

Professional high-speed optical transceiver

OPN-XHD445-80LC2M

10G Multirate / 80 km / 50GHz DWDM XFP Single-Mode Optical Transceiver

PRODUCT FEATURES

- Support 9.95 Gbps to 11.1 Gbps
 - Complaint with XFP MSA
- Compliant with XFI 10G Serial Electrical Interface
 - Maximum Link Length of 80 km
- Temperature-stabilized DWDM EML Transmitter
 - 50 GHz ITU Grid, C Band
- 2-Wire Interface for Integrated Digital Diagnostic Monitoring
 - XFI Loopback Mode Supported
 - No reference Clock required
 - Power Dissipation < 3.5 W
- Dual 5V and +3.3 V Power Supply
 - RoHS Compliant
- 0 to 70°C Case Operating Temperature

APPLICATIONS

- DWDM 10Gb/s SONET/SDH ITU-T G.698.1
- DWDM 10Gb/s SONET/SDH with ITU-T G.709
 - DWDM 80km 10G Ethernet
 - DWDM 80km 10G Fiber Channel
 - DWDM 80km 10G Ethernet with FEC

PRODUCT DESCRIPTION

OPN-XHD445-80LC2M series DWDM transceivers are designed for single-mode fibre serial optical data communications such as 10G SONET/SDH, 10GBASE-ZR/ZW Ethernet and 10G Fibre Channel.

This module is designed for single mode fiber and operates at a nominal wavelength of 50GHz ITU Grid, C Band DWDM wavelength. The transmitter section consists of a temperature-stabilized DWDM electrical-modulated laser (EML), driver and signal conditioner. The receiver section incorporates an avalanche photodiode (APD) integrated with a trans-impedance preamplifier (TIA) and signal conditioner.

The module is with the XFP 30-pin connector to allow hot plug capability. Integrated Tx and Rx signal conditioners provide high jitter-tolerance for full XFI compliance and no external reference clock required. The internally ac coupled high speed serial I/O simplifies interfacing to external circuitry. Dual 5V and 3.3V power supply are used. The optical output can be disabled by LVTTTL logic high-level input of TX_DIS. Loss of signal (RX_LOS) output is provided to indicate the loss of an input optical signal of receiver.

A serial EEPROM in the transceiver allows the user to access transceiver digital diagnostic monitoring and configuration data via the 2-wire XFP Management Interface. This interface uses a single address, A0h, with a memory map divided into a lower and upper area. Basic digital diagnostic data is held in the lower area while specific data is held in a series of tables in the high memory area.

ORDER INFORMATION

P/No.	Bit Rate(Gb/s)	10G	Distance (km)	Spacing (GHz)	Wavelength (nm)	Package	Case Temp (°C)	RoHS Compliant
OPN-XHD445-80LC2M	10G Multirate*	ZR/ZW	80	50	DWDM**	XFP with DMI	0 to 70	Yes

*: multirate for SONET OC-192 IR-2, 10GBASE-ZR/ZW, 10G Fibre Channel, ITU-T G.709, 10GBASE-ZR/ZW + FEC

