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Model 920 Ethernet Data Multiplexer Manual

Document No.: 920-0603-00
Revision: Rev M
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Date of Issue: 2019-AUG-21

Document Revision History

Document Revision	Details of Revision	Author	Date
Rev A	Initial Release.	EM	2012 Feb 1
Rev B	Added The Diagnostics Section. Updated CAN Bus and added REV 1 Errata.	DJ/EM/SST	2012 Mar 23
Rev C	Updated the manual for Rev2 PCBA. Major changes to the power and CANbus connector	EM	2012 May 25
Rev D	Updated the Errata ,CANBUS and MODBUS sections	DJ/EM	2012 Jul 6
Rev E	Updated handling instructions, power harness requirements	EM	2012 Nov 26
Rev F	Updated CANBus specifications for 2.5 GBaud Mode.	EM	2014 Apr 8
Rev G	Updated to include new Single Mode part numbers	EM	2014 Nov 25
Rev H	- Updated cover page, header and footer to include new Focal/Moog logo/info. - Updated section 5.0 Modbus TCP Diagnostics register 4003 bits 2, 3, 6 and 7 to indicate that they “May not indicate real status with FPGA firmware Revision A2”. - Updated Table 10 to show the correct internal fiber core size (62.5um instead of 50um).	ACC	2016 Jul 21
Rev J	Updated to clarify optical budget figures.	EM	2016 Oct 3
Rev K	Removed PHY Control from Diagnostics. This feature has been disabled to increase product reliability.	EM	2017 Mar 7
Rev L	Added diagnostic memory map to advanced FPGA debug counters.	EM	2017 Nov 06
Rev M	Added Modbus diagnostics registers table for externally calibrated SFP support (applicable to Micro FW 0xA6 and PCBA Rev.3)	ACC	2019 Aug 21

Reference Documents

Document Number	Document Title and Description
920-2003-00	Model 920 EDM Configuration Drawing

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ACRONYMS AND ABBREVIATIONS

The list below contains the acronyms and abbreviations used in this user's guide.

BER	Bit Error Rate
CWDM	Coarse Wavelength Division Multiplexer / Multiplexing
DEMUX	Data Demultiplexer (Optics to Copper Ethernet)
ECL	Emitter Coupled Logic (Vcc = 0V)
EDM	Ethernet Data Multiplexer
EIA	Electronic Industries Association
ESD	Electrostatic Discharge
FORJ	Fiber Optic Rotary Joint
FPGA	Field Programmable Gate Array
Gbps	Gigabits Per Second
I/O	Input/output
kbps	Kilobits Per Second
LC/PC	Lucent Connector / Physical Contact
LED	Light Emitting Diode
Mbps	Megabits Per Second
MDI/MDIX	Automatic medium-dependent interface crossover
MUX	Data Multiplexer (Copper Ethernet to Optics)
NRZ	Non Return to Zero (Data Signaling)
NRZI	Non Return to Zero Inverted
P/N	Part Number
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembly
PECL	Positive Emitter Coupled Logic (Vcc = +5 V)
SFP	Small Form-factor Pluggable (Optical Transceiver)
SMT	Surface Mount Technology
ST/PC	Straight Tip optical connector / Physical Contact
TDM	Time Division Multiplexer / Multiplexing
TTL	Transistor-Transistor Logic
VOAT	Variable Optical Attenuator
WDM	Wavelength Division Multiplexer / Multiplexing

1.0 Introduction

The Moog Model 920 Ethernet Data Multiplexer (Model 920 EDM) is a compact and rugged Ethernet, EtherCAT, and CAN Bus multiplexer and fiber optic transmission system designed for Industrial Environments and other applications requiring the transmission of Ethernet and CAN Bus data over an optical link. The Model 920 has been optimized for low power operation and delivery of non-switched (real time) Ethernet, EtherCAT, and CAN Bus in a DIN rail mount box.

This document provides Model 920 EDM users with detailed information relevant to the design, configuration, installation, and operation of the Model 920 EDM. This manual and the appropriate reference documents should be reviewed prior to installation or reconfiguration of the multiplexer system.

Section 2.0 provides an overview of the complete Model 920 EDM multiplexer system and the key technologies employed. Section 5.0 provides an overview of the Model 920 EDM Modbus diagnostics. Section 6.0 provides useful installation instructions and preliminary test procedures.

Appendices in Section 7.0 include a cross-reference for card configuration drawing and any system specific information, if provided, such as relevant installation drawings and configuration drawings.

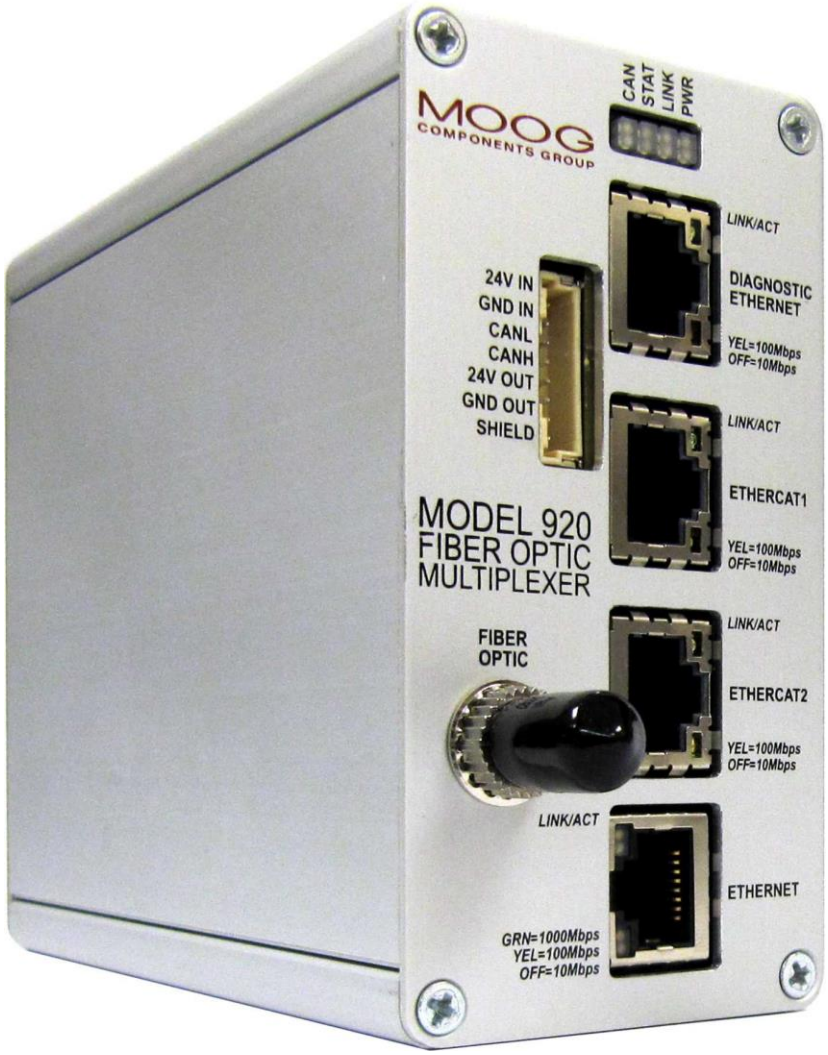

Figure 1: Model 920 EDM

2.0 System Overview

Model 920 EDM systems are sold as pairs to provide a transparent Ethernet, EtherCAT, and CAN Bus link over fiber optics. The installed optical transceivers determine the rated optical link speed, fiber type and link distance. The optical link uses a proprietary data protocol ensuring 100% throughput of all linked Ethernet channels with CAN Bus at up to 500 KBaud and full system diagnostics. The Ethernet channels are non-switched ensuring low deterministic latency, and also ensuring that the Ethernet packets are not mixed between links, i.e. data to/from channel 1 will always be to/from channel 1 on the far side of the optical link.

The uplink and downlink are combined on a single fiber – singlemode or multimode (standard) – with a passive optical coupler known as a wavelength division multiplexer (WDM). Basic systems usually operate with a 1310 nm uplink and 1550 nm downlink. In larger systems, multiple 920 EDM units may be combined on a single fiber using a coarse wavelength division multiplexer (CWDM) to take advantage of the high bandwidth of optical fiber. Figure 2 represents a block diagram of the flow of data through the Model 920 EDM.

Figure 2 illustrates an example of a system configuration using a standard, standalone 920 EDM, which supports the multiplexing of three Ethernet channels (two of which can be EtherCAT) and a single CAN Bus channel of bidirectional data over a single optical fiber using WDM, in this example, passed through a fiber optic rotary joint (FORJ).

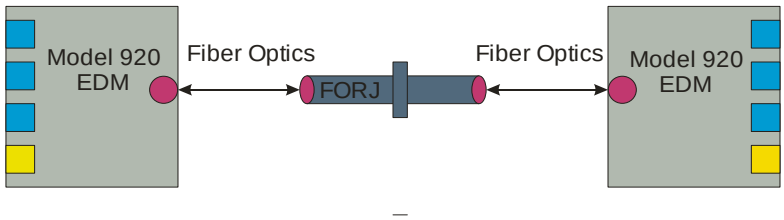

Figure 2: Model 920 EDM System Diagram

2.1 Ethernet Channels

The front panel of the 920 EDM presents 4 Ethernet RJ45 jacks to the user. The top jack is used to provide system diagnostics via Modbus. The next two jacks provide 100 BASE-TX copper links that are tethered via optical fiber to their matching jacks on the far side of the 920 EDM system. The fourth jack provides a 10/100/1000 BASE-T(X) link to its matching Ethernet link on the far side of the system. Depending on the speed of the optical link, this port can be derated to operate at only 10/100 BASE-T(X). Operating this port at 1000 BASE-T while the optical link is configured for low data rates could result in data loss. (i.e. a 1000 Mbps copper link cannot be losslessly connected over a 625 Mbps optical link)

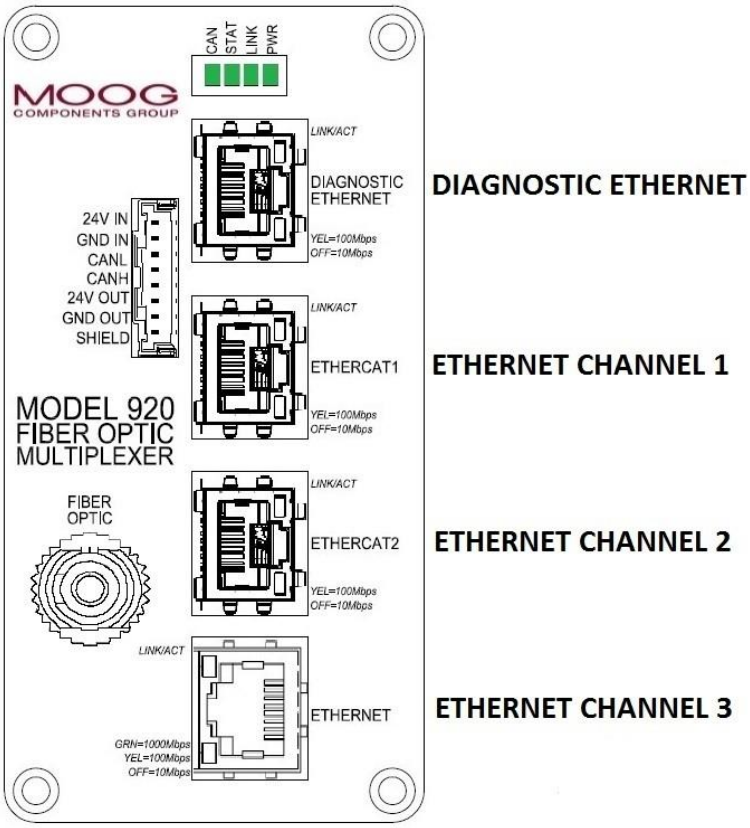

Figure 3: Model 920 EDM Front Side

2.1.1 Diagnostic Ethernet Port – 10/100 Base-T(X)

The diagnostic port provides an Ethernet link to extract system health and statistics via Modbus protocol as detailed in section 5.0. This link provides information about the local 920-EDM, and the status of the 'far end' or Remote 920-EDM. Standard auto-negotiation to 10 or 100 Mbps and auto-crossover capabilities are provided. CAT5 or better cabling is recommended for all installations with a maximum cable length of 100m.

2.1.2 EtherCAT Channels 1 and 2 – 100 Base-TX

All packets to/from Ethernet channel 1 connect directly to Ethernet channel 1 on the Remote far side of the Model 920 system. The same applies to Ethernet channel 2. As such, each Ethernet channel is completely isolated and independent from the other with dedicated bandwidth, ideal for real-time low latency protocols such as Ether CAT.

