**Lanbras**

# 400Gb/s QSFP-DD SR8 100m Transceiver

# LA-OT-400G-SR8

## Description

This product is a parallel 400Gb/s Quad Small Form Factor Pluggable--double density (QSFP-DD) optical module. It provides increased port density and total system cost savings. The QSFP-DD 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 100 meters of OM3 multi-mode fiber. An optical fiber cable with an MTP/MPO-16 connector can be plugged into the QSFP-DD SR8 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 QSFP-DD MSA-compliant edge type connector. The central wavelengths of all the 8 parallel lanes are 850nm. 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 70m OM3 multi-mode 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) Type 2. It has been designed to meet harshest external operating conditions including temperature, humidity and EMI interference.

## Features

- QSFP-DD MSA compliant
- 8 parallel lanes on 850nm center wavelength
- Compliant to IEEE 802.3bs Specification
- Up to 100m transmission on multi-mode fiber (MMF) OM3 with FEC
- Operating case temperature: 0 to 70oC
- 8x53.125Gb/s electrical interface (400GAUI-8)
- Data Rate 53.125Gbps (PAM4) per channel.
- Maximum power consumption 12W
- MPO-16 connector
- RoHS compliant

## Applications

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

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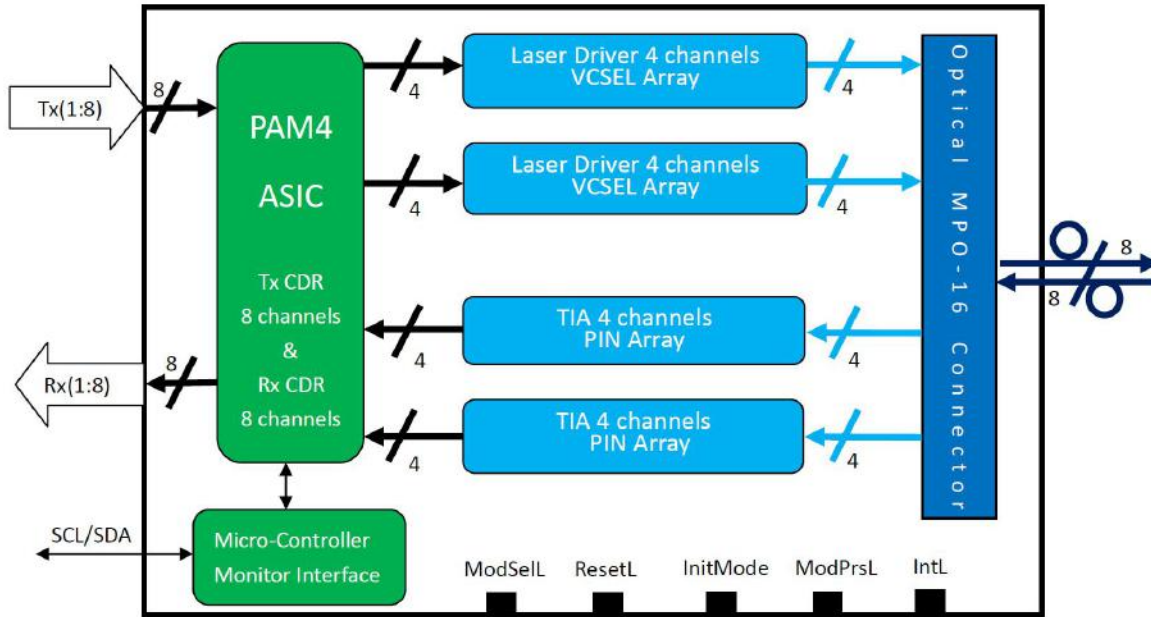
## Transceiver Block Diagram

Figure 1.  Transceiver Block Diagram

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## Optical interface and Pin Assignment

