2x200Gb/s OSFP FR4 2km Optical Transceiver

D-OC8FNT-H00

Product Specification

Features

- OSFP MSA compliant
- 2 sets of 4 CWDM lanes MUX/DEMUX design
- Compliant to IEEE 802.3bs Specification
- Up to 2km transmission on single mode fiber (SMF) with FEC
- Operating case temperature: 20 to 60ºC
- 8x53.125Gb/s electrical interface (400GAUI-8)
- Data Rate 53.125Gbps (PAM4) per channel.
- Maximum power consumption 12W
- CS duplex connectors
- RoHS compliant

Applications

- Data Center Interconnect
- 400G Ethernet
- Infiniband interconnects
- Enterprise networking

Part Number Ordering Information

D-OC8FNT-H00	2x200G OSFP FR4 2km with FEC optical transceiver with full real-time digital diagnostic monitoring and pull tab

1. General Description

This product is a transceiver module designed for 2km optical communication applications. The design is compliant to IEEE 802.3bs Specification. The module converts 8 input channels of 53.125Gb/s electrical data to 2 sets of 4 CWDM optical signals, and multiplexes them into 2 sets of a single channel for 212.5Gb/s optical transmission. Reversely, on the receiver side, the module optically de-multiplexes 2 sets of a single channel 212.5Gb/s signal inputs into 2 sets of 4 CWDM channel signals, and converts them to 8 output channels of 53.125Gb/s electrical data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G.694.2. It contains an optical CS connector for the optical interface and a 60-pin connector for the electrical interface. To minimize the optical dispersion in the long-haul system, single-mode fiber (SMF) has to be applied in this module. Host FEC is required to support up to 2km fiber transmission.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the OSFP Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

2. Functional Description

The module incorporates 2 sets of 4 independent Channels, on CWDM4 1271/1291/1311/1331nm center wavelength, operating at 53.125Gb/s for each channel. The transmitter path incorporates an 8-channel CDR retimer, 2 sets of quad channel EML drivers and 2 Sets of un-cooled CWDM4 EML lasers together with 2 sets of optical multiplexers. On the receiver path, two sets of optical de- multiplexers are coupled to 2 sets of Photodiodes Arrays, along with an 8-channel CDR retimer. The electrical interface is compliant with IEEE 802.3bs and OSFP MSA in the transmitting and receiving directions, and the optical interface is compliant to OSFP MSA with CS optical connector. Figure 2 shows the functional block diagram of this product.

A single +3.3V power supply is required to power up this product. As per MSA specifications the module offers 4 low speed hardware control pins: SCL, SDA, INT/RSTn and LPWn/PRSn

SCL and SDA are a 2-wire serial interface between the host and module using the I2C protocol. SCL is defined as the serial interface clock signal and SDA as the serial interface data signal. Both signals are open-drain and require pull-up resistors to +3.3V on the host. The pull-up resistor value can be 2.2k ohms to 4.7k ohms.

INT/RSTn is a dual function signal that allows the module to raise an interrupt to the host and also allows the host to reset the module. Reset is an active-low signal on the host which is translated to an active-low signal on the module. Interrupt is an active-high signal on the module which gets translated to an active-low signal on the host. The INT/RSTn signal operates in 3 voltage zones to indicate the state of Reset for the module and Interrupt for the host. Figure 1 shows these 3 zones.

LPWn/PRSn is a dual function signal that allows the host to signal Low Power mode and the module to indicate Module Present. Low Power mode is an active-low signal on the host which gets converted to an active-low signal on the module. Module Present is controlled by a pull-down resistor on the module which gets converted to an active-low logic signal on the host. The LPWn/PRSn signal operates in 3 voltage zones to indicate the state of Low Power mode for the module and Module Present for the host. Figure 1 shows these 3 zones.

