

# GBE Bidirectional SFP (SC Connector) Transceiver With Digital Diagnostic Function



## Features:

- Operating data rate at 1.25Gbps
- Distance up to 3Km~20km
- Single 3.3V Power supply and TTL Logic Interface
- Single SC Connector Interface
- Hot Pluggable
- Compliant with MSA SFP Specification
- Compliant with Telcordia GR-253-CORE and IEEE802.3
- Digital Diagnostic Monitor Interface Compatible with SFF-8472
- Operating Case Temperature  
Standard: -5°C ~+75°C  
Industrial: -40°C ~+85°C

## Applications:

- Gigabit Ethernet Switches and Routers
- Fiber Channel Switch
- Other Optical Link

## Product Description

The GBE Bidirectional SFP (SC) optical transceivers are high performance, cost effective modules. They offer the customer a range of design options, including optional DDMI, standard or industrial temperature ranges. They are designed to provide Gigabit Ethernet compliant connections for 1.25 Gbps at short, intermediate and long reach links. These transceivers are qualified in accordance with GR-468-CORE.

## Ordering information

Part No.	Data Rate	Laser	Fiber Type	Distance* <sup>Note1</sup>	Optical Interface	Bail Color	Temp.* <sup>Note2</sup>	DDMI
<a href="#">TSB-GE03-35NCC</a>	1.25G	1310nm-FP	SMF	3Km	SC	Blue	ST	NO
<a href="#">TSB-GE03-53NCC</a>	1.25G	1550nm-FP	SMF	3Km	SC	Purple	ST	NO
<a href="#">TSB-GE03-35DCC</a>	1.25G	1310nm-FP	SMF	3Km	SC	Blue	ST	YES
<a href="#">TSB-GE03-53DCC</a>	1.25G	1550nm-FP	SMF	3Km	SC	Purple	ST	YES
<a href="#">TSB-GE03-35DIC</a>	1.25G	1310nm-FP	SMF	3Km	SC	Blue	IT	YES
<a href="#">TSB-GE03-53DIC</a>	1.25G	1550nm-FP	SMF	3Km	SC	Purple	IT	YES
<a href="#">TSB-GE10-35NCC</a>	1.25G	1310nm-FP	SMF	10Km	SC	Blue	ST	NO
<a href="#">TSB-GE10-53NCC</a>	1.25G	1550nm-FP	SMF	10Km	SC	Purple	ST	MO
<a href="#">TSB-GE10-35DCC</a>	1.25G	1310nm-FP	SMF	10Km	SC	Blue	ST	YES
<a href="#">TSB-GE10-53DCC</a>	1.25G	1550nm-DFB	SMF	10Km	SC	Purple	ST	YES
<a href="#">TSB-GE10-35DIC</a>	1.25G	1310nm-FP	SMF	10Km	SC	Blue	IT	YES
<a href="#">TSB-GE10-53DIC</a>	1.25G	1550nm-DFB	SMF	10Km	SC	Purple	IT	YES
<a href="#">TSB-GE20-35NCC</a>	1.25G	1310nm-FP	SMF	20Km	SC	Blue	ST	NO
<a href="#">TSB-GE20-53NCC</a>	1.25G	1550nm-DFB	SMF	20Km	SC	Purple	ST	NO
<a href="#">TSB-GE20-35DCC</a>	1.25G	1310nm-FP	SMF	20Km	SC	Blue	ST	YES
<a href="#">TSB-GE20-53DCC</a>	1.25G	1550nm-DFB	SMF	20Km	SC	Purple	ST	YES
<a href="#">TSB-GE20-35DIC</a>	1.25G	1310nm-FP	SMF	20Km	SC	Blue	IT	YES
<a href="#">TSB-GE20-53DIC</a>	1.25G	1550nm-DFB	SMF	20Km	SC	Purple	IT	YES

Note1: 10/40/80Km with 9/125µm SMF

Note2: ST: -5 ~ +75deg C IT: -40 ~ +85 deg C.

## Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883G Method 3015.7	Class 1C (>1000 V)
Electrostatic Discharge to the enclosure	EN 55024:1998+A1+A2 IEC-61000-4-2 GR-1089-CORE	Compliant with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN55022:2006 CISPR 22B :2006 VCCI Class B	Compliant with standards Noise frequency range: 30 MHz to 6 GHz. Good system EMI design practice required to achieve Class B margins. System margins depend on customer host board and chassis design.
Immunity	EN 55024:1998+A1+A2 IEC 61000-4-3	Compliant with standards. 1kHz sine-wave, 80% AM, from 80 MHz to 1 GHz. No effect on transmitter/receiver performance is detectable between these limits.

Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN (IEC) 60825-1:2007 EN (IEC) 60825-2:2004+A1 EN (IEC) 60950-1:2006+A1+A11+A12	CDRH compliant and Class I laser product. TUV Certificate No. <a href="#">R50271605</a>
Component Recognition	UL and CUL EN60950-1:2006	TUV Certificate No. <a href="#">E344594</a> (CB:JPTUV-053877)
RoHS2.0	20011/65/EU	Compliant with standards

**Note:** For update of the equipment and strict control of raw materials, Trixon has the ability to supply the customized products since Sep.2008, which meets the requirements of RoHS6 (Restrictions on use of certain Hazardous Substances) of European Union.

In light of item 5 in RoHS exemption list of RoHS Directive 2002/95/EC, Item 5: Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.

In light of item 13 in RoHS exemption list of RoHS Directive 2005/747/EC, Item 13: Lead and cadmium in optical and filter glass. The three exemptions are being concerned for Trixon transceivers, because Trixon transceivers use glass, which may contain Pb, for components such as lenses, windows, isolators, and other electronic components.

### Absolute Maximum Ratings\*Note3

Parameter	Symbol	Min	Max	Unit
Storage Temperature	T <sub>S</sub>	-40	+85	°C
Supply Voltage	V <sub>CC</sub>	0	3.6	V
Operating Humidity	-	5	95	%

Note3: Exceeding any one of these values may destroy the device permanently.

### Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	T <sub>C</sub>	-5		75	°C	ST
		-40		85	°C	IT
Power Supply Voltage	V <sub>CC</sub>	3.14	3.3	3.47	V	
Bit Rate			1.25		Gbps	
Supply Current	I <sub>CC</sub>			300	mA	

### Performance Specifications – Electrical

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
<b>Transmitter</b>						
CML Inputs(Differential)	V <sub>in</sub>	500		2400	mVpp	AC coupled inputs
Input Impedance (Differential)	Z <sub>in</sub>		100		ohm	R <sub>in</sub> > 100 ohms @ DC
Tx_DISABLE Input Voltage – High		2		V <sub>CC</sub>	V	
Tx_DISABLE Input Voltage – Lo		0		0.8	V	
Tx_FAULT Output Voltage – High		2		V <sub>CC</sub>	V	
Tx_FAULT Output Voltage – Low		0		0.8	V	
<b>Receiver</b>						
CML Outputs (Differential)	V <sub>out</sub>	700		1600	mVpp	AC coupled outputs
Output Impedance (Differential)	Z <sub>out</sub>		100		ohm	

Rx_LOS Output Voltage – High	2		V	OC output, should be pull up with 4.7K – 10 K $\Omega$ on the host board
Rx_LOS Output Voltage – Low	0	0.5	V	
MOD_DEF ( 0:2 )	V <sub>OH</sub>	2.5	V	With Serial ID
	V <sub>OL</sub>	0	0.5	

## I/O Timing for Control & Status Functions Timing

Parameter	Symbol	Min	Typ.	Max	Unit
TX Disable Assert Time	t <sub>off</sub>			10	us
TX_DISABLE Negate Time	t <sub>on</sub>			1	ms
Time to initialize, include reset of TX_FAULT	t <sub>init</sub>			300	ms
TX Fault Assert Time	t <sub>fault</sub>			100	us
TX Disable to reset	t <sub>reset</sub>	10			us
LOS Assert Time	t <sub>loss_on</sub>			100	us
LOS De-Assert Time	t <sub>loss_off</sub>			100	us

## Performance Specifications – Optical

( 1310nm/1550nm ,FP and PIN · 3km )

