400Gb/s OSFP PSM8 300m SMF Optical Transceiver

D-OP8FNH-H00

Product Specification

Features

- OSFP MSA compliant
- Silicon Photonic Basis
- 8 parallel lanes on 1550nm center wavelength
- Compliant to 400G_SiP_PSM8_Module Specification
- Up to 300m transmission on single mode fiber (SMF) with KP4 FEC
- Operating case temperature: 20 to 52ºC
- 8x53.125Gb/s electrical interface (400GAUI-8)
- Data Rate 53.125Gbps (PAM4) per channel.
- Maximum power consumption 9W
- MPO-16 connector
- RoHS compliant

Applications

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

Part Number Ordering Information

D-OP8FNH-H00	400G OSFP SiPh PSM8 300m SMF with FEC optical transceiver with full real-time digital diagnostic monitoring and pull tab

1. General Description

This product is a parallel 400Gb/s Octal Small Form-factor Pluggable (OSFP) optical module. It provides increased port density and total system cost savings. The OSFP full-duplex optical module offers 8 independent transmit and receive channels, each capable of 53.125Gb/s operation for an aggregate data rate of 400Gb/s on 300m single mode fiber.

An optical fiber cable with an MTP/MPO-16 connector can be plugged into the OSFP PSM8 module receptacle. Proper alignment is ensured by the guide pins inside the receptacle. The cable usually cannot be twisted for proper channel to channel alignment. Electrical connection is achieved through an OSFP MSA-compliant edge type connector.

It contains an optical MPO-16 connector for the optical interface and a 60-pin connector for the electrical interface. Host FEC is required to support up to 300m single mode 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 is silicon photonic basis. It incorporates 8 parallel channels, on 1550nm Center Wavelength, operating at 50G per channel. The transmitter uses a clock-and-data recovery (CDR) circuit, linear driver, and Silicon Mach-Zehnder modulator (MZM) with a 1550nm continuous wave (CW) laser as the optical source to generate a 26.5625Gbaud/s PAM4 optical signal. The receiver uses a Germanium (Ge) photodetector (PD), linear transimpedance amplifier (TIA), and CDR circuit to generate a 26.5625Gbaud/s PAM4 electrical signal to the host. The MZMs and PDs are integrated into a Silicon-based photonic integrated circuit (PIC). 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 MPO-16 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.

