

## EOLS-1331-07-X Series

Single-Mode 1310nm 3.072/2.4576Gb/s for OBSAI/CPRI  
 Duplex SFP Transceiver  
 RoHS Compliant



### Features

- ◆ Operating Data Rate up to 3.072Gbps
- ◆ 1310nm FP Laser Transmitter
- ◆ Up to 7km with 9µm fiber for 3.072Gb/s
- ◆ Up to 8km with 9µm fiber for 2.4576Gb/s
- ◆ Single 3.3V Power Supply and TTL Logic Interface
- ◆ Hot-Pluggable SFP Footprint Duplex 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

- ◆ Gigabit Ethernet Interface, Fiber channel
- ◆ Wireless and cellular base station system interconnect
- ◆ OBSAI rates: 3.072 Gb/s, 1.536 Gb/s, 0.768 Gb/s
- ◆ CPRI rates: 3.072 Gb/s, 2.4576 Gb/s, 1.2288Gb/s, 0.6144Gb/s
- ◆ Other Optical Links

### Ordering Information

Part No.	Data Rate	Fiber	Distance *Note2	Interface	Temp.	DDMI
EOLS-1331-07*Note1	Up to 3.072Gbps	SMF	7km	LC	Standard	NO
EOLS-1331-07-I*Note1	Up to 3.072Gbps	SMF	7km	LC	Industrial	NO
EOLS-1331-07-D*Note1	Up to 3.072Gbps	SMF	7km	LC	Standard	YES
EOLS-1331-07-DI*Note1	Up to 3.072Gbps	SMF	7km	LC	Industrial	YES

Note1: Standard version

Note2: 7km with 9/125µm SMF under 3.072Gbps

## 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-1331-07-X series single mode transceiver is small form factor pluggable module for serial optical data communications. It is with the SFP 20-pin connector to allow hot plug capability. This module is designed for single mode fiber and operates at a nominal wavelength of 1310nm.

The transmitter section uses a multiple quantum well 1310nm FP laser and is a class 1 laser compliant according to International Safety Standard IEC-60825. The receiver section uses an integrated InGaAs detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

The EOLS-1331-07-X series are designed to be compliant with SFF-8472.

## Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Notes
Storage Temperature	T <sub>s</sub>	-40	+85	°C	
Supply Voltage	V <sub>cc</sub>	-0.5	3.6	V	
Operating Relative Humidity	RH	5	95	%	

## Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max	Unit
Operating Case Temperature	T <sub>c</sub>	EOLS-1331-07-X	0	+70	°C
		EOLS-1331-07-XI	-40	+85	°C
Power Supply Voltage	V <sub>cc</sub>	3.15	3.3	3.4 5	V
Module supply current	I <sub>cc</sub>			350	mA
Data Rate		0.614		3.072	Gbps

**Performance Specifications – Electrical**

Parameter	Symbol	Min.	Typ.	Max	Unit	Notes
<b>Transmitter</b>						
CML Inputs(Differential)	Vin	400		1600	mVpp	AC coupled inputs *Note4
Input Impedance (Differential)	Zin	85	100	115	Ohms	Rin>100 ohms@DC
TX_Dis	Disable	2		Vcc	V	
	Enable	0		0.8		
TX_FAULT	Fault	2		Vcc+0.3	V	
	Normal	0		0.6		
<b>Receiver</b>						
CML Outputs (Differential)	Vout	400	800	1200	mVpp	AC coupled outputs *Note5
Output Impedance (Differential)	Zout	85	100	115	ohm	
RX_LOS	LOS	2		Vcc+0.3	V	
	Normal	0		0.8	V	
MOD_DEF ( 0:2 )	VoH	2		Vcc	V	With Serial ID
	VoL	0		0.6	V	

