SFP+ C-Band Tunable DWDM Optical Transceiver

Key Benefits

- **Supports line rates from 9.95 to 11.3 Gbps**
- **Full C-Band tunable laser source**
- **50 GHzITU channel spacing**
- **80 km reach**
- **Operating temperature range of –5°C to 70°C**
- **Maximum power dissipation of 2 W**
- **Limiting SFI AC-coupled electrical output interface**
- **Supports digital diagnostic monitoring**

Applications

- Wide AreaNetwork (WAN)
- Local Area Network (LAN)
- Storage AreaNetwork (SAN)
- Ethernet switches and applications
- Fibre Channel switches and applications

Compliance

- IEEE 802.3-2012 Clause 52 Standard
- 10 G Fibre Channel standard
- SFF 8431 Rev 4.1
- SFF 8432 Rev 5.0
- SFF 8472 Rev 11.0
- SFF 8690 Rev 1.4
- Class 1 Laser Safety
- Tested in accordance with Telcordia GR-468
- RoHS6/6

The FIBERDYNE Tunable SFP+ Optical Transceiver is a fully duplex, integrated fiber optic transceiver that provides a high-speed serial link at signaling rates from 9.95 to 11.3 Gbps. The module complies with the Enhanced Small Form Factor Pluggable Module (SFP+) specification SFF-8431 Rev. 4.1 for the electrical interface, SFF-8432 Rev. 5.0 for the mechanical interface, SFF-8690 Rev. 1.4 for the tunability interface, and SFF-8472 Rev. 11.0 for the management interface.

The transceiver complies with IEEE 802.3-2012 clause 52 10GBase-ZR/ZW (Ethernet), 10GFC (Fibre Channel) and corresponding forward error correction (FEC) rates. It also supports Telcordia GR-253-CORE OC-192 LR-2 and ITU-T G.959.1 P1L1-2D2 data rates.

The transceiver integrates the receive and transmit path on one module. In the transmit side, the serial data stream is passed from the electrical connector to a modulator driver. The modulator driver biases and modulates a C-Band cooled tunable transmitter, enabling data transmission over up to 80 km of single-mode fiber through an industry standard LC connector. In the receive side, the 10 Gbps optical data stream is recovered from an avalanche photodetector (APD) through a transimpedance amplifier to the electrical connector. This module features a hot-pluggable SFI compliant limiting electrical interface.

Section 1:

Functional Description

The transceiver is a fully duplex serial electric, serial optical device with both transmit and receive functions contained in a single module that provides a high-speedserial link at signaling rates from 9.95 to 11.3 Gbps.It is compliant with IEEE 802.3-2012 clause 52 10GBase-ZR / ZW (Ethernet), 10 GFC (Fibre Channel), and corresponding FEC rates. The module complies with the SFP+specification SFF-8431 Rev. 4.1 for the electrical interface, SFF-8432 Rev. 5.0 for the mechanical interface, SFF-8690 Rev 1.4 for the tunability interface, and SFF-8472 Rev. 11.0 for the management interface. A block diagram is shown in Figure 1 below.

The transceiver has several low-speed interface connections. These connections include: transmitter fault (Tx_Fault), transmitter disable (TX_Disable), rate select (RS0 and RS1), module absent (Mod_ABS), receive loss of signal (RX_LOS), and a 2-wire serial interface clock(SCL) and data (SDA).

The transceiver supports an SFI electrical interface. The electrical interface is based on a high-speed, low-voltage logic AC-coupled limiting interface with a nominal differential impedance of 100Ω.

1.1 Transmitter

The transmitter path converts serial NRZ electrical data from line rates of 9.95to 11.3 Gbps to a standard compliant optical signal. The transmitter accepts a 100 Ω differential 190 mV to 700 mV peak-to-peak CML electrical signal on TD– and TD+ pins.

Inside the module, differential signals are input to the modulator driver which transforms the small swing voltage to an output modulation that drives a cooled InP integrated laser Mach-Zehnder (ILMZ) modulator. The optical signal is engineered to meet 10 Gigabit Ethernet, 10 G Fibre Channel, and corresponding FEC rates. DWDM specifications at ITU grids with 50 GHz channel spacing. Closed-loop control of the transmitted laser power and modulation swing over temperature and voltage variations is provided. The laser is coupled to single-mode optical fiberthrough an industry-standard LC optical connector.

