

## EOLS-BI1624-15-CL XX Series

## EOLS-BI1624-15-LC XX Series

Single-Mode 2.5Gbps SDH /SONET/FC  
 Simplex SC/LC Single-Fiber SFP Transceiver  
 RoHS6 Compliant



### Features

- ◆ Support up to 2.5Gbps data links
- ◆ A type: 1310nm DFB Tx/1490nmRx  
 B type: 1490nm DFB Tx/1310nmRx
- ◆ Up to 15km with 9/125 μm SMF
- ◆ Single 3.3V Power supply and TTL Logic Interface
- ◆ Hot-Pluggable SFP Footprint Simplex SC/LC Connector Interface
- ◆ Class 1 FDA and IEC60825-1 laser safety compliant
- ◆ Operating Case Temperature  
 Standard: 0°C~+70°C  
 Industrial:-40°C~+85°C
- ◆ Compliant with SFP MSA
- ◆ Compliant with SFF-8472

### Applications

- ◆ Fiber Channel Links
- ◆ OC-48 / STM-16 Links
- ◆ WDM Links
- ◆ Other Optical Links

### Ordering information

Part No.	Data Rate	Wavelength	Interface	Temp.	DDMI
EOLS-BI1624-15-CL <sup>*(note1)</sup>	1.063/2.5Gbps	1310nm	SC	Standard	NO
EOLS-BI1624-15-LC <sup>*(note1)</sup>	1.063/2.5Gbps	1490nm	SC	Standard	NO
EOLS-BI1624-15-CLI	1.063/2.5Gbps	1310nm	SC	Industrial	NO
EOLS-BI1624-15-LCI	1.063/2.5Gbps	1490nm	SC	Industrial	NO
EOLS-BI1624-15-CLD	1.063/2.5Gbps	1310nm	SC	Standard	YES
EOLS-BI1624-15-LCD	1.063/2.5Gbps	1490nm	SC	Standard	YES
EOLS-BI1624-15-CLDI	1.063/2.5Gbps	1310nm	SC	Industrial	YES

EOLS-BI1624-15-LCDI	1.063/2.5Gbps	1490nm	SC	Industrial	YES
EOLS-BI1624-15-CLL <sup>*(note1)</sup>	1.063/2.5Gbps	1310nm	LC	Standard	NO
EOLS-BI1624-15-LCL <sup>*(note1)</sup>	1.063/2.5Gbps	1490nm	LC	Standard	NO
EOLS-BI1624-15-CLIL	1.063/2.5Gbps	1310nm	LC	Industrial	NO
EOLS-BI1624-15-LCIL	1.063/2.5Gbps	1490nm	LC	Industrial	NO
EOLS-BI1624-15-CLDL	1.063/2.5Gbps	1310nm	LC	Standard	YES
EOLS-BI1624-15-LCDL	1.063/2.5Gbps	1490nm	LC	Standard	YES
EOLS-BI1624-15-CLDIL	1.063/2.5Gbps	1310nm	LC	Industrial	YES
EOLS-BI1624-15-LCDIL	1.063/2.5Gbps	1490nm	LC	Industrial	YES

Note1: Standard version

## Regulatory Compliance\*

Product Certificate	Certificate Number	Applicable Standard
TUV	R50135086	EN 60950-1:2006+A11+A1+A12
		EN 60825-1:2007
		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
CB	JPTUV-049251	IEC 60825-1
		IEC 60950-1
FCC	WTF14F0514437E	47 CFR PART 15 OCT., 2013
FDA	1331340-000	CDRH 1040.10
ROHS	RHS01G006464	2011/65/EU

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

## Product Description

The EOLS-BI1X24-15 series and EOLS-BI1X24-15 series are small form factor pluggable module for OC-48 / STM-16 and Fiber Channel single fiber communications by using 1310nm/1490nm transmitter and 1490nm /1310nm receiver. It is with the SFP 20-pin connector to allow hot plug capability.

The transmitter section uses a Distributed feedback laser and is a class 1 laser compliant according to International Safety Standard IEC 60825. The receiver section PIN or APD mounted in an optical header and a limiting post-amplifier IC.