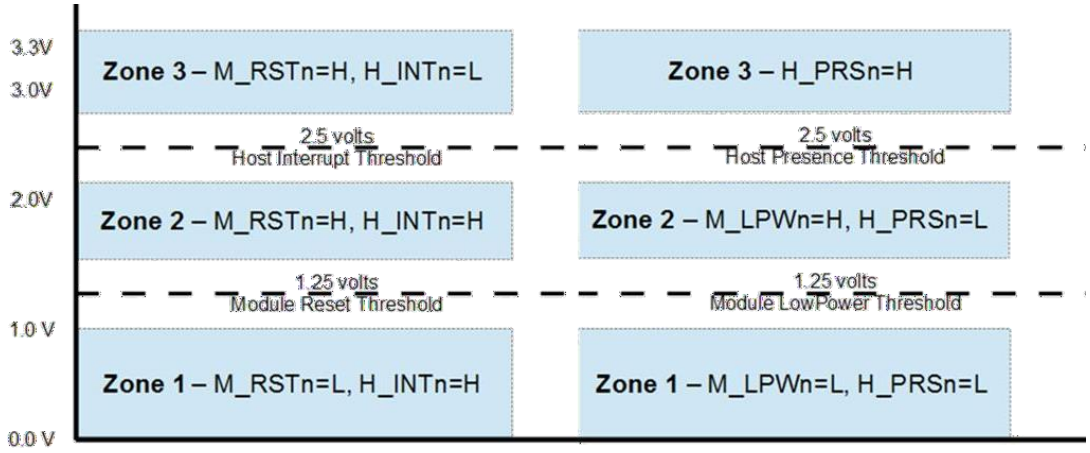

Figure 1. Voltage Zones

3. Transceiver Block Diagram

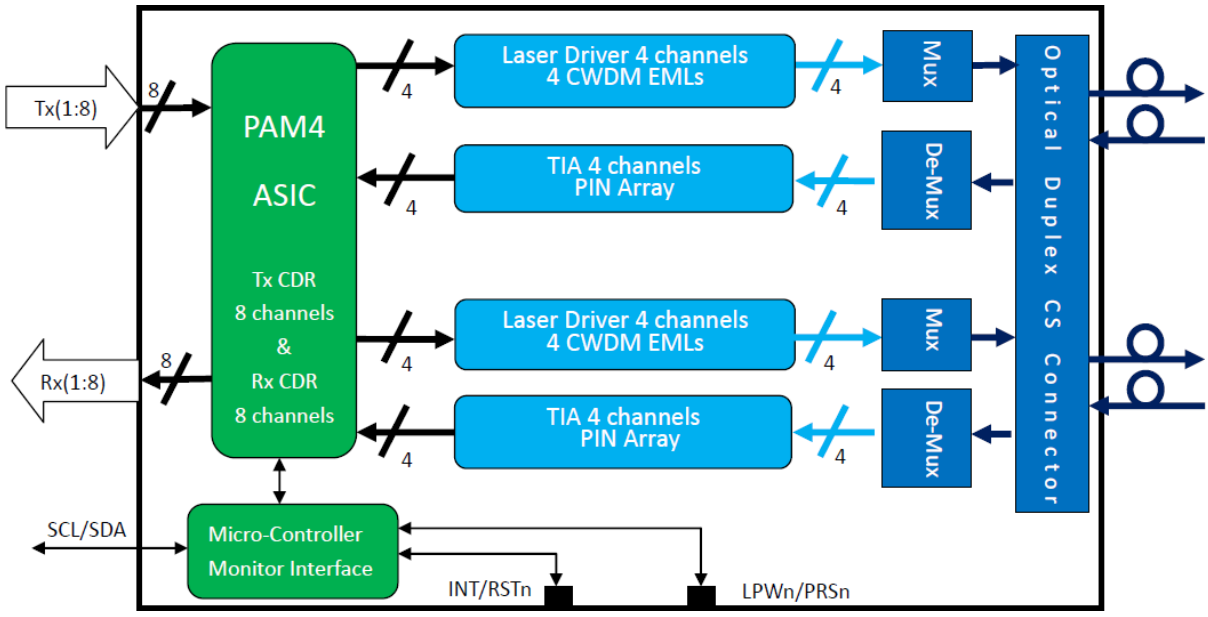

Figure 2. Transceiver Block Diagram

4. Pin Assignment and Description

The electrical pinout of the OSFP module is shown in Figure 3 below. Table 1 shows the electrical to optical channel mapping scheme.

