mux Software Manual). The console outputs a block of diagnostics data every 0.5 seconds and repeats indefinitely. The remote unit does not output any data in this mode. The diagnostics data contains optical, analog, and video information on both the remote and console FMB-X and can be viewed on a PC using Focal's 903-0406-00D UI software. The output string is comma delimited and at the end of the string there is a carriage return symbol followed by a linefeed symbol. Each diagnostic value is a 16 bit word and the order is as follows:

Table 1: Compatibility Mode Output Data

Word	Description
1	Transmitting optical power of console 1550 nm transmitter
2	Laser Current of console 1550 nm transmitter
3	+5V console supply voltage level
4	+12V console supply voltage level
5	-12V console supply voltage level
6	Console temperature
7	Console 1310 nm receiver alarm (1 - alarm inactive, 0 - alarm active)
8	Console 1550 nm transmitter locked (1 - TX locked, 0 - TX not locked)
9	Console Link Ready (1 - Link is OK at console end, 0 - Link is not established at console end)
10	Console Receiver Error (1 - at least one RX error occurred during sampling interval, 0 - no errors recorded during sampling interval)
11	Console video sync-info 2-byte word, CVS: CVS.0 - VIB-RX Slot 1, Channel 4 Sync (1 - Sync, 0 - Loss of Sync) CVS.1 - VIB-RX Slot 1, Channel 3 Sync (1 - Sync, 0 - Loss of Sync) CVS.2 - VIB-RX Slot 1, Channel 2 Sync (1 - Sync, 0 - Loss of Sync) CVS.3 - VIB-RX Slot 1, Channel 1 Sync (1 - Sync, 0 - Loss of Sync) CVS.4 - VIB-RX Slot 2, Channel 4 Sync (1 - Sync, 0 - Loss of Sync) CVS.5 - VIB-RX Slot 2, Channel 3 Sync (1 - Sync, 0 - Loss of Sync) CVS.6 - VIB-RX Slot 2, Channel 2 Sync (1 - Sync, 0 - Loss of Sync) CVS.7 - VIB-RX Slot 2, Channel 1 Sync (1 - Sync, 0 - Loss of Sync) CVS.8 - Fiber Status bit 0 CVS.9 - Fiber Status bit 1 If Fiber Status = '00' Model 903 fiber is switched in 'Manual Mode'. If Fiber Status = '01' Model 903 fiber is switched in 'Autosense Mode' and is presently on channel 1. If Fiber Status = '10' Model 903 fiber is switched in 'Autosense Mode' and is presently on channel 2. CVS 10-15 - Not Used
12	Remote 1550 nm receiver output power
13	Remote 1310 nm transmitter output power
14	+5V remote supply voltage level
15	-5V remote supply voltage level
16	+12V remote supply voltage level
17	-12V remote supply voltage level
18	Remote temperature

19	Remote 1310 nm transmitter alarm (1 - alarm inactive, 0 - alarm active)
20	Remote 1310 nm transmitter locked (1 - TX locked, 0 - TX not locked)
21	Remote Link Ready (1 - Link is OK at remote end, 0 - Link is not established at remote end)
22	Remote Receiver Error (1 - at least one RX error occurred during sampling interval, 0 - no errors recorded during sampling interval)
23	Remote video sync-info byte, RVS : RVS.0 - VIB-TX Slot 1, Channel 4 Sync (1 - Sync, 0 - Loss of Sync) RVS.1 - VIB-TX Slot 1, Channel 3 Sync (1 - Sync, 0 - Loss of Sync) RVS.2 - VIB-TX Slot 1, Channel 2 Sync (1 - Sync, 0 - Loss of Sync) RVS.3 - VIB-TX Slot 1, Channel 1 Sync (1 - Sync, 0 - Loss of Sync) RVS.4 - VIB-TX Slot 2, Channel 4 Sync (1 - Sync, 0 - Loss of Sync) RVS.5 - VIB-TX Slot 2, Channel 3 Sync (1 - Sync, 0 - Loss of Sync) RVS.6 - VIB-TX Slot 2, Channel 2 Sync (1 - Sync, 0 - Loss of Sync) RVS.7 - VIB-TX Slot 2, Channel 1 Sync (1 - Sync, 0 - Loss of Sync)
24	Receiving optical power of console 1310 nm receiver. (Note: If the remote unit is not responding, this value is output immediately following the CVS word 11.)