The EOLS-BI1X24-X-D series are designed to be compliant with SFF-8472 SFP 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 immediately.

## Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit	
Operating Case Temperature	$T_c$	EOLS-BI1X24-X	0		+70	°C
		EOLS-BI1X24-X-I	-40		+85	
Power Supply Voltage	$V_{CC}$	3.15	3.3	3.45	V	
Power Supply Current	$I_{CC}$			300	mA	
Data Rate	FC		1.063		Gbps	
	2xFC		2.125		Gbps	
	OC-48/STM-16		2.5		Gbps	

## Performance Specifications - Electrical

Parameter	Symbol	Min.	Typ.	Max	Unit	Notes
<b>Transmitter</b>						
LVPECL Compatible Inputs(Differential)	$V_{in}$	400		2000	mVpp	AC coupled inputs*(Note4)
Input Impedance (Differential)	$Z_{in}$	85	100	115	ohms	$R_{in} > 100$ kohms @ DC
Tx_Dis	Disable	2		$V_{CC}$	V	
	Enable	0		0.8		
Tx_FAULT	Fault	2		$V_{CC}+0.3$	V	
	Normal	0		0.5		
<b>Receiver</b>						
CML Outputs (Differential)	$V_{out}$	370		1200	mVpp	AC coupled outputs*(Note4)
Output Impedance (Differential)	$Z_{out}$	85	100	115	ohms	
Rx_LOS	LOS	2		$V_{CC}+0.3$	V	
	Normal	0		0.8	V	
MOD_DEF ( 0:2 )	VoH	2.5			V	With Serial ID
	VoL	0		0.5	V	

**Optical and Electrical Characteristics**
**(EOLS-BI1624-15-CL, 1310nm DFB and PIN, 15km)**

Parameter	Symbol	Min.	Typical	Max.	Unit
9µm Core Diameter SMF	L		15		km
Data Rate		1.063		2.5	Gbps
<b>Transmitter</b>					
Centre Wavelength	$\lambda_c$	1260	1310	1360	nm
Spectral Width (-20dB)	$\Delta\lambda$			1	nm
Side Mode Suppression Ratio	SMSR	30			dB
Average Output Power <sup>*(Note2)</sup>	P <sub>out</sub>	-5		0	dBm
Extinction Ratio <sup>*(Note3)</sup>	ER	8.2			dB
Rise/Fall Time(20%~80%)	tr/tf			150	ps
Output Optical Eye <sup>*(Note3)</sup>	Compatible with ITU-T G.957 <sup>*(Note6)</sup>				
TX_Disable Assert Time	t <sub>off</sub>			10	µs
P <sub>out</sub> @TX Disable Asserted	P <sub>out</sub>			-45	dBm
<b>Receiver</b>					
Centre Wavelength	$\lambda_c$	1450	1490	1530	nm
Receiver Sensitivity <sup>*(Note5)</sup>	P <sub>min</sub>			-18	dBm
Receiver Overload	P <sub>max</sub>	0			dBm
Reflection				-27	dB
LOS De-Assert	LOSD			-19	dBm
LOS Assert	LOSA	-35			dBm
LOS Hysteresis <sup>*(Note7)</sup>		0.5			dB

**(EOLS-BI1624-15-LC, 1490nm DFB and PIN, 15km)**

Parameter	Symbol	Min.	Typical	Max.	Unit
9µm Core Diameter SMF	L		15		km
Data Rate		1.063		2.5	Gbps
<b>Transmitter</b>					
Centre Wavelength	$\lambda_c$	1480	1490	1500	nm
Spectral Width (-20dB)	$\Delta\lambda$			1	nm
Average Output Power <sup>*(Note2)</sup>	P <sub>out</sub>	-5		0	dBm
Extinction Ratio <sup>*(Note3)</sup>	ER	8.2			dB
Side Mode Suppression Ratio	SMSR	30			dB
Rise/Fall Time(20%~80%)	tr/tf			150	ps
Output Optical Eye <sup>*(Note3)</sup>	Compatible with ITU-T G.957 <sup>*(Note6)</sup>				
TX_Disable Assert Time	t <sub>off</sub>			10	µs
<b>Receiver</b>					
Centre Wavelength	$\lambda_c$	1260		1360	nm
Receiver Sensitivity <sup>*(Note5)</sup>	P <sub>min</sub>			-18	dBm
Receiver Overload	P <sub>max</sub>	0			dBm
Reflection				-27	dB

Optical Path Penalty				1	dB
LOS De-Assert	LOSD			-19	dBm
LOS Assert	LOSA	-35			dBm
LOS Hysteresis*(Note7)		0.5			dB

Note2: Output is coupled into a 9/125µm single-mode fiber.