Parameter	Symbol	Min	Typ.	Max	Unit	Note
<b>Transmitter</b>						
Centre Wavelength	$\lambda_c$	1280	1310	1340	nm	1310nmTX/1550nmRX
		1520	1550	1580	nm	1550nmTX/1310nmRX
Spectral Width* <sup>Note4</sup>	$\Delta\lambda$			4	nm	FP-LD
Average Output Power	P <sub>OUT</sub>	-9.5		-3	dBm	
Extinction Ratio	ER	9			dB	
Average Power of OFF	P <sub>OFF</sub>			-45	dBm	
Output Optical Eye	Compliant with eye mask Telcordia GR-253-CORE and IEEE 802.3ah-2004					
<b>Receiver</b>						
Centre Wavelength	$\lambda_c$	1530		1570	nm	1310nmTX/1550nmRX
		1280		1340	nm	1550nmTX/1310nmRX
Sensitivity* <sup>Note5</sup>	P <sub>IN</sub>			-20	dBm	
Receiver Overload	Overload	-3			dBm	
Optical Return Loss		12			dB	
LOS Assert	LOSA	-35			dBm	
LOS De-Assert	LOSD			-21	dBm	
LOS Hysteresis		0.5		4	dB	

( 1310nm/1550nm ,FP/DFB and PIN · 10km )

Parameter	Symbol	Min	Typ.	Max	Unit	Note
<b>Transmitter</b>						
Centre Wavelength	$\lambda_c$	1280	1310	1340	nm	1310nmTX/1550nmRX
		1520	1550	1580	nm	1550nmTX/1310nmRX

Spectral Width* <sup>Note4</sup>	$\Delta\lambda$	4		nm	FP-LD
		1		nm	DFB-LD
Average Output Power	$P_{OUT}$	-9.5	-3	dBm	
Extinction Ratio	ER	9		dB	
Average Power of OFF	$P_{OFF}$	-45		dBm	
Output Optical Eye	Compliant with eye mask Telcordia GR-253-CORE and IEEE 802.3ah-2004				

**Receiver**

Centre Wavelength	$\lambda_c$	1530	1570	nm	1310nmTX/1550nmRX
		1280	1340	nm	1550nmTX/1310nmRX
Sensitivity* <sup>Note5</sup>	$P_{IN}$	-20		dBm	
Receiver Overload	Overload	-3		dBm	
Optical Return Loss		12		dB	
LOS Assert	LOSA	-35		dBm	
LOS De-Assert	LOSD	-21		dBm	
LOS Hysteresis		0.5	4	dB	

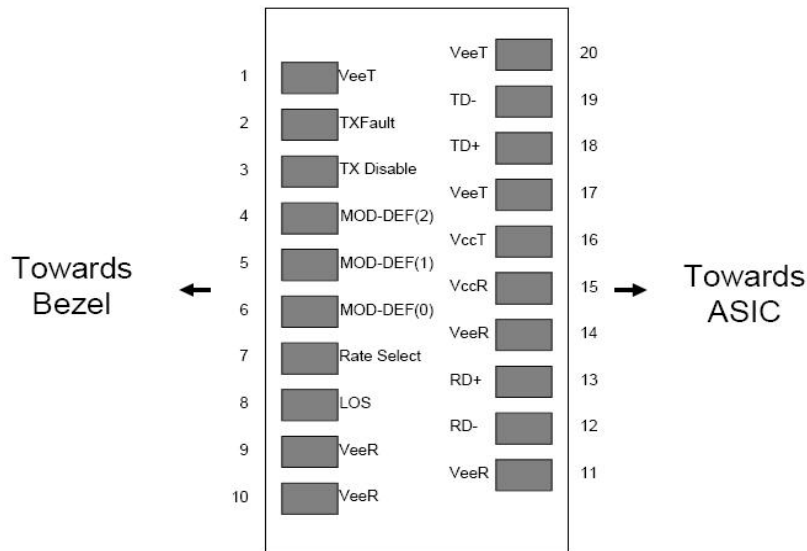
( 1310nm/1550nm ,FP/DFB and PIN · 20km )