**XXX: 50GHz ITU Grid wavelength (Please see below)

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Channel #	Product code	Frequency (THz)	Center Wavelength (nm)	Label
190	OPN-XHD190-80LC2M	191.90	1562.23	190
195	OPN-XHD195-80LC2M	191.95	1561.83	195
200	OPN-XHD200-80LC2M	192.00	1561.42	200
205	OPN-XHD205-80LC2M	192.05	1561.01	205
210	OPN-XHD210-80LC2M	192.10	1560.61	210
215	OPN-XHD215-80LC2M	192.15	1560.20	215
220	OPN-XHD220-80LC2M	192.20	1559.79	220
225	OPN-XHD225-80LC2M	192.25	1559.39	225
230	OPN-XHD230-80LC2M	192.30	1558.98	230
235	OPN-XHD235-80LC2M	192.35	1558.58	235
240	OPN-XHD240-80LC2M	192.40	1558.17	240
245	OPN-XHD245-80LC2M	192.45	1557.77	245
250	OPN-XHD250-80LC2M	192.50	1557.36	250
255	OPN-XHD255-80LC2M	192.55	1556.96	255
260	OPN-XHD260-80LC2M	192.60	1556.55	260
265	OPN-XHD265-80LC2M	192.65	1556.15	265
270	OPN-XHD270-80LC2M	192.70	1555.75	270
275	OPN-XHD275-80LC2M	192.75	1555.34	275
280	OPN-XHD280-80LC2M	192.80	1554.94	280
285	OPN-XHD285-80LC2M	192.85	1554.54	285
290	OPN-XHD290-80LC2M	192.90	1554.13	290
295	OPN-XHD295-80LC2M	192.95	1553.73	295
300	OPN-XHD300-80LC2M	193.00	1553.33	300
305	OPN-XHD305-80LC2M	193.05	1552.93	305
310	OPN-XHD310-80LC2M	193.10	1552.52	310
315	OPN-XHD315-80LC2M	193.15	1552.12	315
320	OPN-XHD320-80LC2M	193.20	1551.72	320
325	OPN-XHD325-80LC2M	193.25	1551.32	325
330	OPN-XHD330-80LC2M	193.30	1550.92	330
335	OPN-XHD335-80LC2M	193.35	1550.52	335
340	OPN-XHD340-80LC2M	193.40	1550.12	340
345	OPN-XHD345-80LC2M	193.45	1549.72	345
350	OPN-XHD350-80LC2M	193.50	1549.32	350
355	OPN-XHD355-80LC2M	193.55	1548.91	355
360	OPN-XHD360-80LC2M	193.60	1548.51	360
365	OPN-XHD365-80LC2M	193.65	1548.11	365
370	OPN-XHD370-80LC2M	193.70	1547.72	370
375	OPN-XHD375-80LC2M	193.75	1547.32	375
380	OPN-XHD380-80LC2M	193.80	1546.92	380
385	OPN-XHD385-80LC2M	193.85	1546.52	385
390	OPN-XHD390-80LC2M	193.90	1546.12	390
395	OPN-XHD395-80LC2M	193.95	1545.72	395
400	OPN-XHD400-80LC2M	194.00	1545.32	400
405	OPN-XHD405-80LC2M	194.05	1544.92	405
410	OPN-XHD410-80LC2M	194.10	1544.53	410
415	OPN-XHD415-80LC2M	194.15	1544.13	415
420	OPN-XHD420-80LC2M	194.20	1543.73	420
425	OPN-XHD425-80LC2M	194.25	1543.33	425
430	OPN-XHD430-80LC2M	194.30	1542.94	430
435	OPN-XHD435-80LC2M	194.35	1542.54	435
440	OPN-XHD440-80LC2M	194.40	1542.14	440
445	OPN-XHD445-80LC2M	194.45	1541.75	445
450	OPN-XHD450-80LC2M	194.50	1541.35	450
455	OPN-XHD455-80LC2M	194.55	1540.95	455
460	OPN-XHD460-80LC2M	194.60	1540.56	460
465	OPN-XHD465-80LC2M	194.65	1540.16	465
470	OPN-XHD470-80LC2M	194.70	1539.77	470
475	OPN-XHD475-80LC2M	194.75	1539.37	475
480	OPN-XHD480-80LC2M	194.80	1538.98	480
485	OPN-XHD485-80LC2M	194.85	1538.58	485
490	OPN-XHD490-80LC2M	194.90	1538.19	490

