



40G QSFP+ PSM4 IR Transceiver

Hot Pluggable, MPO / MTP, 1310nm DFB, SMF 2KM, DDM

Part Number: FQFP-I9-S13-02D



Overview

FQFP-I9-S13-02D is a Four-Channel Parallel SM Fibers QSFP+ transceiver for 40GbE and InfiniBand DDR, QDR, SDR application especially in Data Center & Storage networks. The QSFP full-duplex optical module with MPO-12 receptacle offers 4 independent transmitter and receiver channels each capable of 10.3Gbps operation for an aggregate data rate of 41.2Gbps up to SMF 2km optical links.

Applications

- 40Gb Ethernet
- OTN OTU3 @43.01G, OTU3e2 @44.58G
- Breakout to 4 x 10GBASE-LR Ethernet
- InfiniBand DDR, QDR, SDR interconnects
- Data Center & Storage
- Datacom / Telecom Switch & Router

Features

- Compatible with IEEE802.3ba 40GBASE-LR4
- Compliant to SFF-8436 QSFP+ MSA
- Supports QDR, DDR & SDR InfiniBand
- 4 independent full-duplex channels
- Up to 11.2Gbps data rate per channel
- Hot Pluggable
- 1310nm DFB array transmitter
- MPO-12 receptacle connector
- 2-wire interface for management and diagnostic monitor compliant with SFF-8436, SFF-8636
- Single 3.3V power supply
- Link distance 2km over SM fiber
- Power consumption < 2.5W
- RoHS compliant

Laser Safety

- This is a Class 1 Laser Product complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.
- Caution: Use of control or adjustments or performance of procedure other than those specified herein may result in hazardous radiation exposure.



Absolute Maximum Ratings

| Parameters | Symbol | Min. | Max. | Unit |
|---------------------------|------------------|------|------|------|
| Storage Temperature | T _{ST} | -40 | +85 | °C |
| Storage Relative Humidity | RH | 5 | 85 | % |
| Supply Voltage | V _{CC3} | -0.5 | +3.6 | V |

Recommended Operating Conditions

| Parameters | Symbol | Min. | Typ. | Max. | Unit |
|--|-----------------|-------|---------|-------------------|------|
| Case Operating Temperature | T _{OP} | 0 | - | +70 | °C |
| Supply Voltage | V _{CC} | +3.13 | +3.3 | +3.47 | V |
| Data Rate, per Lane | DR | | 10.3125 | | Gb/s |
| Data Rate Accuracy | ΔDR | -100 | | +100 | ppm |
| Bit Error Rate | BER | | | 10 ⁻¹² | |
| Supply Current | I _{CC} | | | 700 | mA |
| Power Consumption | P | | 1.7 | 2.5 | W |
| Transceiver Power-on Initialization Time | | | | 2000 | ms |



Transmitter Electro-optical Characteristics

$V_{CC} = 3.13V$ to $3.47V$, $T_{OP} = 0^{\circ}C$ to $70^{\circ}C$

| Parameters | Symbol | Min. | Typ. | Max. | Unit | Note |
|--|-----------------|------------------------------------|---------|----------|----------|------|
| Operating Data Rate, per Lane | DR | | 10.3125 | | Gb/s | |
| Average Launch Power, per Lane | P_{AVG} | -5.5 | -0.5 | +2.3 | dBm | |
| Optical Modulation Amplitude (OMA), per Lane | P_{OMA} | -4.5 | -0.5 | +2.5 | dBm | 1 |
| Launch Power in OMA minus Transmitter and Dispersion Penalty, per Lane | OMA-TDP | -9.7 | | | dB | 1 |
| Difference in Launch Power between any two Lanes | $P_{TX-DIFF}$ | | | 5.0 | dB | |
| Optical Wavelength | λ_c | 1270 | 1310 | 1350 | nm | 1 |
| Spectral Width (-20dB) | $\Delta\lambda$ | | | 1 | nm | |
| Side Mode Suppression Ratio | SMSR | 30 | | | dB | |
| Optical Extinction Ratio | ER | 3.5 | | | dB | |
| Optical Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3} | | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4} | | | | |
| Average Launch Power OFF, per Lane | P_{OFF} | | | -30 | dBm | |
| Relative Intensity Noise | RIN | | | -128 | dB/Hz | |
| Optical Return Loss Tolerance | ORLT | | | 12 | dB | |
| Transmitter Reflectance | P_T | | | -12 | dB | |
| Input Differential Impedance | Z_{IN} | 90 | 100 | 110 | Ω | |
| Differential Data Input Voltage | V_{IN-PP} | 300 | | 1100 | mVpp | |
| Control I/O Voltage, High | V_{IH} | 2.0 | | V_{CC} | V | |
| Control I/O Voltage, Low | V_{IL} | GND | | 0.8 | V | |

