1490nm and 1510nm 120km CWDM 10GE/OC-192 XFP Transceiver with Integrated Forward Error Correction

Applications

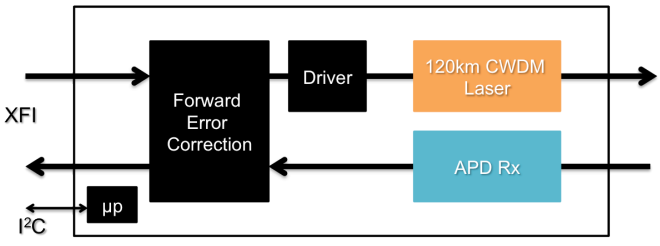
- 1490nm and 1510nm CWDM
- 10GBASE-EZR 10GEthernet
- 8GB/10GB Fibre Channel
- SONET OC-192
- SDH STM-64 ITU-T G.959.1 P1L1-2D2
- Ethernet Switch or IP Router Interconnect

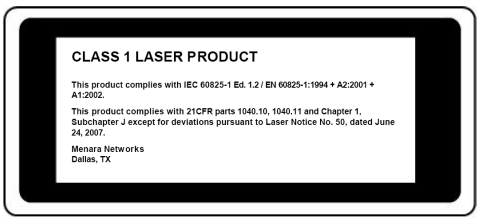
Features

- Hot-pluggable XFP footprint
- Support 9.95Gb/s to 10.35Gb/s bit rates
- 29dB back-to-back Link Budget, 27dB Link Budget over 120km fiber
- Integrated with Enhanced Forward Error Correction
- Pre-FEC Error Rate Calculation
- APD photodiode receiver
- Duplex LC fiber connectors
- 10GE, STM-64, OC-192 and 10G Fibre Channel protocol support
- Built-in PRBS Generator and Checker for self-link testing prior to turn-up
- Full Digital Optical Monitoring
- Metal enclosure for lower EMI
- Complies with RoHS directive (2002/95/EC)
- Compliant with XFP Electrical and Mechanical MSA INF-8077
- Laser Class 1 IEC/CDRH compliant

Description

Menara Networks' 4EZ0Ax-CW49 and -CW51 CWDM transceivers are designed for use in 10Gb/s to 11.1Gb/s links up to 120km over single mode fiber. The XFP module has an integrated ASIC that provides Forward Error Correction operation to extend the optical distance of the XFP signal. The module also supports complete digital diagnostics, loop backs, and PRBS testing that allows for self-testing and simplified turn-up. The XFP module supports 10G Ethernet applications along with SONET OC-192 and SDH STM-64 applications for Ethernet Switches, IP Routers or SONET/SDH optical interfaces. Digital Optical Monitoring interfaces are provided via the XFP standards compliant I^2C interface.





Transmitter E-O Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Host Data Rate	-	9.95	10.3125	10.52	Gb/s	-
Line Data Rate (with FEC)	-	10.709	11.049	11.32	Gb/s	
Side Mode Suppression Ratio	SMSR	30	-	-	dB	-
Wavelength Stability after Startup	$\Delta\lambda_{EOL}$	-5	-	+5	nm	
Average Optical Output Power	Po	0	-	+3	dBm	1
Extinction Ratio	Er	9.0	-	-	dB	-
Differential data Inputs swing	Vinpp	120	-	820	mV	2
Output Power After Disabled	-	-	-	-30	dBm	-
Output Eye Diagram	Compliant with ITU-T and IEEE recommendation MASK					

Receiver O-E Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Data Rate	-	9.95	10.3125	11.32	Gb/s	-
Operate Wavelength	-	1480	-	1520	nm	-
Sensitivity @ 11.05Gbps	Sen1			-29	dBm	1
Saturation	Ps	-7	-	-	dBm	1
Optical Path Penalty @ 11.05Gbps 1550ps/nm (1490nm)	OPP1			2	dB	1
Optical Path Penalty @ 11.05Gbps 1720ps/nm (1510nm)	OPP2			3.5	dB	1
LOS Asserted	-	-37	-	-	dBm	High level: Alarm
LOS De-Asserted	-	-	-	-30	dBm	
LOS Hysteresis	-	0.5	-	-	dB	