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Channel #	Product code	Frequency (THz)	Center Wavelength (nm)	Label
495	OPN-XHD495-80LC2M	194.95	1537.79	495
500	OPN-XHD500-80LC2M	195.00	1537.40	500
505	OPN-XHD505-80LC2M	195.05	1537.00	505
510	OPN-XHD510-80LC2M	195.10	1536.61	510
515	OPN-XHD515-80LC2M	195.15	1536.22	515
520	OPN-XHD520-80LC2M	195.20	1535.82	520
525	OPN-XHD525-80LC2M	195.25	1535.43	525
530	OPN-XHD530-80LC2M	195.30	1535.04	530
535	OPN-XHD535-80LC2M	195.35	1534.64	535
540	OPN-XHD540-80LC2M	195.40	1534.25	540
545	OPN-XHD545-80LC2M	195.45	1533.86	545
550	OPN-XHD550-80LC2M	195.50	1533.47	550
555	OPN-XHD555-80LC2M	195.55	1533.07	555
560	OPN-XHD560-80LC2M	195.60	1532.68	560
565	OPN-XHD565-80LC2M	195.65	1532.29	565
570	OPN-XHD570-80LC2M	195.70	1531.90	570
575	OPN-XHD575-80LC2M	195.75	1531.51	575
580	OPN-XHD580-80LC2M	195.80	1531.12	580
585	OPN-XHD585-80LC2M	195.85	1530.72	585
590	OPN-XHD590-80LC2M	195.90	1530.33	590
595	OPN-XHD595-80LC2M	195.95	1529.94	595
600	OPN-XHD600-80LC2M	196.00	1529.55	600
605	OPN-XHD605-80LC2M	196.05	1529.16	605
610	OPN-XHD610-80LC2M	196.10	1528.77	610

Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	Tstg	-50	85	°C	
Operating Case Temperature	Topr	0	70	°C	
Relative Humidity	RH	0	85	%	Non condensing
Power Supply Voltage (5V)	V _{cc5}	-0.5	3.6	V	
Power Supply Voltage (3.3V)	V _{cc3}	-0.5	3.6	V	
Receiver Input Optical Power	Mip		4	dBm	Received average power

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units / Notes
Power Supply Voltage (5V)	V _{cc5}	4.75	5	5.25	V
Power Supply Voltage (3.3V)	V _{cc3}	3.13	3.3	3.47	V
Power Supply Current (@5V)	I _{cc5}			300	mA / 1
Power Supply Current (@3.3V)	I _{cc3}			750	mA / 1
Power Dissipation	P _D			3.5	W
Operating Case Temperature	Topr	0		70	°C
Data Rate		9.95	10.3125	11.1	Gb/s

1. Including in rush current. Maximum module current ramp rate is 100 mA/μs.

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Transmitter Optical Specifications (Topr= 0 to 70°C, Vcc5=5V±5%, Vcc3 = 3.3V ±5%)						
Parameter	Symbol	Min	Typ	Max	Units	Notes
Average Launch Power	P _{O, Avg}	0		+4	dBm	2
Extinction Ratio	ER	8.2			dB	
Center Wavelength Spacing			50		GHz	
Transmitter Center Wavelength -- over life time	λ_c	X-60	X	X+60	pm	3
Output Spectrum Width	σ_λ			1	nm	-20 dB width
Side Mode Suppression Ratio	SMSR	30			dB	
Transmitter and Dispersion Penalty @ 800 ps/nm	TDP			3	dB	
Relative Intensity Noise	RIN			-130	dB/Hz	
Eye Mask 1	IEEE 802.3ae					10G Ethernet
Eye Mask 2	GR-253-CORE / ITU-T G.691					10G SONET
Average Launch Power of OFF Transmitter				-30	dBm	

