EOLS-1648-XXD Series

SFP Single-Mode for DWDM Application
Duplex SFP Transceiver
Digital Diagnostic Function
RoHS6 Compliant

Features

- Operating Data Rate up to 4.25Gbps
- Available in all C-Band Wavelengths on the 100GHz DWDM ITU Grid
- Single 3.3V Power Supply and TTL Logic Interface
- Hot-Pluggable SFP Footprint Duplex LC Connector Interface
- Compliant with Class 1 FDA and IEC60825-1 Laser Safety
- Compliant with SFP MSA
- Compliant with SFF-8472
- Operating Case Temperature:
  Standard: 0℃ to 70°C
  Industrial: -40℃ to 85°C

Applications

- Amplified DWDM networks
- Ring topologies with fixed and reconfigurable OADMs
- Fast Ethernet, Giga Ethernet
- Fiber Channel
- SONET / SDH Switch

Ordering Information

Part No.	Data Rate	Laser	Power budget*(note2)	Interface	Temperature
EOLS-1648-18XX*(note1)D	4.25GMbps	DWDM EML	18dB	LC	Standard
EOLS-1648-18XX*(note1)DI	4.25GMbps	DWDM EML	18dB	LC	Industrial
EOLS-1648-24XX*(note1)D	4.25GMbps	DWDM EML	24dB	LC	Standard
EOLS-1648-24XX*(note1)DI	4.25GMbps	DWDM EML	24dB	LC	Industrial

Note1: XX refers to DWDM Wavelength range as ITU-T specified, please refer the following table for detailed center wavelength information.

Note2: The power budget which is guaranteed.

XX- Channel refers to the following table:

Channel (XX)	Part NO.	Frequency (THz)	Center Wavelength (nm)
15	EOLS-1648- X15D EOLS-1648- X15DI	191.5	1565.50
16	EOLS-1648- X*16D EOLS-1648- X*16DI	191.6	1564.68
17	EOLS-1648- X*17D EOLS-1648- X*17DI	191.7	1563.86
18	EOLS-1648- X*18D EOLS-1648- X*18DI	191.8	1563.05
19	EOLS-1648- X*19D EOLS-1648- X*19DI	191.9	1562.23
20	EOLS-1648- X*20D EOLS-1648- X*20DI	192.0	1561.42
21	EOLS-1648- X*21D EOLS-1648- X*21DI	192.1	1560.61
22	EOLS-1648- X*22D EOLS-1648- X*22DI	192.2	1559.79
23	EOLS-1648- X*23D EOLS-1648- X*23DI	192.3	1558.98
24	EOLS-1648- X*24D EOLS-1648- X*24DI	192.4	1558.17
25	EOLS-1648- X*25D EOLS-1648- X*25DI	192.5	1557.36
26	EOLS-1648- X*26D EOLS-1648- X*26DI	192.6	1556.55
27	EOLS-1648- X*27D EOLS-1648- X*27DI	192.7	1555.75
28	EOLS-1648- X*28D EOLS-1648- X*28DI	192.8	1554.94
29	EOLS-1648- X*29D EOLS-1648- X*29DI	192.9	1554.13
30	EOLS-1648- X*30D EOLS-1648- X*30DI	193.0	1553.33
31	EOLS-1648- X*31D EOLS-1648- X*31DI	193.1	1552.52
32	EOLS-1648- X*32D EOLS-1648- X*32DI	193.2	1551.72
33	EOLS-1648- X*33D EOLS-1648- X*33DI	193.3	1550.92
34	EOLS-1648- X*34D EOLS-1648- X*34DI	193.4	1550.12