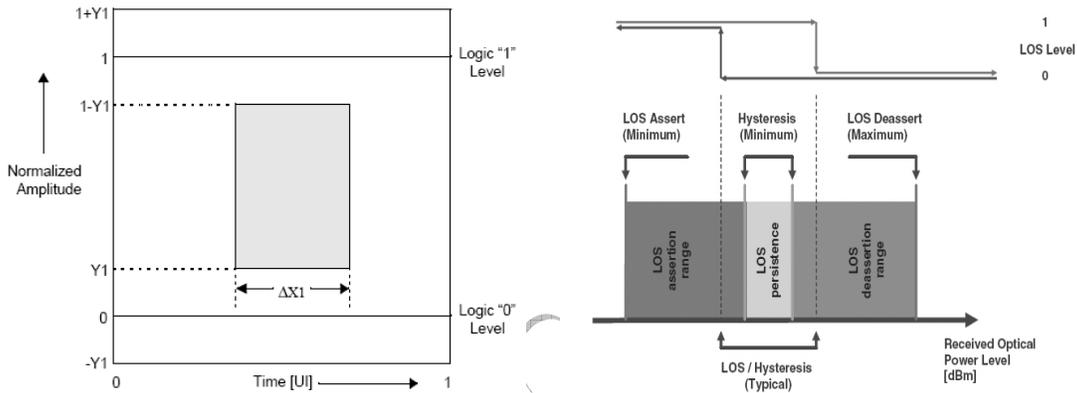
Note3: Filtered, measured with a PRBS 2<sup>23</sup>-1 test pattern @2500Mbps

Note4: LVPECL/CML logic, internally AC coupled.

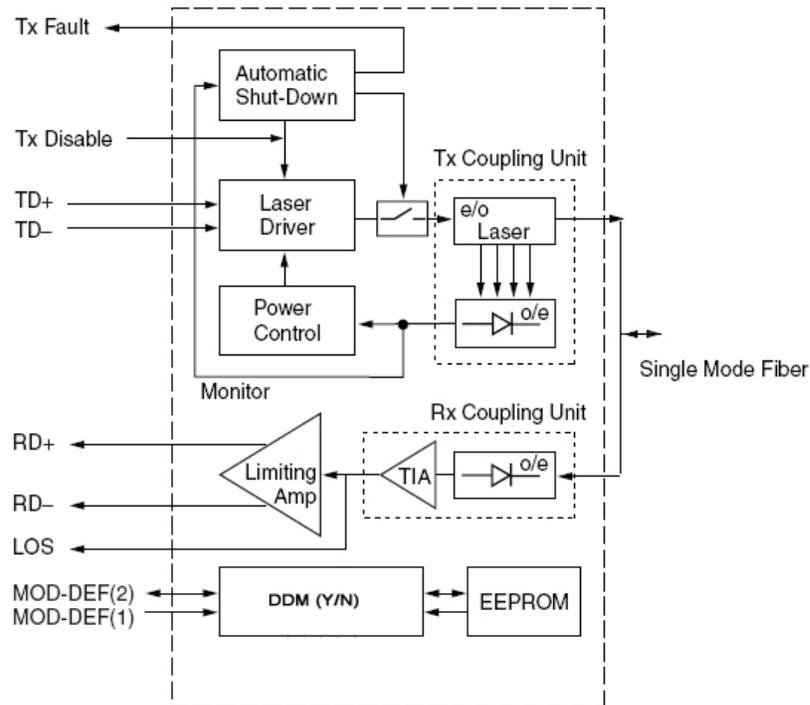
Note5: Measured at all data rates specified in Data Rate table with ER=9 dB, 2<sup>23</sup>-1 PRBS data pattern, BER <1E-10.

