

200Gb/s QSFP-DD LR4 10km Optical Transceiver

PQD2H-3110

Features

- IEEE802.3bs compliant
- QSFP-DD MSA compliant
- 4 LWDM lanes MUX/DEMUX design
- Supports 212.5Gb/s aggregate bit rate
- Up to 10km transmission on single mode fiber (SMF) with FEC
- Operating case temperature: 0 to 70°C
- 200GAUI-8 electrical interface
- Maximum power consumption 10.8W
- LC duplex connector
- RoHS compliant

Applications

- Data Center Interconnect
- 200G Ethernet
- Enterprise networking

Part Number Ordering Information

PQD2H-3110	200G QSFP-DD LR4 10km with FEC optical transceiver with full real-time digital diagnostic monitoring and pull tab
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General Description

This product is a 200Gb/s transceiver module designed for 10km optical communication applications. The design is compliant to IEEE802.3bs 200GBASE-LR4 standard. The module converts 8 input channels(ch) of 25Gb/s electrical data to 4 channels of LWDM optical signals, and multiplexes them into a single channel for 200Gb/s (PAM4) optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 200Gb/s(PAM4) input into 4 LWDM channels of signals, and converts them to 8 channels output electrical data .

The central wavelengths of the 4 LWDM channels. It contains a duplex LC connector for the optical interface and a 76-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 10km fiber transmission.

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

Functional Description

This product converts the 8-channel of 25Gb/s electrical input data into LWDM optical signals .The transmitter path incorporates a quad channel EML driver and EML lasers together with an optical multiplexer. The light is combined by the MUX parts as a 200Gb/s data, propagating out of the transmitter module from the SMF. On the receiver path, an optical de-multiplexer is coupled to a 4 channel photodiode array. A DSP basis gearbox is used to convert 8 channels of 25GBaud PAM4 signals into 4 channels of 8 channels of 25GBaud NRZ signals and also an 8-channel retimer and FEC block are integrated in this DSP. The electrical interface is compliant with IEEE 802.3bs and QSFP-DD MSA in the transmitting and receiving directions, and the optical interface is compliant to IEEE 802.3bs with duplex LC connector.

A single +3.3V power supply is required to power up this product. Both power supply pins VccTx and VccRx are internally connected and should be applied concurrently. As per MSA specifications the module offers 7 low speed hardware control pins (including the 2-wire serial interface): ModSelL, SCL, SDA, ResetL, LPMode, ModPrsL and IntL.

Module Select (ModSelL) is an input pin. When held low by the host, this product responds to 2-wire serial communication commands. The ModSelL allows the use of this product on a single 2-wire interface bus – individual ModSelL lines must be used.

Serial Clock (SCL) and Serial Data (SDA) are required for the 2-wire serial bus communication interface and enable the host to access the QSFP+ memory map.

The ResetL pin enables a complete reset, returning the settings to their default state, when a low

level on the ResetL pin is held for longer than the minimum pulse length. During the execution of a reset the host shall disregard all status bits until it indicates a completion of the reset interrupt. The product indicates this by posting an IntL (Interrupt) signal with the Data_Not_Ready bit negated in the memory map. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

Low Power Mode (LPMode) pin is used to set the maximum power consumption for the product in order to protect hosts that are not capable of cooling higher power modules, should such modules be accidentally inserted.

Module Present (ModPrsL) is a signal local to the host board which, in the absence of a product, is normally pulled up to the host Vcc. When the product is inserted into the connector, it completes the path to ground through a resistor on the host board and asserts the signal. ModPrsL then indicates its present by setting ModPrsL to a "Low" state.

Interrupt (IntL) is an output pin. "Low" indicates a possible operational fault or a status critical to the host system. The host identifies the source of the interrupt using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled to the Host Vcc voltage on the Host board.