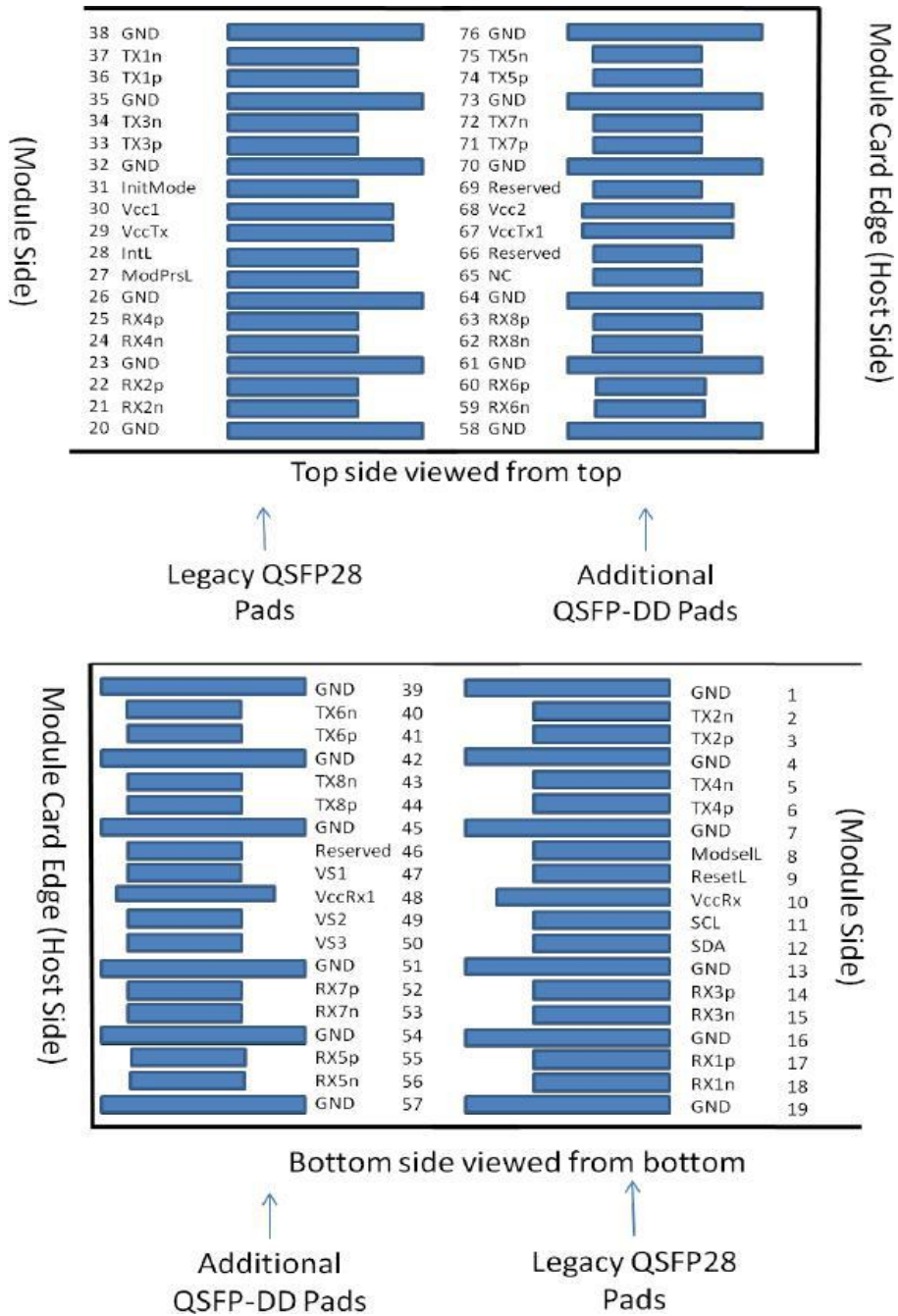The electrical pinout of the QSFP-DD module is shown as Figure 2. And Figure 3 shows the opticalinterface of MPO-16.
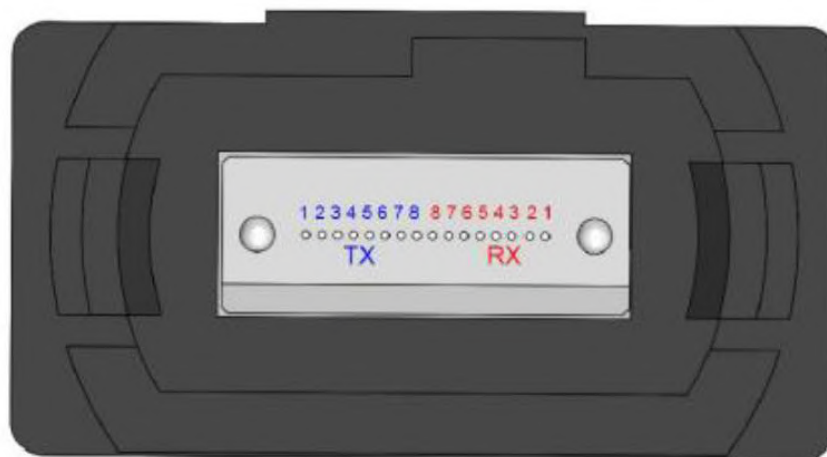


