80km Tunable XFP Optical Transceiver
P/N:GXU-CXXX-08CD

Features

- XFP MSA Rev 4.5 Compliant
- Support 9.95Gb/s to 11.35Gb/s
- Tunability over full C-band 50GHz ITU-T wavelengths (SFF-8477 Control)
- 80km 50GHZ tunable laser
- Adaptive Receiver Decision Threshold Control for improved
- OSNR range
- High performance APD photodiode receiver
- Duplex LC fiber connector
- Compliant with XFP Electrical and Mechanical MSA INF-8077
- Digital diagnostics and alarm reporting
- -5℃ to 70℃ Operating Case Temperature
- Power Dissipation 3.5W Maximum
- ROHS6 Compliant(lead free)

Applications

- 10G Fiber Channel&10G Ethernet
- SONET OC-192&SDH STM64
- Ethernet Switch or IP Router Interconnect
- DWDM Networks

Description

Gigalight Tunable XFP Optical transceiver is designed for use in high speed serial link up to 80km with single fiber at data rates from 9.95Gbps to 11.35Gbps. The transceiver is fully tunable over the entire C-Band and supports ITU-T wavelengths with 50GHZ channel spacing. This XFP transceiver conforms to XFP multisource agreement (MSA). It supports 10G BASE-ZR/ZW applications along with DWDM SONET OC-192/SDH STM64 applications for Ethernet Switch, IP Router Interconnect or SONET/SDH optical interfaces and 10G Fiber Channel. Digital Optical Monitoring interfaces are available via a 2-wire serial interface.

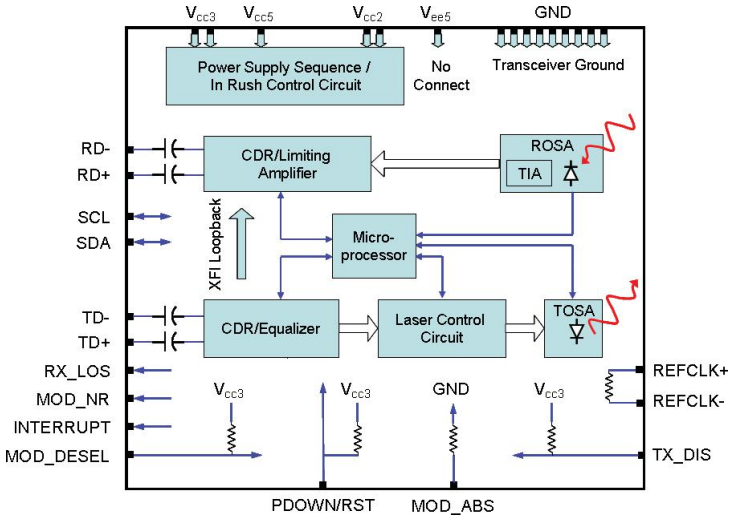


Figure 1. Block diagram

Transmitter

The transmitter path converts serial NRZ electrical data from line rates of 9.95 Gbps to 11.35 Gbps to a standard compliant optical signal. The transmitter accepts a 100 Ω differential 120 mV peak-to-peak to 820 mV peak-to-peak 10 Gbps CML electrical signal on TD- and TD+ pins.

Inside the module, the differential signals pass through a signal conditioner with equalization that compensates for losses and deterministic jitter present on the input data stream. The transmit CDR function generates a clock that is at the same frequency as the incoming data bit rate of the electrical data input. The clock is phase aligned by a phase locked loop (PLL) that samples the data in the center of the data eye pattern. The CDR function does not require a reference clock to lock to incoming data. The CDR contains a lock detect circuit that indicates successful locking of the PLL onto the incoming data.

The output of the Tx signal conditioner is input to the modulator driver which transforms the small-swing digital voltage to an output modulation that drives a cooled InP ILMZ modulator. The optical signal is engineered to meet the SONET/SDH, 10 Gigabit Ethernet, 10 G Fibre Channel, and corresponding Forward Error Correction (FEC) rates DWDM specifications at ITU grids with 50 GHz channel spacing. The unit provides closed-loop control of transmitted laser power, modulation swing, center wavelength over temperature, and voltage variations. The laser is coupled to single-mode optical fiber through an industry-standard LC optical connector.