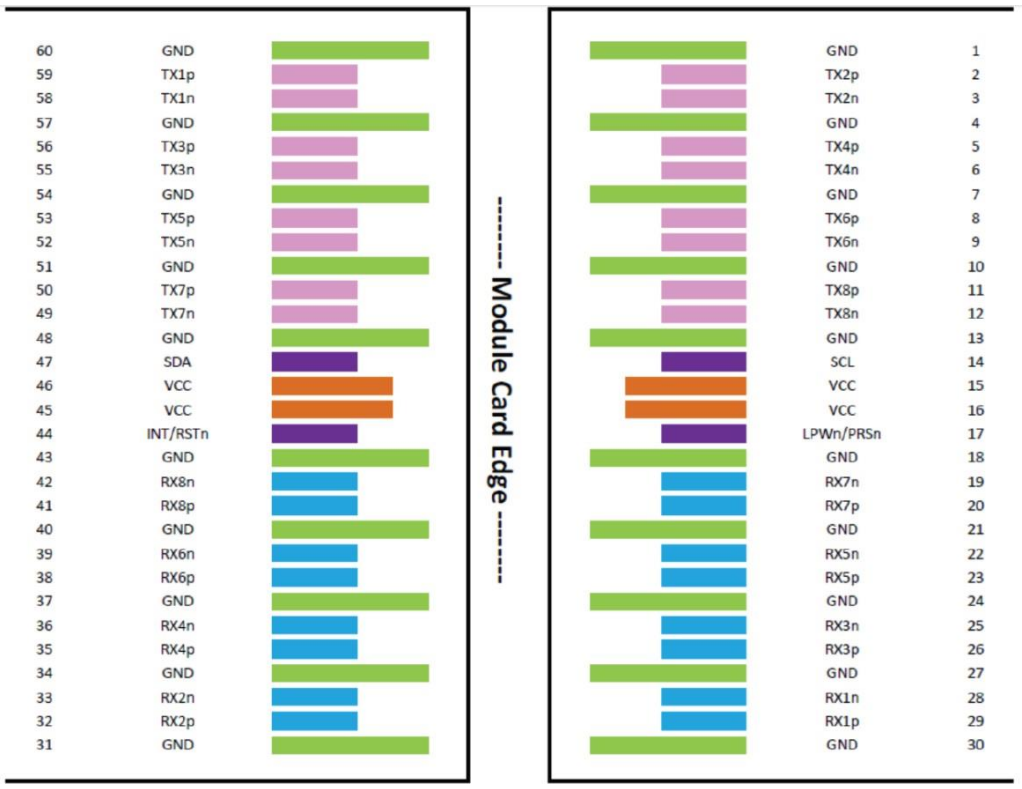

Figure 3. MSA compliant Connector

Pin Definition

Pin#	Symbol	Description	Logic	Direction	Plug Sequence
1	GND		Ground		1
2	TX2p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
3	TX2n	Transmitter Data Inverted	CML-I	Input from Host	3
4	GND		Ground		1
5	TX4p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
6	TX4n	Transmitter Data Inverted	CML-I	Input from Host	3
7	GND		Ground		1
8	TX6p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
9	TX6n	Transmitter Data Inverted	CML-I	Input from Host	3
10	GND		Ground		1

