GBE SFP Transceiver
With Digital Diagnostic Function

Features:

- Operating data rate up to 1.25 Gbps
- Distance up to 550m~120km
- Single 3.3V Power supply and TTL Logic Interface
- Duplex LC Connector Interface
- Hot Pluggable
- Compliant with MSA SFP Specification SFF-8472
- Compliant with IEEE 802.3 and 1x Fibre Channel as defined in FC-PI-2 Rev 10.0
- Operating Case Temperature
  Standard: -5℃ ~+70℃
  Industrial: -40℃ ~+85℃

Applications:

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

Product Description

The GBE SFP Series 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*Note1	Optical Interface	Bail color	Temp. *Note2	DDMI
TSS-GEM5-85NCR	1.25G	850nm-VCSEL	MMF	550m	LC	Black	ST	NO
TSS-GEM5-85DCR	1.25G	850nm-VCSEL	MMF	550m	LC	Black	ST	YES
TSS-GEM5-85DIR	1.25G	850nm-VCSEL	MMF	550m	LC	Black	IT	YES
TSS-GE10-31NCR	1.25G	1310nm-FP	SMF	Up to 15Km	LC	Blue	ST	NO
TSS-GE10-31DCR	1.25G	1310nm-FP	SMF	Up to 15Km	LC	Blue	ST	YES
TSS-GE10-31DIR	1.25G	1310nm-FP	SMF	Up to 15Km	LC	Blue	IT	YES
TSS-GE20-31DCR	1.25G	1310nm-FP	SMF	20 Km	LC	Blue	ST	YES
TSS-GE20-31DIR	1.25G	1310nm-FP	SMF	20Km	LC	Blue	IT	YES
TSS-GE40-31DCR	1.25G	1310nm-DFB	SMF	40Km	LC	Blue	ST	YES
TSS-GE40-31DIR	1.25G	1310nm-DFB	SMF	40Km	LC	Blue	IT	YES
TSS-GE40-55DCR	1.25G	1550nm-DFB	SMF	40Km	LC	Purple	ST	YES
TSS-GE40-55DIR	1.25G	1550nm-DFB	SMF	40Km	LC	Purple	IT	YES
TSS-GE50-55DCR	1.25G	1550nm-DFB	SMF	50Km	LC	Purple	ST	YES
TSS-GE50-55DIR	1.25G	1550nm-DFB	SMF	50Km	LC	Purple	IT	YES
TSS-GE80-55DCR	1.25G	1550nm-DFB	SMF	80Km	LC	Purple	ST	YES
TSS-GE80-55DIR	1.25G	1550nm-DFB	SMF	80Km	LC	Purple	IT	YES
TSS-GEL2-55DCR	1.25G	1550nm-DFB	SMF	120Km	LC	Purple	ST	YES
TSS-GEL2-55DIR	1.25G	1550nm-DFB	SMF	120Km	LC	Purple	IT	YES

Note1: 550m with 50/125μm MMF, 10/20/40/50/80/120Km 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. R50271605
Component Recognition	UL and CUL EN60950-1:2006	TUV Certificate No. E344594 (CB:JPTUV-053877)
RoHS2.0	20011/65/EU	Compliant with standards

Absolute Maximum Ratings*Note3

Parameter	Symbol	Min	Max	Unit
Storage Temperature	TS	-40	+85	℃
Supply Voltage	V_{CC}	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	Tc	-5		70	°C	ST
		-40		85	°C	IT
Power Supply Voltage	V_{CC}	3.14	3.3	3.47	V	
Bit Rate			1.25		Gbps	
Supply Current	Icc			300	mA	