Notes

1 .Measured at PRBS 2^{31}-1, NRZ, BER≤10^{-12} 2. Internally AC coupled

Ordering Information

Part Number	ROHS Compliant	Operating Case Temperature
4EZ0A0x-CW49 (1490nm CWDM)	ROHS-6	-5 ~ +70°C
4EZ0A0x-CW51 (1510nm CWDM)	ROHS-6	-5 ~ +70°C

x = J for Juniper
x = C for Cisco
x = A for Alcatel
x = O for Cisco ONS

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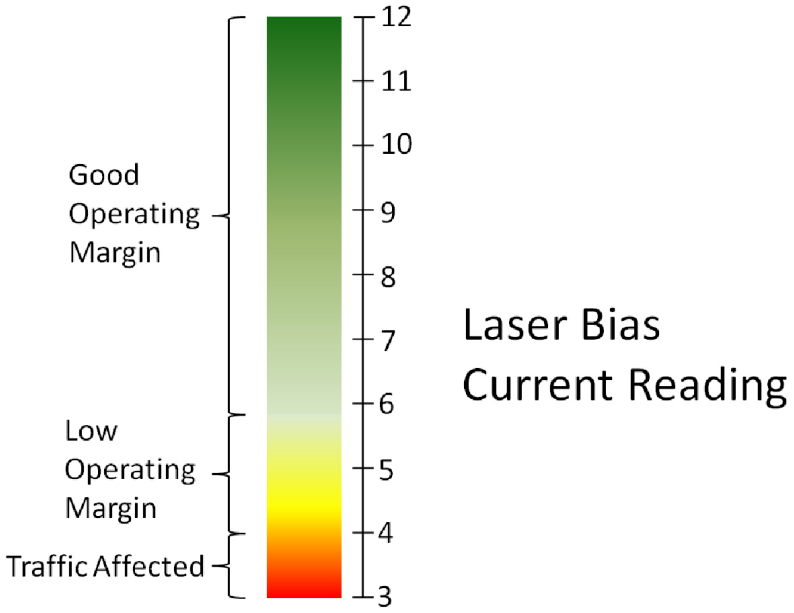
Link Checker Feature

The OTN XFP has the optional "Link Checker" feature, allowing the customer to proactively monitor the link performance margin in real time locally or remotely. Link Checker provides proactive alarms to alert the customer of a link falling below a pre-defined margin threshold, triggering an investigation of the optical layer to rectify the degradation before the customer takes errors. The user monitors Laser Bias Current to verify the health or margin on the OTN wavelength. The Link Checker margin can vary between 3 and 12, in which the higher the number the higher the margin. This is illustrated in the graph below.



As seen an OTN XFP DWDM channel with a Link Checker reading of 6 or higher is operating with a good operating margin. Between 4 and 6 the link margin is low and may be the indicator of a link problem on the DWDM system. At 4 or below traffic is affected or down on that link.

The link margin is supported through the reading of the FEC Correction Error Rate (FCER) in the XFP and displaying that margin as the Laser Bias Current value on the router. The FEC correction error rate is averaged over a 25 second rolling window by the module software. In the case of failure or no errors being corrected, the correction error rate is shown as 12.

The transposition of the correction error rate to laser bias current is shown below:
The FEC Correction BER can be represented as:
xx = Mantissa yy = Exponent
For example, an error correction error rate of $3x10^{-6}$
where the Mantissa xx = 3 and the Exponent yy = 6

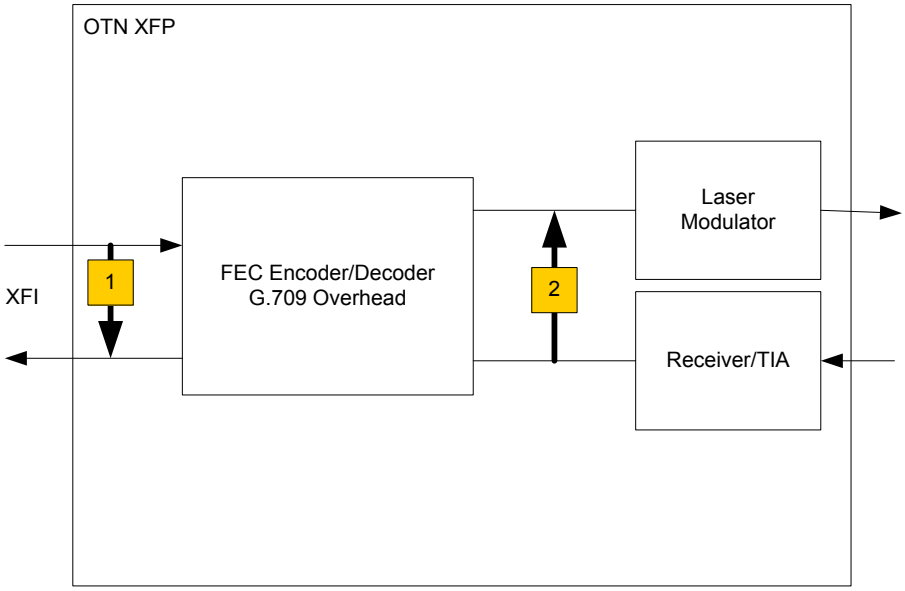
The Laser Bias Current on the router is then shown as = yy.xx mA

Therefore a FEC Correction Error Rate (FCER) of $3x10^{-6}$ is shown as a Laser Bias current of 6.3 mA
Any error rate <10-5 will raise a Laser Bias Low Alarm in the system, which is an early warning indicator to the NOC to proactively monitor and correct for a degraded link before errors are seen by the customer.