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35	EOLS-1648- X*35D EOLS-1648- X*35DI	193.5	1549.32
36	EOLS-1648- X*36D EOLS-1648- X*36DI	193.6	1548.51
37	EOLS-1648- X*37D EOLS-1648- X*37DI	193.7	1547.72
38	EOLS-1648- X*38D EOLS-1648- X*38DI	193.8	1546.92
39	EOLS-1648- X*39D EOLS-1648- X*39DI	193.9	1546.12
40	EOLS-1648- X*40D EOLS-1648- X*40DI	194.0	1545.32
41	EOLS-1648- X*41D EOLS-1648- X*41DI	194.1	1544.53
42	EOLS-1648- X*42D EOLS-1648- X*42DI	194.2	1543.73
43	EOLS-1648- X*43D EOLS-1648- X*43DI	194.3	1542.94
44	EOLS-1648- X*44D EOLS-1648- X*44DI	194.4	1542.14
45	EOLS-1648- X*45D EOLS-1648- X*45DI	194.5	1541.35
46	EOLS-1648- X*46D EOLS-1648- X*46DI	194.6	1540.56
47	EOLS-1648- X*47D EOLS-1648- X*47DI	194.7	1539.77
48	EOLS-1648- X*48D EOLS-1648- X*48DI	194.8	1538.98
49	EOLS-1648- X*49D EOLS-1648- X*49DI	194.9	1538.19
50	EOLS-1648- X*50D EOLS-1648- X*50DI	195.0	1537.40
51	EOLS-1648- X*51D EOLS-1648- X*51DI	195.1	1536.61
52	EOLS-1648- X*52D EOLS-1648- X*52DI	195.2	1535.82
53	EOLS-1648- X*53D EOLS-1648- X*53DI	195.3	1535.04
54	EOLS-1648- X*54D EOLS-1648- X*54DI	195.4	1534.25
55	EOLS-1648- X*55D EOLS-1648- X*55DI	195.5	1533.47
56	EOLS-1648- X*56D	195.6	1532.68

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	EOLS-1648- X*56DI		
57	EOLS-1648- X*57D EOLS-1648- X*57DI	195.7	1531.90
58	EOLS-1648- X*58D EOLS-1648- X*58DI	195.8	1531.12
59	EOLS-1648- X*59D EOLS-1648- X*59DI	195.9	1530.33
60	EOLS-1648- X*60D EOLS-1648- X*60DI	196.0	1529.55
61	EOLS-1648- X*61D EOLS-1648- X*61DI	196.1	1528.77

*: X refers to the DWDM Power budget（18 24）. please contact EOPTOLINK to confirm whether the wavelength is available.

Regulatory Compliance*Note3

Product Certificate	Certificate Number	Applicable Standard
TUV	R50135086	EN 60950-1:2006+A11+A1+A12+A2
		EN 60825-1:2014
		EN 60825-2:2004+A1+A2
UL	E317337	UL 60950-1
		CSA C22.2 No. 60950-1-07
EMC CE	AE 50285865 0001	EN 55022:2010
		EN 55024:2010
FCC	WTF14F0514417E	47 CFR PART 15 OCT., 2013
FDA	/	CDRH 1040.10
ROHS	/	2011/65/EU

*Note3: The above certificate number updated to June 2014, because some certificate will be updated every year, such as FDA and ROHS. For the latest certification information, please check with Eoptolink.

Product Description

The EOLS-1648-XXD series single mode transceiver is small form factor pluggable module for duplex optical data communications. This module is designed for single mode fiber and operates at a nominal DWDM wavelength from 1528.77nm to 1565.50nm as specified by the ITU-T. It is designed to deploy in the DWDM networking equipment in metropolitan access and core networks.

It is with the SFP 20-pin connector to allow hot plug capability. The transmitter section uses a DWDM multiple quantum well EML laser and is a class 1 laser compliant according to International Safety Standard IEC-60825.

The EOLS-1648-XXD series are designed to be compliant with SFF-8472 Multi-Source Agreement (MSA).

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_S	-40	+85	°C
Supply Voltage	V_{CC}	-0.5	3.6	V
Operating Relative Humidity		-	95	%

*Exceeding any one of these values may destroy the device permanently.