Figure 2.  MSA Compliant Connector

Figure 3. MPO-16 Optical Connector Interface

## Pin Definition

| Pin | Logic | Symbol | Description | Plug Sequence |
|---|---|---|---|---|
| 1 | | GND | Ground | 1B |
| 2 | CML-I | Tx2n | Transmitter Inverted Data Input | 3B |
| 3 | CML-I | Tx2p | Transmitter Non-Inverted Data Input | 3B |
| 4 | | GND | Ground | 1B |
| 5 | CML-I | Tx4n | Transmitter Inverted Data Input | 3B |
| 6 | CML-I | Tx4p | Transmitter Non-Inverted Data Input | 3B |
| 7 | | GND | Ground | 1B |
| 8 | LVTTL-I | ModSelL | Module Select | 3B |
| 9 | LVTTL-I | ResetL | Module Reset | 3B |
| 10 | | VccRx | +3.3V Power Supply Receiver | 2B |
| 11 | LVCMOS-I/O | SCL | 2-wire serial interface clock | 3B |
| 12 | LVCMOS-I/O | SDA | 2-wire serial interface data | 3B |
| 13 | | GND | Ground | 1B |
| 14 | CML-O | Rx3p | Receiver Non-Inverted Data Output | 3B |
| 15 | CML-O | Rx3n | Receiver Inverted Data Output | 3B |
| 16 | GND | Ground | 1B | |
| 17 | CML-O | Rx1p | Receiver Non-Inverted Data Output | 3B |
| 18 | CML-O | Rx1n | Receiver Inverted Data Output | 3B |

| 19 | | GND | Ground | 1B |
|----|----------|--------|--------|----|
| 20 | | GND | Ground | 1B |
| 21 | CML-O | Rx2n | Receiver Inverted Data Output | 3B |
| 22 | CML-O | Rx2p | Receiver Non-Inverted Data Output | 3B |
| 23 | | GND | Ground | 1B |
| 24 | CML-O | Rx4n | Receiver Inverted Data Output | 3B |
| 25 | CML-O | Rx4p | Receiver Non-Inverted Data Output | 3B |
| 26 | | GND | Ground | 1B |
| 27 | LVTTL-O | ModPrsL | Module Present | 3B |
| 28 | LVTTL-O | IntL | Interrupt | 3B |
| 29 | | VccTx | +3.3V Power supply transmitter | 2B |
| 30 | | Vcc1 | +3.3V Power supply | 2B |
| 31 | LVTTL-I | InitMode | Initialization mode; In legacy QSFP applications, the InitMode pad is called LPMODE | 3B |
| 32 | | GND | Ground | 1B |
| 33 | CML-I | Tx3p | Transmitter Non-Inverted Data Input | 3B |
| 34 | CML-I | Tx3n | Transmitter Inverted Data Input | 3B |
| 35 | | GND | Ground | 1B |
| 36 | CML-I | Tx1p | Transmitter Non-Inverted Data Input | 3B |
| 37 | CML-I | Tx1n | Transmitter Inverted Data Input | 3B |
| 38 | | GND | Ground | 1B |
| 39 | | GND | Ground | 1A |
| 40 | CML-I | Tx6n | Transmitter Inverted Data Input | 3A |
| 41 | CML-I | Tx6p | Transmitter Non-Inverted Data Input | 3A |
| 42 | | GND | Ground | 1A |
| 43 | CML-I | Tx8n | Transmitter Inverted Data Input | 3A |
| 44 | CML-I | Tx8p | Transmitter Non-Inverted Data Input | 3A |
| 45 | | GND | Ground | 1A |
| 46 | | Reserved | For future use | 3A |
| 47 | | VS1 | Module Vendor Specific 1 | 3A |
| 48 | | VccRx1 | 3.3V Power Supply | 2A |
| 49 | | VS2 | Module Vendor Specific 2 | 3A |