Transceiver Block Diagram

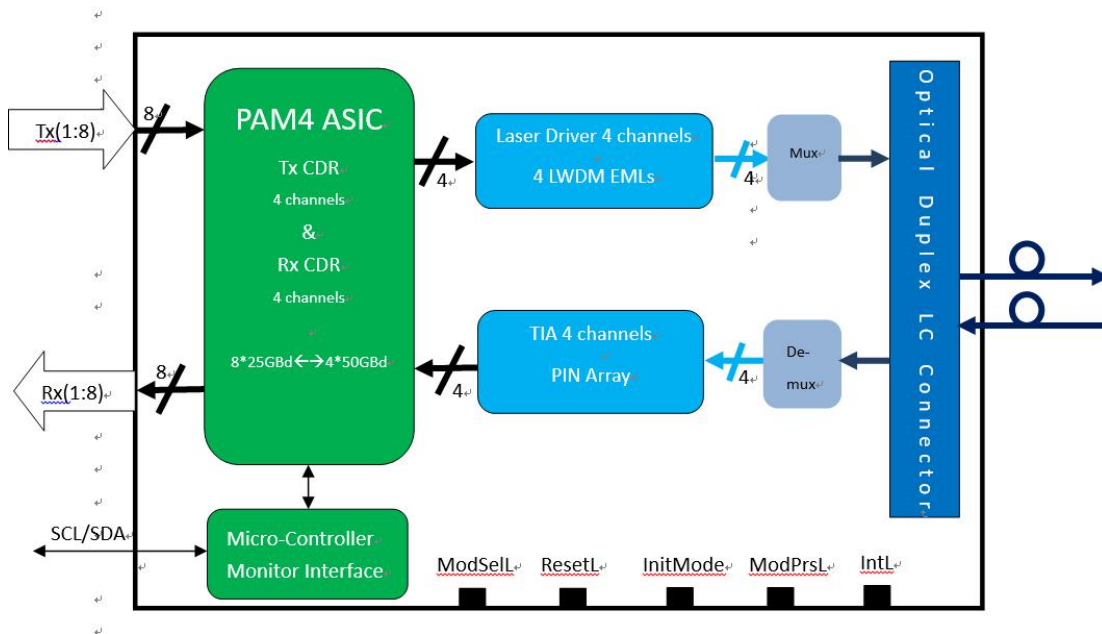


Figure 1. Transceiver Block Diagram

Pin Assignment and Description

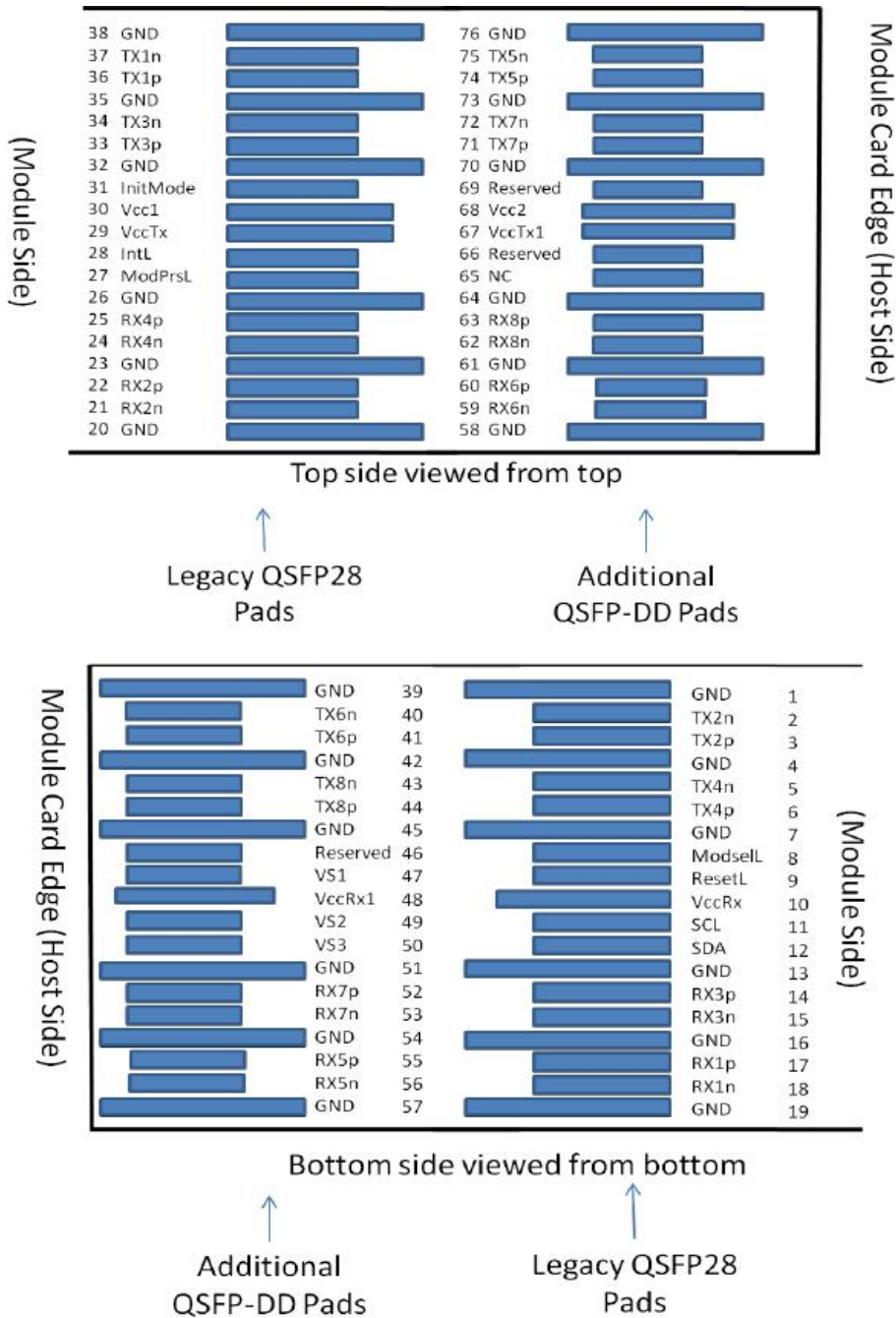


Figure 2. MSA compliant Connector

Pin Definition

Pin #	Logic	Symbol	Description	Plug Sequence	Notes
1		GND	Ground	1B	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3B	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3B	
4		GND	Ground	1B	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3B	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3B	
7		GND	Ground	1B	1
8	LVTTTL-I	ModSelL	Module Select	3B	
9	LVTTTL-I	ResetL	Module Reset	3B	
10		VccRx	+3.3V Power Supply Receiver	2B	2
11	LVC MOS-I/O	SCL	2-wire serial interface clock	3B	
12	LVC MOS-I/O	SDA	2-wire serial interface data	3B	
13		GND	Ground	1B	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3B	
15	CML-O	Rx3n	Receiver Inverted Data Output	3B	
16	GND	Ground	1B		1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3B	
18	CML-O	Rx1n	Receiver Inverted Data Output	3B	
19		GND	Ground	1B	1
20		GND	Ground	1B	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3B	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3B	
23		GND	Ground	1B	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3B	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3B	
26		GND	Ground	1B	1
27	LVTTTL-O	ModPrsL	Module Present	3B	
28	LVTTTL-O	IntL	Interrupt	3B	
29		VccTx	+3.3V Power supply transmitter	2B	2
30		Vcc1	+3.3V Power supply	2B	2
31	LVTTTL-I	InitMode	Initialization mode; In legacy QSFP applications, the InitMode pad is called LPMODE	3B	