Recommended Operating Conditions

Parameter	Symbol		Min.	Typical	Max.	Unit
Operating Case Temperature	T_c	EOLS-1648-XXD	0	-	+70	°C
		EOLS-1648-XXDI	-40	-	+85	
Power Supply Voltage	Vcc		3.15	3.3	3.45	V
Power Supply Current	Icc		-	-	450	mA
Power Supply Current	Icc		-	-	540*	mA
Date Rate					4.25G	bps

*540mA only for Industrial operating case temperature

Performance Specifications - Electrical

Parameter		Symbol	Min.	Typ.	Max	Unit	Notes
Transmitter							
CML Inputs(Differential)		Vin	400		2000	mVpp	AC coupled inputs*(note4)
Input Impedance (Differential)		Zin	85	100	115	ohm	Rin > 100 kohm @ DC
TX_Dis	Disable		2		Vcc	V	
	Enable		0		0.8		
TX_FAULT	Fault		2		Vcc	V	
	Normal		0		0.8		
Receiver							
CML Outputs (Differential)		Vout	400	800	1200	mVpp	AC coupled outputs
Output Impedance (Differential)		Zout	85	100	115	ohm	
RX_LOS	LOS		2		Vcc	V	
	Normal		0		0.8	V	
MOD_DEF (0:2)		VoH	2.5			V	
		VoL	0		0.8	V	

Performance Specifications – Optical

(DWDM EML and PIN/TIA, 18dB Power Budget at Least)

Parameter	Symbol	Min.	Typical	Max.	Unit
Data Rate			4.25		bps
Transmitter					
Center Wavelength Spacing			100		GHz
			0.8		nm
Spectral Width (-20dB)	Δλ			0.3	nm
Deviation From Central Frequency@EOL		-12		12	GHz
Side Mode Suppression Ratio	SMSR	30			dB
Average Output Power*(note5)	Pout	0		5	dBm
Extinction Ratio@4.25Gb/s	ER	4.5			dB
Average Launch Power (Tx: OFF)	Poff			-45	dBm
Rise/Fall Time(Unfiltered，20%～80%)	tr/tf			120	ps
Output Optical Eye*(note6)	Complies with ANSI FC-PI specification*(note8)				
TX_Disable Assert Time	t_off			10	us
P_{out}@TX Disable Asserted	Pout			-45	dBm
Relative Intensity Noise	RIN			-135	dB/Hz
Dispersion Tolerance	DT		800		ps/nm
Receiver					
Center Wavelength	λ	1528		1665	nm
Receiver Sensitivity*(note7)	Pmin			-18	dBm
Receiver Overload	Pmax	-3			dBm
LOS De-Assert	LOSD			-19	dBm
LOS Assert	LOSA	-35			dBm
LOS Hysteresis*(note9)		0.5			dB

(DWDM EML and APD, 24dB Power Budget at Least)

Parameter	Symbol	Min.	Typical	Max.	Unit
Data Rate			4.25G		bps
Transmitter					
Center Wavelength Spacing			100		GHz
			0.8		nm
Spectral Width (-20dB)	Δλ			0.3	nm
Deviation From Central Frequency@EOL		-12		12	GHz
Side Mode Suppression Ratio	SMSR	30			dB
Average Output Power*(note5)	Pout	0		5	dBm
Average Launch Power (Tx: OFF)	Poff			-45	dBm
Extinction Ratio@4.25Gb/s	ER	4.5			dB

Rise/Fall Time(Unfiltered，20%～80%)	tr/tf			120	ps
Output Optical Eye*(note6)	Complies with ANSI FC-PI specification*(note8)				
TX_Disable Assert Time	t_off			10	us
P_{out}@TX Disable Asserted	Pout			-45	dBm
Relative Intensity Noise	RIN			-135	dB/Hz
Dispersion Tolerance	DT		1600		ps/nm
Receiver					
Center Wavelength	λ	1528		1665	nm
Receiver Sensitivity*(note7)	Pmin			-24	dBm
Receiver Overload	Pmax	-9			dBm
LOS De-Assert	LOSD			-25	dBm
LOS Assert	LOSA	-35			dBm
LOS Hysteresis*(note9)		0.5			dB

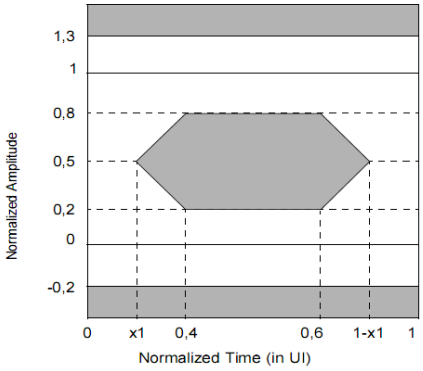
Note4: CML logic, internally AC coupled.