| 50 | | VS3 | Module Vendor Specific 3 | 3A |
|----|------|------|------|----|
| 51 | | GND | Ground | 1A |
| 52 | CML-O | Rx7p | Receiver Non-Inverted Data Output | 3A |
| 53 | CML-O | Rx7n | Receiver Inverted Data Output | 3A |
| 54 | | GND | Ground | 1A |
| 55 | CML-O | Rx5p | Receiver Non-Inverted Data Output | 3A |
| 56 | CML-O | Rx5n | Receiver Inverted Data Output | 3A |
| 57 | | GND | Ground | 1A |
| 58 | | GND | Ground | 1A |
| 59 | CML-O | Rx6n | Receiver Inverted Data Output | 3A |
| 60 | CML-O | Rx6p | Receiver Non-Inverted Data Output | 3A |
| 61 | | GND | Ground | 1A |
| 62 | CML-O | Rx8n | Receiver Inverted Data Output | 3A |
| 63 | CML-O | Rx8p | Receiver Non-Inverted Data Output | 3A |
| 64 | | GND | Ground | 1A |
| 65 | | NC | No Connect | 3A |
| 66 | | Reserved | For future use | 3A |
| 67 | | VccTx1 | 3.3V Power Supply | 2A |
| 68 | | Vcc2 | 3.3V Power Supply | 2A |
| 69 | | Reserved | For Future Use | 3A |
| 70 | | GND | Ground | 1A |
| 71 | CML-I | Tx7p | Transmitter Non-Inverted Data Input | 3A |
| 72 | CML-I | Tx7n | Transmitter Inverted Data Input | 3A |
| 73 | | GND | Ground | 1A |
| 74 | CML-I | Tx5p | Transmitter Non-Inverted Data Input | 3A |
| 75 | CML-I | Tx5n | Transmitter Inverted Data Input | 3A |
| 76 | | GND | Ground | 1A |