1.2 Receiver

The receiver converts incoming DC-balanced serial NRZ optical data from line rates of 9.95 to 11.3 Gbps into serial SFI electrical data. Light is coupled to an APD photodetector from single-mode optical fiber through an industry-standard LC optical connector. The electrical current from the APD photodetector is converted to a voltage in a limiting transimpedance amplifier.

The amplified signal is output directly on the RD+ and RD– pins as a 100Ω CML signal. The output signal meets SFP+ MSA limiting interface requirements.

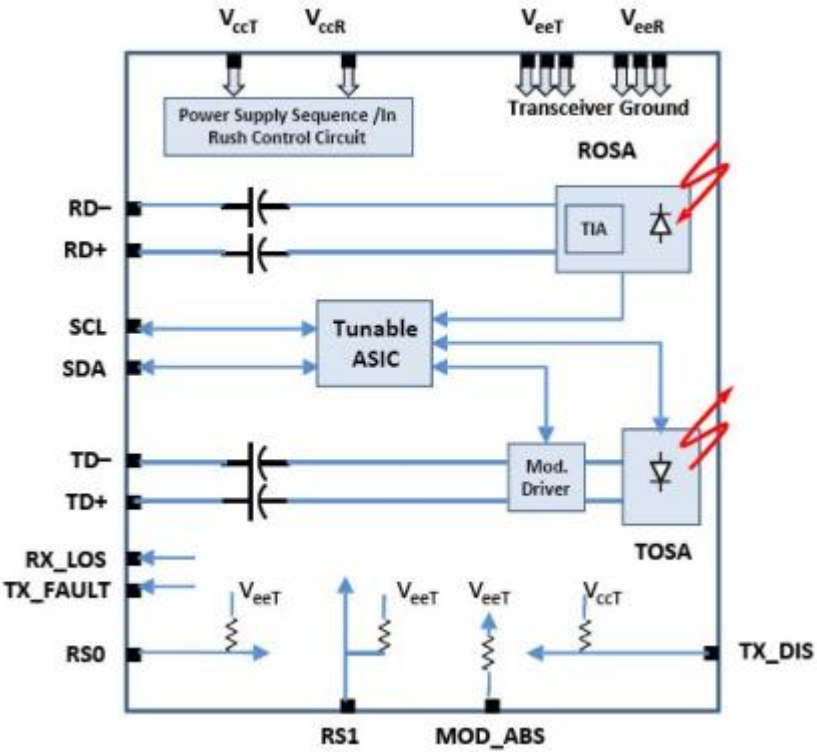


Figure 1. Functional block diagram

1.3 Low-Speed Signaling

Low-speed signaling isbased on low-voltage TTL (LVTTL) operating at anominal voltage of 3.3V. Hosts should use a pull-up resistor connected to Vcc3.3V on the 2-wireinterface SCL (clock),SDA (data), and all low-speedoutputs.

SCL/SDA: 2-wire serial interface clockand data line.

Tx_Fault: Output pin. When asserted high, indicates that the module has detected a transmitter fault condition related to laseroperation or safety.

TX_Disable: Input pin. When asserted high or left open, the transmitter output is turned off. When Tx_Disable is asserted low or grounded the module transmitter is operating normally.

RS0 and RS1: Input pins. Pulled low to VeeT with >100 kΩ resistors in the module. These pins are not used in this product.

Mod_ABS: Output pin. Asserted high when the SFP+ module is absent and is pulled low when the SFP+ module is inserted.

RX_LOS: Output pin. Asserted high when insufficient optical power for reliable signal reception is received.

Section 2 :

Application

Schematics

Recommended MSA connections to the transceiver are shown in Figure 2 below.

Tunable SFP+ modules are hot pluggable and active connections are powered by individual power connections for the transmitter (VccT) and the receiver (VccR). Multiple modules can share a single 3.3 V power supply with individual filtering for each VccT and VccR. The host shall generate an effective weighted integrated spectrum RMS noise less than 25 mV in the frequency range 10 Hz to 10 MHz. Detailed power supply specifications are given in SFF-8431 Rev. 4.1 Section 2.8.

