10G CWDM SFP+ Transceiver
With Digital Diagnostic Function

Features:

- Single 3.3V Power supply and TTL Logic Interface
- Operating data rate at 10.3 Gb/s
- Hot Pluggable SFP+ MSA package
- Compliant with SFF-8431 and SFF-8432
- Compliant with 802.3ae 10GBASE-LR/ER/ZR
- Duplex LC Connector Interface
- Metal enclosure, for lower EMI
- Operating Case Temperature: 0℃ ~+70℃ or -40℃~+85℃
- Class 1 Laser International Safety Standard IEC-60825 compliant

Applications:

- 10GBASE-LR 10G Ethernet
- 10GBASE-ER 10G Ethernet

Product Description

The CWDM SFP+ Series optical transceivers are designed for use in 10G CWDM networks. It' s complying with SFF-8431, SFF-8432, and 10-Gigabit Ethernet IEEE802.3ae .This module is designed for single mode fiber and operates at a nominal wavelength of CWDM wavelength. There are 18 center wavelengths available from 1270nm to 1610nm, with each step 20nm. Digital diagnostics are available via 2-wire serial interface as specified in the SFF-8472. The transceiver is RoHS-6 compliant and lead-free per Directive 2002/95/EC.

Ordering information

Part No. *Note1	Data Rate	Laser	Fiber Type	Link Budget	Optical Interface	TEMP	DDMI
TPC-TG10-XXDCR	10.3G	CWDM DFB	SMF	10dB	LC	C	YES
TPC-TG10-XXDIR	10.3G	CWDM DFB	SMF	10dB	LC	I	YES
TPC-TG40-XXDCR	10.3G	CWDM EML 1270~1610nm	SMF	16dB	LC	C	YES
TPC-TG40-XXDIR	10.3G	CWDM EML 1270~1610nm	SMF	16dB	LC	I	YES

Note1: XX refers to CWDM Wavelength range from 1271nm to 1611nm.

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*Note2

Parameter	Symbol	Min	Max	Unit
Storage Temperature	T_S	-40	+85	°C
Supply Voltage	V_{CC}	0	3.6	V
Operating Humidity	-	5	85	%

Note2: 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	0		70	°C	
Power Supply Voltage	V_{CC}	3.14	3.3	3.47	V	
Supply Current	Icc			350	mA	

Performance Specifications – Electrical

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
Transmitter						
CML Inputs(Differential)	Vin	180		1000	mVpp	AC coupled inputs
Input Impedance (Differential)	Zin		100		ohm	Rin > 100 ohms @DC
Tx_DISABLE Input Voltage – High		2		Vcc+0.3	V	
Tx_DISABLE Input Voltage – Lo		0		0.8	V	
Tx_FAULT Output Voltage – High		2		Vcc+0.3	V	
Tx_FAULT Output Voltage – Low		0		0.8	V	
Receiver						
CML Outputs (Differential)	Vout	350		700	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			100	us
TX_DISABLE Negate Time	t_on			2	ms
Time to initialize, include reset of TX_FAULT	t_init			300	ms
TX Fault Assert Time	t_fault			1	ms
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

(10.3Gbps， 10dB Power budget)

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter						
Centre Wavelength	λc	XX-6.5	XX	XX+6.5	nm	XX:Note5
Spectral Width*[Note3]	Δλ			1	nm	
Average Output Power	P_{OUT}	-1		6	dBm	

Extinction Ratio	ER	3.5			dB
Side Mode Suppression Ratio	SMSR	30			dB
Average Power of OFF Transmitter	P_{OFF}			-30	dBm
Transmitter and Dispersion Penalty	TDP			2	dB
TX Jitter Generation (Peak-to-Peak)	Tj			0.1	UI
TX Jitter Generation (RMS)	Tjrms			0.01	UI
Output Optical Eye	Compliant with IEEE 802.3ae				
Receiver					
Centre Wavelength	λc	1260		1620	nm
Sensitivity	P_{IN}			-15	dBm
Receiver Overload	Overload	0.5			dBm
Receiver Reflectance				-27	dB
LOS Assert	LOSA	-28			dBm
LOS De-Assert	LOSD			-17	dBm
LOS Hysteresis		0.5		4	dB