Note: To best understand this serial data stream read the '903-0611-00B Mux Software Manual'. Also the output optical data is uncalibrated and must be calibrated via the external GUI software, the same as was required in the 1st generation diagnostics.

For compatibility mode the following ASCII inputs shown in Table 2 are accepted on the serial input:

Table 2: Acceptable Compatibility Mode Input Commands

ASCII Character	Description
's' (0x73)	Cause the fiber switch to toggle between fiber1 and fiber2 position.
'm' (0x6D)	Toggle the on-board buzzer.
'c' (0x63)	Terminate the compatibility mode and enter the console command mode.
'r' (0x72)	Terminate the compatibility mode and enter the remote command mode.

3.2 Command Base Mode

The Command Base Mode adds enhanced features to the diagnostics by allowing the ability to configure variables within either the remote or console FMB-X. The command base mode uses the same stereo jack interface as compatibility mode. After power up the Command Base Mode is activated by sending the ASCII character 'c' or 'r' into the serial port, at which point the serial port will output a prompt. Both the 'c' and 'r' options can be issued at either the remote or the console serial ports. Note the commands are case sensitive. Table 3 below shows a list of the commands with syntax and a description. Each command is uppercase ASCII followed by a carriage return and line feed characters (0x0D/0x0A). The first response to a command from the FMB-X will be an ASCII 'ack' (0x06) if the command processing was successful, or an ASCII 'nak' (0x15) if the command processing was unsuccessful. The FMB-X does not echo received ASCII characters, the terminal software used will need to enable 'local echo'. Below is a list of available commands with syntax, the ASCII code of command and a description of each command.

Table 3: Acceptable Command Base Mode Input Commands

Command	ASCII CODE	Description
A X	65	A X: Configure the front panel Ethernet port. X = 0: Auto Negotiate (default). X = 1: Force 10Base-T. X = 2: Force 100Base-Tx.
B X	66	B X: Buzzer control (The buzzer is reset to enable on each power up). X = 0: Buzzer is disabled. X = 1: Buzzer is enabled.
C X	67	C X: Clear X information. X = 0: Clear SFP Tx Calibration. X = 1: Clear SFP Rx Calibration. X = 2: Clear Error log.
E	69	E: Read and display Error log. See 'Table 4' for more detail
F X	70	F X: Set active fiber port. X = 0: Set F1 active. X = 1: Set F2 active. X = 2: Outputs current selected fiber.
H	72	H: Displays a list of all the available commands.
I XXX.XXX.XXX.XXX	73	I XXX.XXX.XXX.XXX: Change the IP Address to XXX.XXX.XXX.XXX (eg. 192.168.0.100)
L {STRING}	76	L {STRING}: Customer descriptive name. STRING = A string of no larger than 64 printable ASCII characters.
N XXX.XXX.XXX.XXX	78	N XXX.XXX.XXX.XXX: Change the FMB SUBNET MASK to XXX.XXX.XXX.XXX(eg. 255.255.255.0)
O X	79	O X: Read and display SFP data. X = 0 will output both calibrated and uncalibrated optical data in user units. X = 1 will output SFP alarms and warnings. X = 2 will output all 256 bytes of SFP bank 0 memory. X = 3 will output all 256 bytes of SFP bank 1 memory.
Q	81	Q: Exit Command Base Mode and resume compatibility mode.
R XXXXX YYY	82	R XXXXX YYY: Read ModBus registers. XXXXX = (d'40001 - d'49999): Register location to start reading. YYY = (1 - 256): Number of 16 bit registers to read.
S X	83	S X: Display status of Model 903 X = 0: Read and display status of FMB-X A/D readings, board ID information, MAC address, and stored EEPROM data. X = 1: Backplane data.
T SX.XX	84	T SX.XX: Calibrate the optical transmitter power. 'S' = (+/-): Sign. X.XX is the measured transmitter power at the front panel in dBm (eg. -1.23dBm).
U A SXX.XX	85	Calibrate the optical receiver power. 'A' = 1,2: Indicates which of the two calibration points are being entered. 'S' = (+/-): Sign. XX.XX is the measured receiver power at the front panel in dBm (eg. -15.23dBm).
V X	86	V X: Data and video diagnostics. X = 0: Get SERDES link state. X = 1: Get active state of video channels. X = 2: Get I/O levels for each data channel of the 4 DIB slots. X = 3: Get data channel activity status.