32		GND	Ground	1B	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3B	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3B	
35		GND	Ground	1B	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3B	

37	CML-I	Tx1n	Transmitter Inverted Data Input	3B	
38		GND	Ground	1B	1
39		GND	Ground	1A	1
40	CML-I	Tx6n	Transmitter Inverted Data Input	3A	
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input	3A	
42		GND	Ground	1A	1
43	CML-I	Tx8n	Transmitter Inverted Data Input	3A	
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input	3A	
45		GND	Ground	1A	1
46		Reserved	For future use	3A	3
47		VS1	Module Vendor Specific 1	3A	3
48		VccRx1	3.3V Power Supply	2A	2
49		VS2	Module Vendor Specific 2	3A	3
50		VS3	Module Vendor Specific 3	3A	3
51		GND	Ground	1A	1
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	3A	
53	CML-O	Rx7n	Receiver Inverted Data Output	3A	
54		GND	Ground	1A	1
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	3A	
56	CML-O	Rx5n	Receiver Inverted Data Output	3A	
57		GND	Ground	1A	1
58		GND	Ground	1A	1
59	CML-O	Rx6n	Receiver Inverted Data Output	3A	
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	3A	
61		GND	Ground	1A	1
62	CML-O	Rx8n	Receiver Inverted Data Output	3A	
63	CML-O	Rx8p	Receiver Non-Inverted Data Output	3A	
64		GND	Ground	1A	1
65		NC	No Connect	3A	3
66		Reserved	For future use	3A	3
67		VccTx1	3.3V Power Supply	2A	2
68		Vcc2	3.3V Power Supply	2A	2
69		Reserved	For Future Use	3A	3
70		GND	Ground	1A	1
71	CML-I	Tx7p	Transmitter Non-Inverted Data Input	3A	
72	CML-I	Tx7n	Transmitter Inverted Data Input	3A	
73		GND	Ground	1A	1
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input	3A	
75	CML-I	Tx5n	Transmitter Inverted Data Input	3A	
76		GND	Ground	1A	1