(10.3Gbps， 40KM 16dB Power budget)

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Transmitter						
Centre Wavelength	λc	XX-6.5	XX	XX+6.5	nm	XX:Note6
Spectral Width*[Note3]	∆λ			1	nm	
Average Output Power	P_{OUT}	-1		6	dBm	
Extinction Ratio	ER	8.2			dB	
Side Mode Suppression Ratio	SMSR	30			dB	
Average Power of OFF Transmitter	P_{OFF}			-30	dBm	
Transmitter and Dispersion Penalty	TDP			3.5	dB	
TX Jitter Generation	Tj	Per 802.3ae requirements			UI	
Relative Intensity Noise	RIN			-128	dB/Hz	
Output Optical Eye	Compliant with IEEE 802.3ae					
Receiver						
Centre Wavelength	λc	1260		1620	nm	
Sensitivity*[Note4]	P_{IN}			-22	dBm	
Receiver Overload	Overload	0.5			dBm	
Receiver Reflectance				-12	dB	
LOS Assert	LOSA	-35			dBm	
LOS De-Assert	LOSD			-24	dBm	
LOS Hysteresis		0.5		4	dB	

Note3: LD measured spectral width –20dB.

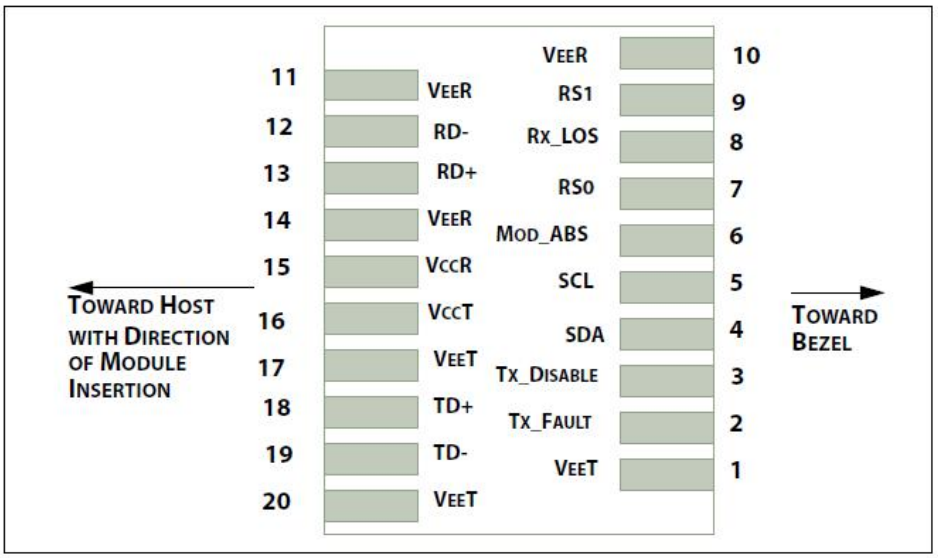
Note4: Minimum average optical power measured at the BER less than 1E-12@pattern is PRBS2^{31}-1@ER=9dB.

Note5: ITU-T G.694.2 CWDM wavelength from 1470nm to 1610nm, each step 20nm.

Note6: ITU-T G.694.2 CWDM wavelength from 1470nm to 1610nm, each step 20nm.

Note7: ITU-T G.694.2 CWDM wavelength from 1470nm to 1610nm, each step 20nm.

SFP Transceiver Electrical Pad Layout



Pin Function Definitions:

Pin Num.	Name	Function	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	Note 11
2	TX Fault	Transmitter Fault Indication	3	Note 7
3	TX Disable	Transmitter Disable	3	Note 8, 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 9
7	RS0	RX Rate Select (LVTTL).	3	Rate Select 0, optionally controls SFP+ module receiver. This pin is pulled low to VeeT with a >30K resistor..
8	LOS	Loss of Signal	3	Note 10
9	RS1	TX Rate Select (LVTTL).	1	Rate Select 1, optionally controls SFP+ module transmitter. This pin is pulled low to VeeT with a >30K resistor
10	VeeR	Receiver Ground	1	Note 11
11	VeeR	Receiver Ground	1	Note 11
12	RD-	Inv. Received Data Out	3	Note 12
13	RD+	Received Data Out	3	Note 13
14	VeeR	Receiver Ground	1	Note 11
15	VccR	Receiver Power	2	3.3V ± 5%, Note 13
16	VccT	Transmitter Power	2	3.3V ± 5%, Note 13
17	VeeT	Transmitter Ground	1	Note 11
18	TD+	Transmit Data In	3	Note 14
19	TD-	Inv. Transmit Data In	3	Note 14
20	VeeT	Transmitter Ground	1	Note 11

Note7: 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.