**Performance Specifications - Optical**

Parameter	Symbol	Min.	Typical	Max.	Unit
9µm Core Diameter SMF	L		7		km
Data Rate		0.614		3.072	Gbps
<b>Transmitter</b>					
Center Wavelength	$\lambda_C$	1280	1310	1345	nm
Spectral Width (RMS)	$\Delta\lambda$			4	nm
Average Output Power*(note6)	Pout	-9.5		-3	dBm
Extinction Ratio*(note7)	ER	3.5	5		dB
Rise/Fall Time(20%~80%)	tr/tf			100	ps
Output Optical Eye*(note7)	FC PI-4 REV 8.0 Compliant*(note9)				
TX_Disable Assert Time	t_off			10	us
P <sub>out</sub> @TX Disable Asserted	P <sub>OFF</sub>			-35	dBm
<b>Receiver</b>					
Center Wavelength	$\lambda_C$	1260		1600	nm
Receiver Sensitivity*(note8)	Pmin			-15.4	dBm
Receiver Overload	Pmax	-3			dBm
Link Penalty	P <sub>L</sub>			1	dB
LOS De-Assert	LOSD			-17.4	dBm
LOS Assert	LOSA	-29.4			dBm

LOS Hysteresis*(note10)		0.5			dB
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Note4: internally AC coupled, and terminated to 100Ω differential load.

Note5: AC-coupled CML logic.

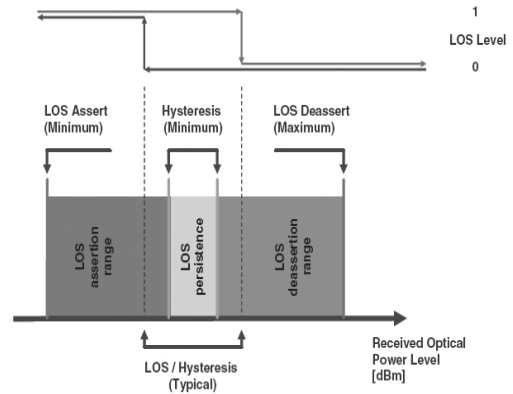
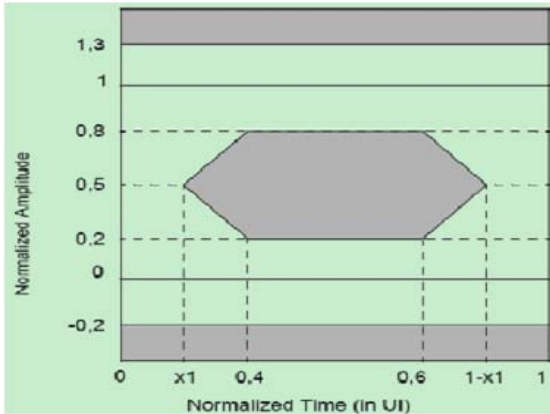
Note6: Output is coupled into a 9/125μm single-mode fiber.

Note7: Filtered, measured with a PRBS 2<sup>7</sup>-1 test pattern @3.1Gbps.

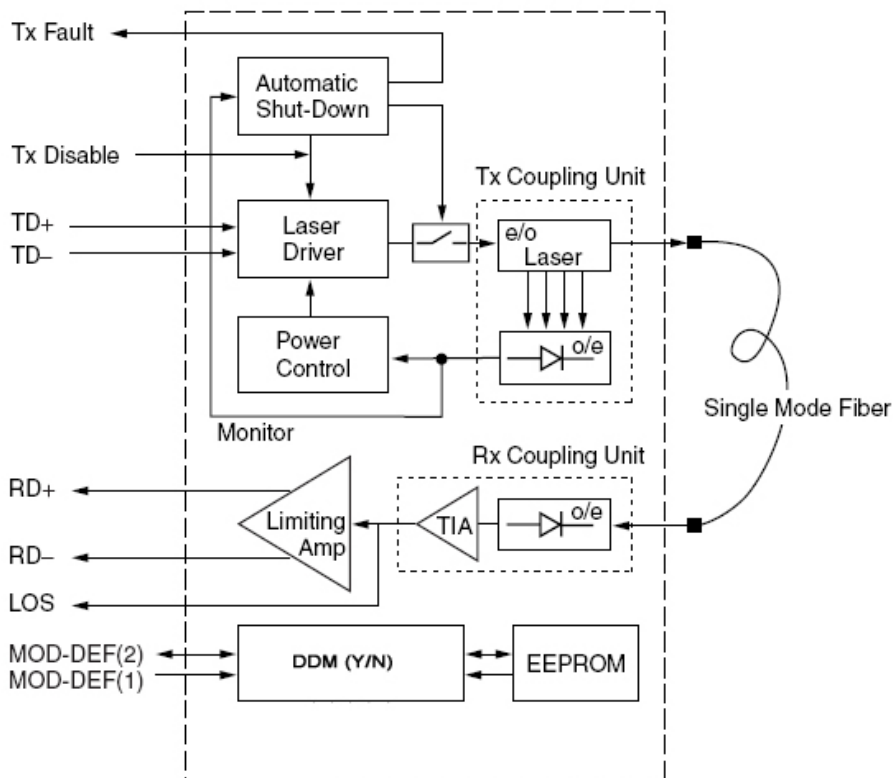
Note8: Minimum average optical power measured at BER less than 1E-12, with a 2<sup>7</sup>-1 PRBS and ER=9dB.