Notes:

1. GND is the symbol for signal and supply (power) common for QSFP-DD modules. All are common within the QSFP-DD module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.
2. VccRx, Vcc1 and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP-DD transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

Recommended Power Supply Filter

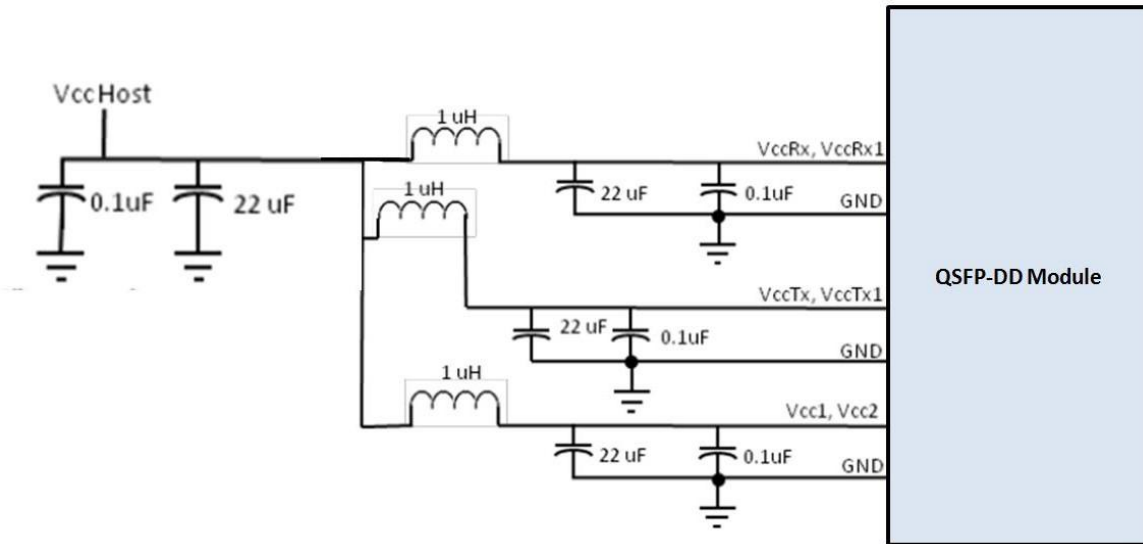


Figure 3. Recommended Power Supply Filter

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}	0	70	degC	
Power Supply Voltage	V_{CC}	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	TH_d	6.3		dBm	

Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Units	Notes
Operating Case Temperature	T_{OP}	0		70	degC	
Power Supply Voltage	V_{CC}	3.135	3.3	3.465	V	
Data Rate, each Lane			26.5625		GBd	
			53.125		Gb/s	

Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				2.4x10 ⁻⁴		
Post-FEC Bit Error Ratio				1x10 ⁻¹²		1
Control Input Voltage High		2		V _{cc}	V	
Control Input Voltage Low		0		0.8	V	
Link Distance with G.652	D	0.002		10	km	2

Notes:

3. FEC provided by host system.
4. FEC required on host system to support maximum distance.

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				10.8	W	
Supply Current	I _{cc}				mA	
Transmitter (each Lane)						
Overload Differential Voltage pk-pk	TP1a			900	mV	
Common Mode Voltage (V _{cm})	TP1	-300		2800	mV	
Receiver (each Lane)						
Differential Voltage, pk-pk	TP4			900	mV	

Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Wavelength Assignment	L0	1294.53		1296.59	nm	
	L1	1299.02		1301.09	nm	
	L2	1303.54		1305.63	nm	
	L3	1308.09		1310.19	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	2.6		11.3	dBm	
Average Launch Power, each Lane	P_{AVG}	-3.4		5.3	dBm	1
Outer Optical Modulation Amplitude (OMA_{outer}), each Lane	P_{OMA}	-0.4		5.1	dBm	2
Launch Power in OMA_{outer} minus TDECQ, each Lane		-1.8			dB	For ER ≥ 4.5 dB
		-1.7			dB	For ER < 4.5 dB
Transmitter and Dispersion Eye Clouser for PAM4, each Lane	TDECQ			3.2	dB	
Extinction Ratio	ER	3.5			dB	
Difference in Launch Power between any Two Lanes (OMA_{outer})				4	dB	
$RIN_{16.5OMA}$	RIN			-132	dB/Hz	
Optical Return Loss Tolerance	TOL			15.6	dB	
Transmitter Reflectance	T_R			-26	dB	
Average Launch Power of OFF Transmitter, each Lane	P_{off}			-30	dBm	
Receiver						
Data Rate, each Lane		26.5625 \pm 100 ppm			GBd	
Modulation Format		PAM4				
Damage Threshold, each Lane	TH_d	6.3			dBm	3
Average Receive Power, each Lane		-9.7		5.3	dBm	4
Receive Power (OMA_{outer}), each Lane				5.1	dBm	
Difference in Receiver Power between any Two Lanes (OMA_{outer})				4.2	dB	