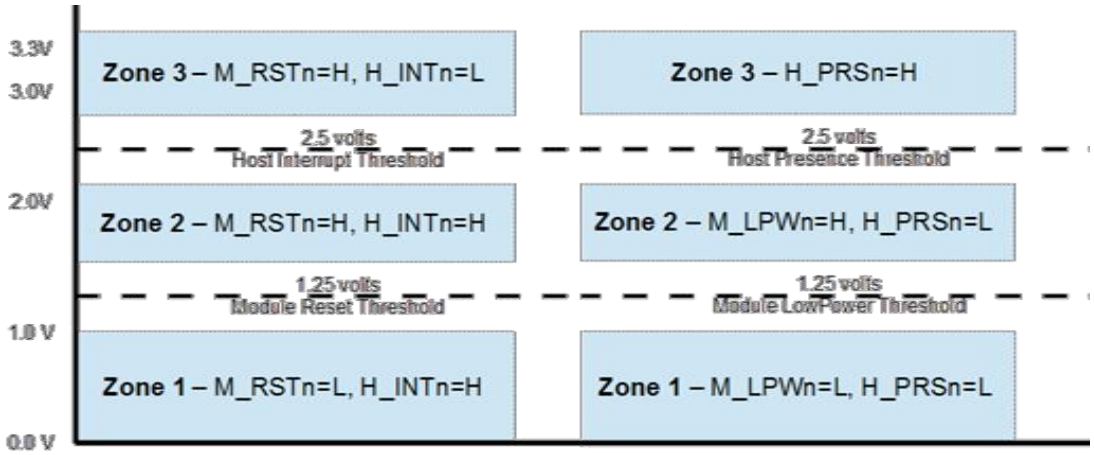

Figure 1. Voltage Zones

3. Transceiver Block Diagram

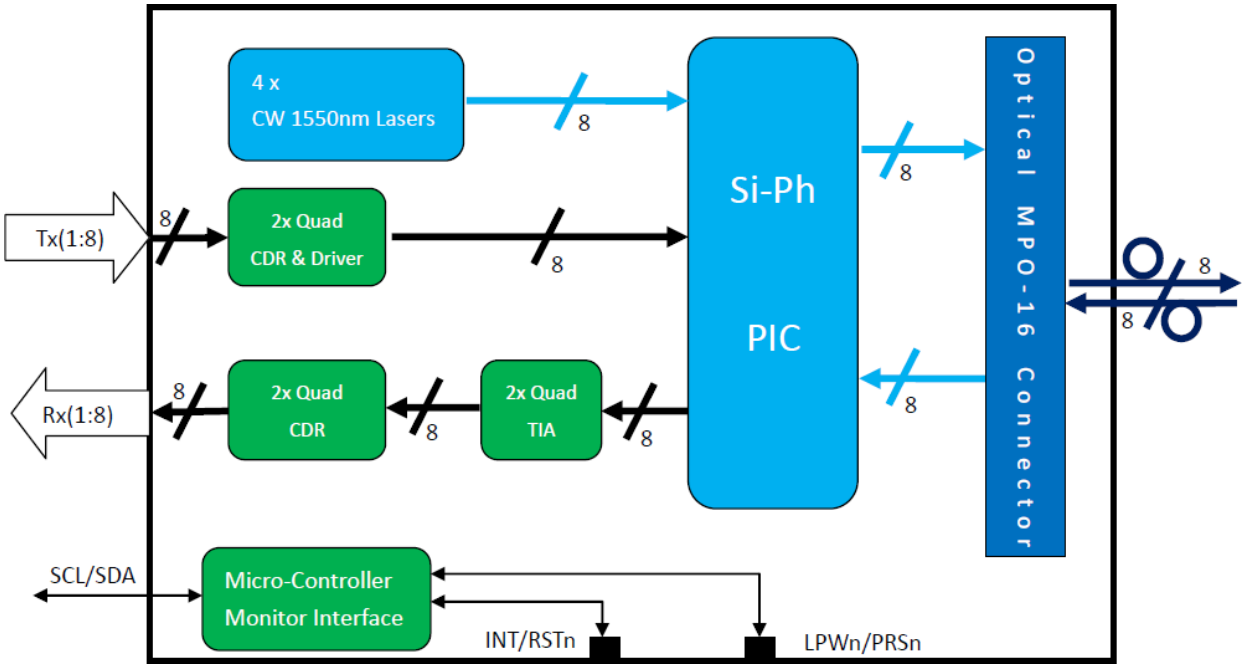

Figure 2. Transceiver Block Diagram

4. Pin Assignment and Description

The electrical pinout of the OSFP module is shown in Figure 3 below. Figure 4 shows the MPO-16 connector interface.