Parameter	Symbol	Min	Typ.	Max	Unit	Note
<b>Transmitter</b>						
Centre Wavelength	$\lambda_c$	1280	1310	1340	nm	1310nmTX/1550nmRX
		1530	1550	1570	nm	1550nmTX/1310nmRX
Spectral Width* <sup>Note4</sup>	$\Delta\lambda$	4		nm	FP-LD	
		1		nm	DFB-LD	
Average Output Power	$P_{OUT}$	-8		-3	dBm	
Extinction Ratio	ER	9		dB		
Average Power of OFF	$P_{OFF}$	-45		dBm		
Output Optical Eye	Compliant with eye mask Telcordia GR-253-CORE and IEEE 802.3ah-2004					
<b>Receiver</b>						
Centre Wavelength	$\lambda_c$	1530		1570	nm	1310nmTX/1550nmRX
		1280		1340	nm	1550nmTX/1310nmRX
Sensitivity* <sup>Note5</sup>	$P_{IN}$	-22		dBm		
Receiver Overload	Overload	-3		dBm		
Optical Return Loss		12		dB		
LOS Assert	LOSA	-35		dBm		
LOS De-Assert	LOSD	-23		dBm		
LOS Hysteresis		0.5		4	dB	

Note4: VSCEL LD and FP LD measured spectral width RMS, DFB LD measured spectral width –20dB.

Note5: Minimum average optical power measured at the BER less than 1E-10@pattern is PRBS2<sup>7</sup>-1@ER=10dB.

# SFP Transceiver Electrical Pad Layout



**Diagram of Host Board Connector Block Pin Numbers and Names**

## Pin Function Definitions

Pin Num.	Name	Function	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	Note 10
2	TX Fault	Transmitter Fault Indication	3	Note 6
3	TX Disable	Transmitter Disable	3	Note 7, Module disables on high or open.
4	SDA	Module Definition 2	3	2-wire Serial Interface Data Line.
5	SCL	Module Definition 1	3	2-wire Serial Interface Clock.
6	MOD-ABS	Module Definition 0	3	Note 8
7	RS0	RX Rate Select (LVTTTL).	3	NC. Function not available
8	LOS	Loss of Signal	3	Note 9
9	RS1	TX Rate Select (LVTTTL).	1	NC. Function not available
10	VeeR	Receiver Ground	1	Note 10
11	VeeR	Receiver Ground	1	Note 10
12	RD-	Inv. Received Data Out	3	Note 11
13	RD+	Received Data Out	3	Note 12
14	VeeR	Receiver Ground	1	Note 10
15	VccR	Receiver Power	2	3.3V ± 5%, Note 12
16	VccT	Transmitter Power	2	3.3V ± 5%, Note 12
17	VeeT	Transmitter Ground	1	Note 10
18	TD+	Transmit Data In	3	Note 13
19	TD-	Inv. Transmit Data In	3	Note 13
20	VeeT	Transmitter Ground	1	Note 10

Note6: TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10K<sub>Ω</sub> 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.

Note7: TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7K – 10 K<sub>Ω</sub> 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.

Note8: Module Absent, connected to VeeT or VeeR in the module.

Note9: LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K –10K<sub>Ω</sub> resistor. Pull up

voltage between 2.0V and  $V_{ccT}/R+0.3V$ . 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  $< 0.8V$ .

Note10: The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.

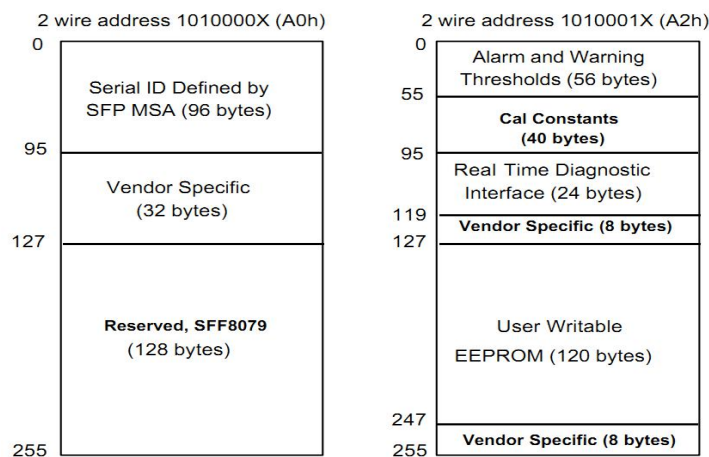
Note11: RD-/+: These are the differential receiver outputs. They are AC coupled 100\_ differential lines which should be terminated with 100\_ (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board.