Note6: Eye pattern mask

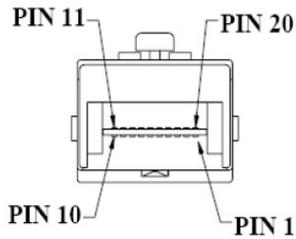
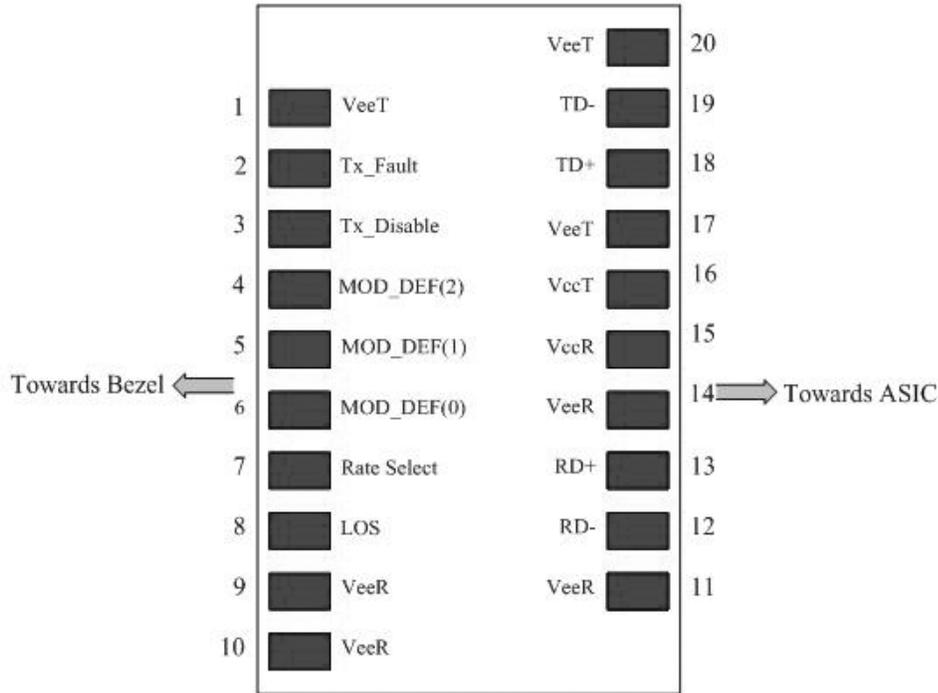
Note7: LOS Hysteresis



## Functional Description of Transceiver



## SFP Transceiver Electrical Pad Layout



## Pin Function Definitions

Pin Num.	Name	FUNCTION	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	5)
2	TX Fault	Transmitter Fault Indication	3	1)
3	TX Disable	Transmitter Disable	3	2), Module disables on high or open
4	MOD-DEF2	Module Definition 2	3	3), Data line for Serial ID.
5	MOD-DEF1	Module Definition 1	3	3), Clock line for Serial ID.
6	MOD-DEF0	Module Definition 0	3	3), Grounded within the module.
7	Rate Select	Not Connect	3	Function not available
8	LOS	Loss of Signal	3	4)
9	VeeR	Receiver Ground	1	5)

10	VeeR	Receiver Ground	1	5)
11	VeeR	Receiver Ground	1	5)
12	RD-	Inv. Received Data Out	3	6)
13	RD+	Received Data Out	3	7)
14	VeeR	Receiver Ground	1	5)
15	VccR	Receiver Power	2	3.3 ± 5%, 7)
16	VccT	Transmitter Power	2	3.3 ± 5%, 7)
17	VeeT	Transmitter Ground	1	5)
18	TD+	Transmit Data In	3	8)
19	TD-	Inv. Transmit Data In	3	8)
20	VeeT	Transmitter Ground	1	5)

### Notes:

1) TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor on the host board. Pull up voltage between 2.0V and VccT, R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.

2) TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7 – 10 K Ω resistor. Its states are:

Low (0 – 0.8V): Transmitter on

(>0.8, < 2.0V): Undefined

High (2.0 – 3.465V): Transmitter Disabled

Open: Transmitter Disabled

3) Mod-Def 0,1,2. These are the module definition pins. They should be pulled up with a 4.7K – 10KΩ resistor on the host board. The pull-up voltage shall be VccT or VccR (see Section IV for further details). Mod-Def 0 is grounded by the module to indicate that the module is present Mod-Def 1 is the clock line of two wire serial interface for serial ID Mod-Def 2 is the data line of two wire serial interface for serial ID

4) LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor. Pull up voltage between 2.0V and VccT, R+0.3V. When high, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.

5) VeeR and VeeT may be internally connected within the SFP module.

6) RD-/+: These are the differential receiver outputs. They are AC coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board. The voltage swing on these lines will be between 370 and 2000 mV differential (185 – 1000 mV single ended) when properly terminated.

7) VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V ±5% at the SFP connector pin. Maximum supply current is 300mA. Recommended host board power supply filtering is shown below. Inductors with DC resistance of less than 1 ohm should be used in

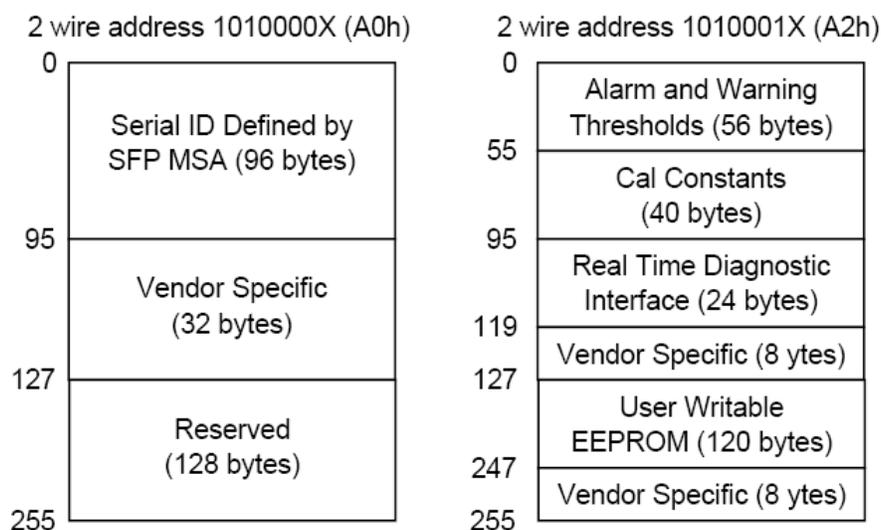
order to maintain the required voltage at the SFP input pin with 3.3V supply voltage. When the recommended supply-filtering network is used, hot plugging of the SFP transceiver module will result in an inrush current of no more than 30mA greater than the steady state value. VccR and VccT may be internally connected within the SFP transceiver module.

8) TD-/+ : These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board. The inputs will accept differential swings of 500 – 2400 mV (250 – 1200mV single-ended), though it is recommended that values between 500 and 1200 mV differential (250 – 600mV single-ended) be used for best EMI performance.