Each port operates at 100 Mbps with auto-crossover capabilities provided. CAT5 or better cabling is recommended for all installations with a maximum cable length of 100m.

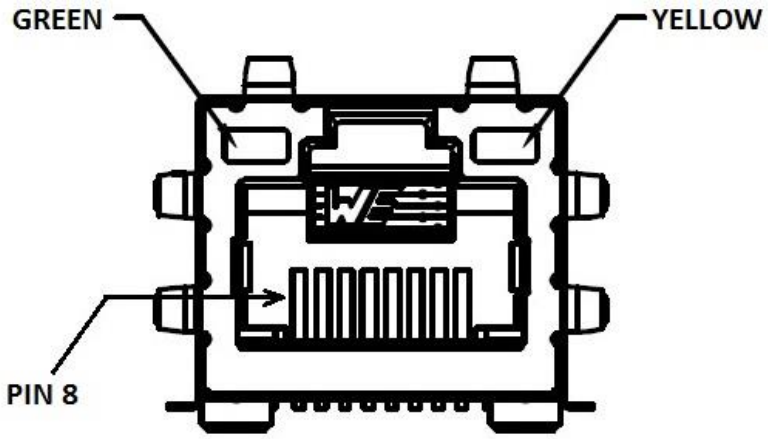

Figure 4: RJ45 10/100 BASE-T(X)

Table 1: RJ45 10/100 BASE-T(X) pinout

Pin #	Function
1	TXP
2	TXN
3	RXP
4	Common
5	Common
6	RXN
7	Common
8	Common

Table 2: 10/100 BASE-T(X) RJ45 LED Indication

Position	LED	Function
Left/Top	Green	Link
	Blinking Green	Activity
Right/Bottom	Yellow	100Mbps
	Off	10 Mbps

2.1.3 EtherCAT Link Latency

The Model 920 EDM is designed for extremely low latency to allow its use in real time control systems. Packets are not buffered in the system, so latency is deterministic based on link speed.

EtherCAT port speed	Maximum Latency NOT included fiber latency of 5 ns/m
10 BASE-T	28 µs
100 BASE-TX	3.7 µs

2.1.4 Ethernet Channel 3, 10/100 BASE-T(X) (and optional 1000 BASE-T)

This port has auto-crossover and standard auto-negotiation abilities to 10, 100 Mbps (and 1000 Mbps for the 2.5Gbps Version). CAT5 or better cabling is recommended for all installations with a maximum cable length of 100m. All packets to/from Ethernet channel 3 connect directly to Ethernet channel 3 on the far side of the Model 920 system.

NOTE: A 1000 BASE-T link is possible for channel 3 if forced. Throughput is limited to 100 Mbps for the 625 MBaud version of the Model 920 EDM. If packets are being dropped, ensure that both ends of the system are linked at the same speed, and not 1000-BASE-T, by reading register [40004].

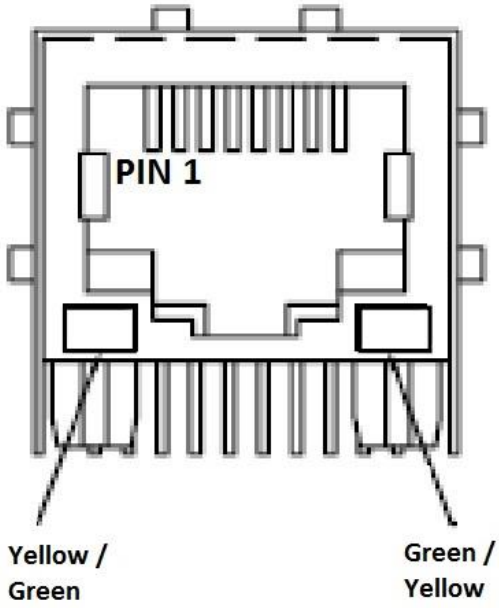

Figure 5: RJ45 10/100/1000 BASE-T(X)

Table 3: RJ45 10/100/1000 BASE-T(X) pinout

Pin #	Function
1	TRD1+
2	TRD1-
3	TRD2+
4	TRD3+
5	TRD3-
6	TRD2-
7	TRD4+
8	TRD4-

Table 4: 10/100/1000 BASE-T(X) RJ45 LED Indication

Position	LED	Function
Left/Top	Yellow	N/A
Left/Top	Green	Link
Left/Top	Green Blinking	Activity
Left/Top	Off	No Link
Right/Bottom	Green	1000 BASE-T
Right/Bottom	Yellow	100 BASE-TX
Right/Bottom	Off	10 BASE-T

2.1.5 Ethernet Link Synchronization

For Ethernet Channels 1 through 3, the Ethernet link state is shared between a pair of 920-EDMs. In this way if the Ethernet link is lost in the local or remote section of an Ethernet channel, the corresponding Ethernet link on the opposing end of the system will be forced off to communicate to host electronics that the link has been lost. Similarly, when the Ethernet achieves link, if the opposing end has been forced off in this channel from a previous down-link condition, it is subsequently 'released' to allow the full end-to-end channel to come on-line.

For the EtherCAT channels (ports 1 and 2), the corresponding port on the near and far sides of the fiber link will connect or disconnect within 40 μs of each other. Ethernet channel 3 will connect or disconnect within 1 s of the corresponding port on the far side of the fiber link.

2.2 8-Pin Header

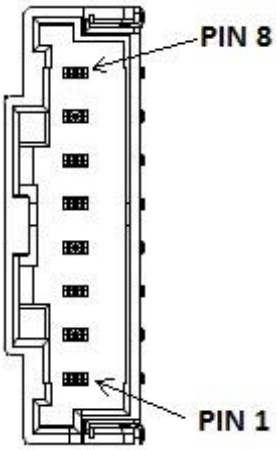

Figure 6: 8-Pin Header, Molex P/N 502352-0800

Table 5: 8-Pin Header Pinout

Pin #	Function
8	24V IN
7	GND
6	CAN L
5	CAN H
4	24V OUT
3	GND OUT
2	SHIELD
1	NO CONNECT

See section 6.1 for mating connector and cable installation guidelines.

Mating Receptacle:	Molex P/N 502351-0800	(Max 30 mating cycles)
Crimps:	Molex P/N 50212-8100	
Crimp Tool:	Molex P/N 63819-0500	

2.2.1 Input Power

The Model 920 EDM is powered via the 8-pin header on the front of the enclosure. The expected input voltage is a regulated +24V, and is non-isolated. Expect a 10% increase in power (inrush) for 0.1 seconds.

Table 6: Input Power

Input	Min	Typical	Max
24V IN - GND	20V	24V	28V
Amperage		0.16A	0.20A

Pin-8 is for 24V IN; Pin-7 is for GND.

2.2.2 CAN Bus

CAN Bus operating at 125, 250, or 500 KBaud can be connected to the terminal connector on the front of the 920 EDM.

The 920-EDM uses a *repeater* solution (see below figure) in which each unit transparently links near and far sides of the optical link onto the same CANbus network. In order to satisfy CAN Bus bit-level arbitration, this architecture relies on short optical and copper links to work.

Latency of the CAN Bus *repeater* solution for the 625 Mbps option is 400 ns, not including additional fiber optic latency of ~5 ns/m. For the 2.5 Gbps option, the latency is reduced to 260 ns. These solutions work reliably at 500 KBaud with up to 20 m of fiber optics, and up to 10 m of copper on each linked CANbus network. CANbus copper networks can be extended to 25m if the 2.5Gbps 920 EDM is specified. If network errors are detected within these limits, adjust the default sampling time of the CANbus network from 75% to 87.5% of a bit.

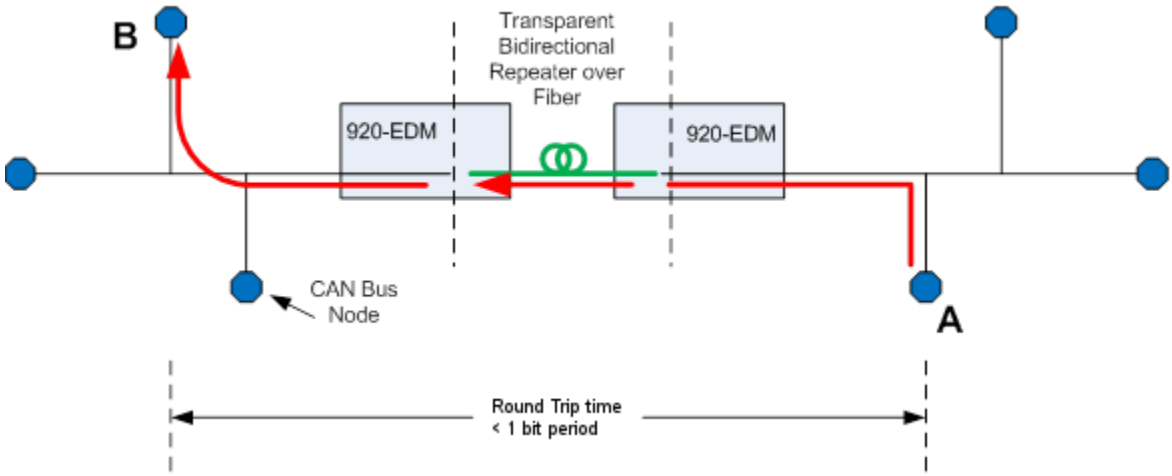

Figure 7: CAN Bus Repeater

CAN L (low) is connected to pin-6 and CAN H (high) is connected to pin-5.

Table 7: CAN Bus

Input	Min	Typical	Max
CAN H – CAN L	-6V		+6V
Common Mode	-7V		+12V

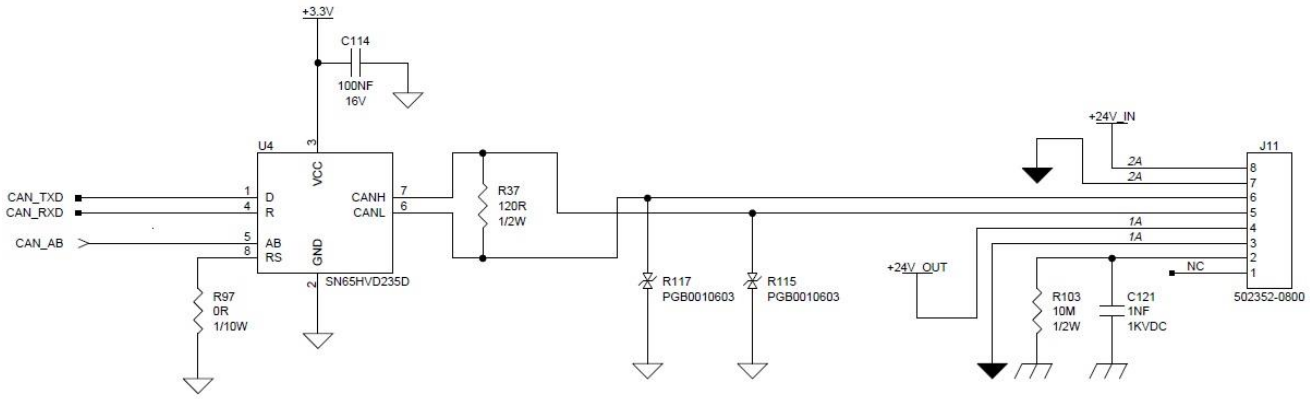

Figure 8: CAN Bus Interface Circuit

2.2.3 CAN Bus Output Power

An output voltage is provided to run low powered non-isolated electronics. This output voltage allows a series power connection with the input power as shown below, and is also rated for a typical 24V less the dual diode voltage drop (0.6V @ 0.1A).

Pin-4 is for 24V OUT and Pin-3 is for GND.

Table 8: Output Power

Input	Min	Typical	Max
24V OUT – GND OUT	20V	24V	28V
Amperage	0A	0.06A	0.1A

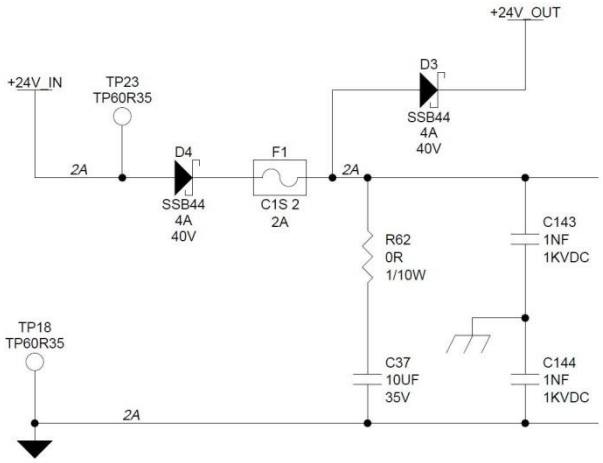

Figure 9: CAN Bus Output Power Circuit

2.2.4 Shield

Pin-2 is an optional connection to the isolated chassis ground. This can be used to terminate cable shielding to the enclosure.