11	TX8p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
12	TX8n	Transmitter Data Inverted	CML-I	Input from Host	3
13	GND		Ground		1
14	SCL	2-wire Serial interface clock	LVCMOS-I/O	Bi-directional	3
15	VCC	+3.3V Power		Power from Host	2
16	VCC	+3.3V Power		Power from Host	2
17	LPWn/PRSn	Low-Power Mode / Module Present	Multi-Level	Bi-directional	3
18	GND		Ground		1
19	RX7n	Receiver Data Inverted	CML-O	Output to Host	3
20	RX7p	Receiver Data Non-Inverted	CML-O	Output to Host	3
21	GND		Ground		1
22	RX5n	Receiver Data Inverted	CML-O	Output to Host	3
23	RX5p	Receiver Data Non-Inverted	CML-O	Output to Host	3
24	GND		Ground		1
25	RX3n	Receiver Data Inverted	CML-O	Output to Host	3
26	RX3p	Receiver Data Non-Inverted	CML-O	Output to Host	3
27	GND		Ground		1
28	RX1n	Receiver Data Inverted	CML-O	Output to Host	3
29	RX1p	Receiver Data Non-Inverted	CML-O	Output to Host	3
30	GND		Ground		1
31	GND		Ground		1
32	RX2p	Receiver Data Non-Inverted	CML-O	Output to Host	3
33	RX2n	Receiver Data Inverted	CML-O	Output to Host	3
34	GND		Ground		1
35	RX4p	Receiver Data Non-Inverted	CML-O	Output to Host	3
36	RX4n	Receiver Data Inverted	CML-O	Output to Host	3
37	GND		Ground		1
38	RX6p	Receiver Data Non-Inverted	CML-O	Output to Host	3
39	RX6n	Receiver Data Inverted	CML-O	Output to Host	3
40	GND		Ground		1
41	RX8p	Receiver Data Non-Inverted	CML-O	Output to Host	3
42	RX8n	Receiver Data Inverted	CML-O	Output to Host	3
43	GND		Ground		1
44	INT/RSTn	Module Interrupt / Module Reset	Multi-Level	Bi-directional	3
45	VCC	+3.3V Power		Power from Host	2
46	VCC	+3.3V Power		Power from Host	2

47	SDA	2-wire Serial interface data	LVCMOS-I/O	Bi-directional	3
48	GND		Ground		1
49	TX7n	Transmitter Data Inverted	CML-I	Input from Host	3
50	TX7p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
51	GND		Ground		1
52	TX5n	Transmitter Data Inverted	CML-I	Input from Host	3
53	TX5p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
54	GND		Ground		1
55	TX3n	Transmitter Data Inverted	CML-I	Input from Host	3
56	TX3p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
57	GND		Ground		1
58	TX1n	Transmitter Data Inverted	CML-I	Input from Host	3
59	TX1p	Transmitter Data Non-Inverted	CML-I	Input from Host	3
60	GND		Ground		1

Table 1. Electrical to Optical Channel Mapping

Electrical Channels	Optical Wavelength (nm)
1	**1271**
2	**1291**
3	**1311**
4	**1331**
5	**1271**
6	**1291**
7	**1311**
8	**1331**

5. Recommended Power Supply Filter

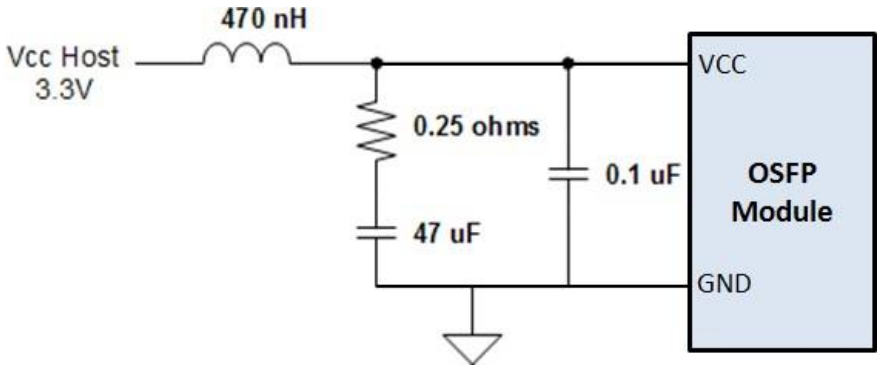

Figure 4. Recommended Power Supply Filter

6. Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	T_S	-40	85	degC	
Operating Case Temperature	T_{OP}	20	60	degC	
Power Supply Voltage	V_{CC}	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	

7. Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Units	Notes
Operating Case Temperature	T_{OP}	20		60	degC	
Power Supply Voltage	V_{CC}	3.135	3.3	3.465	V	
Data Rate, each Lane			26.5625		GBd	PAM4
Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				$2.3x10^{-4}$		
Post-FEC Bit Error Ratio				$1x10^{-12}$		1
Link Distance with G.652	D	2		2000	m	2

Notes:

1. FEC provided by host system.
2. FEC required on host system to support maximum distance.

8. Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Test Point	Min	Typical	Max	Units	Notes
Power Consumption				12	W	
Supply Current	Icc			3.64	A	
Transmitter (each Lane)						
Signaling Rate, each Lane	TP1	26.5625 ± 100 ppm			GBd	
Differential pk-pk Input Voltage Tolerance	TP1a	900			mVpp	1
Differential Termination Mismatch	TP1			10	%	
Differential Input Return Loss	TP1	IEEE 802.3-2015 Equation (83E-5)			dB	
Differential to Common Mode Input Return Loss	TP1	IEEE 802.3-2015 Equation (83E-6)			dB	
Module Stressed Input Test	TP1a	See IEEE 802.3bs 120E.3.4.1				2
Single-ended Voltage Tolerance Range (Min)	TP1a	-0.4 to 3.3			V	
DC Common Mode Input Voltage	TP1	-350		2850	mV	3
Receiver (each Lane)						
Signaling Rate, each lane	TP4	26.5625 ± 100 ppm			GBd	
Differential Peak-to-Peak Output Voltage	TP4			900	mVpp	
AC Common Mode Output Voltage, RMS	TP4			17.5	mV	
Differential Termination Mismatch	TP4			10	%	
Differential Output Return Loss	TP4	IEEE 802.3-2015				

		Equation (83E-2)				
Common to Differential Mode Conversion Return Loss	TP4	IEEE 802.3-2015 Equation (83E-3)				
Transition Time, 20% to 80%	TP4	9.5			ps	
Near-end Eye Symmetry Mask Width (ESMW)	TP4		0.265		UI	
Near-end Eye Height, Differential	TP4	70			mV	
Far-end Eye Symmetry Mask Width (ESMW)	TP4		0.2		UI	
Far-end Eye Height, Differential	TP4	30			mV	
Far-end Pre-cursor ISI Ratio	TP4	-4.5		2.5	%	
Common Mode Output Voltage (Vcm)	TP4	-350		2850	mV	3

Notes:

1. With the exception to IEEE 802.3bs 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.
2. Meets BER specified in IEEE 802.3bs 120E.1.1.
3. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

9. Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Wavelength Assignment	L0	1264.5	1271	1277.5	nm	ITU-T CWDM4
	L1	1284.5	1291	1297.5	nm	
	L2	1304.5	1311	1317.5	nm	
	L3	1324.5	1331	1337.5	nm	
Transmitter						
Data Rate, each Lane		26.5625 ± 100 ppm			GBd	
Modulation Format		PAM4			—	
Side Mode Suppression Ratio	SMSR	30			dB	Modulated
Total Average Launch Power	P_T			10.7	dBm	
Average Launch Power, each Lane	P_{AVG}	-4.2		4.7	dBm	1

Outer Optical Modulation Amplitude (OMA_{outer}), each Lane	P_{OMA}	-1.2		4.5	dBm	2
Launch Power in OMA_{outer} minus TDECQ, each lane		-2.6			dB	For ER ≥ 4.5dB
		-2.5			dB	For ER < 4.5dB
Transmitter and Dispersion Eye Clouser for PAM4, each Lane	TDECQ			3.3	dB	
Extinction Ratio	ER	3.5			dB	
Difference in Launch Power between any Two Lanes (OMA_{outer})				4	dB	
$RIN_{16.5}OMA$	RIN			-132	dB/Hz	
Optical Return Loss Tolerance	TOL			16.5	dB	
Transmitter Reflectance	R_T			-26	dB	3
Average Launch Power of OFF Transmitter, each Lane	P_{off}			-30	dBm	
Receiver						
Data Rate, each Lane		26.5625 ± 100 ppm			GBd	
Modulation Format		PAM4			—	
Damage Threshold, each Lane	TH_d	5.7			dBm	4
Average Receive Power, each Lane		-8.2		4.7	dBm	5
Receive Power (OMA_{outer}), each Lane				4.5	dBm	
Receiver Sensitivity (OMA_{outer}), each Lane	SEN			-6	dBm	6
Stressed Receiver Sensitivity (OMA_{outer}), each Lane	SRS			-3.6	dBm	7
Difference in Receive Power between any Two Lanes (OMA_{outer})				4.1	dB	