Receiver

The receiver converts incoming DC-balanced, serial NRZ optical data from line rates of 9.95 Gbps to 11.35 Gbps into serial XFI 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 trans impedance amplifier.

The amplified signal is passed to a signal-conditioning IC that provides clock and data recovery. The receive

CDR function generates a clock that is at the same frequency as the incoming data bit rate of the optical data input. The clock is phase aligned by a PLL that samples the data in the center of the data eye pattern. The CDR function does not require a reference clock to lock to incoming data. The CDR contains a lock detect circuit that indicates successful locking of the PLL onto the incoming data. Loss of signal and signal lock detection is included in the receive circuitry that is reflected in the Mod_NR status pin. The recovered data is output on the RD+ and RD- pins as a 100 Ω 340 mV peak-to-peak CML signal. The output signal meets XFP MSA requirements.

Low-Speed Signaling

Low-speed signaling is based on low-voltage TTL (LVTTL) operating at a nominal voltage of 3.3 V.

SCL/SDA: Two-wire serial interface clock and data line. Hosts should use a pull-up resistor connected to Vcc 3.3 V on the two-wire interface SCL (clock), SDA (data), and all low-speed outputs.

Mod_NR: Output pin. High indicates the module has detected a condition that renders Tx and/or Rx data invalid.

Mod_DeSel: Input pin. Low indicates the module responds to two-wire serial communication commands. High indicates the module does not respond to or acknowledge any two-wire interface communication from the host.

Interrupt: Output pin. Low indicates a possible module operational fault or a status critical to the host system.

TX_DIS: Input pin. High indicates the transmitter output is turned off.

Mod_ABS: Output pin. High indicates the XFP module is absent. It is pulled low when the XFP module is inserted.

RX_LOS: Output pin. High indicates insufficient optical power for reliable signal reception.

P_Down/RST: Multifunction input pin. The module can be powered down or reset by pulling the low-speed P-Down pin high. In power down mode, no data is transmitted on the optical Tx or the electrical Rx path. The reset pulse is generated on the falling edge of the P-Down signal. Following reset, the internal PLLs must reacquire lock and will
temporarily indicate a Mod_NR failure until the PLLs reacquire lock.

Application Schematics

Recommended MSA connections to the transceiver are shown in Figure 2 on page 5.

Power supply filtering is recommended for the transceiver. To limit wide-band noise power, the host system and module shall each meet a maximum of 2% peak-to-peak noise when measured with a 1 MHz low-pass filter. In addition, the host system and the module shall each meet a maximum of 3% peak-to-peak noise when measured with a filter from 1 MHz – 10 MHz.