2.2.5 NC

Pin-1 is a No Connect Pin.

2.3 LEDs

Four bi-colour green/red LEDs are located at the top of the front panel of the Model 920 EDM enclosure.

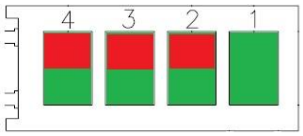

Figure 10: Model 920 EDM LEDs

Table 9: 10/100/1000 BASE-T(X) RJ45 LED Indication

LED	Function	
4 (Left)	**CAN Bus:** Green: CAN Bus Link/Act Red: N/A Off: CANbus Idle / No Link	
3	**System Status:** Green: Voltage rails within specification Red: Voltage rails outside of specification	1.2 V rail between 1.1 V and 1.3 V 3.3 V rail between 3.2 V and 3.4 V 24 V rail between 19.2 V and 28.8 V
2	**Link:** Green: Optical Link established and healthy Red: Optical link fault; Check Register [40006]	
1 (Right)	**Power:** Green: System is powered on Red: N/A Off: System is powered down Dim light: Problem with input power or DC-DC converter. Check input voltage/current	

2.4 Optics

An ST optical bushing on the front side of the enclosure provides a bi-directional optical connection.

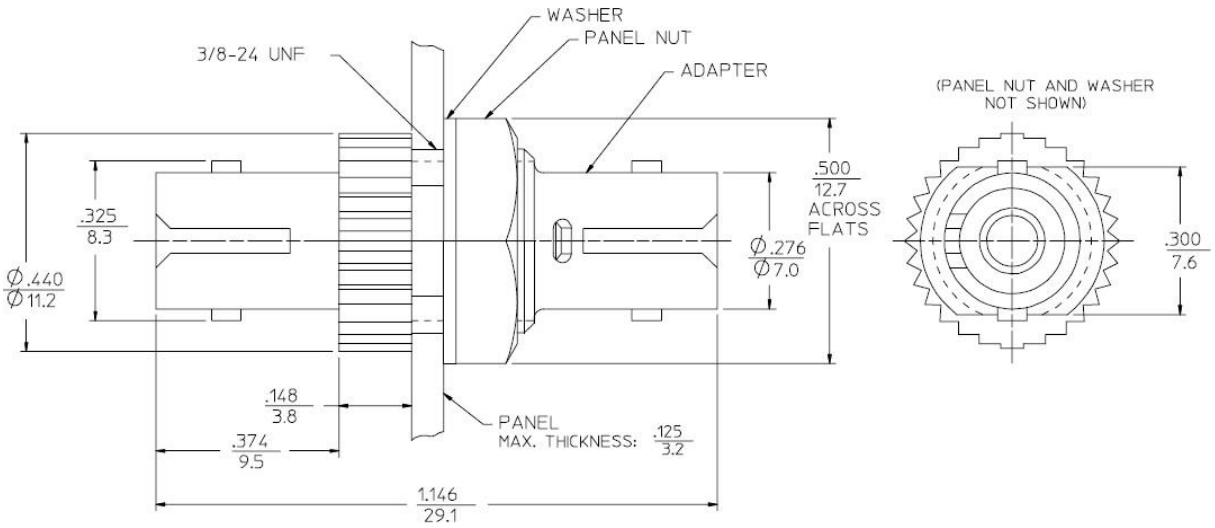

Figure 11: ST Panel Mount Optical Bushing

Table 10: Optical Interface Parameters for 920-8000-00 and 920-8001-00 625MBaud MMF 1310/1550

Parameter	Min.	Typical	Max.	Unit
62.5um Core Diameter MMF **Typical distance with no bushings or other lossy components***		2		km
Data Rate		625		MBaud
Transmit				
Transmitter Centre Wavelength P/N 920-8000-00	1260	1310	1360	nm
Transmitter Centre Wavelength P/N 920-8001-00	1500	1550	1580	nm
Average Output Power***	-13		-8	dBm
Receive				
Receiver Centre Wavelength P/N 920-8000-00	1500	1550	1580	nm
Receiver Centre Wavelength P/N 920-8001-00	1260	1310	1360	nm
Receiver Sensitivity***			-24	dBm
Receiver overload	-3			dBm

*CAN bus operation may limit optical distance
** The 920-8000-00 and 920-8001-00 modules have an internal 62.5/125 um LC-ST fiber jumper.
*** Optical transmit power and receiver sensitivity are based on transceiver limits of -15 dBm minimum transmit power at the SFP and -26 dBm receiver sensitivity.

Table 11: Optical Interface Parameters for 920-8000-01 and 920-8001-01 2.5GBaud MMF 1310/1550

Parameter	Min.	Typical	Max.	Unit
50um Core Diameter MMF **Typical distance with no bushings or other lossy components***		2		km
Data Rate		2500		MBaud
Transmit				
Transmitter Centre Wavelength P/N 920-8000-00	1260	1310	1360	nm
Transmitter Centre Wavelength P/N 920-8001-00	1500	1550	1580	nm
Average Output Power	-5		0	dBm
Receive				
Receiver Centre Wavelength P/N 920-8000-01	1500	1550	1580	nm
Receiver Centre Wavelength P/N 920-8001-01	1260	1310	1360	nm
Receiver Sensitivity			-15	dBm
Receiver overload	-3			dBm

*CAN bus operation may limit optical distance

Table 12: Optical Interface Parameters for 920-8000-02 and 920-8001-02 2.5GBaud SMF 1310/1550

Parameter	Min.	Typical	Max.	Unit
9um Core Diameter SMF **Typical distance with no bushings or other lossy components***			40	km
Data Rate		2500		MBaud
Transmit				
Transmitter Centre Wavelength P/N 920-8000-02	1290	1310	1330	nm
Transmitter Centre Wavelength P/N 920-8001-02	1540	1550	1560	nm
Average Output Power	-2		+3	dBm
Receive				
Receiver Centre Wavelength P/N 920-8000-00	1540	1550	1560	nm
Receiver Centre Wavelength P/N 920-8001-00	1290	1310	1330	nm
Receiver Sensitivity			-22	dBm
Receiver overload	0			dBm

*CAN bus operation may limit optical distance

Contact Moog Components Group for more optical options, including:

- Single Mode / Multi Mode Fiber
- 625 MBaud / 2.5 GBaud Optical Data Rate (1000 BASE-T operation on Ethernet Channel 3)
- Alternative wavelengths, including CWDM wavelengths
- Increased / decreased optical budgets

2.4.1 Optical Safety

All lasers used in the Model 920 EDM system are Class I laser devices per IEC-60825 unless otherwise specified in installation or configuration drawing. No special control measures or warning labels are required, although any needless exposure of the eye should be avoided as a matter of good practice, and fibers should never be viewed with magnifying instruments, e.g. fiber scopes, while optical power is present.

3.0 Diagnostics Functionality

3.1 Network Settings and Accessibility

3.1.1 IP Address Configuration

Each Model 920 is assigned a unique MAC address during factory configuration. The MAC address is marked on the enclosure, and recorded at the factory with cross-reference to serial number, and thereby customer and order, should it ever need to be retrieved.

The IP address for the Model 920 can be assigned statically or dynamically using DHCP. Either mode can be enabled remotely using a virtual Telnet terminal over the Diagnostic Ethernet port, followed by powering cycling the device after the changes have been submitted to the card.

By factory default, the Model 920 obtains an IP address using DHCP (i.e. dynamic IP allocation), configured with a 30 second timeout. If the connecting network does not support DHCP to provide the Model 920 with a dynamic IP within 30 seconds, the Model 920 will automatically revert to use locally stored (i.e. static) IP address and network settings. Factory Default Network Parameters are shown in Table 13.

Table 13: Factory Default Network Parameters

Network Parameter	Factory Default Setting
IP address	192.168.0.100
Subnet	255.255.255.0
Gateway	192.168.0.1
Primary DNS	8.8.8.8
Secondary DNS	8.8.4.4

3.1.2 IP Connectivity

The Model 920 hosts up to two *simultaneous* IP connections using the Diagnostic Ethernet port. These connections include the following:

- **Modbus TCP -** The Modbus TCP connection has full control and diagnostic access.
- **Telnet -** There is a limited set of commands available. Used primarily for IP address and network setting configuration.

3.2 Diagnostics and Control via Modbus TCP/IP

Modbus TCP protocol is used to provide diagnostics and user control messages via a TCP/IP connection to the Model 920. The Modbus TCP protocol stack is illustrated in Figure 12. SFP registers, card status, and control registers are accessible via Modbus TCP/IP over the Diagnostic Ethernet port.

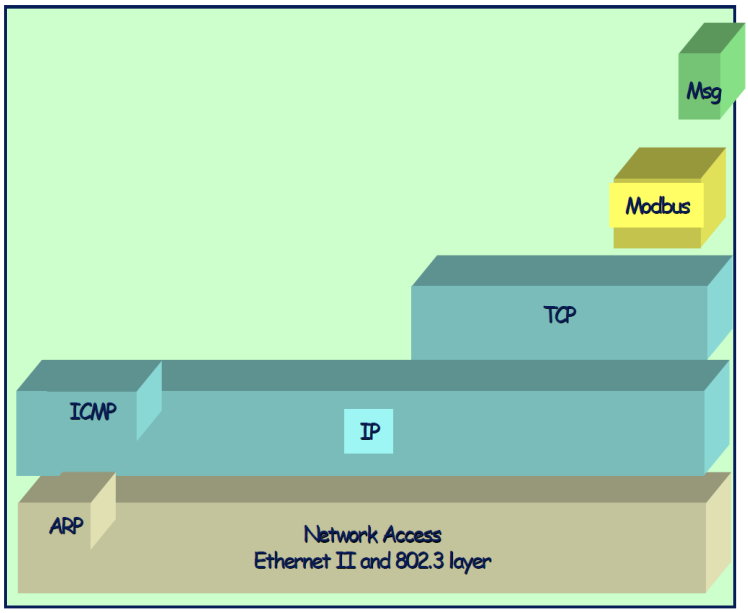

Figure 12: Modbus TCP Protocol Stack

3.2.1 Diagnostics and Modem Status

Remotely accessible, real-time diagnostic data and status information is available from the Model 920 EDM. This information can be used to determine real-time state of health or to monitor long-term trending of critical parameters to characterize the performance of the entire optical link including the Fiber Optic Rotary Joint (FORJ). For example, most SFP optical transceivers are designed to maintain constant output power. As the laser diode efficiency degrades over time, the SFP monitors its output power and increases the applied Tx bias current as needed. It follows that monitoring the profile of the Tx bias current over time can indicate aging of the laser and assist with life predictions.

Diagnostic and status information is retrieved from the following:

1. Onboard microcontroller. A bank of ADCs is used to monitor board voltage rails. The microcontroller also provides status information such as Serial number, MAC address, IP address and other Network settings

2. Status registers of the Ethernet. Key Ethernet status indicators are:
   - Link Speed and activity status
   - Link status of the optical port

3. Diagnostic data 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

Diagnostics and status information are retrievable using Modbus TCP. The Modbus TCP register map is provided in Section 5.0. Limited configuration information is available over Telnet, per section 4.0.

Moog has created a sample version of a .NET graphical user interface (GUI) for use on Microsoft Windows with a Modbus TCP backend for integration and bench testing the Model 920 Modbus functionality. Typically users have or develop their own Modbus TCP interfaces for local PLCs and other controllers. A screenshot of the sample GUI is shown below in Figure 13.

Figure 13: Sample .NET GUI for Modbus TCP Access to Model 920

3.2.2 Control and Configuration Capabilities

Diagnostic Modbus registers described in Section 3.2.1 above are read-only, however the Model 920 supports some read/write control registers. Supported control and configuration functionality includes:

- SFP Warning and Alarm Thresholds Values, stored in non-volatile memory within the SFPs
- Ethernet PHY port Control Registers
- Configuration of Network Settings (See section 3.1.1 above)

4.0 Telnet Interface

The Telnet interface of the Model 920 card is accessed from any Telnet client by setting the Telnet port to 23 and by entering the IP address of the card. Once connected, the Telnet interface comes up with a home screen containing a list of the available commands and also detailed help on using each command.

Typically the Telnet interface is used for convenient configuration of the TCP/IP settings of the card.