Performance Specifications – Electrical

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Transmitter						
CML Inputs(Differential)	Vin	500		2400	mVpp	AC coupled inputs
Input Impedance (Differential)	Zin		100		ohm	Rin > 100 ohms @ DC
Tx_DISABLE Input Voltage – High		2		Vcc	V	
Tx_DISABLE Input Voltage – Lo		0		0.8	V	
Tx_FAULT Output Voltage – High		2		Vcc	V	
Tx_FAULT Output Voltage – Low		0		0.8	V	
Receiver						
CML Outputs (Differential)	Vout	700		1600	mVpp	AC coupled outputs
Output Impedance (Differential)	Zout		100		ohm	
Rx_LOS Output Voltage – High		2			V	OC output, should be pull up with 4.7K – 10 KΩ on the host board
Rx_LOS Output Voltage – Low		0		0.5	V	
MOD_DEF (0:2)	V_{OH}	2.5			V	With Serial ID
	V_{OL}	0		0.5	V	

I/O Timing for Control & Status Functions Timing

Parameter	Symbol	Min	Typ.	Max	Unit
TX Disable Assert Time	t_off			10	us
TX_DISABLE Negate Time	t_on			1	ms
Time to initialize, include reset of TX_FAULT	t_init			300	ms
TX Fault Assert Time	t_fault			100	us
TX Disable to reset	t_reset	10			us
LOS Assert Time	t_loss_on			100	us
LOS De-Assert Time	t_loss_off			100	us

Performance Specifications – Optical

(850nm VCSEL and PIN， 550m)

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter						
Centre Wavelength	λc	830	850	870	nm	
Spectral Width*[Note4]	∆λ			0.85	nm	VSCEL-LD
Average Output Power	P_{OUT}	-9.5		-3	dBm	
Extinction Ratio	ER	9			dB	
Average Power of OFF Transmitter	P_{OFF}			-45	dBm	
Output Optical Eye	Compliant with IEEE 802.3ah-2004					
Receiver						
Centre Wavelength	λc	830		870	nm	
Sensitivity*[Note5]	P_{IN}			-17	dBm	
Receiver Overload	Overload	0			dBm	
Optical Return Loss		12			dB	
LOS Assert	LOSA	-35			dBm	
LOS De-Assert	LOSD			-25	dBm	
LOS Hysteresis		0.5		4	dB	

(1310nm FP and PIN， up to 15Km)

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter						
Centre Wavelength	λc	1270	1310	1355	nm	
Spectral Width*[Note4]	∆λ			4	nm	FP-LD
Average Output Power	P_{OUT}	-9.5		-3	dBm	
Extinction Ratio	ER	9			dB	
Average Power of OFF Transmitter	P_{OFF}			-45	dBm	
Output Optical Eye	Compliant with IEEE 802.3ah-2004					
Receiver						
Centre Wavelength	λc	1260		1610	nm	
Sensitivity*[Note5]	P_{IN}			-20	dBm	

Receiver Overload	Overload	-3			dBm	
Optical Return Loss		12			dB	
LOS Assert	LOSA	-35			dBm	
LOS De-Assert	LOSD			-25	dBm	
LOS Hysteresis		0.5		4	dB	

（ 1310nm FP and PIN， 20Km ）

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter						
Centre Wavelength	λc	1270	1310	1355	nm	
Spectral Width*[Note4]	Δλ			4	nm	FP-LD
Average Output Power	P_{OUT}	-9		-3	dBm	
Extinction Ratio	ER	9			dB	
Average Power of OFF Transmitter	P_{OFF}			-45	dBm	
Output Optical Eye	Compliant with IEEE 802.3ah-2004					
Receiver						
Centre Wavelength	λc	1260		1610	nm	
Sensitivity*[Note5]	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	

（ 1310nm DFB and PIN， 40Km ）

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter						
Centre Wavelength	λc	1280	1310	1340	nm	
Spectral Width*[Note4]	Δλ			1	nm	DFB-LD
Average Output Power	P_{OUT}	-5		0	dBm	
Extinction Ratio	ER	9			dB	
Average Power of OFF Transmitter	P_{OFF}			-45	dBm	
Output Optical Eye	Compliant with IEEE 802.3ah-2004					
Receiver						
Centre Wavelength	λc	1260		1610	nm	
Sensitivity*[Note5]	P_{IN}			-22	dBm	
Receiver Overload	Overload	-3			dBm	
Optical Return Loss		12			dB	
LOS Assert	LOSA	-35			dBm	
LOS De-Assert	LOSD			-25	dBm	
LOS Hysteresis		0.5		4	dB	