Note9: Eye Pattern Mask

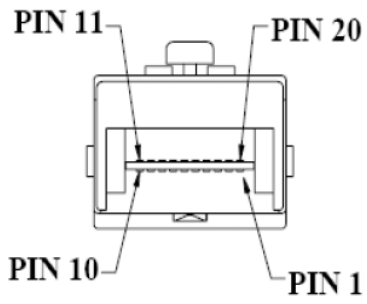
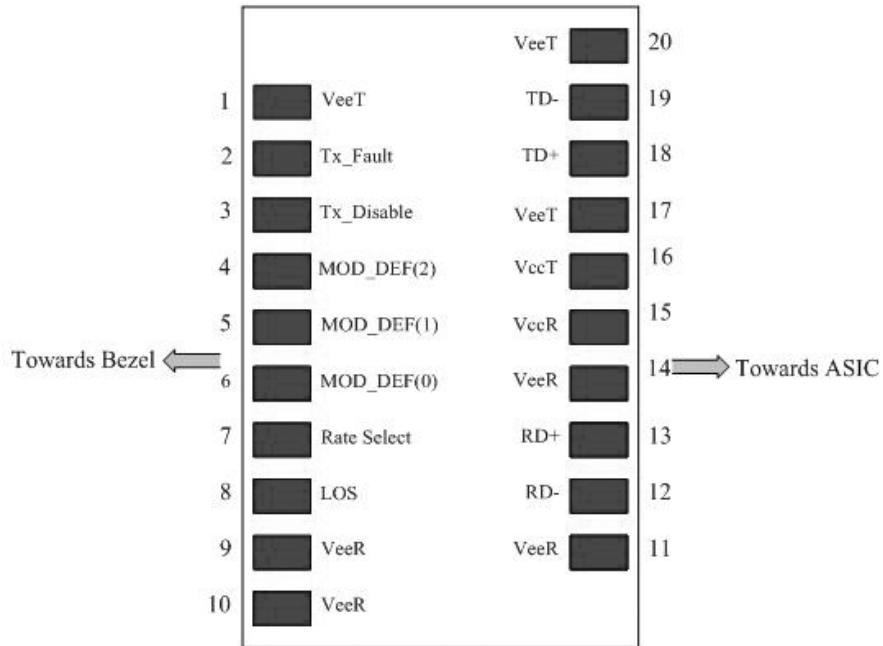
Note10: LOS Hysteresis



### 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	6)
14	VeeR	Receiver Ground	1	5)
15	VccR	Receiver Power	2	7) 3.3 ± 5%
16	VccT	Transmitter Power	2	7) 3.3 ± 5%
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 KΩ 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.

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 400 and 1200mV differential (200 –600mV single ended) when properly terminated.