## Recommended Power Supply Filter
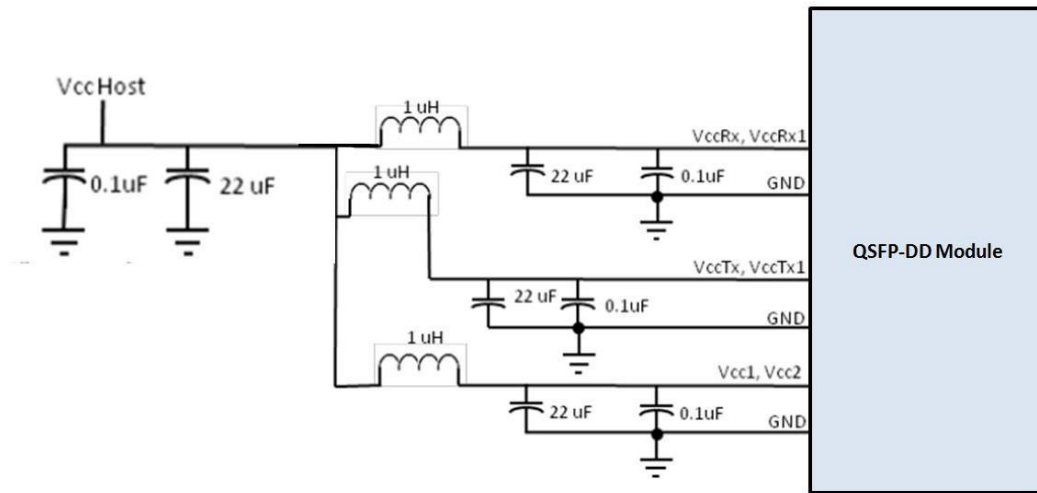


**Figure 4. Recommended Power Supply Filter**

## Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings mightcause 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 | VCC | -0.5 | 3.6 | V | |
| Relative Humidity (non-condensation) | RH | 0 | 85 | % | |

## 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 | VCC | 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 | | | | $2.4 \times 10^{-4}$ | | |
| Post-FEC Bit Error Ratio | | | | $1 \times 10^{-12}$ | | 1 |
| Link Distance with OM3 | D | 0.5 | | 100 | m | 2 |

**Notes:**

1. FEC provided by host system.

2. FEC required on host system to support maximum distance.

## Electrical Characteristics

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

| Parameter | Test Point | Min | Typical | Max | Units | Notes |
|---|---|---|---|---|---|---|
| Power Consumption | | | | 12 | W | |
| Supply Current | Icc | | | 3.63 | 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 ModeInput 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 ReturnLoss | 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.

## Optical Characteristics

| Parameter | Symbol | Min | Typical | Max | Units | Notes |
|---|---|---|---|---|---|---|
| Transmitter | | | | | | |
| Center Wavelength | λC | 840 | 850 | 860 | nm | |
| Data Rate, each Lane | | | 26.5625 ± 100 ppm | | GBd | |
| Modulation Format | | | PAM4 | | | |
| RMS Spectral Width | Δλrms | | | 0.6 | nm | Modulated |
| Average Launch Power, each Lane | PAVG | -6.5 | | 4 | dBm | 1 |
| Outer Optical Modulation Amplitude (OMA$_{outer}$), each Lane | POMA | -4.5 | | 3 | dBm | 2 |
| Launch Power in OMA$_{outer}$ minus TDECQ, each Lane | | -5.9 | | | dB | |
| Transmitter and Dispersion Eye Clouser for PAM4, each Lane | TDECQ | | | 4.5 | dB | |
| Extinction Ratio | ER | 3 | | | dB | |
| Optical Return Loss Tolerance | TOL | | | 12 | dB | |
| Average Launch Power of OFF Transmitter, each Lane | Poff | | | -30 | dBm | |
| Encircled Flux | | | ≥86% at 19 µm<br>≤ 30% at 4.5 µm | | | |
| Receiver | | | | | | |

| | | 840 | 850 | 860 | | |
|---|---|---|---|---|---|---|
| Center Wavelength | $\lambda_C$ | 840 | 850 | 860 | nm | |
| Data Rate, each Lane | | 26.5625 ± 100 ppm | | | GBd | |
| Modulation Format | | PAM4 | | | | |
| Damage Threshold, eachLane | $TH_d$ | 5 | | | dBm | 3 |
| Average Receive Power, each Lane | | -7.9 | | 4 | dBm | 4 |
| Receive Power (OMA$_{outer}$),each Lane | | | | 3 | dBm | |
| Receiver Sensitivity (OMA$_{outer}$), each Lane | SEN | | | -6.5 | dBm | 5 |
| Stressed Receiver Sensitivity (OMA$_{outer}$), each Lane | SRS | | | -3 | dBm | 6 |
| Receiver Reflectance | RR | | | -12 | dB | |
| LOS Assert | LOSA | -30 | | | dBm | |
| LOS De-assert | LOSD | | | -12 | dBm | |
| LOS Hysteresis | LOSH | 0.5 | | | dB | |
| **Stressed Conditions for Stress Receiver Sensitivity (Note 7)** | | | | | | |
| Stressed Eye Closure for PAM4 (SECQ), Lane under Test | | | 4 | | dB | |
| OMA$_{outer}$ of each Aggressor$_{Lane}$ | | | 3 | | 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 dB, the OMAouter (min) must exceed the minimum value specified here.

3. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

4. 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.

5. Receiver Sensitivity OMAouter, each lane (max) is informative and is defined for a BER of 2.4x10-4.

6. Measured with conformance test signal at receiver input for the BER of 2.4x10-4.

7. 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 conditionsunless otherwise specified.

| Parameter | Symbol | Min | Max | Units | Notes |
|---|---|---|---|---|---|
| Temperature monitorsabsolute 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 fibers, there could be an additional +/-1 dB fluctuation, or a +/- 3 dB total accuracy.

## Outline Drawing (mm)
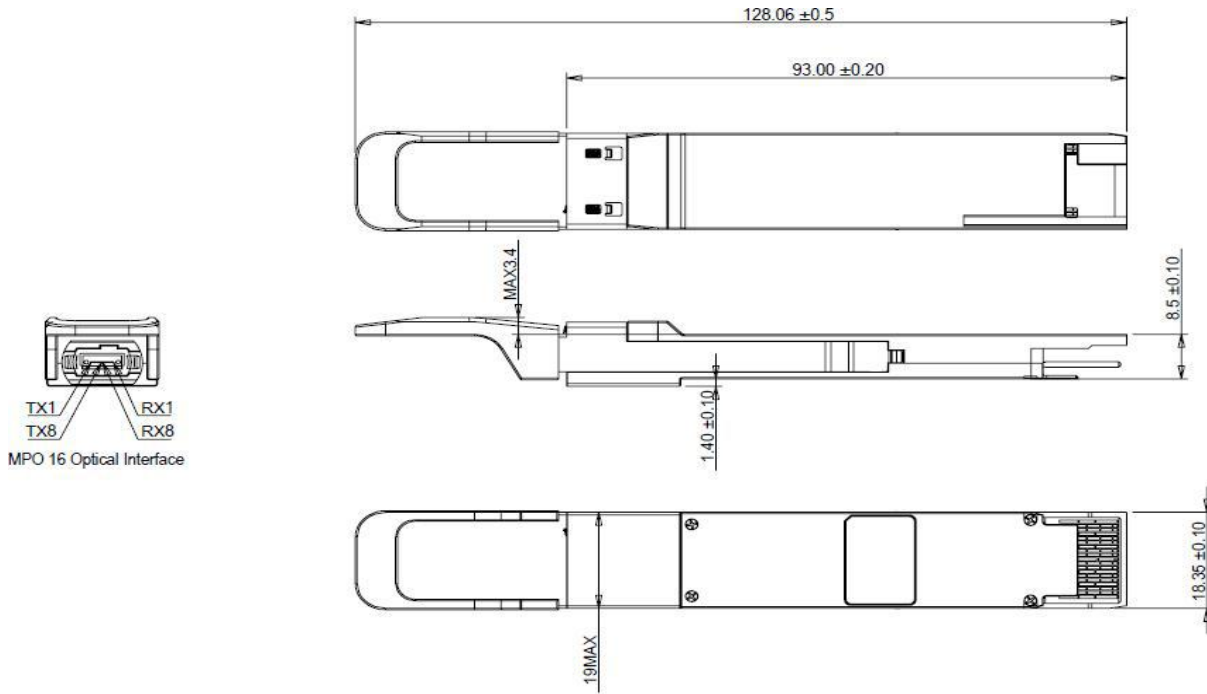


QSFP- DD SR8 MPO 16 Optical Interface Outline

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