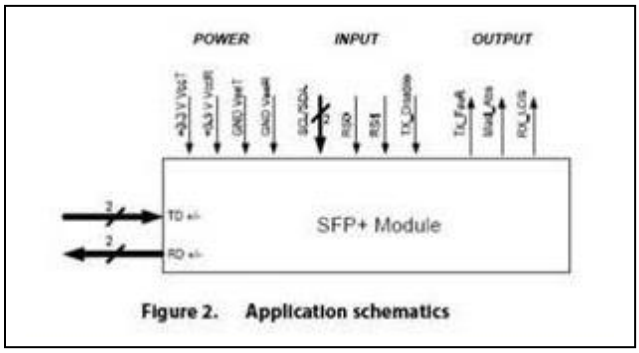


Figure 2. Application schematics

Section 3:

Specifications

Technical specifications related to the transceiver include:

- Section 3.1 Pin Function Definitions
- Section 3.2 SFP+ SFI Reference Model Compliance Points
- Section 3.3 Absolute Maximum Ratings
- Section 3.4 Low-Speed Electrical and Power Characteristics
- Section 3.5 High-Speed Electrical Specifications
- Section 3.6 Timing Requirement of Control and Status I/O
- Section 3.7 SFP+ 2-Wire Interface Protocol and Management Interface
- Section 3.8 Optical Transmitter Characteristics
- Section 3.9 Optical Receiver Characteristics
- Section 3.10 OSNR Characteristics with External CDR
- Section 3.11 Tunable SFP+ Channel Number and Wavelength Grid
- Section 3.12 Regulatory Compliance
- Section 3.13 Module Outline
- Section 3.14 Connectors

3.1 Pin Function Definitions

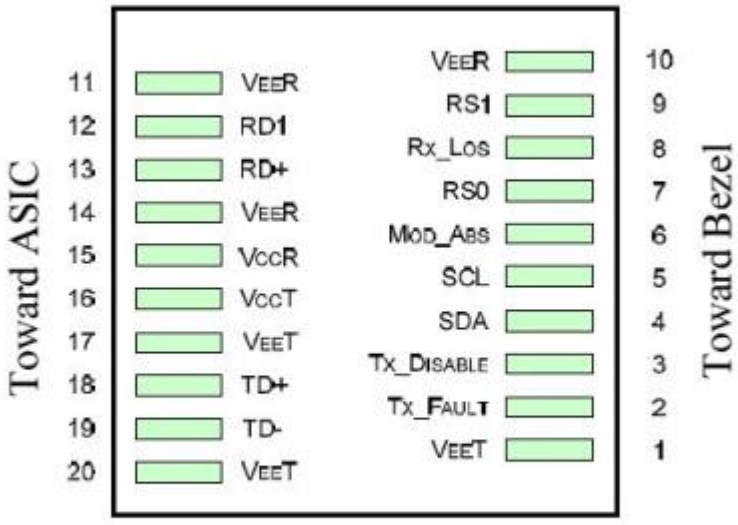


Figure 3. Transceiver pin-out on host board

Table 1. Pin Descriptions

Pin Number	Type	Name	Description
1		VeeT[1]	Module transmitter ground
2	LVTTL-O	Tx_Fault	Module transmitter fault
3	LVTTL-I	Tx_Disable	Transmitter disable; When held high or left open, transmitter laser source is turned off.
4	LVTTL-I/O	SDA[2]	Two wire interface data line
5	LVTTL-I	SCL[2]	Two wire interface clock
6		Mod_Abs[2]	Indicates module is not present. Grounded to VeeTor VeeR in the module.
7	LVTTL-I	RS0	Rate select 0 (not used)
8	LVTTL-O	RX_LOS[2]	Receiver loss of signal indicator
9	LVTTL-I	RS1	Rate select 1 (not used)
10		VeeR[1]	Module receiver ground
11		VeeR[1]	Module receiver ground
12	CML-O	RD–	Receiver inverted data output
13	CML-O	RD+	Receiver non-inverted data output
14		VeeR[1]	Module receiver ground
15		VccR	Module receiver +3.3V supply
16		VccT	Module transmitter +3.3V supply
17		VeeT[1]	Module transmitter ground
18	CML-I	TD+	Transmitter non-inverted data input
19	CML-I	TD–	Transmitter inverted data input
20		VeeT[1]	Module transmitter ground

1. Module ground pins (GND) are isolated from the module caseand chassis ground within the module.
2. Shall be pulled up with 4.7kΩ − 10 kΩ to a voltage between 3.15 V and 3.45 V on the host board.