Y A B C D	89	Y A B C D: Video test pattern control. A = (1 or 2): Selects the video slot 1 or 2. B = (h'00 - h'ff): VIB-X-8 remote cards only (If unused, set to 0). Bit 3: Control VIB-X-8 ch4 (0 = Select Ch4A, 1 = Ch4B) Bit 2: Control VIB-X-8 ch3 (0 = Select Ch3A, 1 = Ch3B) Bit 1: Control VIB-X-8 ch2 (0 = Select Ch2A, 1 = Ch2B) Bit 0: Control VIB-X-8 ch1 (0 = Select Ch1A, 1 = Ch1B) C = (h'00 - h'ff): Video Generator Routing. Bit 7: signal to FP CH4| Bit 3: signal to BP CH4 Bit 6: signal to FP CH3| Bit 2: signal to BP CH3 Bit 5: signal to FP CH2| Bit 1: signal to BP CH2 Bit 4: signal to FP CH1| Bit 0: signal to BP CH1 D = (h'00 - h'ff): Video Generator Enable. Bit7 – Bit4: '1010' Enable video generator Bit3 – Bit0: Video pattern selector (1 only valid pattern)

3.2.1 Calibrating Optical TX and RX Readings

The raw optical TX and RX data as measure from SFP in the FMB has an accuracy of +/- 3dB. There are two commands to calibrate these optical TX and RX raw measurements and provide a more accurate reading. These commands are 'T SX.XX' and the 'U A SXX.XX' as shown in Table 3 above. The procedure to calibrate both the TX and RX readings is as follows:

3.2.1.1 Calibrating TX Readings

This procedure applies to both the remote and the console units. Connect the PC serial port into the FMB-X stereo port and established serial port communications with a terminal program. Enter Command Mode with either the 'r' or 'c' command (case sensitive). Use 'r' if calibrating the remote unit and 'c' if calibrating the console unit. If 'r' is pressed then a 'Remote>' prompt will appear and if 'c' is pressed then a 'Console>' prompt will appear.

- With an optical power meter measure the optical power in dBm units that is transmitted from the FMB-X unit (typically -3.5dBm at the remote FMB-X output).
- At the command prompt enter 'T'<space>, followed by the measured optical power in the format 'SX.XX'. Where 'S' is the sign + or - and 'X.XX' is the power reading in dBm. Always enter a sign even if the reading is not negative. Follow the entry with the return key. The FMB-X will now determine the offset between what it read from the SFP and what was measured to display user values.
- If needed, repeat the calibration procedure to the other FMB-X unit. Press 'r' key on the keyboard to switch from communicating with the console FMB-X to communicating with the remote FMB-X or press 'c' key on the keyboard to switch from communicating with the remote FMB-X to communicating with the console FMB-X.
- Press 'Q' to exit Command Mode.

3.2.1.2 Calibrating RX Readings

This procedure applies to both the remote and the console units. The remote and console units must be linked through a VOAT (Variable Optical Attenuator) or at least through multiple attenuators, or linked through the actual optical system used in the field. Connect the PC serial port into the FMB-X stereo port and establish serial port communications with a terminal program. Enter Command Mode with either the 'r' or 'c' command. Use 'r' if calibrating the remote unit and 'c' if calibrating the console unit. If 'r' is pressed then a 'Remote>' prompt will appear and if 'c' is pressed then a 'Console>' prompt will appear.

- Disconnect the optical connector from the front panel of the FMB-X being calibrated and plug into an optical power meter. Adjust the optical loss so that the receive power measures approximately -15dBm. Plug the optical connector back into the FMB-X front panel.
- At the command prompt enter 'U'<space>'1'<space>, followed by the measured optical receive power in the format 'SXX.XX'. Where 'S' is the sign '+' or '-' and 'XX.XX' is the power reading in dBm that

was just measured. Always enter a sign even if the reading is not negative. Follow the entry with the return key.