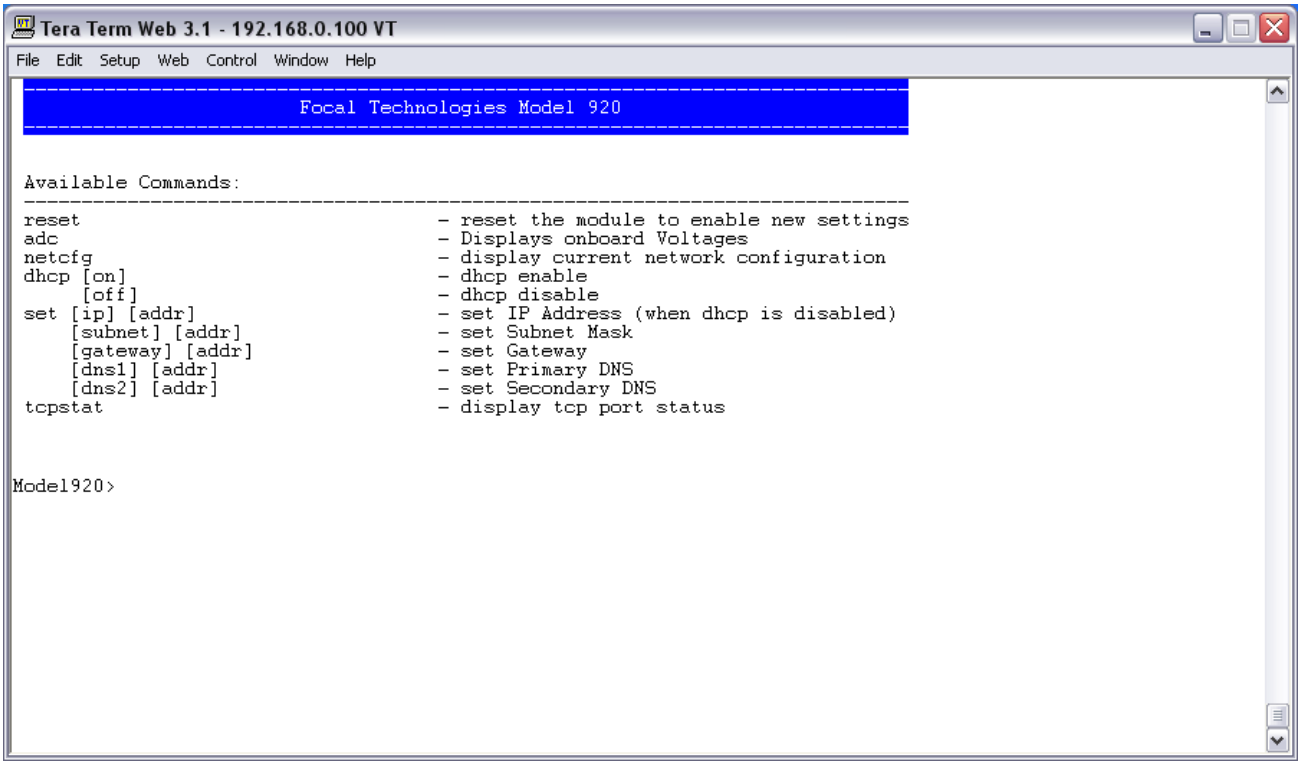

Figure 14: Telnet Interface

5.0 Modbus TCP Diagnostics

Note: The term **Local** has been used in the following table to represent information pertaining to the near end Model 920 EDM card (The end where the user is physically connected to the Diagnostic Ethernet port of the Model 920 card) and the term **Remote** is used to represent the information pertaining to the far end Model 920 card

Table 14: Modbus Register Map

Diagnostics				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40001		R	Reserved	
40002		R	Reserved	
40003	15	R	Reserved	
	14	R	Reserved	
	13	R	Reserved	
	12	R	Reserved	
	11	R	SFP Remote Installed	1 = Installed 0=Not present
	10	R	SFP Local Installed	1 = Installed 0=Not present
	9	R	Remote Diag Ethernet Link	1 = Link, 0 = No Link
	8	R	Remote GBE Ethernet Link	1 = Link, 0 = No Link
	7	R	Remote Ch2 Ethernet Link	1 = Link, 0 = No Link *(May not indicate real status with FPGA firmware Revision A2)*
	6	R	Remote Ch1 Ethernet Link	1 = Link, 0 = No Link *(May not indicate real status with FPGA firmware Revision A2)*
	5	R	Local Diag Ethernet Link	1 = Link, 0 = No Link
	4	R	Local GBE Ethernet Link	1 = Link, 0 = No Link
	3	R	Local Ch2 Ethernet Link	1 = Link, 0 = No Link *(May not indicate real status with FPGA firmware Revision A2)*
	2	R	Local Ch1 Ethernet Link	1 = Link, 0 = No Link *(May not indicate real status with FPGA firmware Revision A2)*
	1	R	SFP Remote Ethernet Link	1 = Link, 0 = No Link
	0	R	SFP Local Ethernet Link	1 = Link, 0 = No Link
40004	15		Reserved	
	14		Reserved	
	13		Reserved	
	12		Reserved	
	11	R	Remote Diag Ethernet Link Speed	1= 100Mbit, 0 = 10 Mbit (only valid if 'Ethernet Link = 1')
	10	R	Remote GBE_2 Ethernet Link Speed	(Local GBE_1 Ethernet Link Speed, Local GBE_2 Ethernet Link Speed) 00 =100 Base-TX, 01=10 Base-T 10 = 1000 Base-T
	9	R	Remote l GBE_1 Ethernet Link Speed	
	8	R	Remote Ch2 Ethernet Link Speed	1= 100Mbit, 0 = 10 Mbit (only valid if 'Ethernet Link = 1')
	7	R	Remote Ch1 Ethernet Link Speed	1= 100Mbit, 0 = 10 Mbit (only valid if 'Ethernet Link = 1')
	6	R	Local Diag Ethernet Link Speed	1= 100Mbit, 0 = 10 Mbit (only valid if 'Ethernet Link = 1')

Diagnostics				
	5	R	Local GBE_2 Ethernet Link Speed	(Local GBE_1 Ethernet Link Speed, Local GBE_2 Ethernet Link Speed) 00 =100 Base-TX, 01=10 Base-T 10 = 1000 Base-T
	4	R	Local GBE_1 Ethernet Link Speed	
	3	R	Local Ch2 Ethernet Link Speed	1= 100Mbit, 0 = 10 Mbit (only valid if 'Ethernet Link = 1')
	2	R	Local Ch1 Ethernet Link Speed	1= 100Mbit, 0 = 10 Mbit (only valid if 'Ethernet Link = 1')
	1	R	SFP Remote Loss Of Signal	1 = Loss, 0 = Ok
	0	R	SFP Local Loss Of Signal	1 = Loss, 0 = Ok
40005	15	R	SFP LOCAL Temp High Alarm	Set when internal temperature exceeds high alarm level.
	14	R	SFP LOCAL Temp Low Alarm	Set when internal temperature is below low alarm level.
	13	R	SFP LOCAL Vcc High Alarm	Set when internal supply voltage exceeds high alarm level.
	12	R	SFP LOCAL Vcc Low Alarm	Set when internal supply voltage is below low alarm level.
	11	R	SFP LOCAL Tx Bias High Alarm	Set when TX Bias current exceeds high alarm level.
	10	R	SFP LOCAL Tx Bias Low Alarm	Set when TX Bias current is below low alarm level.
	9	R	SFP LOCAL Tx Pwr High Alarm	Set when TX output power exceeds high alarm level.
	8	R	SFP LOCAL Tx Pwr Low Alarm	Set when TX output power is below low alarm level.
	7	R	SFP LOCAL Rx Pwr High Alarm	Set when Received Power exceeds high alarm level.
	6	R	SFP LOCAL Rx Pwr Low Alarm	Set when Received Power is below low alarm level.
	5		Reserved	
	4		Reserved	
	3		Reserved	
	2		Reserved	
	1		Reserved	
	0		Reserved	
40006	15	R	SFP LOCAL Temp High Warning	Set when internal temperature exceeds high warning level.
	14	R	SFP LOCAL Temp Low Warning	Set when internal temperature is below low warning level.
	13	R	SFP LOCAL Vcc High Warning	Set when internal supply voltage exceeds high warning level.
	12	R	SFP LOCAL Vcc Low Warning	Set when internal supply voltage is below low warning level.
	11	R	SFP LOCAL Tx Bias High Warning	Set when TX Bias current exceeds high warning level.
	10	R	SFP LOCAL Tx Bias Low Warning	Set when TX Bias current is below low warning level.
	9	R	SFP LOCAL Tx Pwr High Warning	Set when TX output power exceeds high warning level.
	8	R	SFP LOCAL Tx Pwr Low Warning	Set when TX output power is below low warning level.
	7	R	SFP LOCAL Rx Pwr High Warning	Set when Received Power exceeds high warning level.
	6	R	SFP LOCAL Rx Pwr Low Warning	Set when Received Power is below low warning level.

Diagnostics				
	5		Reserved	
	4		Reserved	
	3		Reserved	
	2		Reserved	
	1		Reserved	
	0		Reserved	
40007	15	R	SFP REMOTE Temp High Alarm	Set when internal temperature exceeds high alarm level.
	14	R	SFP REMOTE Temp Low Alarm	Set when internal temperature is below low alarm level.
	13	R	SFP REMOTE Vcc High Alarm	Set when internal supply voltage exceeds high alarm level.
	12	R	SFP REMOTE Vcc Low Alarm	Set when internal supply voltage is below low alarm level.
	11	R	SFP REMOTE Tx Bias High Alarm	Set when TX Bias current exceeds high alarm level.
	10	R	SFP REMOTE Tx Bias Low Alarm	Set when TX Bias current is below low alarm level.
	9	R	SFP REMOTE Tx Pwr High Alarm	Set when TX output power exceeds high alarm level.
	8	R	SFP REMOTE Tx Pwr Low Alarm	Set when TX output power is below low alarm level.
	7	R	SFP REMOTE Rx Pwr High Alarm	Set when Received Power exceeds high alarm level.
	6	R	SFP REMOTE Rx Pwr Low Alarm	Set when Received Power is below low alarm level.
	5		Reserved	
	4		Reserved	
	3		Reserved	
	2		Reserved	
	1		Reserved	
	0		Reserved	
40008	15	R	SFP REMOTE Temp High Warning	Set when internal temperature exceeds high warning level.
	14	R	SFP REMOTE Temp Low Warning	Set when internal temperature is below low warning level.
	13	R	SFP REMOTE Vcc High Warning	Set when internal supply voltage exceeds high warning level.
	12	R	SFP REMOTE Vcc Low Warning	Set when internal supply voltage is below low warning level.
	11	R	SFP REMOTE Tx Bias High Warning	Set when TX Bias current exceeds high warning level.
	10	R	SFP REMOTE Tx Bias Low Warning	Set when TX Bias current is below low warning level.
	9	R	SFP REMOTE Tx Pwr High Warning	Set when TX output power exceeds high warning level.

Diagnostics				
	8	R	SFP REMOTE Tx Pwr Low Warning	Set when TX output power is below low warning level.
	7	R	SFP REMOTE Rx Pwr High Warning	Set when Received Power exceeds high warning level.
	6	R	SFP REMOTE Rx Pwr Low Warning	Set when Received Power is below low warning level.
	5		Reserved	
	4		Reserved	
	3		Reserved	
	2		Reserved	
	1		Reserved	
	0		Reserved	
40009	[15:0]	R	SFP LOCAL Temperature	Convert all analog values to little endian.
40010	[15:0]	R	SFP LOCAL Voltage	
40011	[15:0]	R	SFP LOCAL Tx Bias	
40012	[15:0]	R	SFP LOCAL Tx Pwr	
40013	[15:0]	R	SFP LOCAL Rx Pwr	
40014	[15:0]	R	SFP REMOTE Temperature	
40015	[15:0]	R	SFP REMOTE Voltage	
40016	[15:0]	R	SFP REMOTE Tx Bias	
40017	[15:0]	R	SFP REMOTE Tx Pwr	
40018	[15:0]	R	SFP REMOTE Rx Pwr	
40019	[15:0]	R	Local Onboard Voltage ADC Reading: 1.2VDC	
40020	[15:0]	R	Local Onboard Voltage ADC 3.3VDC	
40021	[15:0]	R	Local Onboard Voltage ADC 24 VDC	
40022	[15:0]	R	Local Microcontroller Firmware Revision Number	
40023	[15:0]	R	Local Microcontroller Cause of Last Processor Reset	0 = Power-up 2 = Watchdog 3 = Software Reset 4 = User (NRST pin) 5 = Brownout
40024	[15:0]	R	Remote Onboard Voltage ADC Reading: 1.2VDC	
40025	[15:0]	R	Remote Onboard Voltage ADC 3.3VDC	
40026	[15:0]	R	Remote Onboard Voltage ADC 24 VDC	
40027	[15:0]	R	Remote Microcontroller Firmware Revision Number	
40028	[15:0]	R	Remote Microcontroller Cause of Last Processor Reset	0 = Power-up 2 = Watchdog 3 = Software Reset 4 = User (NRST pin) 5 = Brownout