Note5: Output power is power coupled into a 9/125μm single-mode fiber.

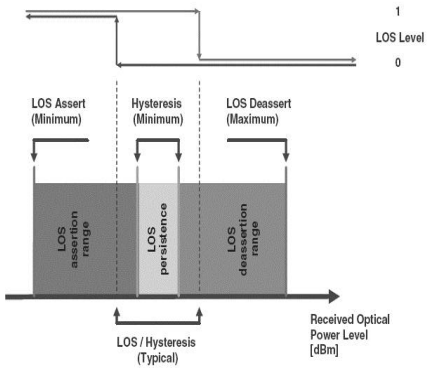
Note6: Filtered, measured with a PRBS 2^7-1 test pattern @4.25Gbps

Note7: Minimum average optical power at BER less than 1E-12 or lower, with a 2^7-1 NRZ PRBS.

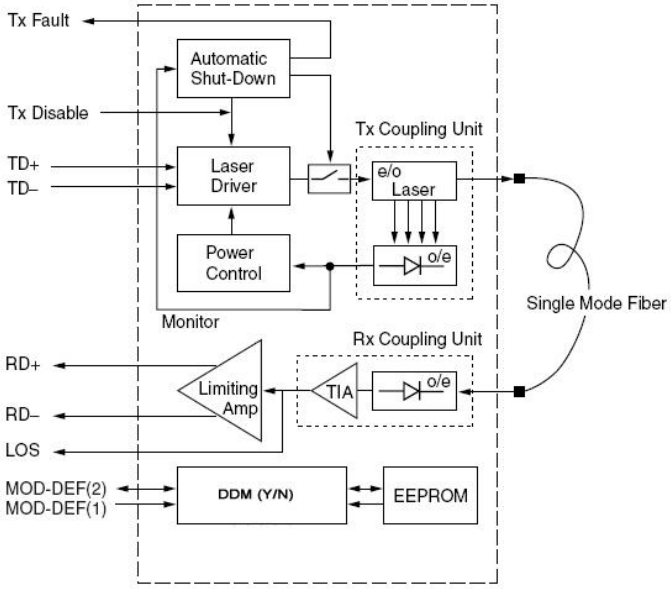
Note8: Eye Pattern Mask



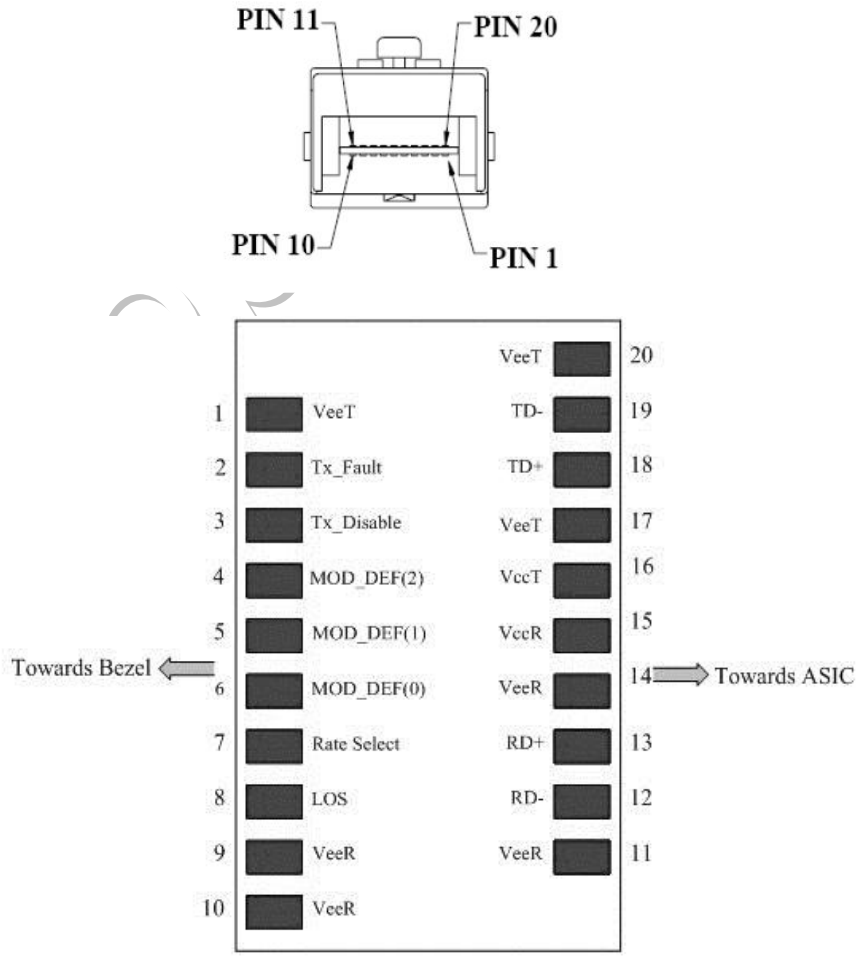
Note9: LOS Hysteresis



Functional Description of Transceiver



SFP Transceiver Electrical Pad Layout



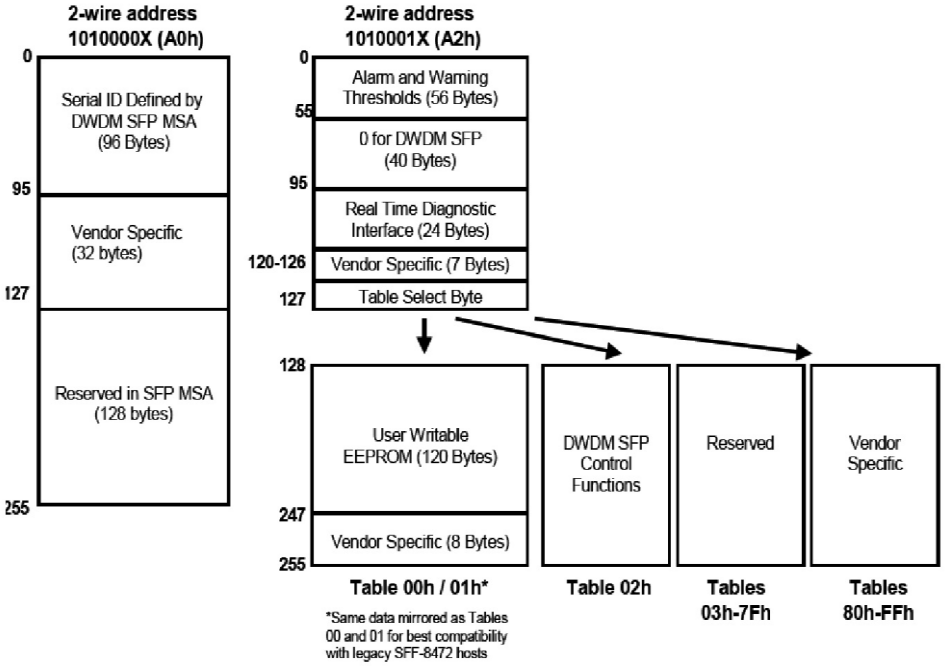
Pin Function Definitions

Pin Num.	Name	Function Description
1	VeeT	Transmitter Ground
2	TX Fault	Transmitter Fault Indication, open collector/drain output
3	TX Disable	Transmitter Disable
4	MOD-DEF2	Module Definition 2, Data line for Serial ID.
5	MOD-DEF1	Module Definition 1, Clock line for Serial ID.
6	MOD-DEF0	Module Definition 0, Grounded within the module.
7	Rate Select	Not Connect, Function not available
8	LOS	Loss of Signal, open collector/drain output
9	VeeR	Receiver Ground
10	VeeR	Receiver Ground
11	VeeR	Receiver Ground
12	RD-	Inv. Received Data Out
13	RD+	Received Data Out
14	VeeR	Receiver Ground
15	VccR	Receiver Power, 3.3 ± 5%
16	VccT	Transmitter Power, 3.3 ± 5%
17	VeeT	Transmitter Ground
18	TD+	Transmit Data In
19	TD-	Inv. Transmit Data In
20	VeeT	Transmitter Ground