3.2 SFP+ SFI Reference Model Compliance Points

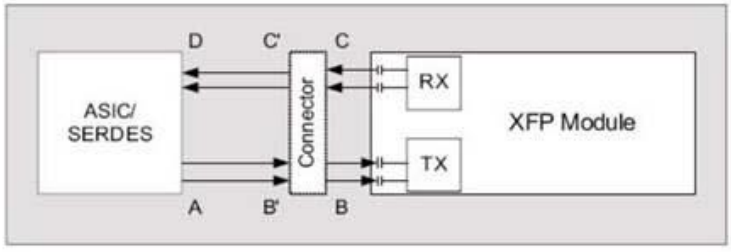


Figure 4. Model compliance points

3.3 Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Storage temperature	T_{ST}	−40 to +85	°C
Operating case temperature	T_{OP}	−5 to +70	°C
Relative humidity	RH	5 to 85 (non-condensing)	%
Static electrical discharge (human body model)	ESD	100	V
Power supply voltages	$V_{CC}T$, $V_{CC}R$, max	−0.3 to 4.0	V
Receive input optical power (damage threshold)	P_{dth}	+3	dBm

Note:
Absolute maximum ratings represent the damage threshold of the device. Damage may occur if the device is operated above the limits stated here except for brief excursions. Performance is not guaranteed and reliability is not implied for operation at any condition outside the recommended operating limits.

3.4 Low-Speed Electrical and Power Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
Supply currents and voltages						
Supply voltage	$V_{CC}T$, $V_{CC}R$	3.13	3.3	3.47	V	With respect to GND
Instantaneous operating peak current				1000	mA	
Sustained operating peak current				600	mA	
Power dissipation	P_{wr}			2	W	Maximum module power consumption for power level II module is 1.5 W per SFF_8431.
Low-speed control and sense signals (detailed specification in SFP+ MSA SFF 8431 Rev. 4.1)						
Outputs (TX_Fault, RX_LOS)	V_{OL}	−0.3		0.4	V	At 0.7 mA
	I_{OH}	−50		37.5	µA	Measured with a 4.7kΩ load pulled up to Vcc_host
Inputs (TX_Disable, RS0, RS1)	V_{IL}	−0.3		0.8	V	Pulled up in module to $V_{CC}T$
	V_{IH}	2		Vcc3+ 0.3	V	Pulled up in module to $V_{CC}T$
SCL and SDA inputs	V	−0.3		Vcc3*0.3	V	Rpullup pulled to Vcc_host
	V_{IH}	Vcc3*0.7		Vcc3+0.5	V	Rpullup pulled to Vcc _host

3.5 High-Speed Electrical Specifications

Parameter	Symbol	Min	Max	Unit	Notes
Transmitter Electrical Input Jitter from Host at B" (detailed specification in SFP+ MSA SFF 8431 Rev. 4.1)					
Data-dependent jitter	DDJ		0.10	UI(p-p)	PRBS9 pattern, TP1, at 10.3 Gbps
Uncorrelated jitter	UJ		0.023	UI(rms)	
Pulse-width shrinkage	DDPWS		0.055	UI(p-p)	jitter
Total jitter	TJ		0.28	UI(p-p)	PRBS31 pattern, TP1, BER <1x10^{-12}, at 10.3 Gbps
Eye mask	X1		0.12	UI	Mask hit ratio of 5x10^{-5}
Eye mask	X2		0.33	UI	Mask hit ratio of 5x10^{-5}
Eye mask	Y1	95		mV	Mask hit ratio of 5x10^{-5}
Eye mask	Y2		350	mV	Mask hit ratio of 5x10^{-5}
Limiting Module Receiver Electrical Output Jitter to Host at C' (detailed specification in SFP+ MSA SFF 8431 Rev. 4.1)					
Output rise and fall time (20% to 80%)	Tr, Tf	28		ps	
Total jitter	TJ		0.70	UI	PRBS31 pattern, BER <1x10^{12}
Eye mask	X1		0.35	UI	Mask hit ratio of 1x10^{12}
Eye mask	Y1	100		mV	Mask hit ratio of 1x10^{-12}
Eye mask	Y2		425	mV	Mask hit ratio of 1x10^{-12}