Note8: 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.

Note9: Module Absent, connected to VeeT or VeeR in the module.

Note10: 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.

Note11: The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.

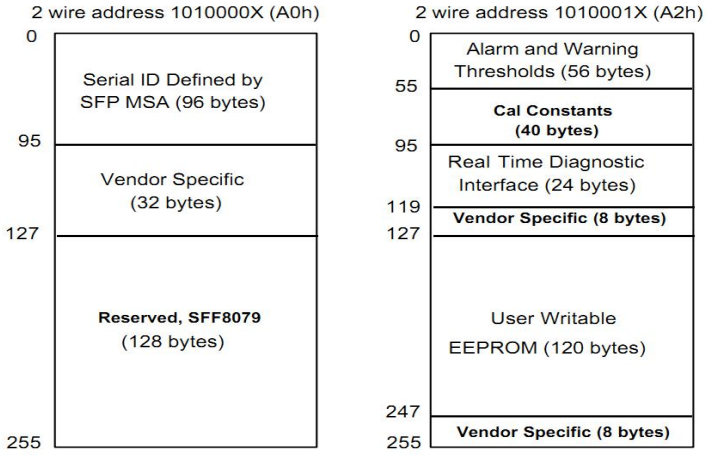
Note12: RD-/+: These are the differential receiver outputs. They are AC coupled 100_ differential lines which should be terminated with 100_ (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board.

Note13: 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.

Note14: 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 TPC-xxxx-xxDCR[*Note15] 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 TPC-xxxx-xxDCR are internally calibrated by default. Calibration and alarm/warning threshold data is written during device manufacturing.

Monitor accuracy

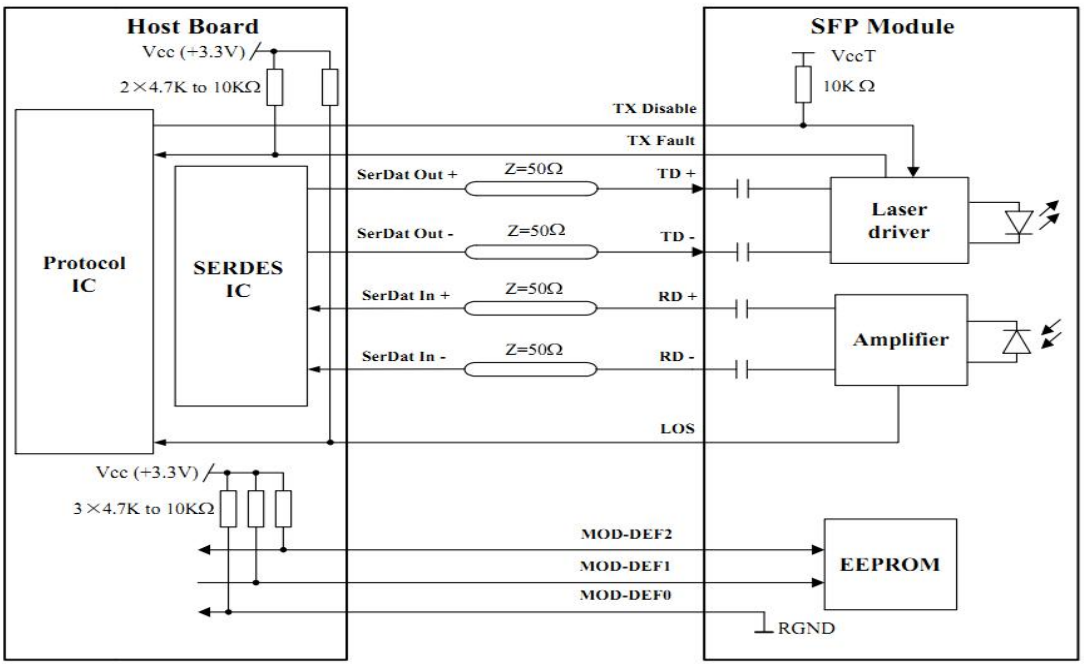
Parameter	Min	Typ	Max	Units
Internally measured transceiver temperature			±3	ºC
Internally measured transceiver supply voltage			±3%	V
Measured TX bias current			±10	%
Measured TX output power			±3	dB
Measured RX received average optical power			±3	dB