EEPROM

The serial interface uses the 2-wire serial CMOS EEPROM protocol defined for the ATMEL AT24C02/04 family of components. When the serial protocol is activated, the host generates the serial clock signal (SCL). The positive edge clocks data into those segments of the EEPROM that are not write protected within the SFP transceiver. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

The Module provides diagnostic information about the present operating conditions. The transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture. Received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring all are implemented. If the module is defined as external calibrated, the diagnostic data are raw A/D values and must be converted to real world units using calibration constants stored in EEPROM locations 56 – 95 at wire serial bus address A2H. The digital diagnostic memory map specific data field define as following .For detail EEPROM information, please refer to the related document of SFF 8472 Rev 9.3.



EEPROM Serial ID Memory Contents

Accessing Serial ID Memory uses the 2 wire address 1010000X(A0H). Memory Contents of Serial ID are shown in Table 1.

Table 1 Serial ID Memory Contents

Addr.	Size (bytes)	Name of field	Vaule(Hex)	Description
0	1	Identifier	0B	DWDM SFP
1	1	Ext. Identifier	XX	
2	1	Connector	07	LC connector
3-10	8	Transceiver Codes	00	Reserved
			00	-
			00	-
			XX	
			XX	
			XX	
			01	Single mode
			XX	
11	1	Encoding	XX	
12	1	BR, Nominal	XX(note10)	
13	1	Reserved	00	-
14	1	Length (9μm)km	XX	
15	1	Length(9μm)100m	FF	
16	1	Length (50μm) 10m	00	
17	1	Length(62.5μm)10m	00	

18	1	Length (Copper)	00	Not compliant
19	1	Reserved	00	
20~35	16	Vendor Name	XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX(note11)	Vendor name
36	1	Implemented Optional DWDM Features	00	-
37-39	3	Vendor OUI	00 00 00	-
40-55	16	Vendor PN	XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX(note11)	PN
56-59	4	Vendor Rev	XX XX XX XX(note11)	
60-62	3	Wavelength	XX	Laser Wavelength
63	1	CC-BASE	XX	CC for Base ID fields implemented (addresses 0 to62)
64~65	2	Options	00	Reserved
			1A	1.TX_DISABLE is implemented and disables the serial output; 2.TX_FAULT signal implemented; 3.Loss of Signal implemented
66	1	BR, max	00	-
67	1	BR, max	00	-
68~83	16	Vendor SN	XX	Serial number of Transceiver (ASCII)
84~89	6	Date code	XX	The vendor's date code (ASCII)
90~91	2	Vendor specific lot code	XX XX	-
92	1	Diagnostic Monitoring Type	XX	1. Digital diagnostic monitoring implemented 2.Internally/Externally Calibrated; 3.Received power measurement type is Average Power
93	1	Enhanced Options	F0	1.Optional Alarm/warning flags implemented for all monitored quantities

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				2. Optional Soft TX_DISABLE control and monitoring implemented 3. Optional Soft TX_FAULT monitoring Implemented 4. Optional Soft RX_LOS monitoring Implemented
94	1	SFF-8472 Compliance	01	Includes functionality described in Rev 9.3 of SFF-8472.
95	1	CC_EXT	XX	CC for the extended ID Fields (addresses 64 to 94) implemented.
96~127	32	Vendor Specific	XX	Read only memory
128-255	128	Reserved	Read only	

Note10: The “XX” byte should be filled in according to practical case. For more information, please refer to the related document of SFP Multi-Source Agreement (MSA).