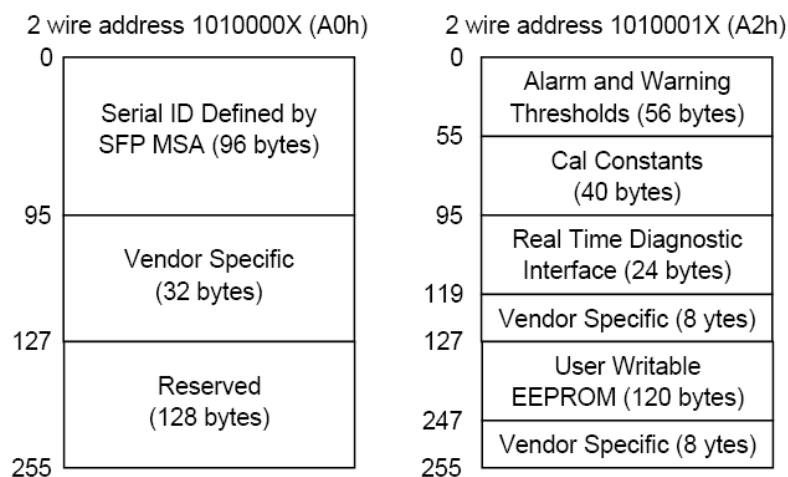
7) VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V  $\pm 5\%$  at the SFP connector pin. Maximum supply current is 300Ma. Recommended host board power supply filtering is shown below. Inductors with DC resistance of less than 1ohm should be used in order to maintain 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 100 $\Omega$  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 400 – 1600Mv (200 – 800Mv single-ended).

## 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. 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	Hex	Description
<b>BASE ID FIELDS</b>				
0	1	Identifier	03	SFP
1	1	Ext. Identifier	04	SFP function is defined by serial ID only
2	1	Connector	07	LC Connector
3-10	8	Transceiver	00 00 00 00 0A 00 01 00	Transmitter Code
11	1	Encoding	01	Compatible with 8B/10B encoded data
12	1	BR, Nominal	1F	3.1Gbps
13	1	Reserved	00	
14	1	Length (9µm)km	07	7km of single mode @ 3.1Gbit/sec
15	1	Length(9µm)100m	46	7km of single mode @ 3.1Gbit/sec
16	1	Length (50µm) 10m	00	
17	1	Length(62.5µm)10m	00	
18	1	Length (Copper)	00	
19	1	Reserved	00	
20-35	16	Vendor name	XX XX XX XX XX XX XX XX XX <sup>(note11)</sup> 20 20 20 20 20 20 20 20	Vendor name (ASCII)
36	1	Reserved	00	
37-39	3	Vendor OUI	XX XX XX <sup>(note11)</sup>	
40-55	16	Vendor PN	XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX	Transceiver part number
56-59	4	Vendor rev	XX XX XX XX <sup>(note11)</sup>	
60-61	2	Wavelength	05 1E	1310nm
62	1	Reserved	00	
63	1	CC_BASE	Check Sum (Variable)	Check code for Base ID Fields
<b>EXTENDED ID FIELDS</b>				
64-65	2	Options	00 1A	TX_DISABLE, TX_FAULT and Loss of Signal implemented.
66	1	BR, max	00	
67	1	BR, min	50	80% below nominal rate tolerated (0.614 Gb/s)
68-83	16	Vendor SN	XX XX XX XX XX XX XX XX	Serial Number of transceiver