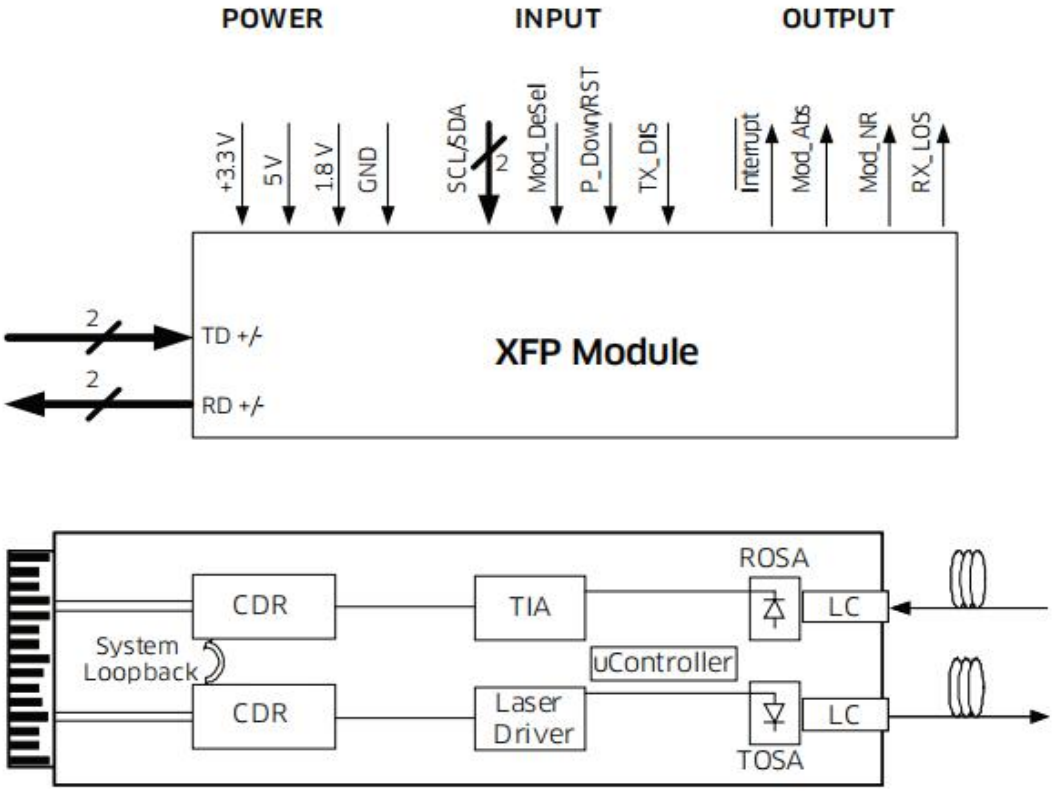


Figure 2. Application schematics

Pin Function Definitions

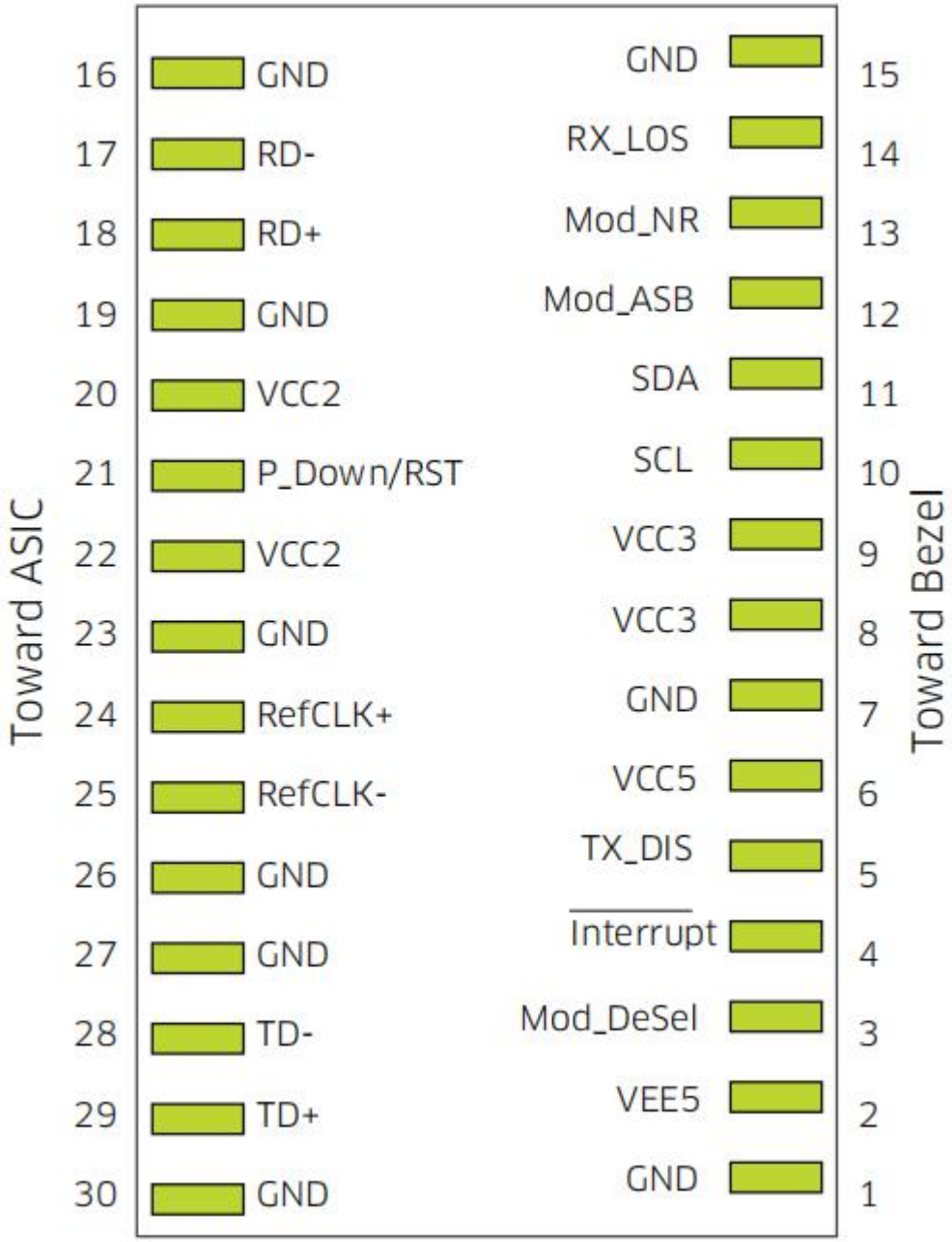


Figure 3. Transceiver pin-out on host board

Table 1. XFP Optical Transceiver Pin Descriptions

Pin Number	Type	Name	Description
1		GND1	Module ground

2		VEE5	Not used; may be left unconnected (Optional -5.2 V Power Supply).
3	LVTTL-I	Mod_Desel	Module de-select: when held low, allows the module to respond to 2-wire serial interface commands.
4	LVTTL-O	Interrupt[2]	Interrupt: indicates presence of an important condition which can be read over the serial 2-wire interface.
5	LVTTL-I	TX_DIS	Transmitter disable: transmitter laser source turned off
6		VCC5	+5 V power supply
7		GND[1]	Module ground
8		VCC3	+3.3 V power supply
9		VCC3	+3.3 V power supply
10	LVTTL-I	SCL[2]	Two-wire interface clock
11	LVTTL-I/O	SDA[2]	Two-wire interface data line
12	LVTTL-O	Mod_Abs[2]	Indicates module is not present. Connected to ground with 302 Ω resistor.
13	LVTTL-O	Mod_NR[2]	Module not ready: indicating module operational fault
14	LVTTL-O	RX_LOS[2]	Receiver loss of signal indicator
15		GND[1]	Module ground
16		GND[1]	Module ground