- Again remove the optical front panel connector of the FMB-X being calibrated and plug into an optical power meter. Adjust the optical loss so that the receive power measures approximately -25dBm. Plug the optical connector back into the FMB-X.
- At the command prompt enter 'U<space>2<space>', followed by the measured optical receive power in the format 'SXX.XX'. Where 'S' is the sign '+' or '-' and 'XX.XX' is the power reading in dBm that was just measured. Always enter a sign even if the reading is not negative. Follow the entry with the return key.
- The FMB-X will now determine a slope and offset value and store in non-volatile memory for use in calculating the calibrated receive powers.
- If needed, repeat the calibration procedure to the other FMB-X unit. Press 'r' key on the keyboard to switch from communicating with the console FMB-X to communicating with the remote FMB-X or press 'c' key on the keyboard to switch from communicating with the remote FMB-X to communicating with the console FMB-X.
- Press 'Q' to exit 'Command mode'.

3.2.2 Error Log

The micro controller in the FMB-X Motherboard uses I2C and SPI to continuously retrieve information from multiple devices on its own board, the backplane, and other video and data cards (if they exist and have diagnostics capability). If any of these devices fail to communicate with the micro, then a 16 bit error code value is placed in the error log. These error codes can be viewed using the 'E' command. There is no time tag associated with the error code, but the error codes are placed in volatile memory sequentially. If power is turned OFF the error log will be erased. Some of these errors will cause the FMB-X front panel 'STAT' LED to go from green to red. The following table is a list of the error codes:

Table 4: Error Codes

Error Code (Hex)	Description
0x0000	The FMB-X micro controller encountered an error initializing internal processes.
0x0001	The FMB-X micro controller encountered an error initializing the Ethernet Switch.
0x00XX	Error reading I2C address: 'XX' on FMB-X Motherboard. The current values for XX or I2C addresses are as follows: • 0x70 – Could not communicate with the FMB-X Motherboard I2C Mux. • 0x48 – Could not communicate with the FMB-X Motherboard Temperature sensor. • 0x57 – Could not communicate with the FMB-X Motherboard EEPROM. • 0x6B – Could not communicate with the FMB-X Motherboard Time Recorder. • 0x61 – Could not communicate with the FMB-X Motherboard Video LED Driver. • 0x60 – Could not communicate with the FMB-X Motherboard Status LED Driver. • 0x30 – Could not communicate with the FMB-X Motherboard FPGA.
0x01XX	Error reading I2C address: 'XX' on FMB-X Daughter card. The current values for XX or I2C addresses are as follows: • 0x77 – Could not communicate with the FMB-X Daughter card I2C Mux IC. • 0x48 – Could not communicate with the FMB-X Daughter card Temperature sensor. • 0x57 – Could not communicate with the FMB-X Daughter card EEPROM. • 0x6B – Could not communicate with the FMB-X Daughter card Time Recorder (Not Used). • 0x61 – Could not communicate with the FMB-X Daughter card Status I/O. • 0x60 – Could not communicate with the FMB-X Daughter card SFP.
0x03XX	Error reading I2C address: 'XX' on BP-X. The current values for XX or I2C addresses are as follows: • 0x71 – Could not communicate with the FMB-X BP-X I2C Mux IC. • 0x48 – Could not communicate with the FMB-X BP-X Temperature sensor.

	• 0x57 – Could not communicate with the FMB-X BP-X EEPROM. • 0x6B – Could not communicate with the FMB-X BP-X Time Recorder. • 0x20 – Could not communicate with the FMB-X BP-X Video Status I/O. • 0x21 – Could not communicate with the FMB-X BP-X Data Card Status I/O. • 0x1B – Could not communicate with the FMB-X BP-X Fan Controller.
0x04XX	Error reading I2C address: 'XX' on VIB-X. The current values for XX or I2C addresses are as follows: • 0x57 – Could not communicate with the VIB-X EEPROM. • 0x6B – Could not communicate with the VIB-X Time Recorder. • 0x30 – Could not communicate with the VIB-X FPGA.
0x05XX	Error reading I2C address: 'XX' on Quad Ethernet Switch Card. The current values for XX or I2C addresses are as follows: • 0x57 – Could not communicate with the QEIB EEPROM. • 0x48 – Could not communicate with the QEIB Temperature sensor. • 0x6B – Could not communicate with the QEIB Time Recorder. • 0x30 – Could not communicate with the QEIB FPGA.

4.0 Ethernet Interface

The RJ-45 connector on both the remote and console FMB-X front panels, give access, through internal Ethernet switches, to both the remote and console diagnostics, and the RJ-45 connectors also provide a dedicated bi-directional Ethernet channel between the remote and console systems. The Ethernet ports will auto negotiate at either 10Base-T or 100Base-Tx

The remote and console microcontrollers each have a unique IP address, which allows access to the diagnostics from either the remote or console FMB-X Ethernet ports. The IP address and other network parameters can be programmed via the command mode interface, but as factory shipped defaults, the console FMB-X-2.5 IP will default to 192.168.0.100 and the remote FMB-X-2.5 IP will default to 192.168.0.101. These IP addresses can be changed only through the command base mode of the serial port.