（ 1550nm DFB and PIN， 40KM/50Km ）

Parameter	Symbol	Min	Typ.	Max	Unit	Note

Transmitter						
Centre Wavelength	λc	1500	1550	1580	nm	
Spectral Width*Note4	Δλ			1	nm	DFB-LD
Average Output Power	P_{OUT}	-5		0	dBm	
Extinction Ratio	ER	9			dB	
Average Power of OFF Transmitter	P_{OFF}			-45	dBm	
Output Optical Eye	Compliant with IEEE 802.3ah-2004					
Receiver						
Centre Wavelength	λc	1260		1610	nm	
Sensitivity*Note5	P_{IN}			-22	dBm	
Receiver Overload	Overload	-3			dBm	
Optical Return Loss		12			dB	
LOS Assert	LOSA	-35			dBm	
LOS De-Assert	LOSD			-25	dBm	
LOS Hysteresis		0.5		4	dB	

（ 1550nm DFB and PIN， 80Km ）

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter						
Centre Wavelength	λc	1500	1550	1580	nm	
Spectral Width*Note4	Δλ			1	nm	DFB-LD
Average Output Power	P_{OUT}	0		+5	dBm	
Extinction Ratio	ER	9			dB	
Average Power of OFF Transmitter	P_{OFF}			-45	dBm	
Output Optical Eye	Compliant with IEEE 802.3ah-2004					
Receiver						
Centre Wavelength	λc	1260		1610	nm	
Sensitivity*Note5	P_{IN}			-23	dBm	
Receiver Overload	Overload	-3			dBm	
Optical Return Loss		12			dB	
LOS Assert	LOSA	-35			dBm	
LOS De-Assert	LOSD			-25	dBm	
LOS Hysteresis		0.5		4	dB	

（ 1550nm DFB and APD， 120Km ）

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter						
Centre Wavelength	λc	1530	1550	1570	nm	
Spectral Width*Note4	Δλ			1	nm	DFB-LD
Average Output Power	P_{OUT}	0		+5	dBm	
Extinction Ratio	ER	9			dB	
Average Power of OFF Transmitter	P_{OFF}			-45	dBm	
Output Optical Eye	Compliant with IEEE 802.3ah-2004					

Receiver					
Centre Wavelength	λc	1200	1650	nm	
Sensitivity*[Note5]	P_{IN}		-32	dBm	APD
Receiver Overload	Overload	-8		dBm	
Optical Return Loss		12		dB	
LOS Assert	LOSA	-45		dBm	
LOS De-Assert	LOSD		-35	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-12@pattern is PRBS2^7-1@ER=9dB.

SFP Transceiver Electrical Pad Layout

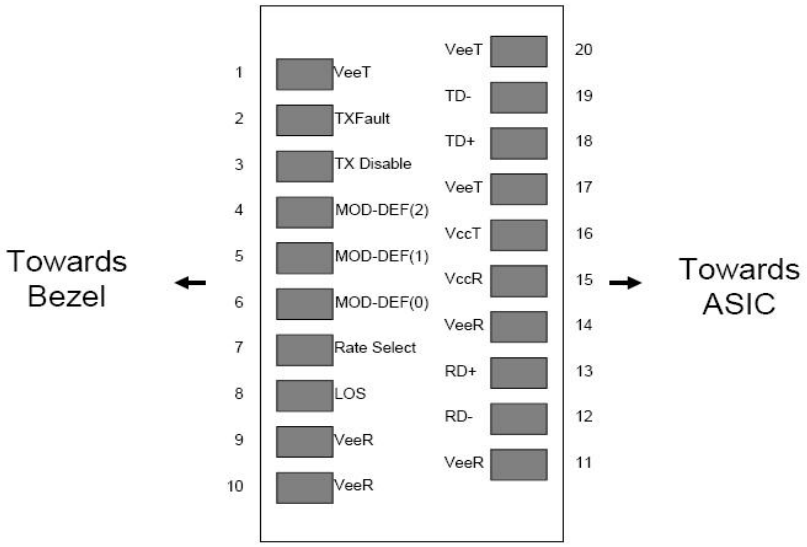


Diagram of Host Board Connector Block Pin Numbers and Names

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 (LVTTL).	3	NC. Function not available
8	LOS	Loss of Signal	3	Note 9
9	RS1	TX Rate Select (LVTTL).	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_ 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_ 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_ 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.