Note12: 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. 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.

Note13: TD-/+: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100\_ differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board.

## Digital Diagnostic Functions:

- 1) SFP transceiver supports the 2-wire serial communication protocol as defined in SFP MSA: in which defines a 256-byte memory map in EEPROM at 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface is assigned with 8 bit address 1010001X (A2h). Additionally, SFP transceivers provide a unique digital diagnostic monitoring interface (DDMI), which allows real-time access to product operating parameters such as transceiver supply voltage, transceiver temperature, transmitted optical power, laser bias current and received optical power. It also defines alarm and warning threshold, which alerts end-users when particular operating parameters are outside of factory setting.
- 2) When the serial protocol is activated, the serial clock signal (SCL, Mod Def 1) is generated by the host. The positive edge clocks data into those segments of the EEPROM that are not write-protected. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA, Mod Def 2) 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.



## Digital Diagnostic Monitoring Specifications

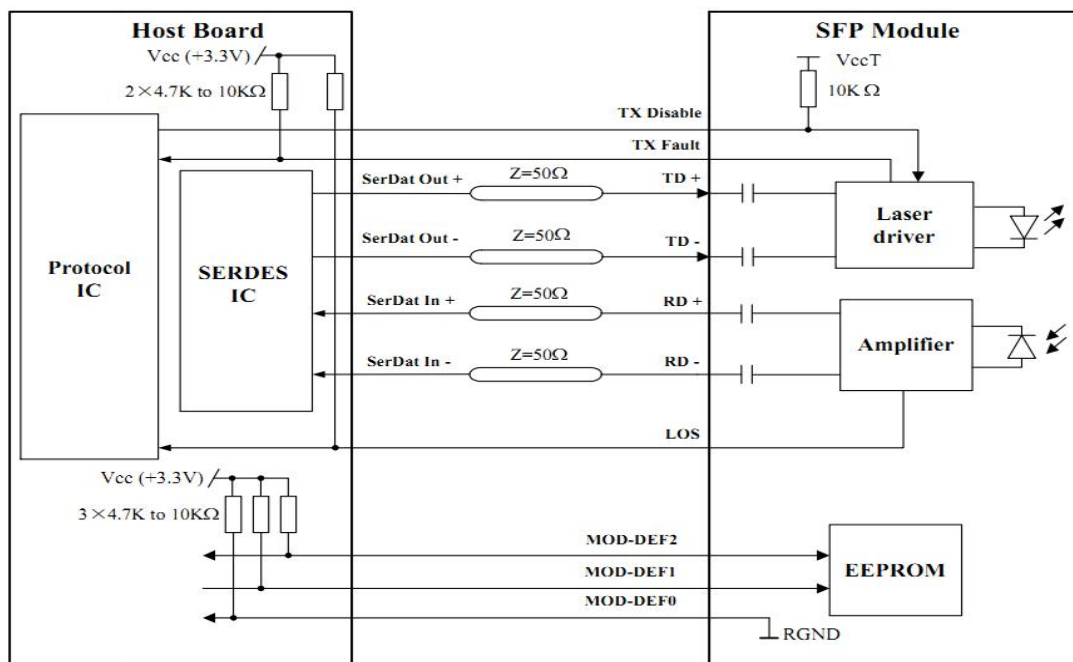
- 1) Additionally, SFP transceivers TSB-xxxx-xxDxC<sup>\*Note14</sup> provide a unique digital diagnostic monitoring interface (DDMI) be assigned with 8 bit address 1010001X (A2h) as defined in SFP MSA , which allows real-time access to product operating parameters such as transceiver supply voltage, transceiver temperature, transmitted optical power, laser bias current and received optical power. It also defines alarm and warning threshold, which alerts end-users when particular operating parameters are outside of factory setting.
- 2) Digital diagnostics for the TSB-xxxx-xxDxC are internally calibrated by default. Calibration and

alarm/warning threshold data is written during device manufacturing.