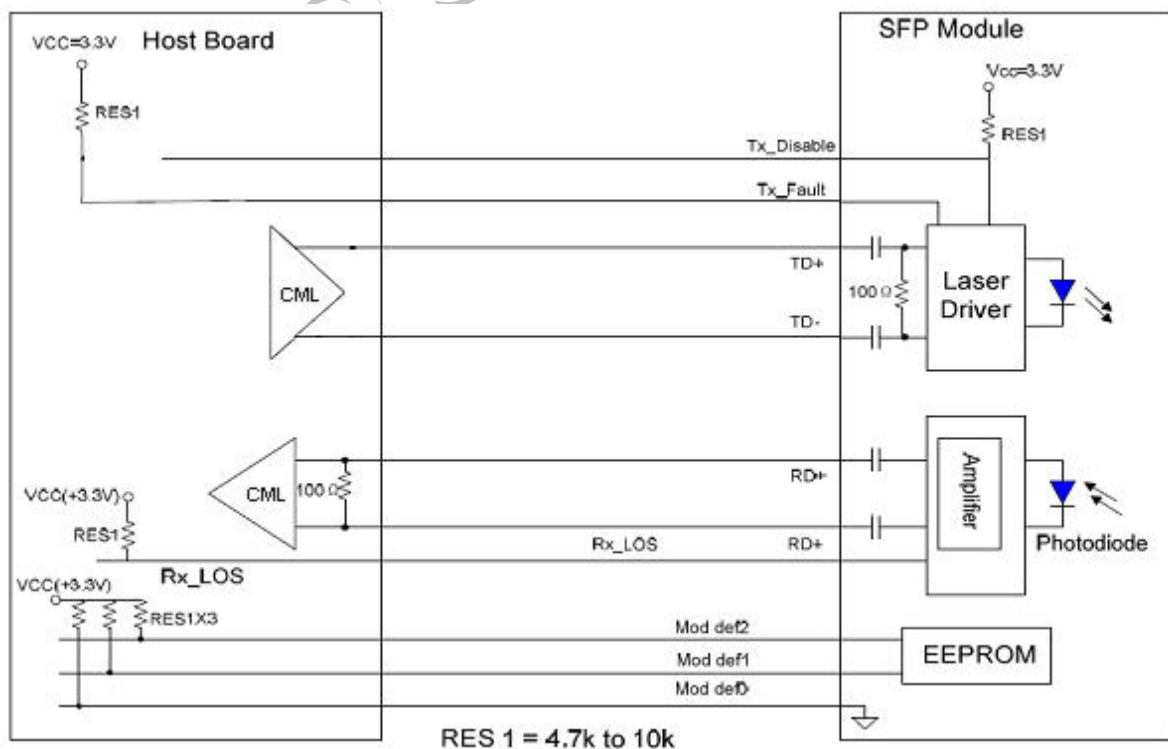
			20 20 20 20 20 20 20 20 <sup>(note11)</sup>	(ASCII). For example "B000822".
84-91	8	Date code	XX XX XX XX XX XX XX XX XX <sup>(note11)</sup>	Manufactory date code. For example "080405".
92	1	Diagnostic Monitoring Type	XX <sup>(note11)</sup>	Digital diagnostic monitoring implemented
93	1	Enhanced Options	F0	Optional flags
94	1	SFF_8472 Compliance	03	SFF-8472 Compliance to revision 10
95	1	CC_EXT	Check Sum (Variable)	Check sum for Extended ID Field.
<b>VENDOR SPECIFIC ID FIELDS</b>				
96-127	32	Vendor Specific	Read only	Depends on customer information
128-255	128	Reserved	Read only	

Note11: 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).

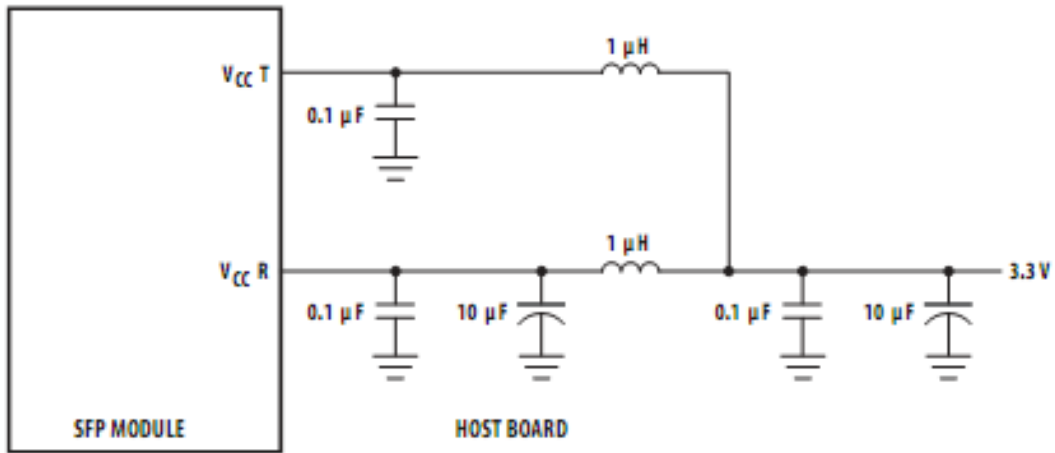
## DDM Monitoring Specification (2-Wire Address A2H)