2. Output power is power coupled into a 9/125 μ m single-mode fiber.

3. X = specified ITU Grid wavelength. Wavelength stability is achieved within 60 seconds of power up.

Receiver Optical Specifications (Topr= 0 to 70°C, Vcc5=5V±5%, Vcc3 = 3.3V ±5%)						
Parameter	Symbol	Min	Typ	Max	Units	Notes
Sensitivity	Sen1			-24	dBm	4 / at 9.95 Gb/s
	Sen2			-22		4 / at 11.1 Gb/s
Receiver Overload	P _{MAX}	-7	---		dBm	
LOS -- Deasserted	LOS _D	---	---	-28	dBm	Transition: low to high
LOS -- Asserted	LOS _A	-36	---	---	dBm	Transition: high to low
LOS -- Hysteresis		0.5	---		dB	
Wavelength of Operation	λ_c	1260		1620	nm	
Optical Return Loss	ORL			-27	dB	

4. Measured with worst ER; BER < 10⁻¹² and PRBS 2³¹-1.

Electrical Characteristics						
Parameter	Symbol	Min	Typ	Max	Units	Notes
High-Speed Signal (CML) Interface Specification						
Input Data Rate		9.95	10.3125	11.1	Gb/s	5
Differential Input Impedance	R _{in}		100		Ω	
Differential Data Input Amplitude		120		820	mVpp	6, Internally AC coupled
Output Data Rate		9.95	10.3125	11.1	Gb/s	5
Differential Output Impedance	R _{out}		100		Ω	
Differential Data Output Amplitude		340	650	850	mVpp	6, Internally AC coupled
Low-Speed Signal (LVTTTL) Interface Specification						
Input High Voltage		2.0		V _{cc}	V	
Input Low Voltage		GND		0.8	V	
Output High Voltage		2.4		V _{cc}	V	
Output Low Voltage		GND		0.5	V	
Reference Clock (LVPECL) Interface Specification						
No reference clock required.						

5. 10GBASE-ER/EW and 10G Fiber Channel.

6. The differential input and output amplitudes are per XFP MSA mask at points B' and C'.

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Transceiver Timing Characteristics						
Parameter	Symbol	Min	Typ	Max	Units	Notes
TX_DIS Assert Time	t _{off}			10	μs	
TX_DIS Negate Time	t _{on}			2	ms	
Time to Initialize	t _{init}			300	ms	
Interrupt Assert Delay	interrupt _{on}			200	ms	
Interrupt Negate Delay	interrupt _{off}			500	μs	
P_Down/PST Assert Delay	P_Down/RST _{on}			100	μs	
P_Down Nagate Delay	P_Down/RST _{off}			300	ms	
Mod_NR Assert Delay	Mod_nr _{on}			1	ms	
Mod_NR Negate Delay	Mod_nr _{off}			1	ms	
Mod_Desel Assert Time	T_Mod_Desel			2	ms	
Mod_Desel De-Assert Time	T_Mod_Sel			2	ms	
P_Down Reset Time	T _{reset}	10			μs	
RX_LOS Assert Delay	T_Los _{on}			100	μs	
RX_LOS Negate Delay	T_Los _{off}			100	μs	
Serial ID Clock Rate	f _{SCL}	0		400	kHz	

MANAGEMENT INTERFACE

The structure of the memory map is shown in Figure 1, which is accessible over a 2-wire serial interface at the 8-bit address 1010000X (A0h). The normal 256 byte I2C address space is divided into low and upper blocks of 128 Bytes. The lower block of 128 Bytes is always directly available and is used for the diagnostics and control function. Multiple blocks of memories are available in the upper 128 Bytes of the address space. These are individually addressed through a table select Byte which the user enters into a location in the lower address space. Thus, there is a total available address space of 128*256 = 32 Kbytes in this upper memory space. The contents of Table 01h are listed in Table 1 below. Please refer SFF INF-8077i (Revision 4.5) for detailed information.