3.6 Timing Requirement of Control and Status I/O

Parameter	Symbol	Min	Max	Unit	Notes
TX_Disable assert time	t_off		100	µs	Rising edge of TX_Disable to fall of output signal below 10% of nominal.
TX_Disable negate time	t_on		2	ms	Falling edgeof TX_DIS to rise of output signal above 90% of nominal .
Time to initialize 2-wire interfaces	t_2w_start_up		300	ms	[1] From power on or hot plug.
Time to initialize	t_start_up_cooled		60		From power on or hot plug.
Tx_Fault assert	Tx_Fault_on		50	ms	From occurrence of fault to assertion of Tx_Fault.
Tx_Fault reset	Tx_Fault_reset	10		µs	Time Tx_Disable must be held high to reset Tx_Fault.
RX_LOS assert delay	t_loss_on		100	µs	From occurrence of lossof signalto assertion of RX_LOS.
RX_LOS negate delay	t_loss_off		100	µs	From occurrence of return of signalto negation of RX_LOS.

1. The transceiver is stabilized prior to TX_Disable negating event.

3.7 SFP+ 2-Wire Interface Protocol and Management Interface

The transceiver incorporates a 2-wire management interface which is used for serial ID, digital diagnostics, and certain control functions. It is modeled on the SFF-8472 Rev 11.0 specification modified to accommodate a single 2-wire interface address. Details of the protocol and interface are explicitly described in the MSA. Please refer to the MSA for design reference.

3.8 Optical Transmitter Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Average optical power[1]	P_{avg}	−1.0		3.0	dBm
Extinction ratio	ER	9			dB
Wavelength range[1, 3]	λ_c	1528.384		1568.77	nm
Frequency range		191.1		196.15	THz
Center wavelength spacing			50		GHz
Wavelength stability (BOL)		λ_c−1.5	λ_c	λ_c+1.5	GHz
Wavelength stability (EOL)		λ_c−2.5	λ_c	λ_c+2.5	GHz
Channel tuning time[4]				50	ms
Sidemode suppression ratio	SMSR	35			dB
Relative intensity noise	RIN			−130	dB/Hz
Return loss tolerance				27 dB	

1. Optical power and wavelength range is only guaranteed when electrical input is applied to TD+ and TD−.
2. Tested with PRBS $2^{31}-1$ pattern.
3. ITU grid wavelength
4. Any channel to any channel

3.9 Optical Receiver Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Center wavelength	λ	1260		1600	nm
Receiver sensitivity[1]	R_{sen}			−24	dBm
Receiver sensitivity over fiber[2]	R_{sen_fiber}			−22	dBm
Receive overload[3]	P_{max}	−7			dBm
Receiver reflectance	R_{rx}			−27	dB
LOS assert	P_{los_on}	−33.5			dBm
LOS deassert	P_{los_off}			−26	dBm
LOS hysteresis		0.5		4	dB

1. Measured with worst ER; BER<10^{-12}; PRBS $2^{31}-1$ pattern; BTB; 10.709 Gbps.
2. Measured with worst ER; BER<10^{-12}; PRBS $2^{31}-1$ pattern; −400ps/nm to +1600ps/nm dispersion; 10.709 Gbps.
3. Guaranteed up to 10.709 Gbps.