Parameter	Range	Accuracy	Calibration
Temperature	-40 to +85°C	± 3°C	Internal
Voltage	3.0 to 3.6V	± 3%	Internal
Bias Current	0 to 70mA	±10%	Internal
TX Power	-9.5 to -3dBm	± 3dB	Internal
RX Power	-15.4 to -3dBm	± 3dB	Internal

## Recommend Circuit Schematic

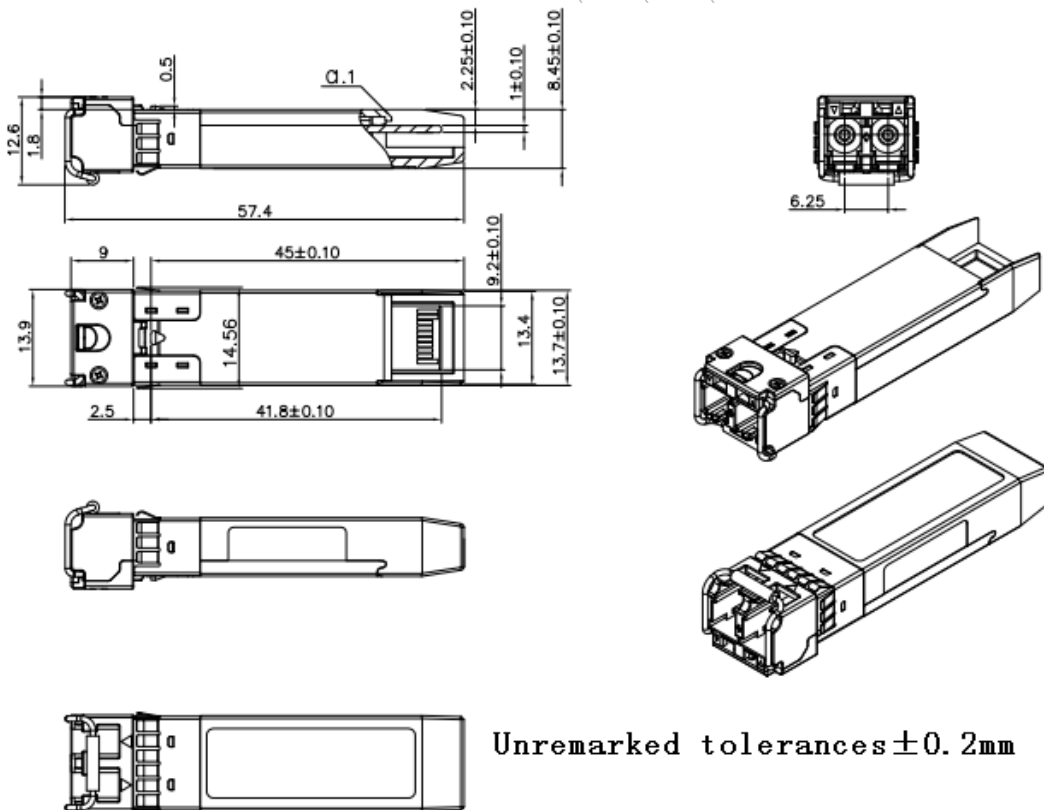


Recommended Power Supply Filter

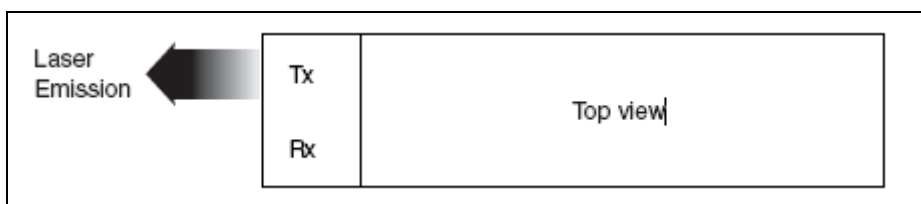


\* Inductors must have less than 1 series resistance to limit voltage drop to the SFP module

Mechanical Specifications



Laser Emission



## Obtaining Document

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## Revision History

Revision	Initiated	Reviewed	Approved	DCN	Release Date
V1.a	Abby	Kelly		Released.	Oct 22, 2012
V1.b	Angela	Kelly/Vina		Update the regulatory compliance and 2D drawing.	July 8, 2015

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