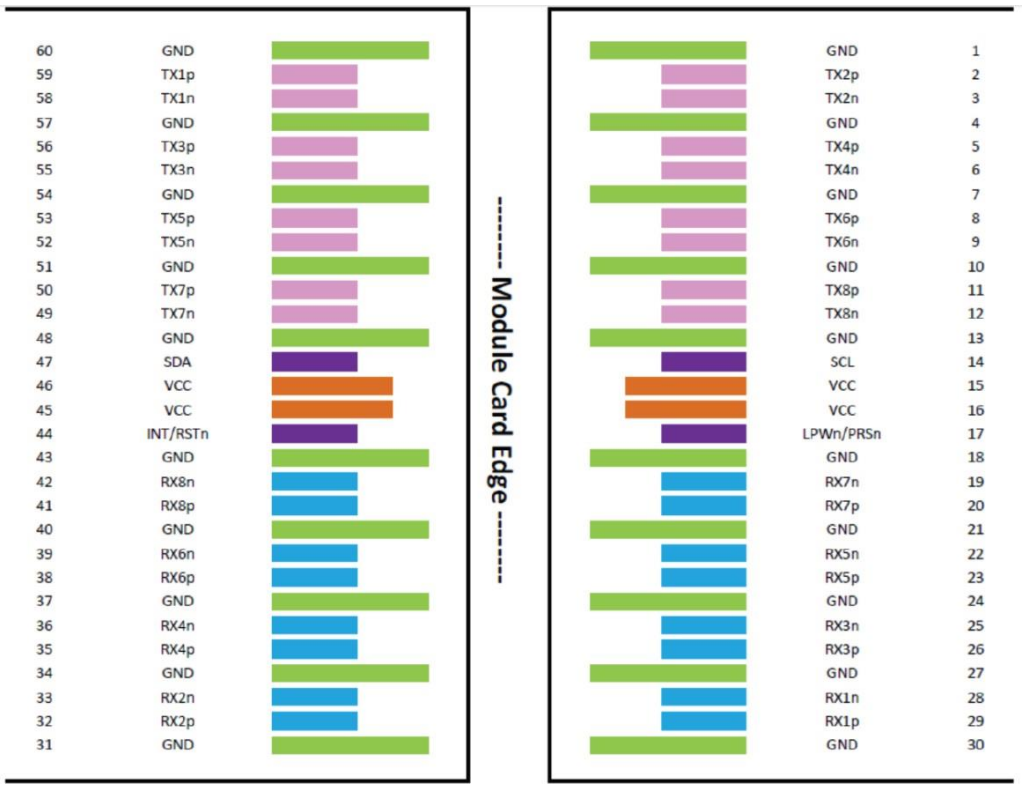

Figure 3. MSA Compliant Connector

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

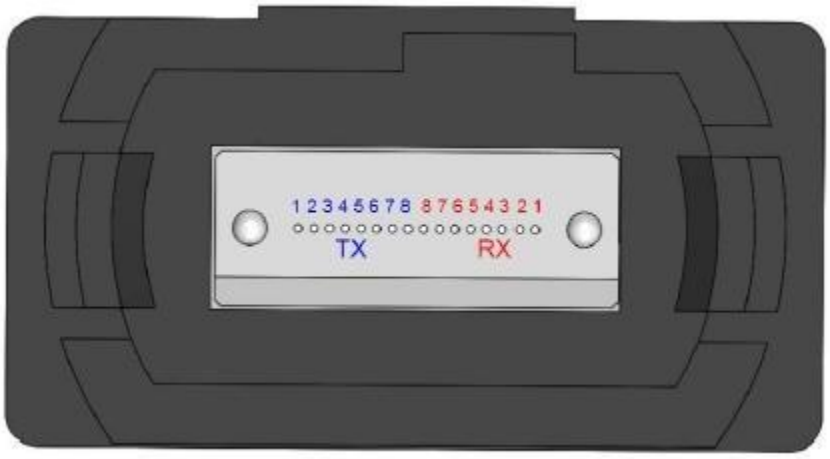

Figure 4. MPO-16 Optical Connector Interface

5. Recommended Power Supply Filter

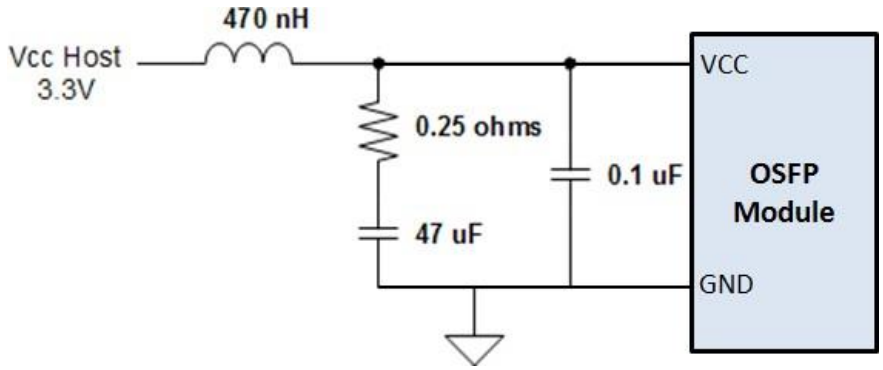

Figure 5. Recommended Power Supply Filter

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	70	degC	
Operating Case Temperature	T_{OP}	20	52	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		52	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				$2.4x10^{-4}$		
Post-FEC Bit Error Ratio				$1x10^{-12}$		1
Link Distance	D	0.5		300	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				9	W	
Supply Current	Icc			2.73	A	
Transmitter (each Lane)						
Differential Voltage Input Swing, pk-pk	TP1a			900	mVpp	
Differential Input Termination Resistance	TP1	90	100	110	ohm	
DC Common Mode Input Voltage,	TP1	-350		2850	mV	
Differential Input Return Loss	TP1	≥9.5-0.37f, 0.01≤f≤8GHz ≥4.75-7.4log10(f/14), 8≤f≤19Hz			dB	
Differential to Common Mode Input Return Loss	TP1	≥22-(20/25.78) f, 0.01≤f≤12.89GHz ≥15-(6/25.78) f, 12.89≤f≤19GHz			dB	
Receiver (each Lane)						
Differential Output Termination Resistance	TP4	90	100	110	ohm	
Differential Voltage Output Swing, pk-pk	TP4			900	mVpp	
AC Common Mode Output Voltage, RMS	TP4			17.5	mV	
Differential Output Return Loss (SDD22)	TP4	≥9.5-0.37f, 0.01≤f≤8GHz ≥4.75-7.4log10(f/14), 8≤f≤19Hz			dB	
Common Mode to Differential Return Loss	TP4	≥22-(20/25.78) f, 0.01≤f≤12.89GHz ≥15-(6/25.78) f, 12.89≤f≤19GHz			dB	
Vertical Eye Closure	TP4			5.8	dB	
Eye Width	TP4	0.4			UI	1
Eye Height(differential)	TP4	120			mV	1
Common-Mode Output Return Loss	TP4	2			dB	