3.10 OSNR Characteristics with External CDR

Parameter	Maximum	Unit
OSNR tolerance (EOL), fixed RxDTV, non-FEC rates (9.95/10.3/10.5 Gbps)		
Back to back, 1E-12, −7 dBm to −24 dBm	30	dB
Back to back, 1E-12, −7 dBm to −19 dBm	25	dB
−400 ps/nm to +1600 ps/nm, 1E-12, −7 dBm to −19 dBm	26	dB
OSNR tolerance (EOL), fixed RxDTV, FECrate 10.709G		
Back to back, 1E-4, −7 dBm to −24 dBm	16.5	dB
−400 ps/nm to +1600 ps/nm, 1E-4, −7 dBm to −24 dBm	18.5	dB
OSNR tolerance (EOL), fixed RxDTV, FECrate 11.09G		
Back to back, 1E-4, −7 dBm to −24 dBm	17	dB
−400 ps/nm to +1600 ps/nm, 1E-4, −7 dBm to −24 dBm	19.5	dB

3.11 Tunable SFP+ Channel Number andWavelength grid

Channel	Frequency (THz)	Center Wavelength (nm)	Channel	Frequency (THz)	Center Wavelength (nm)
1	191.1	1568.77	52	193.65	1548.11
2	191.15	1568.36	53	193.7	1547.72
3	191.2	1567.95	54	193.75	1547.32
4	191.25	1567.54	55	193.8	1546.92
5	191.3	1567.13	56	193.85	1546.52
6	191.35	1566.72	57	193.9	1546.12
7	191.4	1566.31	58	193.95	1545.72
8	191.45	1565.90	59	194	1545.32
9	191.5	1565.50	60	194.05	1544.92
10	191.55	1565.09	61	194.1	1544.53
11	191.6	1564.68	62	194.15	1544.13
12	191.65	1564.27	63	194.2	1543.73
13	191.7	1563.86	64	194.25	1543.33
14	191.75	1563.45	65	194.3	1542.94
15	191.8	1563.05	66	194.35	1542.54
16	191.85	1562.64	67	194.4	1542.14
17	191.9	1562.23	68	194.45	1541.75
18	191.95	1561.83	69	194.5	1541.35
19	192	1561.42	70	194.55	1540.95
20	192.05	1561.01	71	194.6	1540.56
21	192.1	1560.61	72	194.65	1540.16
22	192.15	1560.20	73	194.7	1539.77
23	192.2	1559.79	74	194.75	1539.37
24	192.25	1559.39	75	194.8	1538.98
25	192.3	1558.98	76	194.85	1538.58
26	192.35	1558.58	77	194.9	1538.19
27	192.4	1558.17	78	194.95	1537.79
28	192.45	1557.77	79	195	1537.40
29	192.5	1557.36	80	195.05	1537.00
30	192.55	1556.96	81	195.1	1536.61
31	192.6	1556.55	82	195.15	1536.22
32	192.65	1556.15	83	195.2	1535.82
33	192.7	1555.75	84	195.25	1535.43
34	192.75	1555.34	85	195.3	1535.04
35	192.8	1554.94	86	195.35	1534.64
36	192.85	1554.54	87	195.4	1534.25
37	192.9	1554.13	88	195.45	1533.86
38	192.95	1553.73	89	195.5	1533.47
39	193	1553.33	90	195.55	1533.07
40	193.05	1552.93	91	195.6	1532.68
41	193.1	1552.52	92	195.65	1532.29
42	193.15	1552.12	93	195.7	1531.90
43	193.2	1551.72	94	195.75	1531.51
44	193.25	1551.32	95	195.8	1531.12
45	193.3	1550.92	96	195.85	1530.72
46	193.35	1550.52	97	195.9	1530.33
47	193.4	1550.12	98	195.95	1529.94
48	193.45	1549.72	99	196	1529.55
49	193.5	1549.32	100	196.05	1529.16
50	193.55	1548.91	101	196.1	1528.77
51	193.6	1548.51	102	196.15	1528.38