Monitor accuracy						
Parameter	Min	Typ	Max	Units		
Internally measured transceiver temperature			±3	°C		
Internally measured transceiver supply voltage			±3%	V		
Measured TX bias current			±10	%		
Measured TX output power			±3	dB		
Measured RX received average optical power			±3	dB		
Dynamic range for operation						
Parameter	H-Alarm	H-warning	L-Warnin g	L- Alarm	Units	Note
Internally measured transceiver temperature	+85	80	0	-5	°C	ST
	100	95	-35	-40	°C	IT
Internally measured transceiver supply voltage	3.9	3.6	3.0	2.7	V	
Measured TX bias current	100	80	2	1	mA	
Measured TX output power	Pout_max+1	Pout_max	Pout_min	Pout_min-1	dBm	
Measured RX received average optical power	Overload+1	Overload	P <sub>IN</sub>	P <sub>IN</sub> -2	dBm	

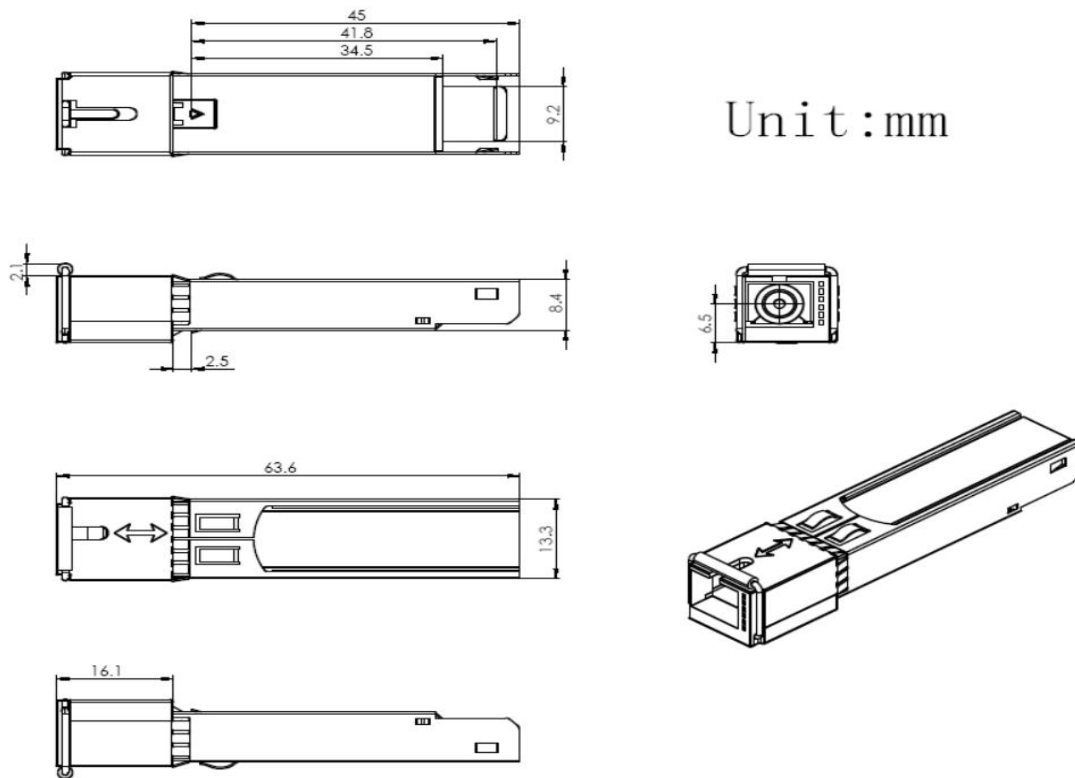
Note14: TSB-xxxx-xxxxR provides an EEPROM addressed 1010000X (A0h) as defined in SFP MSA, and only TSB-xxxx-xxDxC is compliant with digital diagnostic monitoring interface (DDMI) be assigned with 8 bit address 1010001X (A2h) .

## Recommended Circuit





## Mechanical Dimension



## Eye Safety

This single-mode transceiver is a Class 1 laser product. It complies with IEC-60825 and FDA 21 CFR 1040.10 and 1040.11. The transceiver must be operated within the specified temperature and voltage limits. The optical ports of the module shall be terminated with an optical connector or with a dust plug.

## Obtaining Document

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## Notice

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