The FMB-X-2.5 can host up to two *simultaneous* IP connections. These connections include the following:

- **Modbus TCP over Ethernet,** including 'remotely' (i.e. console) via the optical ports. The Modbus TCP connection has read only diagnostic access.

- **Embedded HTML web server over Ethernet**. The web server provides read only diagnostics, which can be accessed by entering the IP address of the FMB-X-2.5 into a standard web browser.

4.1 Web Interface

The microcontroller in the FMB-X-2.5 has an internal web server that can be accessed through most internet browsers, such as Microsoft Internet Explorer, using the appropriate IP address. This web server link provides read only data of the FMB-X-2.5. The displayed information will consist of readings of the FMB-X-2.5 power supply voltages, SFP data, link status, video status, etc. Figure 2 shows a typical display from the Firefox internet browser.

Data values or buttons with a green background are in a normal range or state. Data values or buttons with an orange background are in a warning range or state. Data values or buttons with a red background are in an alarm range or state. Positioning the mouse pointer over the data value will pop up a window showing the warning and alarm limits for the particular data box. The data values will continuously update without the need to refresh the display. Note the optical TX and RX data has been calibrated from the factory and is not the raw value retrieved from the SFPs.

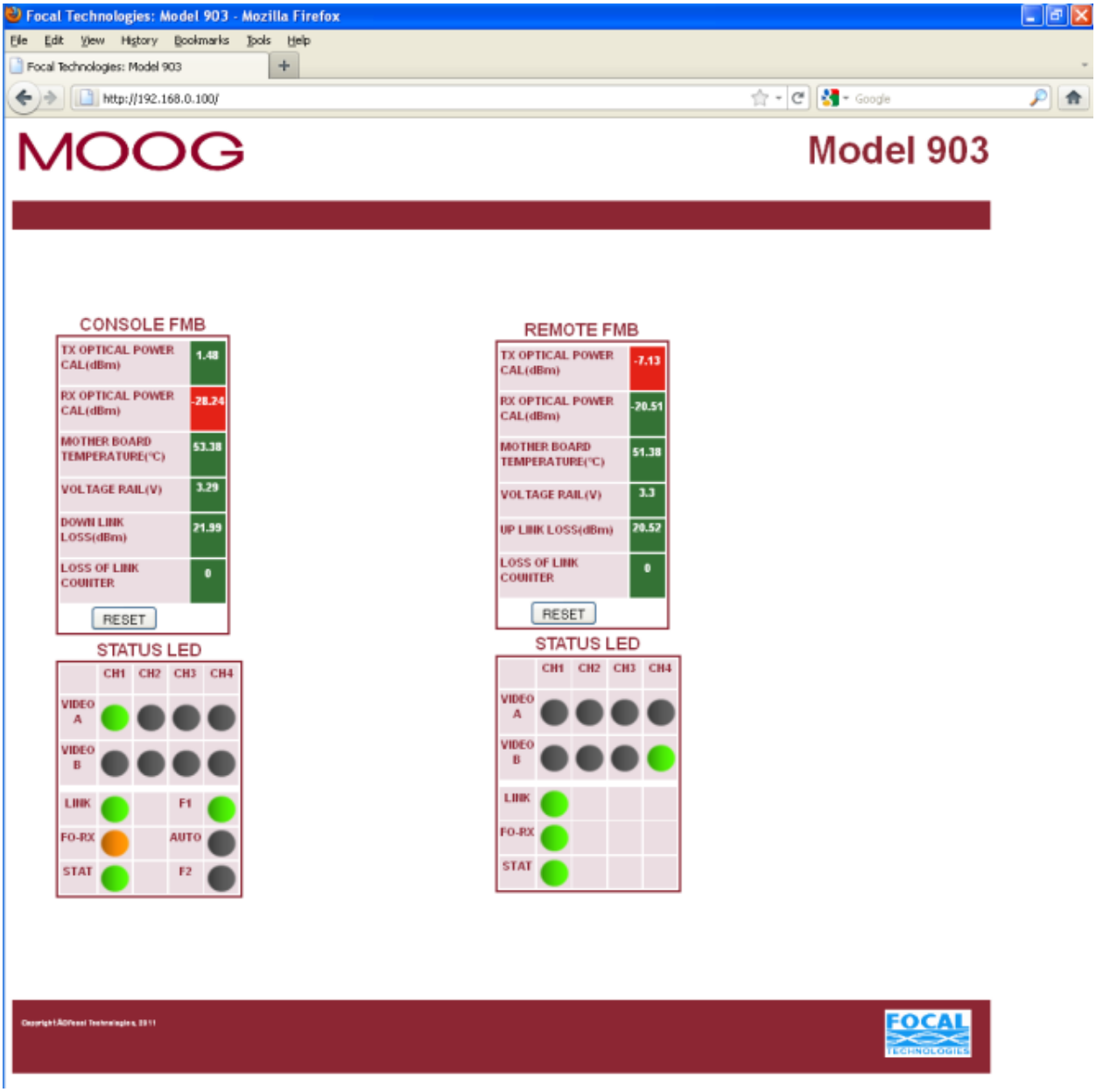

Figure 2: Web Interface Screen Capture

4.2 ModBus TCP/IP interface

Modbus TCP protocol is used to provide diagnostics via a TCP/IP connection to the FMB-X-2.5. The Modbus TCP protocol stack is illustrated in the figure below. SFP registers, local card status, and control registers are accessible via Modbus TCP/IP from the surface or other subsea equipment over any Ethernet port. The following Table shows a detailed ModBus register map.

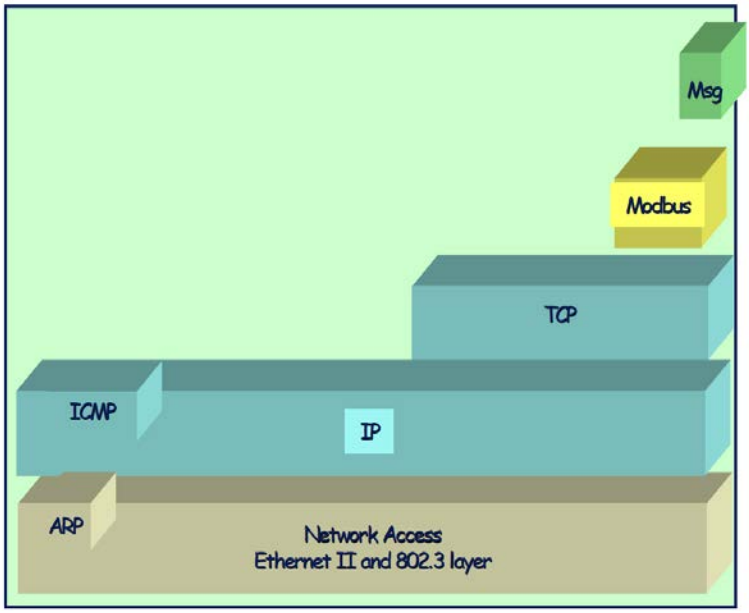

Figure 3: Modbus TCP Protocol Stack

The SFP data in the ModBus table has been pulled directly from the SFP according to the *SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transceivers.* Key real-time diagnostic parameters provided from the SFP are:

- Tx optical power
- Rx optical power
- Tx bias current (to monitor laser aging)
- SFP voltage rail
- SFP temperature

Table 5: Model 903 FMB-X-2.5 MODBUS Register Map

Diagnostic				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40001	[15:0]	R	Reserved	
40002	[15:0]	R	Reserved	
40003	[15:0]	R	Reserved	
40004	15	R	Reserved	
	14	R	Reserved	
	13	R	Reserved	
	12	R	Reserved	
	11	R	Reserved	
	10	R	Reserved	
	9	R	Reserved	
	8	R	Reserved	
	7	R	Reserved	