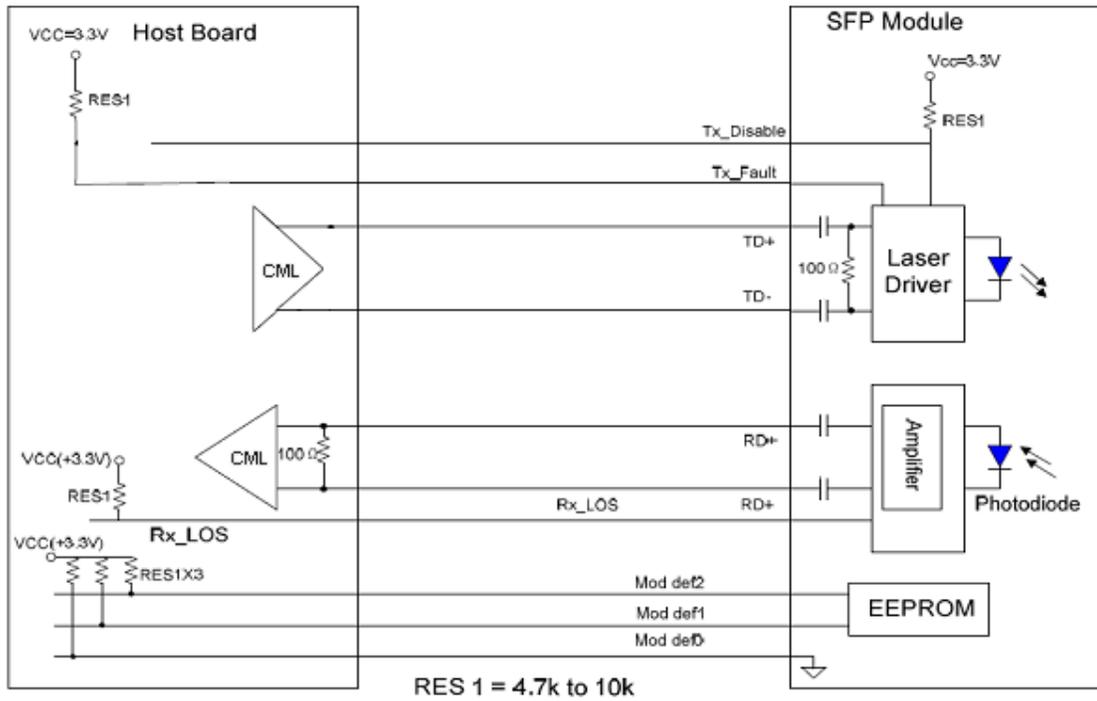
## EEPROM

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 writing 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.

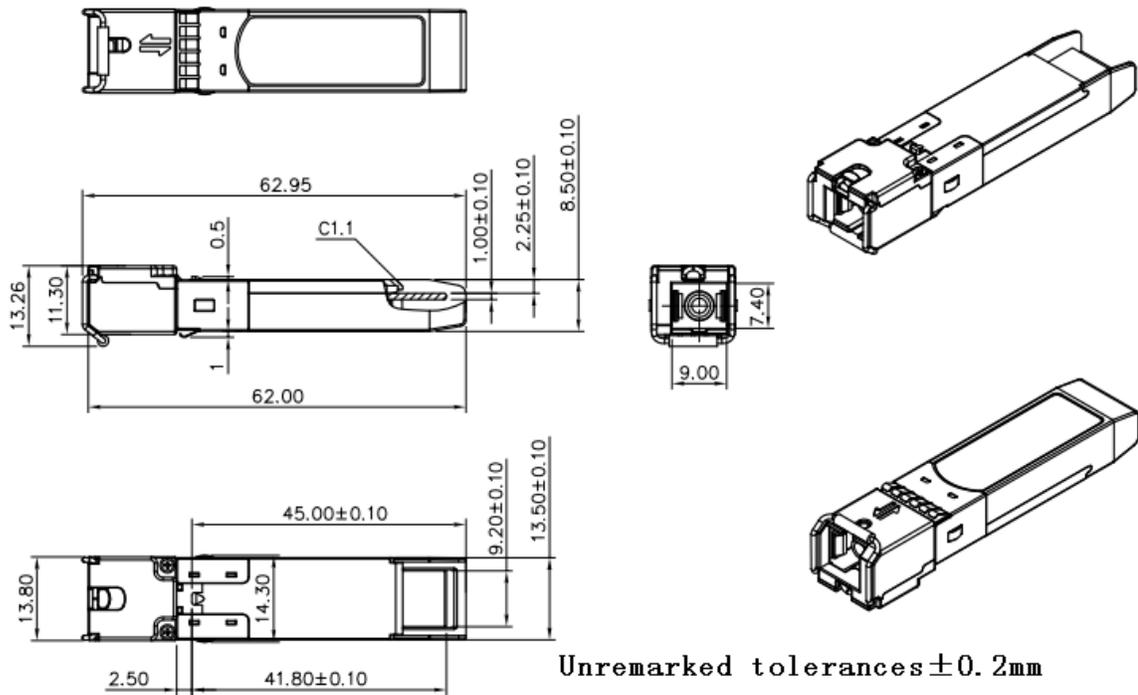
The Module provides diagnostic information about the present operating conditions. The transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture. Received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring all are implemented. 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.