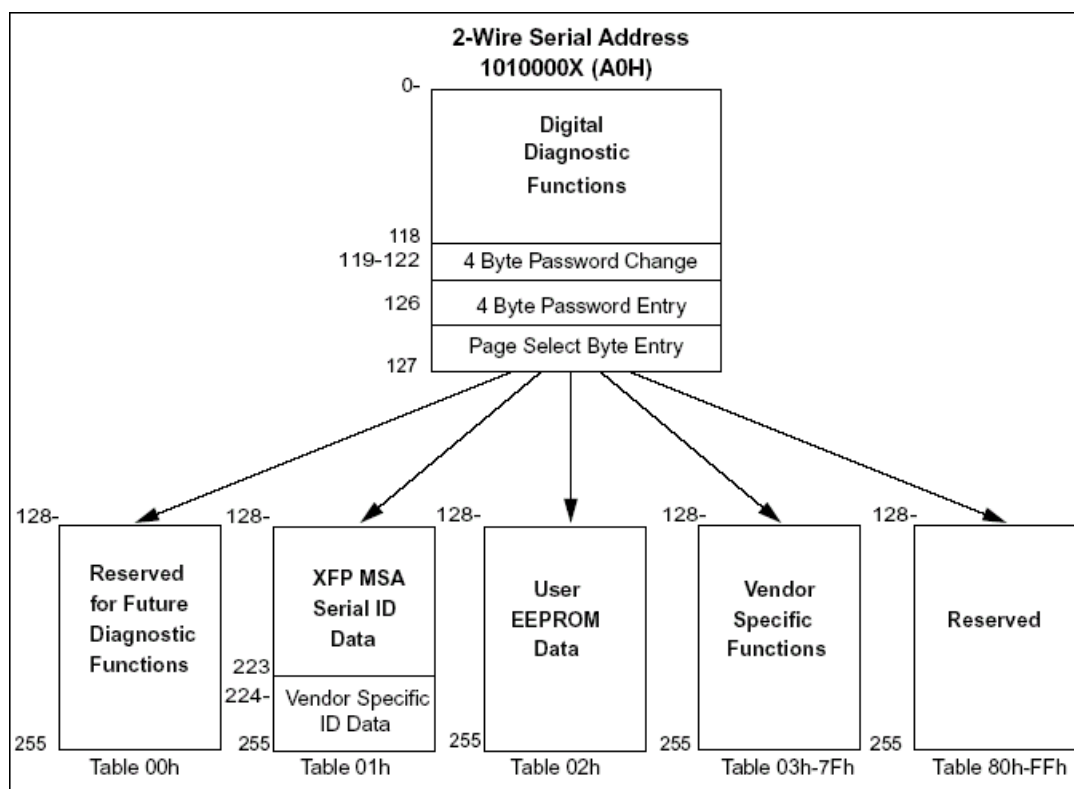


Figure 1. 2-wire Serial Digital Diagnostic Memory Map

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Table 1 Monitoring Specification

Data Address	Parameter	Accuracy
96 ~ 97	Temperature	± 3°C
98 ~ 99	Reserved	
100 ~ 101	Tx Bias	± 10%
102 ~ 103	Tx Power	± 2dB
104 ~ 105	Rx Power	± 2dB
106 ~ 107	Vcc3	± 3%