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

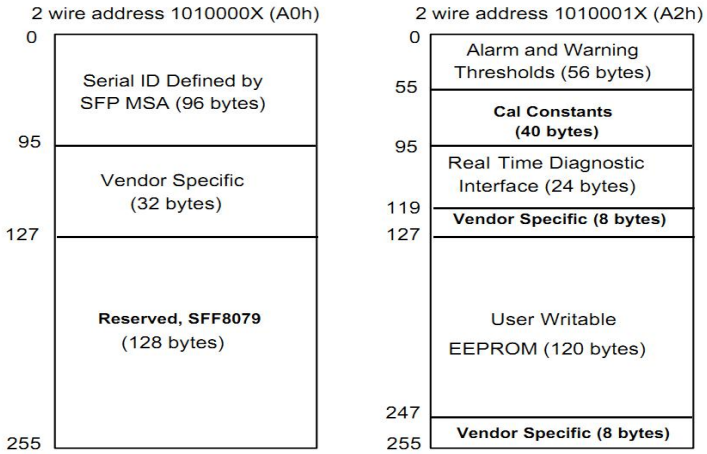
Note11: RD-/+: These are the differential receiver outputs. They are AC coupled 100_ differential lines which should be terminated with 100_ (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board.

Note12: VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V ±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 be 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 TSS-xxxx-xxDxR[*Note14] 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 TSS-xxxx-xxDxR are internally calibrated by default. Calibration and alarm/warning threshold data is written during device manufacturing.

Monitor accuracy

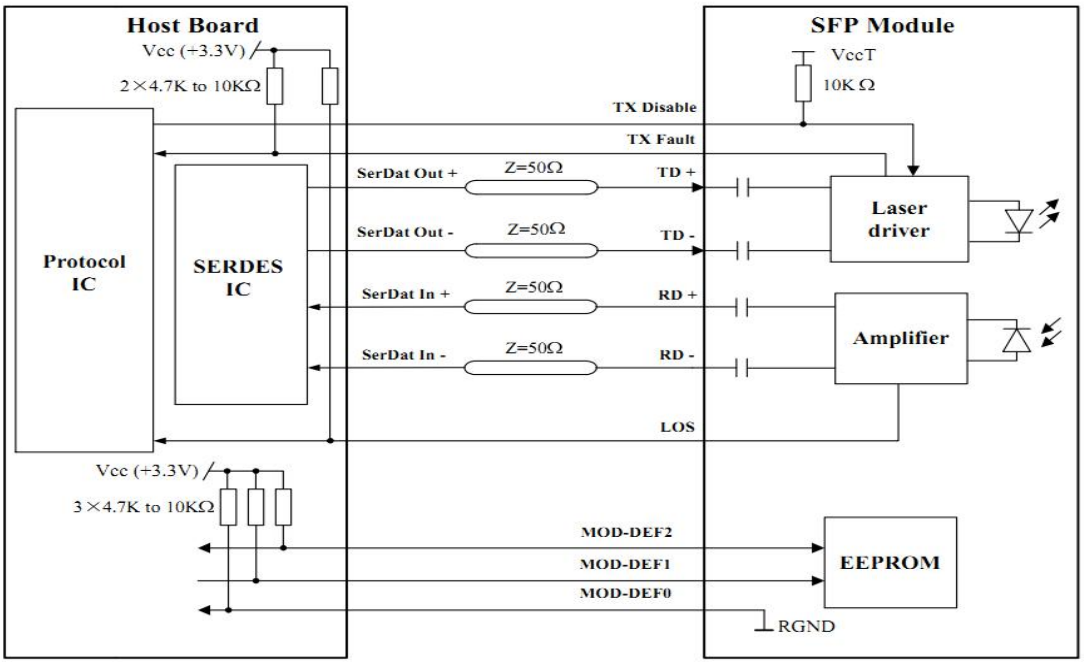
Parameter	Min	Typ	Max	Units
Internally measured transceiver temperature			±3	°C
Internally measured transceiver supply voltage			±3%	V
Measured TX bias current			±10	%
Measured TX output power			±3	dB
Measured RX received average optical power			±3	dB