17	CML-O	RD-	Receiver inverted data output
18	CML-O	RD+	Receiver noninverted data output
19		GND[1]	Module ground
20		VCC2	+1.8 V power supply
21	LVTTL-I	P_Down/RST	Power down; when high, the module limits power consumption to 1.5 W or below. Serial interface is functional in the low power mode. Reset: the falling edge initiates a complete reset of the module including the serial interface, equivalent to a power cycle.
22		VCC2	+1.8 V power supply
23		GND[1]	Module ground
24	PECL-I	RefCLK+	Reference clock noninverted input (not used)
25	PECL-I	RefCLK-	Reference clock inverted input (not used)
26		GND[1]	Module ground
27		GND[1]	Module ground
28	CML-I	TD-	Transmitter inverted data input
29	CML-I	TD+	Transmitter noninverted data input
30		GND[1]	Module ground

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

XFP/XFI Reference Model Compliance Points

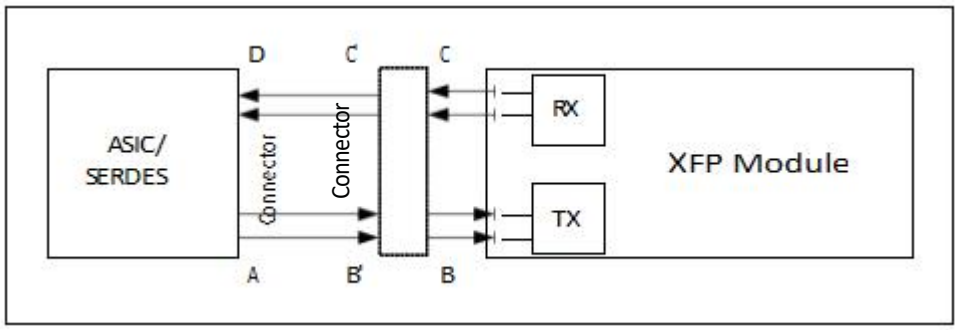


Figure 4. XFP/XFI reference model compliance points

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	500	V
Power supply voltages	$V_{CC2, max}$ $V_{CC3, max}$ $V_{CC5, max}$	-0.3 to 1.98 -0.3 to 3.63 -0.5 to 6.0	V V 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.