CONNECTION DIAGRAM

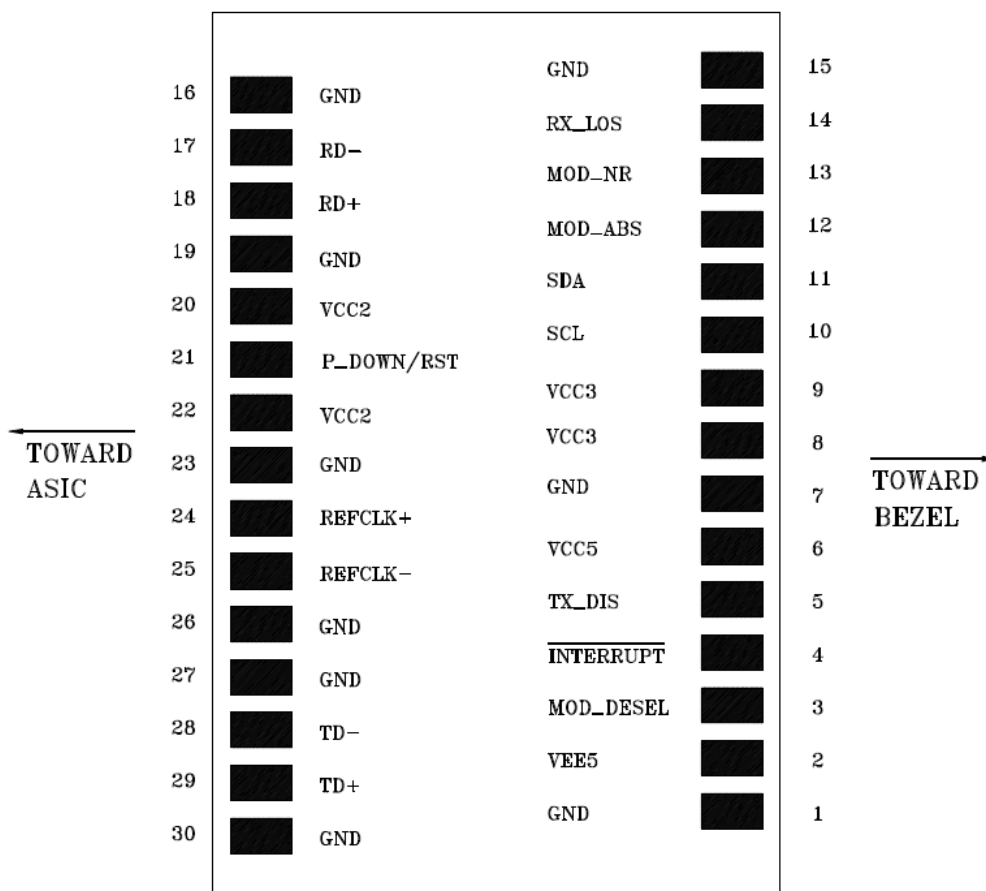


Table 2 PIN Description

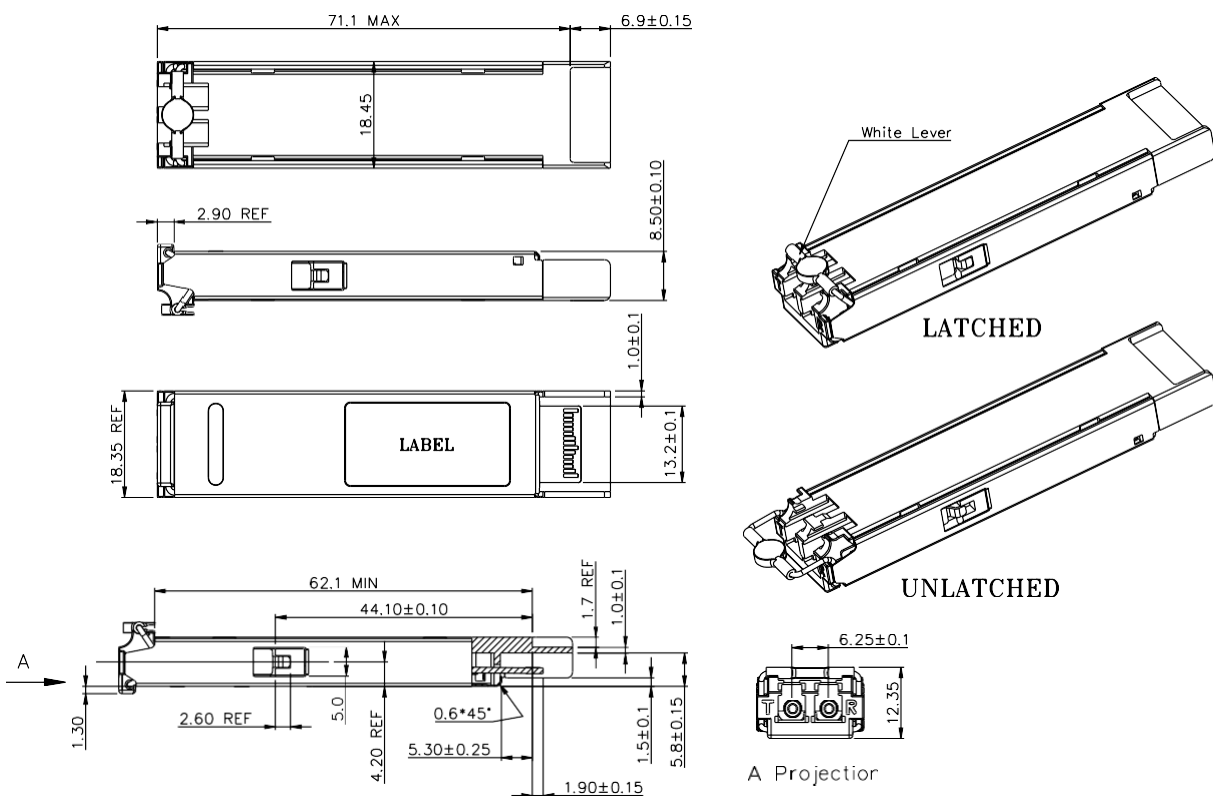
PIN	Logic	Signal Name	Description	Note
1		GND	Module Ground	1
2		VEE5	-5.2V Power Supply (Not required)	3
3	LVTTL-I	Mod_Desel	Module De-select; When held low allows module to respond to 2-wire serial interface	
4	LVTTL-O	Interrupt	Interrupt; Indicates presence of an important condition which can be read over the 2-wire serial interface	2
5	LVTTL-I	TX_DIS	Transmitter Disable; Turns off transmitter laser output	
6		VCC5	+5V Power Supply	3
7		GND	Module Ground	1
8		VCC3	+3.3V Power Supply	
9		VCC3	+3.3V Power Supply	
10	LVTTL-I/O	SCL	Serial 2-wire interface clock	2
11	LVTTL-I/O	SDA	Serial 2-wire interface data line	2
12	LVTTL-O	Mod_Abs	Indicates Module is not present. Grounded in the Module	2

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13	LVTTL-O	Mod_NR	Module Not Ready; Indicating Module Operational Fault	2
14	LVTTL-O	RX_LOS	Receiver Loss Of Signal Indicator	2
15		GND	Module Ground	1
16		GND	Module Ground	1
17	CML-O	RD-	Receiver Inverted Data Output	
18	CML-O	RD+	Receiver Non-Inverted Data Output	
19		GND	Module Ground	1
20		VCC2	+1.8V Power Supply (Not required)	3
21	LVTTL-I	P_Down/RST	Power down; When high, requires the module to limit power consumption to 1.5W or below. 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 (Not required)	3
23		GND	Module Ground	1
24	PECL-I	RefCLK+	Reference Clock Non-Inverted Input, AC coupled on the host board. (Not used. Internally terminated to 50 ohm (100 ohm diff.))	4
25	PECL-I	RefCLK-	Reference Clock Inverted Input, AC coupled on the host board. (Not used. Internally terminated to 50 ohm (100 ohm diff.))	4
26		GND	Module Ground	1
27		GND	Module Ground	1
28	CML-I	TD-	Transmitter Inverted Data Input	
29	CML-I	TD+	Transmitter Non-Inverted Data Input	
30		GND	Module Ground	1

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-10Kohms to a voltage between 3.15V and 3.45V on the host board.
3. These PINs are open within module.
4. A Reference Clock input is not required. If present, it will be ignored.

MECHANICAL SPECIFICATION (UNITS IN MM)



RECOMMENDED POWER CIRCUIT SCHEMATIC