Dynamic range for operation

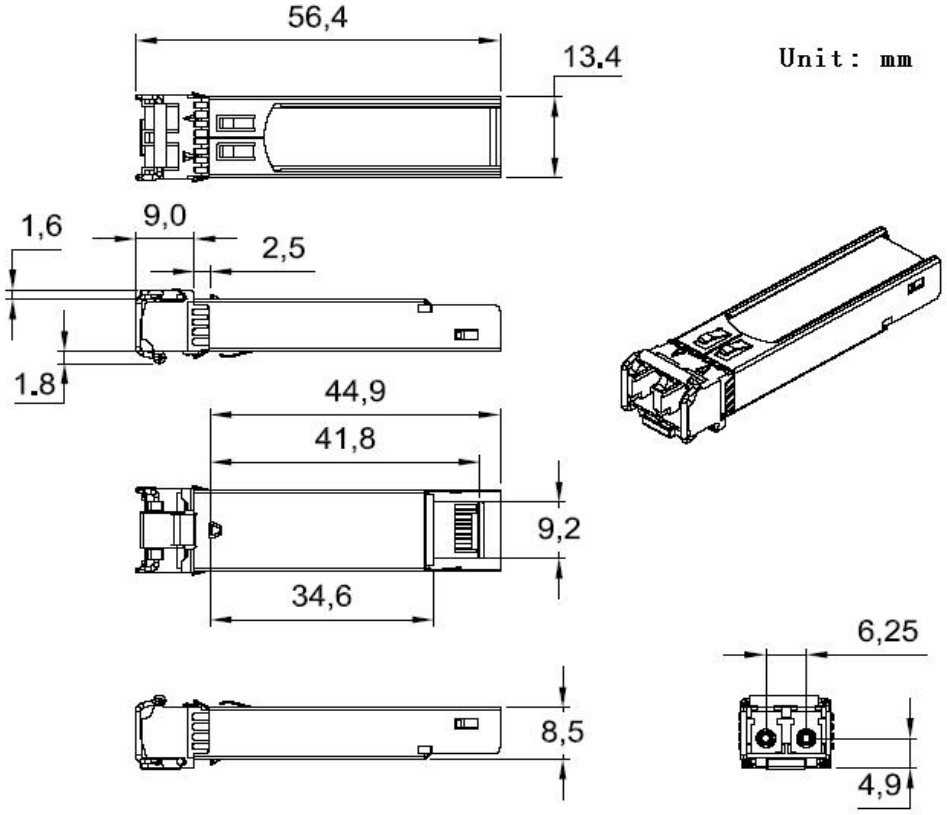
Parameter	H-Alarm	H-warning	L-Warning	L- Alarm	Units	Note
Internally measured transceiver temperature	+85	80	0	-5	ºC	
Internally measured transceiver supply voltage	3.9	3.6	3.0	2.7	V	
Measured TX bias current	130	120	2	1	mA	
Measured TX output power	Pout_max+1	Pout_max	Pout_min	Pout_min-1	dBm	
Measured RX received average optical power	Overload+1	Overload	P_{IN}	P_{IN}-2	dBm	

Note15: TPC-xxxx-xxxxR provides an EEPROM addressed 1010000X (A0h) as defined in SFP MSA, and only TPC-xxxx-xxDCR 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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Add: # 202, Section A, Building 1 No.209, Sanse Road, Jinjiang District Industry Park Chengdu 610063. Sichuan P.R. CHINA
Tel: (+86) 028-85925400/Fax: (+86) 028-85925445
E-mail: info@trixontech.com
http://www.trixontech.com