One-time reads

Analog Alarm & Warning Thresholds (Internally Calibrated - see SFF-8472 rev 10.2 page 24 for scaling)

Register Number	Bit	R/W	Description	Comments
40029	[15:0]	R	SFP LOCAL Temperature High Alarm Threshold	
40030	[15:0]	R	SFP LOCAL Temperature Low Alarm Threshold	
40031	[15:0]	R	SFP LOCAL Temperature High Warning Threshold	
40032	[15:0]	R	SFP LOCAL Temperature Low Warning Threshold	
40033	[15:0]	R	SFP LOCAL Voltage High Alarm Threshold	
40034	[15:0]	R	SFP LOCAL Voltage Low Alarm Threshold	
40035	[15:0]	R	SFP LOCAL Voltage High Warning Threshold	
40036	[15:0]	R	SFP LOCAL Voltage Low Warning Threshold	
40037	[15:0]	R	SFP LOCAL Tx Bias High Alarm Threshold	
40038	[15:0]	R	SFP LOCAL Tx Bias Low Alarm Threshold	
40039	[15:0]	R	SFP LOCAL Tx Bias High Warning Threshold	
40040	[15:0]	R	SFP LOCAL Tx Bias Low Warning Threshold	
40041	[15:0]	R	SFP LOCAL Tx Power High Alarm Threshold	
40042	[15:0]	R	SFP LOCAL Tx Power Low Alarm Threshold	
40043	[15:0]	R	SFP LOCAL Tx Power High Warning Threshold	
40044	[15:0]	R	SFP LOCAL Tx Power Low Warning Threshold	
40045	[15:0]	R	SFP LOCAL Rx Power High Alarm Threshold	
40046	[15:0]	R	SFP LOCAL Rx Power Low Alarm Threshold	
40047	[15:0]	R	SFP LOCAL Rx Power High Warning Threshold	
40048	[15:0]	R	SFP LOCAL Rx Power Low Warning Threshold	
40049	[15:0]	R	SFP REMOTE Temperature High Alarm Threshold	
40050	[15:0]	R	SFP REMOTE Temperature Low Alarm Threshold	
40051	[15:0]	R	SFP REMOTE Temperature High Warning Threshold	
40052	[15:0]	R	SFP REMOTE Temperature Low Warning Threshold	
40053	[15:0]	R	SFP REMOTE Voltage High Alarm Threshold	
40054	[15:0]	R	SFP REMOTE Voltage Low Alarm Threshold	
40055	[15:0]	R	SFP REMOTE Voltage High Warning Threshold	
40056	[15:0]	R	SFP REMOTE Voltage Low Warning Threshold	
40057	[15:0]	R	SFP REMOTE Tx Bias High Alarm Threshold	
40058	[15:0]	R	SFP REMOTE Tx Bias Low Alarm Threshold	
40059	[15:0]	R	SFP REMOTE Tx Bias High Warning Threshold	
40060	[15:0]	R	SFP REMOTE Tx Bias Low Warning Threshold	
40061	[15:0]	R	SFP REMOTE Tx Power High Alarm Threshold	
40062	[15:0]	R	SFP REMOTE Tx Power Low Alarm Threshold	

One-time reads

Analog Alarm & Warning Thresholds (Internally Calibrated - see SFF-8472 rev 10.2 page 24 for scaling)

Register Number	Bit	R/W	Description	Comments
40063	[15:0]	R	SFP REMOTE Tx Power High Warning Threshold	
40064	[15:0]	R	SFP REMOTE Tx Power Low Warning Threshold	
40065	[15:0]	R	SFP REMOTE Rx Power High Alarm Threshold	
40066	[15:0]	R	SFP REMOTE Rx Power Low Alarm Threshold	
40067	[15:0]	R	SFP REMOTE Rx Power High Warning Threshold	
40068	[15:0]	R	SFP REMOTE Rx Power Low Warning Threshold	
40069	[15:0]		Reserved	
40070	[15:0]		Reserved	
40071	[15:0]		Reserved	
40072	[15:0]		Reserved	
40073	[15:0]		Reserved	
40074	[15:0]		Reserved	
40075	[15:0]		Reserved	
40076	[15:0]		Reserved	
40077	[15:0]		Reserved	
40078	[15:0]		Reserved	

SFP Vendor Information

Register Number	Bit	R/W	Description	Comments
40079	[15:0]	R	SFP LOCAL Vendor Name [0]	2 ASCII characters per register
40080	[15:0]	R	SFP LOCAL Vendor Name [1]	2 ASCII characters per register
40081	[15:0]	R	SFP LOCAL Vendor Name [2]	2 ASCII characters per register
40082	[15:0]	R	SFP LOCAL Vendor Name [3]	2 ASCII characters per register
40083	[15:0]	R	SFP LOCAL Vendor Name [4]	2 ASCII characters per register
40084	[15:0]	R	SFP LOCAL Vendor Name [5]	2 ASCII characters per register
40085	[15:0]	R	SFP LOCAL Vendor Name [6]	2 ASCII characters per register
40086	[15:0]	R	SFP LOCAL Vendor Name [7]	2 ASCII characters per register
40087	[15:0]	R	SFP LOCAL Vendor Part Number [0]	2 ASCII characters per register
40088	[15:0]	R	SFP LOCAL Vendor Part Number [1]	2 ASCII characters per register
40089	[15:0]	R	SFP LOCAL Vendor Part Number [2]	2 ASCII characters per register
40090	[15:0]	R	SFP LOCAL Vendor Part Number [3]	2 ASCII characters per register
40091	[15:0]	R	SFP LOCAL Vendor Part Number [4]	2 ASCII characters per register
40092	[15:0]	R	SFP LOCAL Vendor Part Number [5]	2 ASCII characters per register
40093	[15:0]	R	SFP LOCAL Vendor Part Number [6]	2 ASCII characters per register
40094	[15:0]	R	SFP LOCAL Vendor Part Number [7]	2 ASCII characters per register
40095	[15:0]	R	SFP LOCAL Vendor Rev Number [0]	2 ASCII characters per register

SFP Vendor Information				
40096	[15:0]	R	SFP LOCAL Vendor Rev Number [1]	2 ASCII characters per register
40097	[15:0]	R	SFP LOCAL Wavelength	
40098	[15:0]	R	SFP LOCAL Serial Number [0]	
40099	[15:0]	R	SFP LOCAL Serial Number [1]	
40100	[15:0]	R	SFP LOCAL Serial Number [2]	
40101	[15:0]	R	SFP LOCAL Serial Number [3]	
40102	[15:0]	R	SFP LOCAL Serial Number [4]	
40103	[15:0]	R	SFP LOCAL Serial Number [5]	
40104	[15:0]	R	SFP LOCAL Serial Number [6]	
40105	[15:0]	R	SFP LOCAL Serial Number [7]	
40106	[15:0]	R	SFP LOCAL Date Code [0]	2 ASCII characters per register
40107	[15:0]	R	SFP LOCAL Date Code [1]	2 ASCII characters per register
40108	[15:0]	R	SFP LOCAL Date Code [2]	2 ASCII characters per register
40109	[15:0]	R	SFP LOCAL Date Code [3]	2 ASCII characters per register
40110	[15:0]	R	SFP LOCAL Focal PN [0]	2 ASCII characters per register
40111	[15:0]	R	SFP LOCAL Focal PN [1]	2 ASCII characters per register
40112	[15:0]	R	SFP LOCAL Focal PN [2]	2 ASCII characters per register
40113	[15:0]	R	SFP LOCAL Focal PN [3]	2 ASCII characters per register
40114	[15:0]	R	SFP LOCAL Focal PN [4]	2 ASCII characters per register
40115	[15:0]	R	SFP LOCAL Focal PN [5]	2 ASCII characters per register
40116	[15:0]	R	SFP LOCAL Focal PN [6]	2 ASCII characters per register
40117	[15:0]	R	SFP LOCAL Focal PN [7]	2 ASCII characters per register
40118	[15:0]	R	SFP LOCAL Focal SN [0]	2 ASCII characters per register
40119	[15:0]	R	SFP LOCAL Focal SN [1]	2 ASCII characters per register
40120	[15:0]	R	SFP LOCAL Focal SN [2]	2 ASCII characters per register
40121	[15:0]	R	SFP LOCAL Focal SN [3]	2 ASCII characters per register
40122	[15:0]	R	SFP LOCAL Focal SN [4]	2 ASCII characters per register
40123	[15:0]	R	SFP LOCAL Focal SN [5]	2 ASCII characters per register
40124	[15:0]	R	SFP LOCAL Focal SN [6]	2 ASCII characters per register
40125	[15:0]	R	SFP LOCAL Focal SN [7]	2 ASCII characters per register
40126	[15:0]	R	SFP LOCAL Diagnostic Monitoring Type	Bit 14, 1= Diagnostic Monitoring Implemented Bit 13, 1= Internally Calibrated Bit 12, 1= Externally Calibrated Bit 7, 1 = Alarm/Warning Flags Implemented Bit 6, 1= Soft Tx Disable Control Implemented There are no reserved Modbus registers for external calibrated values. More details in SFF-8472 document. Note: Externally calibrated SFPs are only supported on units with Micro FW >=0xA6 with PCBA Rev.3
40127	[15:0]	R	SFP REMOTE Vendor Name [0]	2 ASCII characters per register
40128	[15:0]	R	SFP REMOTE Vendor Name [1]	2 ASCII characters per register
40129	[15:0]	R	SFP REMOTE Vendor Name [2]	2 ASCII characters per register
40130	[15:0]	R	SFP REMOTE Vendor Name [3]	2 ASCII characters per register
40131	[15:0]	R	SFP REMOTE Vendor Name [4]	2 ASCII characters per register

SFP Vendor Information				
40132	[15:0]	R	SFP REMOTE Vendor Name [5]	2 ASCII characters per register
40133	[15:0]	R	SFP REMOTE Vendor Name [6]	2 ASCII characters per register
40134	[15:0]	R	SFP REMOTE Vendor Name [7]	2 ASCII characters per register
40135	[15:0]	R	SFP REMOTE Vendor Part Number [0]	2 ASCII characters per register
40136	[15:0]	R	SFP REMOTE Vendor Part Number [1]	2 ASCII characters per register
40137	[15:0]	R	SFP REMOTE Vendor Part Number [2]	2 ASCII characters per register
40138	[15:0]	R	SFP REMOTE Vendor Part Number [3]	2 ASCII characters per register
40139	[15:0]	R	SFP REMOTE Vendor Part Number [4]	2 ASCII characters per register
40140	[15:0]	R	SFP REMOTE Vendor Part Number [5]	2 ASCII characters per register
40141	[15:0]	R	SFP REMOTE Vendor Part Number [6]	2 ASCII characters per register
40142	[15:0]	R	SFP REMOTE Vendor Part Number [7]	2 ASCII characters per register
40143	[15:0]	R	SFP REMOTE Vendor Rev Number [0]	2 ASCII characters per register
40144	[15:0]	R	SFP REMOTE Vendor Rev Number [1]	2 ASCII characters per register
40145	[15:0]	R	SFP REMOTE Wavelength	
40146	[15:0]	R	SFP REMOTE Serial Number [0]	
40147	[15:0]	R	SFP REMOTE Serial Number [1]	
40148	[15:0]	R	SFP REMOTE Serial Number [2]	
40149	[15:0]	R	SFP REMOTE Serial Number [3]	
40150	[15:0]	R	SFP REMOTE Serial Number [4]	
40151	[15:0]	R	SFP REMOTE Serial Number [5]	
40152	[15:0]	R	SFP REMOTE Serial Number [6]	
40153	[15:0]	R	SFP REMOTE Serial Number [7]	
40154	[15:0]	R	SFP REMOTE Date Code [0]	2 ASCII characters per register
40155	[15:0]	R	SFP REMOTE Date Code [1]	2 ASCII characters per register
40156	[15:0]	R	SFP REMOTE Date Code [2]	2 ASCII characters per register
40157	[15:0]	R	SFP REMOTE Date Code [3]	2 ASCII characters per register
40158	[15:0]	R	SFP REMOTE Focal PN [0]	2 ASCII characters per register
40159	[15:0]	R	SFP REMOTE Focal PN [1]	2 ASCII characters per register
40160	[15:0]	R	SFP REMOTE Focal PN [2]	2 ASCII characters per register
40161	[15:0]	R	SFP REMOTE Focal PN [3]	2 ASCII characters per register
40162	[15:0]	R	SFP REMOTE Focal PN [4]	2 ASCII characters per register
40163	[15:0]	R	SFP REMOTE Focal PN [5]	2 ASCII characters per register
40164	[15:0]	R	SFP REMOTE Focal PN [6]	2 ASCII characters per register
40165	[15:0]	R	SFP REMOTE Focal PN [7]	2 ASCII characters per register
40166	[15:0]	R	SFP REMOTE Focal SN [0]	2 ASCII characters per register
40167	[15:0]	R	SFP REMOTE Focal SN [1]	2 ASCII characters per register
40168	[15:0]	R	SFP REMOTE Focal SN [2]	2 ASCII characters per register
40169	[15:0]	R	SFP REMOTE Focal SN [3]	2 ASCII characters per register
40170	[15:0]	R	SFP REMOTE Focal SN [4]	2 ASCII characters per register
40171	[15:0]	R	SFP REMOTE Focal SN [5]	2 ASCII characters per register
40172	[15:0]	R	SFP REMOTE Focal SN [6]	2 ASCII characters per register
40173	[15:0]	R	SFP REMOTE Focal SN [7]	2 ASCII characters per register

SFP Vendor Information				
40174	[15:0]	R	SFP REMOTE Diagnostic Monitoring Type	Bit 14, 1= Diagnostic Monitoring Implemented Bit 13, 1= Internally Calibrated Bit 12, 1= Externally Calibrated Bit 7, 1 = Alarm/Warning Flags Implemented Bit 6, 1= Soft Tx Disable Control Implemented There are no reserved Modbus registers for external calibrated values. More details in SFF-8472 document.