Electrical Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes

Supply currents and voltages

Voltage3	V_{CC3}	3.13	3.3	3.47	V	With respect to GND
Voltage5	V_{CC5}	4.75	5	5.25	V	With respect to GND
Voltage2	V_{CC2}	1.71	1.8	1.89	V	With respect to GND
Supply current3	I_{CC3}			750	mA	3.3 V
Supply current5	I_{CC5}			500	mA	5.0 V
Supply current2	I_{CC2}			1000	mA	1.8 V
Power dissipation	Pwr			3.5	W	

Low speed control and sense signals (detailed specification in XFP MSA INF8077i Rev. 4.5)

Outputs (Interrupt, Mod_NR, RX_LOS)	V_{OL} V_{OH}	0 host_Vcc-0.5		0.4 host_Vcc + 0.3	V V	Rpullup pulled to host _Vcc, measured at host side of connector. IOL (max)=3 mA Rpullup pulled to host _Vcc, measured at host side of connector.
Inputs (TX_DIS, P_Down/RST, M_DSEL)	V_{IL} V_{IH}	-0.3 2		0.8 Vcc3+ 0.3	V V	Pulled up in module to Vcc3 Pulled up in module to Vcc3
SCL and SDA inputs	V_{IL} V_{IH}	-0.3 Vcc3*0.7		Vcc3*0.3 Vcc3+0.5		Rpullup pulled to host _Vcc, measured at XFP side of connector. Rpullup pulled to host _Vcc, measured at XFP side of Connector.

Transmitter input (detailed specification in XFP MSA INF8077i Rev. 4.5)

Data input baud rate nominal		9.95		11.35	Gbps	
Data input bit rate tolerance (10GbE/10GFC)		-100		+100	ppm	
Data input bit rate tolerance (SONET/SDH)		-20		+20	ppm	
Data input compliance			B			Internally AC-coupled signals
Data input differential impedance	R_I	90	100	110	Ω	

Receiver output (detailed specification in XFP MSA INF8077i Rev. 4.5)

Data output baud rate nominal		9.95		11.35	Gbps	
Data output compliance			C			Internally AC-coupled signals
Data output bit rate stability (10GbE / 10GFC)		-100		+100	ppm	
Data output bit rate stability (SONET/SDH)		-20		+20	ppm	

Jitter Specifications

Parameter	Symbol	Min	Max	Unit	Notes
Transmitter electrical input jitter from host at B (detailed specification in XFP MSA INF8077i Rev. 4.5)					
Total non-EQJ jitter			0.41	UI(p-p)	Total jitter less ISI
Total jitter	TJ		0.61	UI(p-p)	
Eye mask	X1		0.305	UI	Mask coordinate X1=0.205 if total non-DDJ is measured.
Eye mask	Y1	60		mV	
Eye mask	Y2		410	mV	50 mV is allocated for multiple reflections.
Receiver electrical output jitter to host at C (detailed specification in XFP MSA INF8077i Rev. 4.5)					
Deterministic jitter	DJ		0.18	UI(p-p)	Includes jitter transferred from the optical receiver during any valid operational input condition.
Total jitter	TJ		0.34	UI(p-p)	Includes jitter transferred from the optical receiver during any valid operational input condition.
Eye mask	X1		0.17	UI	
Eye mask	X2		0.42	UI	
Eye mask	Y1	170		mV	
Eye mask	Y2		425	mV	
Jitter transfer bandwidth	BW		8	MHz	PRBS 2^{31}-1, OC-192 / SDH-64 Sinusoidal jitter tolerance mask
Jitter peaking			1	dB	Frequency >120 KHz
Transmitter jitter generation			0.3 0.1	UI_{pp} UI_{pp}	20 KHz to 80 MHz 4 MHz to 80 MHz

XFP Two-Wire Interface Protocol and Management Interface

The transceiver incorporates an XFP-compliant, two-wire management interface which is used for serial ID, digital diagnostics, and certain control functions. It is modeled on the SFF-8472

Rev 9.3 specification modified to accommodate a single two-wire interface address. In addition to the basic I2C read/write functionality, the modules support packet error checking that, when enabled, allows the host system to confirm the validity of any read data. Details of the protocol and interface are explicitly described in the MSA. Please refer to the MSA for design reference.