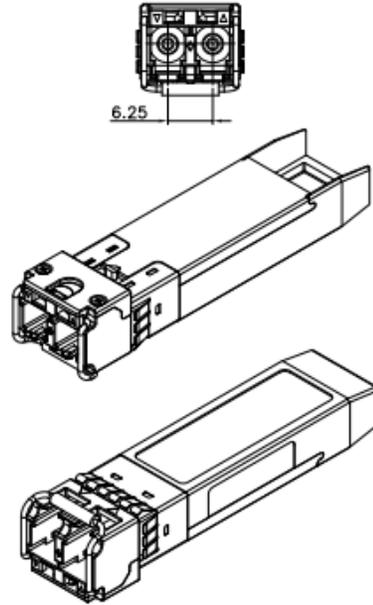
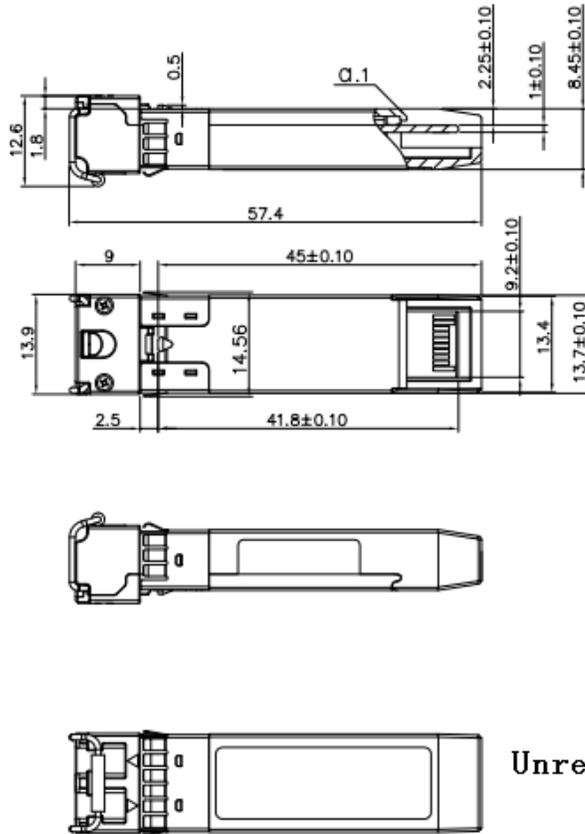
Recommend Circuit Schematic



Mechanical Specifications



SC



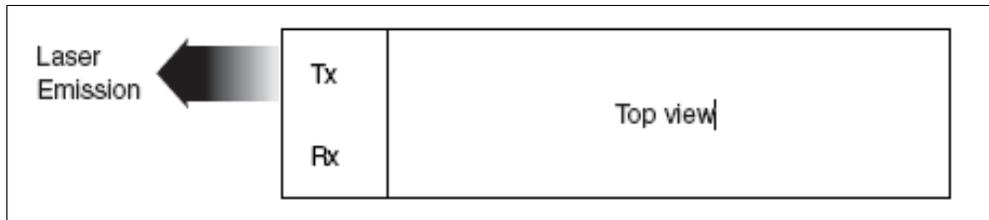
Unremarked tolerances ±0.2mm

LC

**Laser Emission Data**

Wavelength	1310nm
Total output power (as defined by FDA: 7 mm aperture at 20 cm distance)	<0.195mW
Total output power (as defined by IEC: 7 mm aperture at 10 cm distance)	<15.6mW
Beam divergence	12.5°
Wavelength	1490nm
Total output power (as defined by FDA: 7 mm aperture at 20 cm distance)	<0.79mW
Total output power (as defined by IEC: 7 mm aperture at 10 cm distance)	<10mW
Beam divergence	12.5°

**Laser Emission**



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**Revision History**

Revision	Initiate	Review	Approve	Revision History	Date
V1.a	Angela	Lyn/Jason/ Walt/Nygai	Phlio	Released.	October 9,2013
V1.b	Angela/Vina	Lyn/Jason/Nygai	Phlio	Update the regulatory compliance LOSA and the tolerances of 2D drawing.	April 20,2015

**Notice:**

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