OTN XFP Loopbacks

OTN XFP supports both host and line loopbacks. The host loopback is designed to loopback traffic towards the host before processing by the FEC and G.709 overhead processor in the OTN XFP module. A line loopback loops the traffic towards the OTN fiber network before processing the FEC and G.709 overhead. Both loopbacks are completed in the FEC/G.709 ASIC.
All loopbacks are supported via the I2C interface.
The following loopbacks are supported:

1. Host Loopback (towards host). This is referred to as the XFI loopback in the XFF MSA Rev 4.5.
2. Line Loopback (towards OTN fiber network)

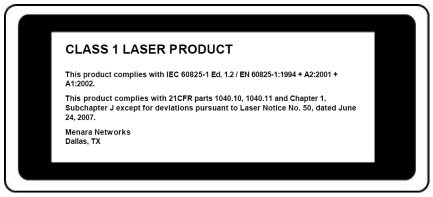


The XFP loopback settings are controlled according to the MSA XFP I2C interface using the following registers:

Table	Reg	Bits	Type	Category	Register Item	Feature Notes
Any	1	2	R/W	**Signal Conditioner**	Line Side Loopback	**0 = Normal Operation** 1 = Loopback Module Optical Input to Output
Any	1	1			XFI Loopback	**0 = Normal Operation** 1 = Loopback Module XFI Input to Output

Laser Safety

OTN XFP is compliant to IEC 60825-1 laser safety. The DWDM laser output is specified as a Class 1 output power as defined in IEC 60825-1.



CAUTION – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

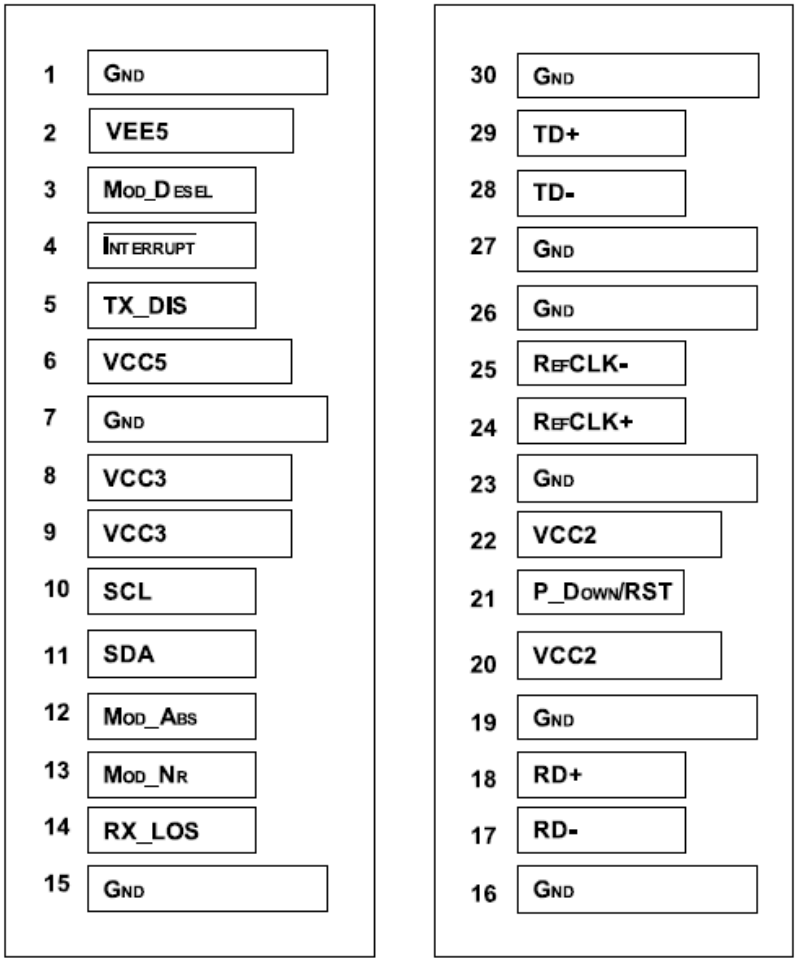
DOM Alarm Thresholds and I2C Locations

All Alarm Thresholds for OTN XFP are configured at the manufacturer and cannot be configured through the I2C interface (i.e. thresholds are not provisionable). Alarm thresholds for each DOM parameter are located in the following registers.