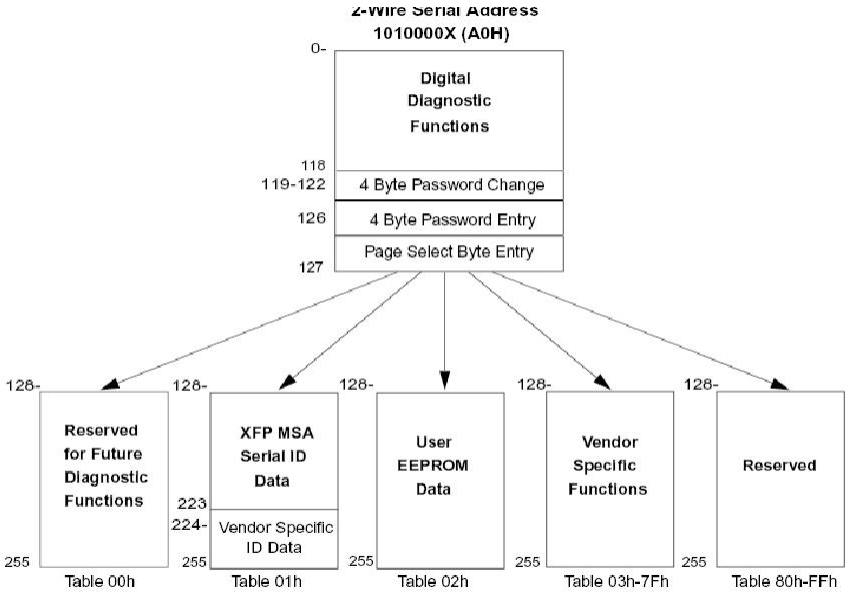


Figure 5. XFP two-wire serial digital diagnostic memory map

Optical Transmitter Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Average optical power (EOL)	P_{avg}	-1.0		3.0	dBm
Extinction ratio[1]	ER	9			dB
Wavelength range[2]	λ_c	1528.384		1568.773	nm
Frequency range[3]		191.1		196.15	THz
Channel spacing		50			GHz
Frequency stability (BOL)		f_c-1.5	f_c	f_c+1.5	GHz
Frequency stability (EOL)		f_c-2.5	f_c	f_c+2.5	GHz
Channel tuning time[4]				50	ms
Side-mode suppression ratio	SMSR	35			dB
Relative intensity noise	RIN			-130	dB/Hz
Return loss tolerance				27	dB

Note:
Specifications are applicable to the operating temperature range listed in Section 3.4.
1.Tested with PRBS 2^{31}-1 pattern
2.ITU grid wavelength
3.ITU grid frequency
4.Any channel to any channel

Optical Receiver Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Center wavelength	λ	1260		1600	nm
Receiver sensitivity (EOL)[1] Back to back (0 ps/nm) Fiber (-400 to 1600 ps/nm)	R_{sen} R_{senf}			-24 -21.5	dBm dBm
Receive overload[2]	P_{max}	-7			dBm
Receiver reflectance	R_{rx}			-27	dB
LOS assert	P_{los_on}	-33.5		-28	dBm
LOS deassert	P_{los_off}	-33		-26	dBm
LOS hysteresis		0.5		4	dB

Note:
Specifications are applicable to the operating temperature range listed in Section 3.4.

1.Guaranteed at 10.709 Gbps. Measured with worst ER; BER<10^{-12}; PRBS 2^{31}-1 pattern.
2.Guaranteed up to 10.709 Gbps.

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

The transceiver complies with international electromagnetic compatibility (EMC) and safety requirements and standards. EMC performance depends on the overall system design. Information included herein is intended for 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	UL 60950-1 CSA C22.2 No. 60950-1 EN 60950-1 IEC 60950-1 Flame Class V-0 Low Voltage Directive 2006/95/EC	UL-recognized component for US and CAN TUV certificate CB certificate Passes needle-point flame test. 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	TUV Certificate CB certificate FDA/CDRH certified with accession number; Class 1 laser product.
Electromagnetic Compatibility		
Radiated emissions	EMC Directive 2004/108/EC FCC rules 47 CFR Part 15CISPR 22 AS/NZS CISPR22 EN 55022 ICES-003, Issue 5 VCCI V-3	Class B digital device with a minimum -2 dB margin 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), whichever is less. Good system EMI design practice is required to achieve Class B margins at the system level.