3.12 Regulatory Compliance

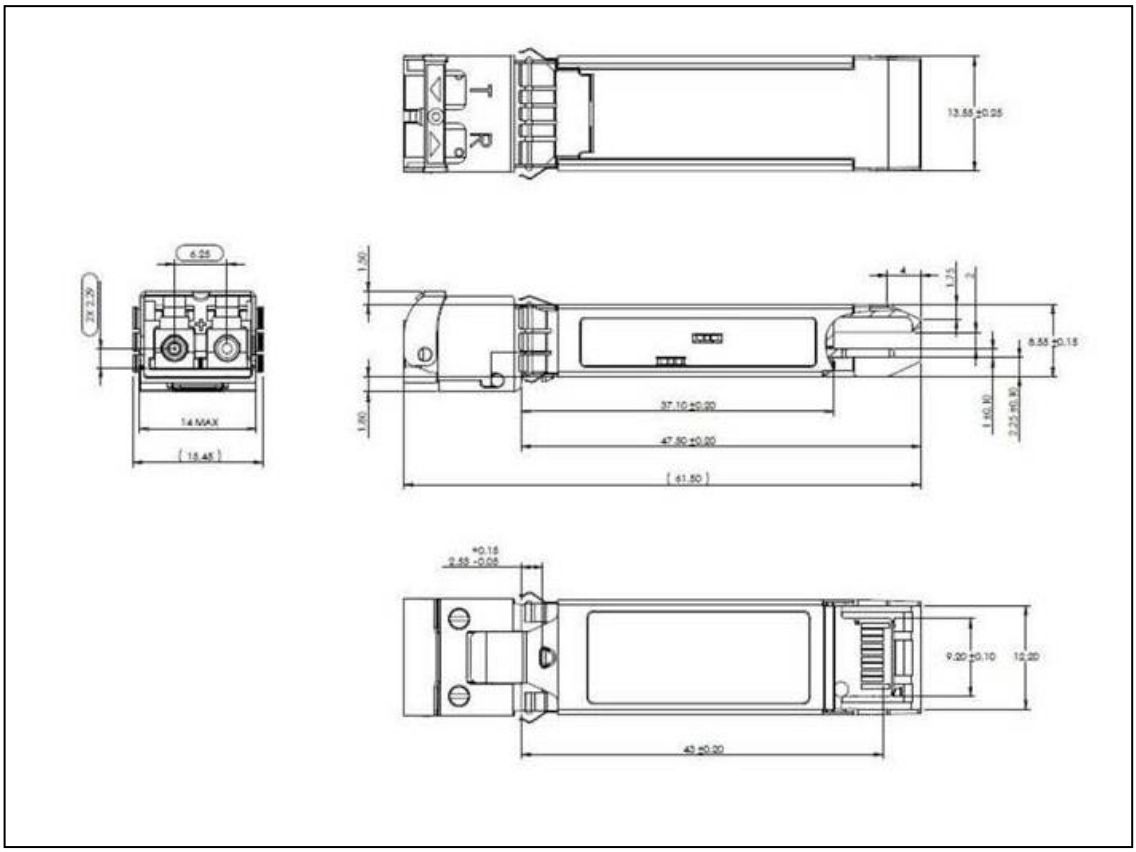
The transceiver is lead-free and RoHS 6/6 compliant.

The transceiver complies with international electromagnetic compatibility (EMC) and international safety requirements and standards. EMC performance depends on the overall system design. The information included herein is intended to use as a basis for design decisions and any subsequent system level testing and certifications.