Ethernet PHY Control				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40175	15	R	Reserved	Ethernet PHY Control Register
	14	R	Reserved	
	13	R	Reserved	
	12	R	Reserved	
	11	R	Reserved	
	10	R	Reserved	
	9	R	Reserved	
	8	R	Reserved	
	7	R	Reserved	
	6	R	Reserved	
	5	R	Reserved	
	4	R	Reserved	
	3	R	Reserved	
	2	R	Reserved	
	1	R	Reserved	
	0	R	Reserved	

CAN Bus and I2C Status Registers				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40176	[15:0]	R/W	Reserved	
40177	[15:0]	R/W	System Status Local	1 System Voltages OK 2 Voltages Out of Range
40178	[15:0]	R/W	Reserved	
40179	[15:0]	R	CAN Activity Local	1 CAN Activity 0 No CAN Activity
40180	[15:0]	R	Reserved	
40181	[15:0]	R	Reserved	
40182	[15:0]	R/W	System Status Remote	1 System Voltages OK 2 Voltages Out of Range
40183	[15:0]	R/W	Reserved	
40184	[15:0]	R	Reserved	
40185	[15:0]	R	Reserved	
40186	[15:0]	R	Reserved	
40187	[15:0]		Reserved	
40188	[15:0]		Reserved	
40189	[15:0]		CAN Activity Remote	1 CAN Activity 0 No CAN Activity
40190	[15:0]	R	I2C Error Counter Local	16-bit value that indicates the number of I2C errors detected after power up. The counter is reset after a power cycle or after the max count is reached.
40191	[15:0]	R	I2C Error Counter Remote	16-bit value that indicates the number of I2C errors detected after power up. The counter is reset after a power cycle or after the max count is reached.
40192	[15:0]	R/W	Trigger Packet Counter Reset	1= Reset Packet Counter 0= Normal Operation

Board Serial Numbers Local				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40198	[15:0]	R	Board Serial Number [0]	
40199	[15:0]	R	Board Serial Number [1]	
40200	[15:0]	R	Board Serial Number [2]	
40201	[15:0]	R	Board Serial Number [3]	
40202	[15:0]	R	Board Serial Number [4]	
40203	[15:0]	R	Board Serial Number [5]	
40204	[15:0]	R	Board Serial Number [6]	
40205	[15:0]	R	Board Serial Number [7]	
40206	[15:0]	R	Board Date Code [0]	
40207	[15:0]	R	Board Date Code [1]	
40208	[15:0]	R	Board Date Code [2]	
40209	[15:0]	R	Board Date Code [3]	
40210	[15:0]	R	Board Date Code [4]	
40211	[15:0]	R	Board Date Code [5]	
40212	[15:0]	R	Board Date Code [6]	
40213	[15:0]	R	Board Date Code [7]	

Board Serial Numbers Local				
40214	[15:0]	R	Board Assembly Number [0]	
40215	[15:0]	R	Board Assembly Number [1]	
40216	[15:0]	R	Board Assembly Number [2]	
40217	[15:0]	R	Board Assembly Number [3]	
40218	[15:0]	R	Board Assembly Number [4]	
40219	[15:0]	R	Board Assembly Number [5]	
40220	[15:0]	R	Board Assembly Number [6]	
40221	[15:0]	R	Board Assembly Number [7]	
40222	[15:0]	R	Board PCB Number [0]	
40223	[15:0]	R	Board PCB Number [1]	
40224	[15:0]	R	Board PCB Number [2]	
40225	[15:0]	R	Board PCB Number [3]	
40226	[15:0]	R	Board PCB Number [4]	
40227	[15:0]	R	Board PCB Number [5]	
40228	[15:0]	R	Board PCB Number [6]	
40229	[15:0]	R	Board PCB Number [7]	

Board Serial Numbers Remote				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40230	[15:0]	R	Board Serial Number [0]	
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]	

Board Serial Numbers Remote				
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]	

Local/ Remote PHY & FPGA Registers				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
40262 - 40389	[15:0]	R	ETHERNET PHY Registers Local	Used for Transferring Diagnostics Between Local And Remote
40390 - 40645	[15:0]	R/W	FPGA Registers Local	Used for Transferring Diagnostics Between Local And Remote
40646 - 40773	[15:0]	R	ETHERNET PHY Registers Remote	Used for Transferring Diagnostics Between Local And Remote
40774 - 41029	[15:0]	R/W	FPGA Registers Remote	Used for Transferring Diagnostics Between Local And Remote

Externally Calibrated SFP Registers (Local & Remote) *Only supported on Micro Firmware Version >=0xA6 with PCBAs Rev.3*				
Register Number	**Bit**	**R/W**	**Description**	**Comments**
41100	[15:0]	R	RX Power Calibration Constant 4 SFP-Local [0]	
41101	[15:0]	R	RX Power Calibration Constant 4 SFP-Local [1]	
41102	[15:0]	R	RX Power Calibration Constant 3 SFP-Local [0]	
41103	[15:0]	R	RX Power Calibration Constant 3 SFP-Local [1]	
41104	[15:0]	R	RX Power Calibration Constant 2 SFP-Local [0]	
41105	[15:0]	R	RX Power Calibration Constant 2 SFP-Local [1]	
41106	[15:0]	R	RX Power Calibration Constant 1 SFP-Local [0]	
41107	[15:0]	R	RX Power Calibration Constant 1 SFP-Local [1]	
41108	[15:0]	R	RX Power Calibration Constant 0 SFP-Local [0]	
41109	[15:0]	R	RX Power Calibration Constant 0 SFP-Local [1]	
41110	[15:0]	R	TX Current Slope SFP-Local	
41111	[15:0]	R	TX Current Offset SFP-Local	
41112	[15:0]	R	TX Power Slope SFP-Local	
41113	[15:0]	R	TX Power Offset SFP-Local	
41114	[15:0]	R	Temperature Slope SFP-Local	
41115	[15:0]	R	Temperature Offset SFP-Local	
41116	[15:0]	R	Voltage Slope SFP-Local	
41117	[15:0]	R	Voltage Offset SFP-Local	
41120	[15:0]	R	RX Power Calibration Constant 4 SFP-Remote [0]	
41121	[15:0]	R	RX Power Calibration Constant 4 SFP-Remote [1]	
41122	[15:0]	R	RX Power Calibration Constant 3 SFP-Remote [0]	
41123	[15:0]	R	RX Power Calibration Constant 3 SFP-Remote [1]	
41124	[15:0]	R	RX Power Calibration Constant 2 SFP-Remote [0]	
41125	[15:0]	R	RX Power Calibration Constant 2 SFP-Remote [1]	
41126	[15:0]	R	RX Power Calibration Constant 1 SFP-Remote [0]	
41127	[15:0]	R	RX Power Calibration Constant 1 SFP-Remote [1]	
41128	[15:0]	R	RX Power Calibration Constant 0 SFP-Remote [0]	
41129	[15:0]	R	RX Power Calibration Constant 0 SFP-Remote [1]	
41130	[15:0]	R	TX Current Slope SFP-Remote	
41131	[15:0]	R	TX Current Offset SFP-Remote	
41132	[15:0]	R	TX Power Slope SFP-Remote	
41133	[15:0]	R	TX Power Offset SFP-Remote	
41134	[15:0]	R	Temperature Slope SFP-Remote	
41135	[15:0]	R	Temperature Offset SFP-Remote	
41136	[15:0]	R	Voltage Slope SFP-Remote	
41137	[15:0]	R	Voltage Offset SFP-Remote	

Table 15: FPGA Register Map

FPGA Register Map			
Register Name	**Address (dec)**	**RW/ RO**	**Description**
ID	0	RO	Identification Number Default = 01
Reserved	1	RO	
FPGA Version	2	RO	FPGA Version Number
Optical Link Status	3	RO	Status from the FPGA SERDES [7]: reserved [6]: rx_cdr_lol_diag SERDES Receive Clock and Data Recovery Loss of Lock [5]: lsm_status_diag SERDES State Machine Status [4]: ffs_rlos_lo_diag SERDES Receive Loss of Signal [3]: rx_disp_err_detect_diag SERDES Even / odd disparity error detection [2]: rx_cv_err_diag SERDES Receive Comma Value error [1]: tx_pll_lol_qd_diag Transmit SERDES PLL Loss of Lock [0]: rx_link_valid_diag Valid Optical Link as perceived by the FPGA.
Reserved	4	RO	
Power Up Value	5	RO	Set to 0xAA (170 dec) at power up or global reset, clears to 0xBB (187 dec) after statistics have been cleared via user intervention at FPGA reg[244]. This allows the user during a debug process to differentiate between a 'live' problem and normal transitions during the power up process. It can also indicate if the unit has been inadvertently power cycled or reset.
Reserved	9-6	RO	
Ethernet Channel 1 LED 0	10	RO	[7:1]: reserved [0]: LED driver from channel 1 PHY
Ethernet Channel 2 LED 0	11	RO	[7:1]: reserved [0]: LED driver from channel 2 PHY
Ethernet Channel 3 LEDs and reset. (GBE PHY)	12	RO	[7:3]: reserved [2]: gig_phy_led2 [1]: gig_phy_led1 [0]: gig_phy_reset_n
RJ45 LEDs	13	RO	LED status of RJ45s [7]: gig_rj45_green_left_n [6]: gig_rj45_yellow_left_n [5]: gig_rj45_green_right_n [4]: gig_rj45_yellow_right_n [3]: eth_100_ch2_green_led_n [2]: eth_100_ch2_yellow_led_n [1]: eth_100_ch1_green_led_n [0]: eth_100_ch1_yellow_led_n
Reserved	15-14	RO	
Ethernet Channel 1 Local Status	16	RO	Status from local Ethernet channel 1 PHY device: [7:6]: reserved (00) [5]: 1 = Rx Cable Detected [4]: 1 = Transmitter Disabled [3]: Reserved (0) [2]: 1 = Linked at 100 BASE-TX [1]: 1 = Linked at 10 BASE-T [0]: 1 = Linked