Notes:

1. Application to all three PAM4 eyes at BER level of 1E-6.

9. Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Transmitter						
Center Wavelength	λ_C	1544		1558	nm	
Data Rate, each Lane		26.5625 ± 100 ppm			GBd	
Side Mode Suppression Ratio	SMSR	35			dB	Modulated
Outer Optical Modulation Amplitude (OMA_{outer}), each Lane	P_{OMA}	-3.3		0	dBm	
Launch Power in OMA_{outer} minus TDECQ, each Lane		-3.8			dB	
Difference in Average Launch Power Between Any Two Lanes				3	dB	
Extinction Ratio	ER	3			dB	
Relative Intensity Noise	RIN			-135	dB/Hz	
Transmitter Optical Mask	EMM	25Gb/s: Compliant with 100GBASE-LR4 50Gb/s: TBD			%	
Receiver						
Center Wavelength	λ_C	1544		1558	nm	
Data Rate, each Lane		26.5625 ± 100 ppm			GBd	
Receiver Saturation		3			dBm	
Receiver Sensitivity (OMA_{outer}), each Lane	SEN1			-6.3	dBm	1
Receiver Sensitivity (OMA_{outer}), each Lane	SEN2			-11.35	dBm	2
Receiver Reflectance	R_R			-12	dB	
LOS Assert	LOSA			-17	dBm	OMA
LOS De-assert	LOSD			-16	dBm	OMA

Notes:

1. Tested with PRBS31 pattern at 53.13Gb/s, BER of 2E-4.
2. Tested with PRBS31 pattern at 25.78Gb/s, BER of 5E-5.

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

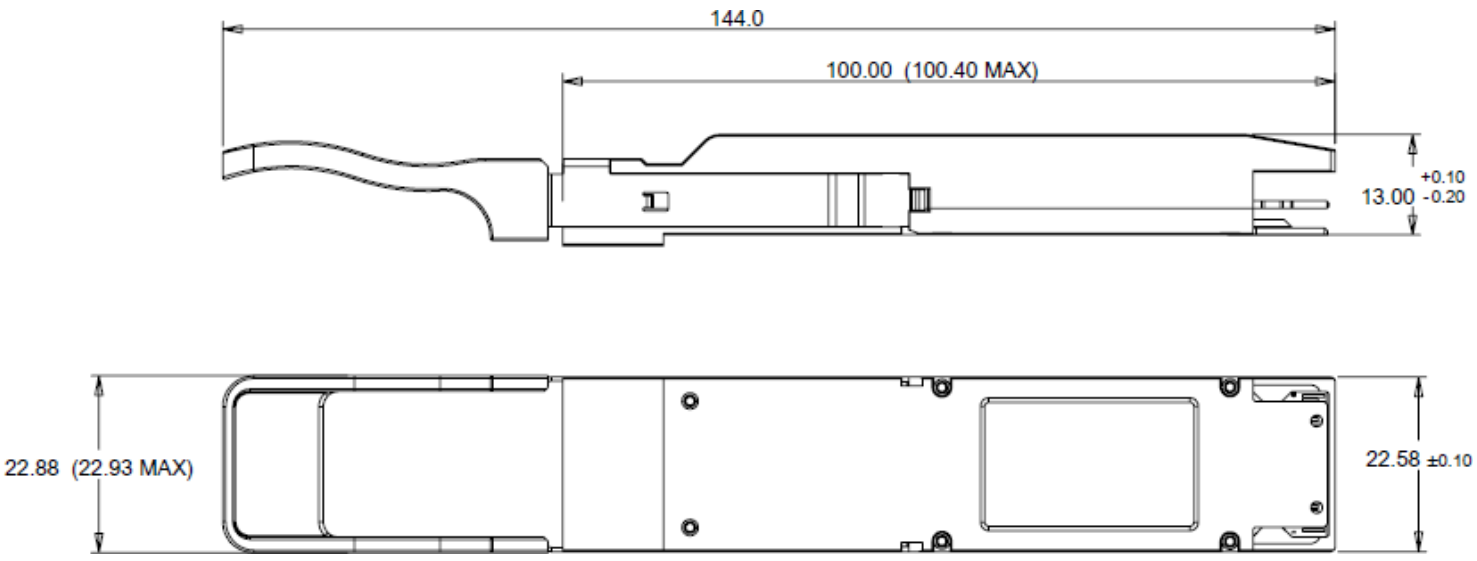

Figure 6. Mechanical Outline

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.