Diagnostic				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
	6	R	Reserved	
	5	R	Reserved	
	4	R	Reserved	
	3	R	Reserved	
	2	R	Reserved	
	1	R	Reserved	
	0	R	SFP Loss Of Signal	1 = Loss, 0 = Ok
40005	15	R	SFP Temp High Alarm	Set when internal temperature exceeds high alarm level.
	14	R	SFP Temp Low Alarm	Set when internal temperature is below low alarm level.
	13	R	SFP Vcc High Alarm	Set when internal supply voltage exceeds high alarm level.
	12	R	SFP Vcc Low Alarm	Set when internal supply voltage is below low alarm level.
	11	R	SFP Tx Bias High Alarm	Set when TX Bias current exceeds high alarm level.
	10	R	SFP Tx Bias Low Alarm	Set when TX Bias current is below low alarm level.
	9	R	SFP Tx Pwr High Alarm	Set when TX output power exceeds high alarm level.
	8	R	SFP Tx Pwr Low Alarm	Set when TX output power is below low alarm level.
	7	R	SFP Rx Pwr High Alarm	Set when Received Power exceeds high alarm level.
	6	R	SFP Rx Pwr Low Alarm	Set when Received Power is below low alarm level.
	5	R	Reserved	
	4	R	Reserved	
	3	R	Reserved	
	2	R	Reserved	
	1	R	Reserved	
	0	R	Reserved	
40006	15	R	SFP Temp High Warning	Set when internal temperature exceeds high warning level.
	14	R	SFP Temp Low Warning	Set when internal temperature is below low warning level.
	13	R	SFP Vcc High Warning	Set when internal supply voltage exceeds high warning level.
	12	R	SFP Vcc Low Warning	Set when internal supply voltage is below low warning level.
	11	R	SFP Tx Bias High Warning	Set when TX Bias current exceeds high warning level.
	10	R	SFP Tx Bias Low Warning	Set when TX Bias current is below low warning level.
	9	R	SFP Tx Pwr High Warning	Set when TX output power exceeds high warning level.
	8	R	SFP Tx Pwr Low Warning	Set when TX output power is below low warning level.
	7	R	SFP Rx Pwr High Warning	Set when Received Power exceeds high warning level.
	6	R	SFP Rx Pwr Low Warning	Set when Received Power is below low warning level.
	5	R	Reserved	

Diagnostic				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
	4	R	Reserved	
	3	R	Reserved	
	2	R	Reserved	
	1	R	Reserved	
	0	R	Reserved	
40007	[15:0]	R	Reserved	
40008	[15:0]	R	Reserved	
40009	[15:0]	R	SFP Temperature	Convert all analog values to little endian.
40010	[15:0]	R	SFP Voltage	
40011	[15:0]	R	SFP Tx Bias	
40012	[15:0]	R	SFP Tx Pwr	
40013	[15:0]	R	SFP Rx Pwr	
40014	[15:0]	R	Reserved	
40015	[15:0]	R	Reserved	
40016	[15:0]	R	Reserved	
40017	[15:0]	R	Reserved	
40018	[15:0]	R	Reserved	
40019	[15:0]	R	Onboard Voltage ADC Reading: 3.3VDC	
40020	[15:0]	R	Onboard Voltage ADC Reading: 5VDC	
40021	[15:0]	R	Main Board Temperature Sensor	
40022	[15:0]	R	Microcontroller Firmware Revision Number	
40023	[15:0]	R	Microcontroller Cause of Last Processor Reset	0 = Power-up 2 = Watchdog 3 = Software Reset 4 = User (NRST pin) 5 = Brownout
40024	[15:0]	R	Daughter card Temperature Sensor	
40025	[15:0]	R	Reserved	
40026	[15:0]	R	Reserved	
40027	[15:0]	R	Reserved	
40028	[15:0]	R	Reserved	
40029	[15:0]	R	SFP Temperature High Alarm Threshold	
40030	[15:0]	R	SFP Temperature Low Alarm Threshold	
40031	[15:0]	R	SFP Temperature High Warning Threshold	
40032	[15:0]	R	SFP Temperature Low Warning Threshold	
40033	[15:0]	R	SFP Voltage High Alarm Threshold	