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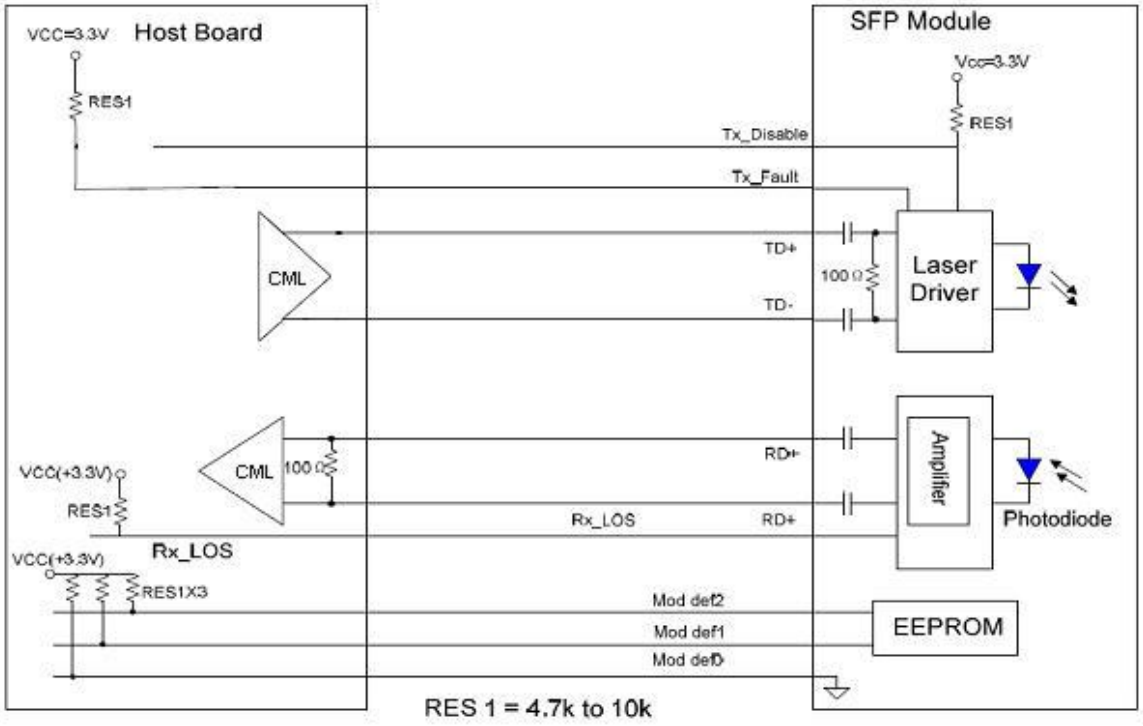
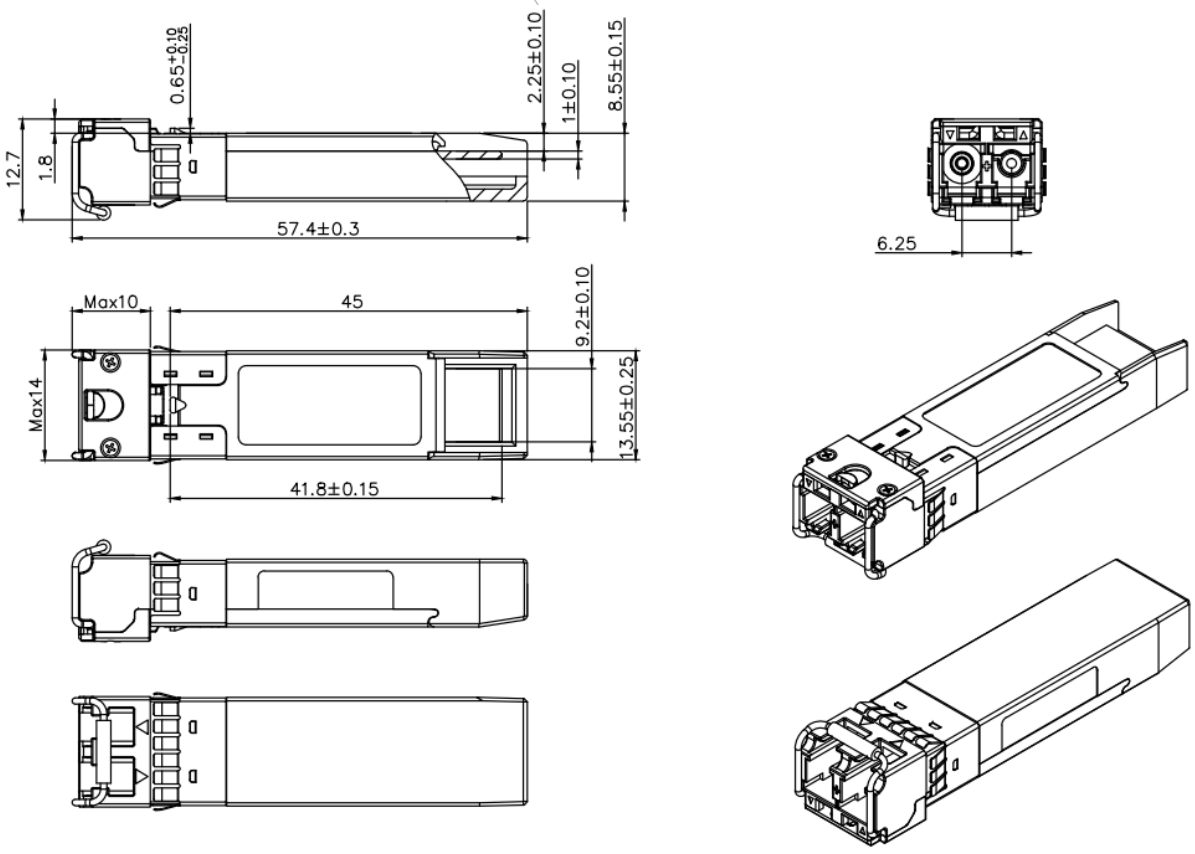
Recommend Circuit Schematic