Table 2. Regulatory Compliance

Feature	Test Method	Performance
Safety		
Product safety	UL60950-1 CSA C22.2 No. 60950-1 EN 60950-1 IEC 60950-1 Flame Class V-0 Low VoltageDirective 2006/95/EC	UL-recognizedcomponent for USand CAN. TUV certificate CB certificate Passes needle point flametest. Certified to harmonized standards listed; Declaration of Conformity issued.
Laser safety	EN 60825-1, EN 60825-2 IEC 60825-1 U.S.21CFR 1040.10	TUVcertificate CB certificate FDA/CDRHcertified withaccessionnumber; Class 1 laser product.
Electromagnetic Compatibility		
Radiated emissions	EMCDirective 2004/108/EC FCC rules 47 CFRPart 15 CISPR 22 AS/NZS CISPR22 EN 55022 ICES-003, Issue 5 VCCI V-3	Class B digital device with a minimum −2 dBmargin to the limit when tested in a representative host. Tested frequency range: 30 MHz to 40 GHz or 5th harmonic (5 times the highest frequency), whicheveris less. Good system EMI design practice is required to achieve Class B margins at the system level.
Immunity	EMCDirective 2004/108/EC CISPR 24 EN 55024	
ESD	IEC/EN 61000-4-2	Exceeds requirements. Withstands discharges of ±8 kV contact, ±15 kV air.
Radiated immunity	IEC/EN 61000-4-3	Exceeds requirements. Fieldstrength of 10 V/m from 10 MHz to 1 GHz. No effect on transmitter/receiver performance is detectable between these limits.
Restriction of Hazardous Substances (RoHS)		
RoHS	EU Directive2002/95/EC+ EU Directive2011/65/EU	Compliant per the Directive 2002/95/EC of the European Parliament and of the Council of27January 2003 and the Directive2011/65/EUof the European Parliament and of the Council of 8June 2011 on the restriction ofthe useof certain hazardous substances in electrical and electronic equipment.A RoHS Certificate of Conformance (C of C) is available upon request. The product may use certain RoHS exemptions.

3.13 Module Outline



3.14 Connectors

Fiber
Themodule has a duplex LC receptacleconnector.

Electrical
The electrical connector is the 20-way, two-row PCB edge connector. Customer connector is Tyco/AMP Part No. 188247 or equivalent.

Section 4 :

Related Information

Other information related to the transceiver includes:

- Section 4.1 Packing and Handling Instructions
- Section 4.2 ElectrostaticDischarge (ESD)
- Section 4.3 Laser Safety

4.1 Package and Handling Instructions

Connector Covers

The transceiver is supplied with an LC duplex receptacle. The connector plug supplied protects the connector during standard manufacturing processes and handling by preventing contamination from dust, aqueous solutions, body oils, or airborne particles.

Note: It is recommended that the connector plug remain on whenever the transceiver optical fiber connector is not inserted.

Recommended Cleaning and De-greasing Chemicals
FIBERDYNE recommends the use of methyl, isopropyl and isobutyl alcohols for cleaning.

Do not use halogenated hydrocarbons (e.g. trichloroethane, ketones such as acetone, chloroform, ethyl acetate, MEK, methylene chloride, methylene dichloride, phenol, N-methylpyrolldone).

This product is not designed for aqueous wash.

Housing
The transceiver housing is made from zinc.

4.2 Electrostatic Discharge (ESD)

Handling

Normal ESD precautions are required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and otherwise handled in an ESD protected environment utilizing standard grounded benches, floor mats, and wrist straps.

Test and Operation

In most applications, the optical connector will protrude through the system chassis and be subjected to the same ESD environment as the system. Once properly installed in the system, this transceiver should meet and exceed common ESD testing practices and fulfill systemESD requirements.

Typical of optical transceivers, this module's receiver contains a highly sensitive optical detector and amplifier which may become temporarily saturated during an ESD strike. This could result in a short burst of bit errors. Such an event might require that the application re-acquire synchronization at the higher layers (for example,viaa serializer/deserializer chip).

4.3 Laser Safety

The transceiver is certified as a Class 1 laser product per international standard IEC 60825-1:2007 2nd edition and is considered non-hazardous when operated within the limits of this specification.

The transceiver complies with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50 dated June 24,2007.

Caution

Operating this product in a manner inconsistent with intended usageand specifications may result in hazardous radiation exposure.

Use of controls or adjustments or performance of procedures other than these specified in this product data sheet may result in hazardous radiation exposure.

Tampering with this laser product or operating this product outside the limits of this specification may be considered an "act of manufacturing" and may require recertification of the modified product.

Viewing the laser output with certain opticalinstruments (for example, eye loupes, magnifiers,microscopes) within a distance of 100mm may pose an eye hazard.

Ordering Information

Model Number	Data	Wavelength	Material	Fib	Distance	D
FDN-SFP-10G-TD-40DXX	8/10g	Tunable Wavelength	DWDM+PIN	SM	40km	
FDN-SFP-10G-TD-80DXX	8/10g	Tunable Wavelength	DWDM+APD	SM	80km	