Diagnostic				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40034	[15:0]	R	SFP Voltage Low Alarm Threshold	
40035	[15:0]	R	SFP Voltage High Warning Threshold	
40036	[15:0]	R	SFP Voltage Low Warning Threshold	
40037	[15:0]	R	SFP Tx Bias High Alarm Threshold	
40038	[15:0]	R	SFP Tx Bias Low Alarm Threshold	
40039	[15:0]	R	SFP Tx Bias High Warning Threshold	
40040	[15:0]	R	SFP Tx Bias Low Warning Threshold	
40041	[15:0]	R	SFP Tx Power High Alarm Threshold	
40042	[15:0]	R	SFP Tx Power Low Alarm Threshold	
40043	[15:0]	R	SFP Tx Power High Warning Threshold	
40044	[15:0]	R	SFP Tx Power Low Warning Threshold	
40045	[15:0]	R	SFP Rx Power High Alarm Threshold	
40046	[15:0]	R	SFP Rx Power Low Alarm Threshold	
40047	[15:0]	R	SFP Rx Power High Warning Threshold	
40048	[15:0]	R	SFP Rx Power Low Warning Threshold	
40049	[15:0]	R	Reserved	
40050	[15:0]	R	Reserved	
40051	[15:0]	R	Reserved	
40052	[15:0]	R	Reserved	
40053	[15:0]	R	Reserved	
40054	[15:0]	R	Reserved	
40055	[15:0]	R	Reserved	
40056	[15:0]	R	Reserved	
40057	[15:0]	R	Reserved	
40058	[15:0]	R	Reserved	
40059	[15:0]	R	Reserved	
40060	[15:0]	R	Reserved	
40057	[15:0]	R	Reserved	
40058	[15:0]	R	Reserved	
40059	[15:0]	R	Reserved	

Diagnostic				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40060	[15:0]	R	Reserved	
40061	[15:0]	R	Reserved	
40062	[15:0]	R	Reserved	
40063	[15:0]	R	Reserved	
40064	[15:0]	R	Reserved	
40079 - 40086	[15:0]	R	SFP Vendor Name	
40095 – 40096	[15:0]	R	SFP Vendor Revision Number	
40087 – 40094	[15:0]	R	SFP Vendor Part Number	
40097	[15:0]	R	SFP Wavelength	
40098 - 400105	[15:0]	R	SFP Serial Number	
40106 - 400109	[15:0]	R	SFP Date Code	
40110 - 400117	[15:0]	R	Reserved	
40118 – 400125	[15:0]	R	Reserved	
40126	[15:0]	R	SFP Diagnostic monitoring type	
40195 Thru 40229	[15:0]	R	Reserved	

Board Serial Numbers				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40230	[15:0]	R	Board Serial Number [0]	Each 16 bit word contains one ASCII value.
40231	[15:0]	R	Board Serial Number [1]	
40232	[15:0]	R	Board Serial Number [2]	
40233	[15:0]	R	Board Serial Number [3]	
40234	[15:0]	R	Board Serial Number [4]	
40235	[15:0]	R	Board Serial Number [5]	
40236	[15:0]	R	Board Serial Number [6]	
40237	[15:0]	R	Board Serial Number [7]	
40238	[15:0]	R	Board Date Code [0]	
40239	[15:0]	R	Board Date Code [1]	
40240	[15:0]	R	Board Date Code [2]	
40241	[15:0]	R	Board Date Code [3]	
40242	[15:0]	R	Board Date Code [4]	
40243	[15:0]	R	Board Date Code [5]	
40244	[15:0]	R	Board Date Code [6]	
40245	[15:0]	R	Board Date Code [7]	
40246	[15:0]	R	Board Assembly Number [0]	
40247	[15:0]	R	Board Assembly Number [1]	
40248	[15:0]	R	Board Assembly Number [2]	
40249	[15:0]	R	Board Assembly Number [3]	
40250	[15:0]	R	Board Assembly Number [4]	
40251	[15:0]	R	Board Assembly Number [5]	
40252	[15:0]	R	Board Assembly Number [6]	
40253	[15:0]	R	Board Assembly Number [7]	
40254	[15:0]	R	Board PCB Number [0]	
40255	[15:0]	R	Board PCB Number [1]	
40256	[15:0]	R	Board PCB Number [2]	
40257	[15:0]	R	Board PCB Number [3]	
40258	[15:0]	R	Board PCB Number [4]	
40259	[15:0]	R	Board PCB Number [5]	
40260	[15:0]	R	Board PCB Number [6]	
40261	[15:0]	R	Board PCB Number [7]	
40262 Thru 40326	[15:0]	R	User Data String	Each 16 bit word is a 8 bit ASCII value
40327 Thru 40391	[15:0]	R	Error Log Codes	Each 16 bit word is an error code. The codes go from oldest to newest. See Table 4 for a list of the error codes.
40392	[15:0]	R	Elapsed Time Counter Low	The time from first power up in 0.25 second increments
40393	[15:0]	R	Event Counter	Incremented every time the power to the FMB-X is turned OFF