Immunity	EMC Directive 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. Field strength of 10 V/m from 10 MHz to 1 GHz. No effect on transmitter/receiver performance is detectable between these limits.

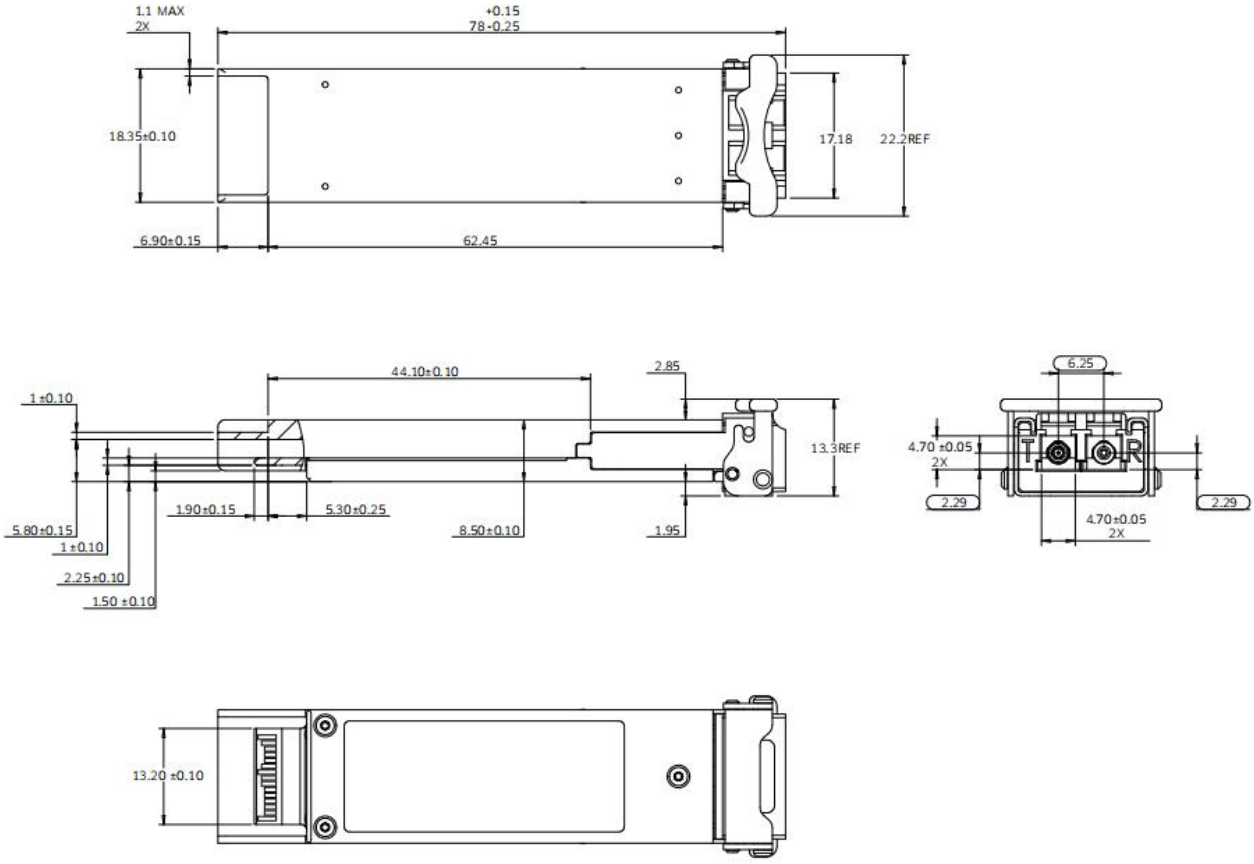
Restriction of Hazardous Substances (RoHS)

RoHS	EU Directive 2002/95/EC + EU Directive2011/65/ EU	Compliant per the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 and the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of 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.

PCB Layout

Recommended PCB layout is given in XFP MSA INF8077i Rev. 4.5.

Module Outline



Ordering information

Part Number	Product Description
GXU-CXXX-08CD	XXX=ITU channel(Gigalight ID), C-band Tunable DWDM XFP,80km, 0℃~70℃

Important Notice

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