FPGA Register Map			
Ethernet Channel 2 Local Status	17	RO	Status from local Ethernet channel 2 PHY device: [7:6]: reserved (00) [5]: 1 = Rx Cable Detected [4]: 1 = Transmitter Disabled [3]: Reserved (0) [2]: 1 = Linked at 100 BASE-TX [1]: 1 = Linked at 10 BASE-T [0]: 1 = Linked
Ethernet Channel 3 Local Status	18	RO	Status from local Ethernet channel 3 PHY device: [7:6]: reserved (00) [5]: 1 = Rx Cable Detected [4]: 1 = Transmitter Disabled [3]: 1 = Linked at 1000 BASE-T [2]: 1 = Linked at 100 BASE-TX [1]: 1 = Linked at 10 BASE-T [0]: 1 = Linked
Ethernet Channel 1 Far Side Status	19	RO	Status from far side Ethernet channel 1 PHY device: [7:6]: reserved (00) [5]: 1 = Rx Cable Detected [4]: 1 = Transmitter Disabled [3]: Reserved (0) [2]: 1 = Linked at 100 BASE-TX [1]: 1 = Linked at 10 BASE-T [0]: 1 = Linked
Ethernet Channel 2 Far Side Status	20	RO	Status from far side Ethernet channel 2 PHY device: [7:6]: reserved (00) [5]: 1 = Rx Cable Detected [4]: 1 = Transmitter Disabled [3]: Reserved (0) [2]: 1 = Linked at 100 BASE-TX [1]: 1 = Linked at 10 BASE-T [0]: 1 = Linked
Ethernet Channel 3 Far Side Status	21	RO	Status from far side Ethernet channel 3 PHY device: [7:6]: reserved (00) [5]: 1 = Rx Cable Detected [4]: 1 = Transmitter Disabled [3]: 1 = Linked at 1000 BASE-T [2]: 1 = Linked at 100 BASE-TX [1]: 1 = Linked at 10 BASE-T [0]: 1 = Linked
Reserved	23-22	RO	
Transmit Packet Count Ethernet Channel 1	27-24	RO	tx_packet_count[1][31:0]
Receive Packet Count Ethernet Channel 1	31-28	RO	rx_packet_count[1][31:0]
Transmit Packet Count Ethernet Channel 2	35-32	RO	tx_packet_count[2][31:0]
Receive Packet Count Ethernet Channel 2	39-36	RO	rx_packet_count[2][31:0]
Transmit Packet Count Ethernet Channel 3	43-40	RO	tx_packet_count[3][31:0]
Receive Packet Count Ethernet Channel 3	47-44	RO	rx_packet_count[3][31:0]
Optical Link loss Count (Firmware A9 or C2 only)	51-48	RO	Counts the number of fiber unlink events. [31:0]
Reserved	55-52	RO	
Reserved	59-56	RO	
Reserved	63-60	RO	

FPGA Register Map			
Local Channel 1 Link Status Change Counter (Firmware A9 or C2 only)	65-64	RO	Counts the number of link status change events for local channel 1. [15:0]
Local Channel 1 10 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	67-66	RO	Counts the number of link status change events @ 10 BASE-T for local channel 1. [15:0]
Local Channel 1 100 BASE-TX Link Status Change Counter (Firmware A9 or C2 only)	69-68	RO	Counts the number of link status change events @ 100 BASE-TX for local channel 1. [15:0]
Local Channel 1 1000 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	71-70	RO	Counts the number of link status change events @ 1000 BASE-T for local channel 1. [15:0]
Local Channel 1 Tx Transmitter Disable Status Change Counter (Firmware A9 or C2 only)	73-72	RO	Counts the number of Tx Transmitter Disable status changes for local channel 1. [15:0]
Local Channel 1 Rx Cable Detect Status Change Counter (Firmware A9 or C2 only)	75-74	RO	Counts the number of Rx Cable Detect status changes for local channel 1. [15:0]
Local Channel 2 Link Status Change Counter (Firmware A9 or C2 only)	77-76	RO	Counts the number of link status change events for local channel 2. [15:0]
Local Channel 2 10 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	79-78	RO	Counts the number of link status change events @ 10 BASE-T for local channel 2. [15:0]
Local Channel 2 100 BASE-TX Link Status Change Counter (Firmware A9 or C2 only)	81-80	RO	Counts the number of link status change events @ 100 BASE-TX for local channel 2. [15:0]
Local Channel 2 1000 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	83-82	RO	Counts the number of link status change events @ 1000 BASE-T for local channel 2. [15:0]
Local Channel 2 Tx Transmitter Disable Status Change Counter (Firmware A9 or C2 only)	85-84	RO	Counts the number of Tx Transmitter Disable status changes for local channel 2. [15:0]
Local Channel 2 Rx Cable Detect Status Change Counter (Firmware A9 or C2 only)	87-86	RO	Counts the number of Rx Cable Detect status changes for local channel 2. [15:0]
Local Channel 3 Link Status Change Counter (Firmware A9 or C2 only)	89-88	RO	Counts the number of link status change events for local channel 3. [15:0]
Local Channel 3 10 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	91-90	RO	Counts the number of link status change events @ 10 BASE-T for local channel 3. [15:0]
Local Channel 3 100 BASE-TX Link Status Change Counter (Firmware A9 or C2 only)	93-92	RO	Counts the number of link status change events @ 100 BASE-TX for local channel 3. [15:0]

FPGA Register Map			
Local Channel 3 1000 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	95-94	RO	Counts the number of link status change events @ 1000 BASE-T for local channel 3. [15:0]
Local Channel 3 Tx Transmitter Disable Status Change Counter (Firmware A9 or C2 only)	97-96	RO	Counts the number of Tx Transmitter Disable status changes for local channel 3. [15:0]
Local Channel 3 Rx Cable Detect Status Change Counter (Firmware A9 or C2 only)	99-98	RO	Counts the number of Rx Cable Detect status changes for local channel 3. [15:0]
Far Side Channel 1 Link Status Change Counter (Firmware A9 or C2 only)	101-100	RO	Counts the number of link status change events for far side channel 1. [15:0]
Far Side Channel 1 10 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	103-102	RO	Counts the number of link status change events @ 10 BASE-T for far side channel 1. [15:0]
Far Side Channel 1 100 BASE-TX Link Status Change Counter (Firmware A9 or C2 only)	105-104	RO	Counts the number of link status change events @ 100 BASE-TX for far side channel 1. [15:0]
Far Side Channel 1 1000 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	107-106	RO	Counts the number of link status change events @ 1000 BASE-T for far side channel 1. [15:0]
Far Side Channel 1 Tx Transmitter Disable Status Change Counter (Firmware A9 or C2 only)	109-108	RO	Counts the number of Tx Transmitter Disable status changes for far side channel 1. [15:0]
Far Side Channel 1 Rx Cable Detect Status Change Counter (Firmware A9 or C2 only)	111-110	RO	Counts the number of Rx Cable Detect status changes for far side channel 1. [15:0]
Far Side Channel 2 Link Status Change Counter (Firmware A9 or C2 only)	113-112	RO	Counts the number of link status change events for far side channel 2. [15:0]
Far Side Channel 2 10 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	115-114	RO	Counts the number of link status change events @ 10 BASE-T for far side channel 2. [15:0]
Far Side Channel 2 100 BASE-TX Link Status Change Counter (Firmware A9 or C2 only)	117-116	RO	Counts the number of link status change events @ 100 BASE-TX for far side channel 2. [15:0]
Far Side Channel 2 1000 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	119-118	RO	Counts the number of link status change events @ 1000 BASE-T for far side channel 2. [15:0]
Far Side Channel 2 Tx Transmitter Disable Status Change Counter (Firmware A9 or C2 only)	121-120	RO	Counts the number of Tx Transmitter Disable status changes for far side channel 2. [15:0]
Far Side Channel 3 Rx Cable Detect Status Change Counter (Firmware A9 or C2 only)	123-122	RO	Counts the number of Rx Cable Detect status changes for far side channel 2. [15:0]

FPGA Register Map			
Far Side Channel 3 Link Status Change Counter (Firmware A9 or C2 only)	125-124	RO	Counts the number of link status change events for far side channel 3. [15:0]
Far Side Channel 3 10 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	127-126	RO	Counts the number of link status change events @ 10 BASE-T for far side channel 3. [15:0]
Far Side Channel 3 100 BASE-TX Link Status Change Counter (Firmware A9 or C2 only)	129-128	RO	Counts the number of link status change events @ 100 BASE-TX for far side channel 3. [15:0]
Far Side Channel 3 1000 BASE-T Link Status Change Counter (Firmware A9 or C2 only)	131-130	RO	Counts the number of link status change events @ 1000 BASE-T for far side channel 3. [15:0]
Far Side Channel 3 Tx Transmitter Disable Status Change Counter (Firmware A9 or C2 only)	133-132	RO	Counts the number of Tx Transmitter Disable status changes for far side channel 3. [15:0]
Far Side Channel 3 Rx Cable Detect Status Change Counter (Firmware A9 or C2 only)	135-134	RO	Counts the number of Rx Cable Detect status changes for far side channel 3. [15:0]
Local MUX Channel 1 FIFO Almost Full Change Counter (Firmware A9 or C2 only)	137-136	RO	Counts the number of almost full changes for the local channel 1 MUX FIFO. [15:0]
Local MUX Channel 2 FIFO Almost Full Change Counter (Firmware A9 or C2 only)	139-138	RO	Counts the number of almost full changes for the local channel 2 MUX FIFO. [15:0]
Local MUX Channel 3 FIFO Almost Full Change Counter (Firmware A9 or C2 only)	141-140	RO	Counts the number of almost full changes for the local channel 3 MUX FIFO. [15:0]
Local DEMUX Channel 1 FIFO Almost Full Change Counter (Firmware A9 or C2 only)	143-142	RO	Counts the number of almost full changes for the local channel 1 DEMUX FIFO. [15:0]
Local DEMUX Channel 2 FIFO Almost Full Change Counter (Firmware A9 or C2 only)	145-144	RO	Counts the number of almost full changes for the local channel 2 DEMUX FIFO. [15:0]
Local DEMUX Channel 3 FIFO Almost Full Change Counter (Firmware A9 or C2 only)	147-146	RO	Counts the number of almost full changes for the local channel 3 DEMUX FIFO. [15:0]
Local MUX FIFO fill level for Channel 1 (Firmware A9 or C2 only)	149-148	RO	Instantaneous fill level of the local channel 1 MUX FIFO. [15:0]
Local MUX FIFO fill level for Channel 2 (Firmware A9 or C2 only)	151-150	RO	Instantaneous fill level of the local channel 2 MUX FIFO. [15:0]
Local MUX FIFO fill level for Channel 3 (Firmware A9 or C2 only)	153-152	RO	Instantaneous fill level of the local channel 3 MUX FIFO. [15:0]
Local DEMUX FIFO fill level for Channel 1 (Firmware A9 or C2 only)	155-154	RO	Instantaneous fill level of the local channel 1 DEMUX FIFO. [15:0]

FPGA Register Map			
Local DEMUX FIFO fill level for Channel 2 (Firmware A9 or C2 only)	157-156	RO	Instantaneous fill level of the local channel 2 DEMUX FIFO. [15:0]
Local DEMUX FIFO fill level for Channel 3 (Firmware A9 or C2 only)	159-158	RO	Instantaneous fill level of the local channel 3 DEMUX FIFO. [15:0]
Local MUX Channel 3 FIFO bit[3] Fill Level Transition Counter (Firmware A9 or C2 only)	161-160	RO	Transitions of the fill level bit[3] for MUX channel 3 FIFO fill level. [15:0]
Local MUX Channel 2 FIFO bit[3] Fill Level Transition Counter (Firmware A9 or C2 only)	163-162	RO	Transitions of the fill level bit[3] for MUX channel 2 FIFO fill level. [15:0]
Local MUX Channel 1 FIFO bit[3] Fill Level Transition Counter (Firmware A9 or C2 only)	165-164	RO	Transitions of the fill level bit[3] for MUX channel 1 FIFO fill level. [15:0]
Local DEMUX Channel 3 FIFO bit[3] Fill Level Transition Counter (Firmware A9 or C2 only)	167-166	RO	Transitions of the fill level bit[3] for DEMUX channel 3 FIFO fill level. [15:0]
Local DEMUX Channel 2 FIFO bit[3] Fill Level Transition Counter (Firmware A9 or C2 only)	169-168	RO	Transitions of the fill level bit[3] for DEMUX channel 2 FIFO fill level. [15:0]
Local DEMUX Channel 1 FIFO bit[3] Fill Level Transition Counter (Firmware A9 or C2 only)	171-170	RO	Transitions of the fill level bit[3] for DEMUX channel 1 FIFO fill level. [15:0]
Local MUX Channel 1 FIFO Max Value (Firmware A9 or C2 only)	173-172	RO	Records the maximum fill level reached for MUX Channel 1 FIFO. [15:0]
Local MUX Channel 2 FIFO Max Value (Firmware A9 or C2 only)	175-174	RO	Records the maximum fill level reached for MUX Channel 2 FIFO. [15:0]
Local MUX Channel 3 FIFO Max Value (Firmware A9 or C2 only)	177-176	RO	Records the maximum fill level reached for MUX Channel 3 FIFO. [15:0]
Local DEMUX Channel 1 FIFO Max Value (Firmware A9 or C2 only)	179-178	RO	Records the maximum fill level reached for DEMUX Channel 1 FIFO. [15:0]
Local DEMUX Channel 2 FIFO Max Value (Firmware A9 or C2 only)	181-180	RO	Records the maximum fill level reached for DEMUX Channel 2 FIFO. [15:0]
Local DEMUX Channel 3 FIFO Max Value (Firmware A9 or C2 only)	183-182	RO	Records the maximum fill level reached for DEMUX Channel 3 FIFO. [15:0]
DEMUX Channel 1 discard Counter (Firmware A9 or C2 only)	185-184	RO	Records the number of frames discarded at the DEMUX for channel 1 due to congestion.
DEMUX Channel 2 discard Counter (Firmware A9 or C2 only)	187-186	RO	Records the number of frames discarded at the DEMUX for channel 2 due to congestion.
DEMUX Channel 3 discard Counter (Firmware A9 or C2 only)	189-188	RO	Records the number of frames discarded at the DEMUX for channel 3 due to congestion.
MII Management interface Read Error Counter (Firmware A9 or C2 only)	191-190	RO	Counts the number of read failures for the Ethernet PHY management interface. [15:0]