Receiver Reflectance	R_R			-26	dB	
LOS Assert	LOSA	-30			dBm	
LOS De-assert	LOSD			-16	dBm	
LOS Hysteresis	LOSH	0.5			dB	
Stressed Conditions for Stress Receiver Sensitivity (Note 8)						
Stressed Eye Closure for PAM4 (SECQ), Lane under Test			3.3		dB	
OMA_{outer} of each Aggressor Lane			0.5		dBm	

Notes:

1. Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
2. Even if the TDECQ < 1.4 dB for an extinction ratio of ≥ 4.5 dB or TDECQ < 1.3 dB for an extinction ratio of < 4.5 dB, the OMA_{outer} (min) must exceed the minimum value specified here.
3. Transmitter reflectance is defined looking into the transmitter.
4. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.
5. Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
6. Receiver Sensitivity OMA_{outer}, each lane (max) is informative and is defined for a transmitter with SECQ of 0.9 dB and for the BER of $2.4x10^{-4}$.
7. Measured with conformance test signal at receiver input for the BER of $2.4x10^{-4}$.
8. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

10. Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

Parameter	Symbol	Min	Max	Units	Notes
Temperature monitor absolute error	DMI_Temp	-3	3	degC	Over operating temperature range
Supply voltage monitor absolute error	DMI _VCC	-0.1	0.1	V	Over full operating range
Channel RX power monitor absolute error	DMI_RX_Ch	-2	2	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-2	2	dB	1

Notes:

1. Due to measurement accuracy of different single mode fibers, there could be an additional +/-1 dB fluctuation, or a +/- 3 dB total accuracy.

11. Mechanical Dimensions

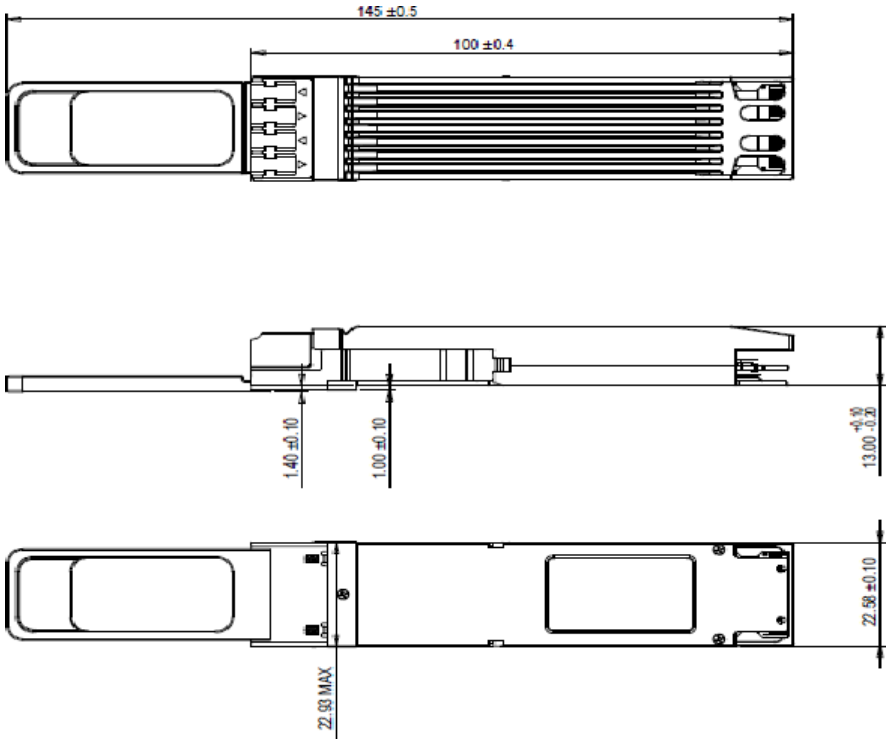

Figure 5. Mechanical Outline

12. ESD

This transceiver is specified as ESD threshold 1kV for high speed data pins and 2kV for all other electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

13. Laser Safety

This is a Class 1 Laser Product according to EN 60825-1:2014. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).

Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.