Mechanical Specifications



Unremarked tolerances ±0.2mm

Obtaining Document

You can visit our website:http://www.eoptolink.com
Or contact Eoptolink Technology Inc., Ltd. Listed at the end of the documentation to get the latest documents.

Revision History

Revision	Initiated	Reviewed	Approved	Revision History	Release Date
V2.a	Tim.Liang	Kelly.Cao		Released.	Oct 24, 2009
V2.b	Kelly			Revise the A2H.	Nov 24, 2009
V2.c	Kelly			Complete the DWDM wavelength.	Jan 18, 2010
V2.d	Kelly			Correct Rx λ range.	Apr 8, 2010
V3.a	Kelly			Update PN&LOGO.	July 19, 2011
V3.b	Jans	Kelly		Update EEPROM map, integrate 3 products.	Sep 21, 2011
V3.C	Jans	Kelly		Update Extinction Ratio.	Oct 27，2012
V3.d	Jans	Lyn,Jason, Walt	Phlio	Update the applications. Update the MAX Budget from 26dB to 24dB.	June 4, 2013
V3.e	Jans/ Angela	Nigai/Lyn/ Jason/Walt	Phlio	Add Dispersion Tolerance	August 14, 2013
V3.f	Angela	Kelly/Vina		Update the regulatory compliance,LOSA and 2D drawing.	Oct 28,2015
V3.g	Oliver	Abby/Chao/ Downey/Phlio /Picard/Marvin/Kelly/Lyn/ Elaine/Nico/ Jp/John/Flagon		Add the industrial temperature range, update the laser type, the label picture, the regulatory compliance and 2D drawing.	Feb 9,2017

Notice:

Eoptolink reserves the right to make changes to or discontinue any optical link product or service identified in this publication, without notice, in order to improve design and/or performance. Applications that are described herein for any of the optical link products are for illustrative purposes only. Eoptolink makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Contact:

Add: Floor 5, Building 2, No. 21 Gaopeng Avenue, High-Tech District, CHENGDU, SICHUAN 610041 P.R. CHINA
Tel: (+86) 028-85122709 ext 816 & 809
Fax: (+86) 028-85121912
Postal: 610041
E-mail:sales@eoptolink.com
http://www.eoptolink.com

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