Dynamic range for operation

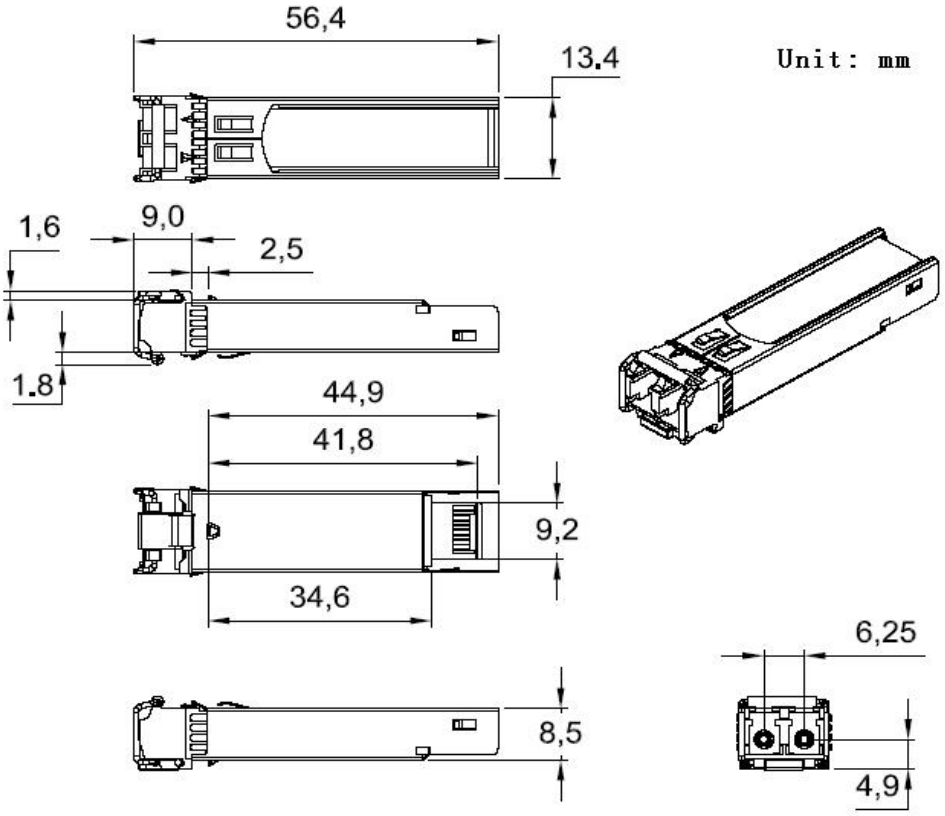
Parameter	H-Alarm	H-warning	L-Warning	L- Alarm	Units	Note
Internally measured transceiver temperature	+85	80	0	-5	°C	ST
	100	95	-35	-40	°C	IT
Internally measured transceiver supply voltage	3.9	3.6	3.0	2.7	V	
Measured TX bias current	100	80	2	1	mA	
Measured TX output power	Pout_max+1	Pout_max	Pout_min	Pout_min-1	dBm	
Measured RX received average optical power	Overload+1	Overload	P_{IN}	P_{IN}-2	dBm	

Note14: TSS-xxxx-xxxxR provides an EEPROM addressed 1010000X (A0h) as defined in SFP MSA, and only TSS-xxxx-xxDxR 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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