FPGA Register Map			
Local Channel 1 Unlink while Far Side is Linked Counter (Firmware A9 or C2 only)	193-192	RO	Counts the number of local unlinks while the far side is linked, this indicates a local link issue. [15:0]
Local Channel 2 Unlink while Far Side is Linked Counter (Firmware A9 or C2 only)	195-194	RO	Counts the number of local unlinks while the far side is linked, this indicates a local link issue. [15:0]
Local Channel 3 Unlink while Far Side is Linked Counter (Firmware A9 or C2 only)	197-196	RO	Counts the number of local unlinks while the far side is linked, this indicates a local link issue. [15:0]
Far Side Channel 1 Unlink while Local Side is Linked Counter (Firmware A9 or C2 only)	199-198	RO	Counts the number of far side unlinks while the local side is linked, this indicates a far side link issue. [15:0]
Far Side Channel 2 Unlink while Local Side is Linked Counter (Firmware A9 or C2 only)	201-200	RO	Counts the number of far side unlinks while the local side is linked, this indicates a far side link issue. [15:0]
Far Side Channel 3 Unlink while Local Side is Linked Counter (Firmware A9 or C2 only)	203-202	RO	Counts the number of far side unlinks while the local side is linked, this indicates a far side link issue. [15:0]
Local Channel 1 Unlink Duration (Firmware A9 or C2 only)	207-204	RO	Counter to indicate the duration of the first local unlink event. [31:0] Duration = Count * 16 ns (625M optical link) or Duration = Count * 8 ns (2.5G optical link)
Local Channel 2 Unlink Duration (Firmware A9 or C2 only)	211-208	RO	Counter to indicate the duration of the first local unlink event. [31:0] Duration = Count * 16 ns (625M optical link) or Duration = Count * 8 ns (2.5G optical link).
Local Channel 3 Unlink Duration (Firmware A9 or C2 only)	215-212	RO	Counter to indicate the duration of the first local unlink event. [31:0] Duration = Count * 16 ns (625M optical link) or Duration = Count * 8 ns (2.5G optical link).
Channel 1 unlink before Channel 2 Unlink Counter (Firmware A9 or C2 only)	217-216	RO	Counter to indicate how many times channel 1 unlinked before Channel 2. [15:0]
Channel 1 unlink before Channel 3 Unlink Counter (Firmware A9 or C2 only)	219-218	RO	Counter to indicate how many times channel 1 unlinked before Channel 3. [15:0]
Channel 2 unlink before Channel 1 Unlink Counter (Firmware A9 or C2 only)	221-220	RO	Counter to indicate how many times channel 2 unlinked before Channel 1. [15:0]
Channel 2 unlink before Channel 3 Unlink Counter (Firmware A9 or C2 only)	223-222	RO	Counter to indicate how many times channel 2 unlinked before Channel 3. [15:0]
Channel 3 unlink before Channel 1 Unlink Counter (Firmware A9 or C2 only)	225-224	RO	Counter to indicate how many times channel 3 unlinked before Channel 1. [15:0]
Channel 3 unlink before Channel 2 Unlink Counter (Firmware A9 or C2 only)	227-226	RO	Counter to indicate how many times channel 3 unlinked before Channel 2. [15:0]
Reserved	243-228	RW	
Statistics Reset	244	RW	[7:1]: reserved [0]: reset_statistics 1 = Reset all packet counts 0 = Normal operation

FPGA Register Map			
Diagnostic PHY Register Write Command	245	RW	[7:6]: reserved [5]: diag_phy_write_enable (active high) [4:0]: diag_phy_write_register_address Takes the data from the corresponding register in the RW section of the diagnostic PHY register and writes it to the PHY. A write to register zero will cause the data located at register 64 within the diagnostic PHY data I2C device address to be written to the PHY.
Reserved	255-246	RW	

6.0 Installation and Operation

6.1 Installation

The Model 920 EDM is intended to be installed on a DIN rail with the DIN mount adaptor on the rear on the enclosure.

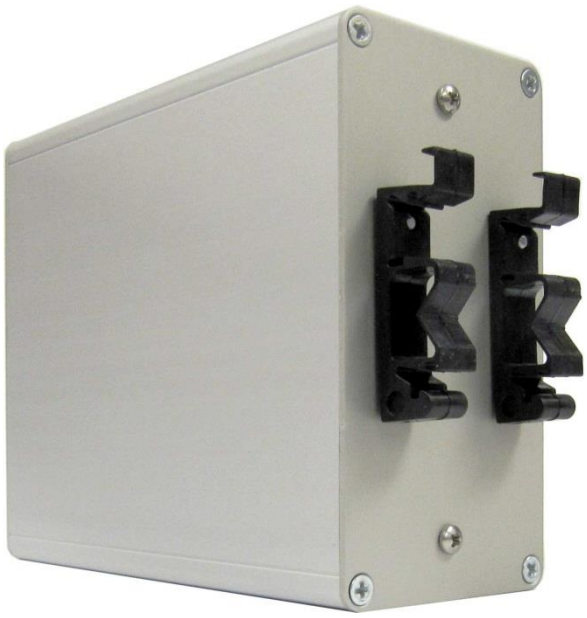

Figure 15: Model 920 EDM Rear with DIN Rail Mount Adaptors

When mounting, disassembling, or reassembling the Model 920 EDM, ensure that no fibers are subjected to bends in excess of those held by the natural routing of the fibers. The minimum bend radius of the fibers should generally be no less than 25 mm, though single partial bends may be less than this – as low as 15 mm – without damaging the fiber. Allowable long term values for bend radius are dependent on the fiber type and environment. Avoid even temporary bends with a radius less than 15 mm, which may affect the long-term reliability of the fiber.

It is important that the 8-lead power and CANbus cable is properly assembled with no exposed conductors and appropriate strain relief. The power and data leads must be twisted in pairs, 24V IN with GND, 24V OUT with GND OUT, and CANL with CANH. The cable assembly must not put undue stress or torque on the connector or the modem itself. Suggested cable harness receptacles and crimp tools are listed in Section 2.2. All Materials must be corrosion resistant.

All Ethernet ports require 8 lead CAT5 or CAT6 cabling. Inspect all plugs for damage before installation. No excessive strain or torque should be applied to these cables, as this could damage the jack and/or modem.

6.2 Power

Power is provided through the 8-pin connector on the front panel. Please see Section 2.2.1 for more details.

6.3 Bench Test

Basic Link Operation

Basic operation of the uplink and downlink can be verified in a bench test simply by connecting fiber jumpers between the optical access bushings. The number of jumpers and the optical attenuation required depends on the optical configuration of the system under test. In some optical configurations, it may be required to use 5 or 10 dB optical attenuators placed between the fiber bushings on the remote modem and the bushings on the console modem to ensure the optical receivers are not saturated. Complete a flux budget calculation for your system, referring to the optical transmit power and receive overload level to determine whether optical attenuation is required or not.

After power is applied to the Model 920 EDM, the power LEDs should be on. A red Link LED usually indicates insufficient received optical power, typically due to excessive loss in the fiber link. Excessive loss may be caused by poor fiber connections (contaminated bushings, damaged fiber, damaged ferrules) or excessive fiber bends. It is good practice to carefully clean all fiber connections prior to mating them for testing.

If the basic optical link is present, there should be good Ethernet data continuity through the multiplexer system.

Optical Power Budget Test

1. To verify the near-to-far side flux budget (downlink), measure the transmit power of the near side modem by connecting the optical output directly to a calibrated optical power meter using a short, low-loss, singlemode test jumper. (Use 50 µm core multimode jumpers if it's a multimode system.)
2. Remove the test jumper and install a variable optical attenuator (VOAT) between the near and far side modems.
3. Adjust the VOAT until the red Link LED on either one of the modules turns on, then reduce the loss to the point where both green link LEDs are continuously on. A stable Ethernet connection is a good reference point.
4. Measure the optical power at the far side modem by connecting that end of the VOAT to the optical power meter. The difference between this value and the transmit power previously measured is an estimate of optical power budget. A spool of fiber used with the VOAT can also be used to simulate losses due to dispersion over long cable lengths.
5. Repeat steps 1-4 with connections reversed to verify the far side to near side optical budget (uplink).

6.4 Electrical and Environmental Specifications

Table 16: Electrical Specification

Electrical Specification	Min	Typ	Max	Units
Power Voltage (In)	20	24	28	Volts
Power Current (In)		0.16	0.30*	Amps
Power Voltage (Out)	20	24	28	Volts
Power Current (Out)		0.06	0.1	Amps

*Inrush Current

Table 17: Environmental Specification

Environmental Specification	Min	Typ	Max	Units
Temperature Range (Operational)	-10		+70	Celsius
Temperature Range (Storage)	-45		+85	Celsius
Humidity			85% RH, non-condensing	
Shock			30 g, 11 ms half sine, 3 axes	g
Vibration			5 g, 25-1000 Hz, 3 axes	g, Hz

6.5 Maintenance

The unit requires no routine maintenance or calibration for the specified performance. Maintenance of the units is limited to cleaning the various components using the methods described below.

Dust or dirt on the cards can be blown off using compressed air. If severe contamination of the cards should occur, they can be removed and cleaned using distilled water. Cards must be thoroughly dried before reapplying power.

In order to maintain optical performance, ensure the fiber optic connectors are kept clean. Use a suitable solvent, such as reagent grade isopropyl alcohol, and a lint free tissue paper, such as Kimwipes® EX-L, to carefully wipe any dirt off the face and barrel of the ceramic ferrules prior to making a connection.

Always replace dust caps on the Model 920 EDM fiber optic bushings when removing connectors. If bushings are left open, they should be cleared of dust with compressed air prior to reconnection. Fiber jumpers and pigtails should be periodically inspected for damage, such as nicks in the jackets or excessive bends.

The 8-pin power and CANbus connector is rated for 30 connection cycles. Avoid excessive and/or unnecessary mating cycles.

6.6 Model 920 EDM Product Handling

General Handling

Care must always be taken during the handling of the Model 920 EDM to ensure product integrity. The following guidelines should be observed while working it:

- Handle products at an ESD safe workstation with a clean surface
- Ensure fibers are not crimped or moved away from their intended routes
- Ensure any disconnected optical connectors are cleaned immediately prior to reconnection
- Do not exceed the recommended minimum fiber bend radius, even momentarily
- Mishandling may cause damage to the enclosure, the fiber bushing, DIN Mount connector, or internal components. The modems must always be handled appropriately during installation, operation, maintenance, storage, and transportation to ensure safe and problem free operation.
- Any visible damage or evidence of loose parts inside the enclosure requires removal of the modem from operation and investigation by qualified service personnel.t

7.0 Appendices

Part Number	Options	Order Code
920-8000-00	625Mb/s, MMF, 1310nm, 10DBM, DIAGNOSTICS	920-EDM-LS-MMJ13-10-DIN-F
920-8001-00	625Mb/s, MMF, 1550nm, 10DBM, DIAGNOSTICS	920-EDM-LS-MMJ15-10-DIN-F
920-8000-01	2.5Gb/s, MMF, 1310nm, 10DBM, DIAGNOSTICS	920-EDM-HS-MMJ13-10-DIN-F
920-8001-01	2.5Gb/s, MMF, 1550nm, 10DBM, DIAGNOSTICS	920-EDM-HS-MMJ15-10-DIN-F
920-8000-02	2.5Gb/s, SMF, 1310nm, 20DBM, DIAGNOSTICS	920-EDM-HS-SMJ13-20-DIN-F
920-8001-02	2.5Gb/s, SMF, 1550nm, 20DBM, DIAGNOSTICS	920-EDM-HS-SMJ15-20-DIN-F

Drawing	Document Number
Configuration Drawing	920-2003-00
Installation Drawing (600 Mb/s, 1310nm, MMF)	920-8000-00
Installation Drawing (600 Mb/s, 1550nm, MMF)	920-8001-00
Installation Drawing (2.5 Gb/s, 1310nm, MMF)	920-8000-01
Installation Drawing (2.5 Gb/s, 1550nm, MMF)	920-8001-01
Installation Drawing (2.5 Gb/s, 1310nm, SMF)	920-8000-02
Installation Drawing (2.5 Gb/s, 1550nm, SMF)	920-8001-02