Threshold Value Register	Latched Alarm	Threshold Size (Bytes)	Name
02-03	80.7	2	Transceiver Temp High Alarm
04-05	80.6	2	Transceiver Temp Low Alarm
06-07	82.7	2	Transceiver Temp High Warning
08-09	82.6	2	Transceiver Temp Low Warning
10-17	N/A	8	Reserved
18-19	80.3	2	Laser Bias Current High Alarm
20-21	80.2	2	Laser Bias Current Low Alarm
22-23	82.3	2	Laser Bias Current High Warning
24-25	82.2	2	Laser Bias Current Low Warning
26-27	80.1	2	Laser Output Power High Alarm
28-29	80.0	2	Laser Output Power Low Alarm
30-31	82.1	2	Laser Output Power High Warning
32-33	82.0	2	Laser Output Power Low Warning
34-35	81.7	2	Receive Optical Power High Alarm
36-37	81.6	2	Receive Optical Power Low Alarm
38-39	83.7	2	Receive Optical Power High Warning
40-41	83.6	2	Receive Optical Power Low Warning
N/A	86.7	N/A	5V High Alarm
	86.6		5V Low Alarm
	86.5		3.3V High Alarm
	86.4		3.3V Low Alarm
	86.3		1.8V High Alarm
	86.2		1.8V Low Alarm
	86.1		-5V High Alarm (Not Used)
	86.0		-5V Low Alarm (Not Used)
	87.7		5V High Warning
	87.6		5V Low Warning
	87.5		3.3V High Warning
	87.4		3.3V Low Warning
	87.3		1.8V High Warning
	87.2		1.8V Low Warning
	87.1		-5V High Warning (Not Used)
	87.0		-5V Low Warning (Not Used)

Host Connector Specifications

The XFP PCB host electrical connections are shown in the figure below.



Bottom of Board
(As viewed thru top of board)

Top of Board

XFP PCB Electrical Connections

Pin No	Name	Logic	Function	Notes
1	GND		Electrical Ground	1
2	VEE5		Optional -5.2V power Supply (Not used)	
3	Mod_DeSel	LVTTL-I	Module De-select; When held low allows module to respond to 2-wire serial interface	
4	Interrupt	LVTTL-O	Interrupt; Indicates presence of an important condition which can be read over the 2-wire serial interface	2
5	Tx_DIS	LVTTL-I	Transmitter Disable; Turns off transmitter laser output	
6	VCC5		+5V Power Supply	
7	GND		Module Ground	1
8	VCC3		+3.3V Power Supply	
9	VCC3		+3.3V Power Supply	
10	SCL	LVTTL-I/O	2-Wire Serial Interface Clock	2
11	SDA	LVTTL-I/O	2-Wire Serial Interface Data Line	2
12	Mod_Abs	LVTTL-O	Indicates Module is not present. Grounded in the Module	2
13	Mod_NR	LVTTL-O	Module Not Ready; Indicating Module Operational Fault	2
14	RX_LOS	LVTTL-O	Receiver Loss Of Signal Indicator	2
15	GND		Module Ground	1
16	GND		Module Ground	1
17	RD-	CML-O	Receiver Inverted Data Output	
18	RD+	CML-O	Receiver Non-Inverted Data Output	
19	GND		Module Ground	1
20	VCC2		+1.8V Power Supply	3
21	P_Down/RST	LVTTL-I	Power down; When high, requires the module to limit power consumption. 2-Wire serial interface must be functional in the low power mode.	
			Reset; The falling edge initiates a complete reset of the module including the 2-wire serial interface, equivalent to a power cycle.	
22	VCC2		+1.8V Power Supply	3
23	GND		Module Ground	1
24	RefCLK+	PECL-I	Reference Clock Non-Inverted Input, AC coupled on the host board (not required)	
25	RefCLK-	PECL-I	Reference Clock Inverted Input, AC coupled on the host board (not required)	
26	GND		Module Ground	1
27	GND		Module Ground	1
28	TD-	CML-I	Transmitter Inverted Data Input	
29	TD+	CML-I	Transmitter Non-Inverted Data Input	
30	GND		Module Ground	1

Notes:
1. Module ground pins (GND) are isolated from the module case and chassis ground within the module.
2. Shall be pulled up with 4.7K-10K ohms to a voltage between 3.15V and 3.45V on the host board.