Receiver Sensitivity (OMA _{outer}), each Lane	SEN			max (- 7.2 ,SECQ -8.6)	dBm	For BER of 2.4E-4
Stressed Receiver Sensitivity (OMA _{outer}), each Lane	SRS			-5.4	dBm	5
Receiver Reflectance	R _R			-26	dB	
LOS Assert	LOSA	-25.7			dBm	
LOS De-assert	LOSD			-11.7	dBm	
LOS Hysteresis	LOSH	0.5			dB	

Notes:

5. 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.
6. 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.
7. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.
8. 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.
9. Measured with conformance test signal for BER = 2.4x10⁻⁴.
10. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

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	-3	3	dB	
Channel Bias current monitor	DMI_Ibias_Ch	-10%	10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	-3	3	dB	

Mechanical Dimensions

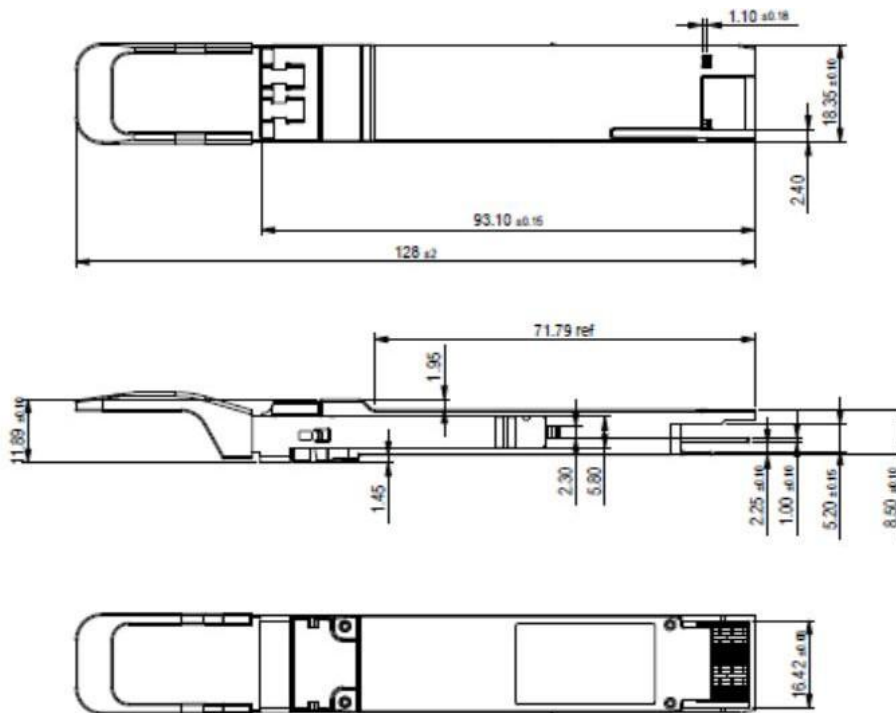


Figure 4. Mechanical Outline

Alarm & warning threshold

Parameters	Unit	Value
Low temperature warning	°C	0
High temperature warning	°C	70
Low voltage warning	V	3.135
High voltage warning	V	3.465
Low Tx power warning	dBm	-3.4
High Tx power warning	dBm	5.3
Low Rx power warning	dBm	-10.2
High Rx power warning	dBm	5.3
Low temperature alarm	°C	-10
High temperature alarm	°C	80
Low voltage alarm	V	2.97
High voltage alarm	V	3.63
Low Tx power alarm	dBm	-6.4
High Tx power alarm	dBm	8.2
Low Rx power alarm	dBm	-13.2
High Rx power alarm	dBm	8.2

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.

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.

Important Notice

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