Note1: Transmitter wavelength and launch power need to meet the OMA minus TDP specs to guarantee link performance.



Receiver Electro-optical Characteristics

$V_{CC} = 3.13V$ to $3.47V$, $T_{OP} = 0\text{ }^{\circ}C$ to $70\text{ }^{\circ}C$

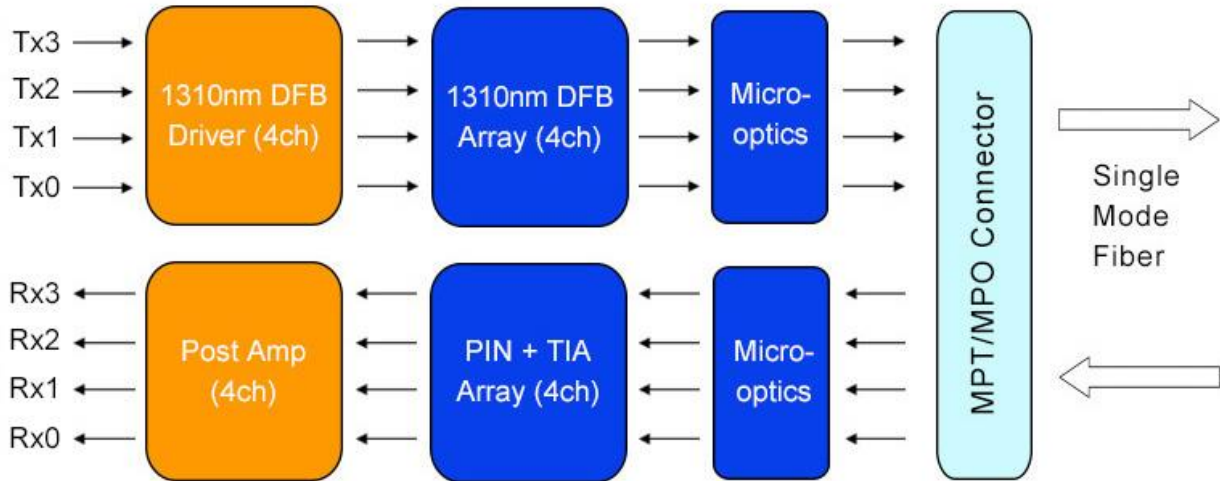
| Parameters | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---------------|-------|---------|-------|----------|------|
| Operating Data Rate, per Lane | DR | | 10.3125 | | Gb/s | |
| Damage Threshold, per Lane | D_{TH} | +3.0 | | | dBm | 1 |
| Average Receive Power, per Lane | P_{RX-AVG} | -11.5 | | +2.3 | dBm | |
| Receiver Power (OMA), per Lane | | | | +2.5 | dBm | |
| Receive Sensitivity (OMA), per Lane | P_{RX-OMA} | | | -11.5 | dBm | 2 |
| Difference in Receive Power between any two Lanes (OMA) | $P_{RX-DIFF}$ | | | 5.0 | dB | |
| Center Wavelength | λ_c | 1270 | 1310 | 1350 | nm | |
| Optical Return Loss | ORL | | | -12 | dB | |
| LOS De-Assert | LOS_D | | | -15 | dBm | |
| LOS Assert | LOS_A | -30 | | | dBm | |
| LOS Hysteresis | LOS_{HY} | 0.5 | | | dB | |
| Output Differential Impedance | Z_{OUT} | 90 | 100 | 110 | Ω | |
| Differential Data Output Voltage | V_{OUT-PP} | 500 | | 800 | mVpp | |

Note1: The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.

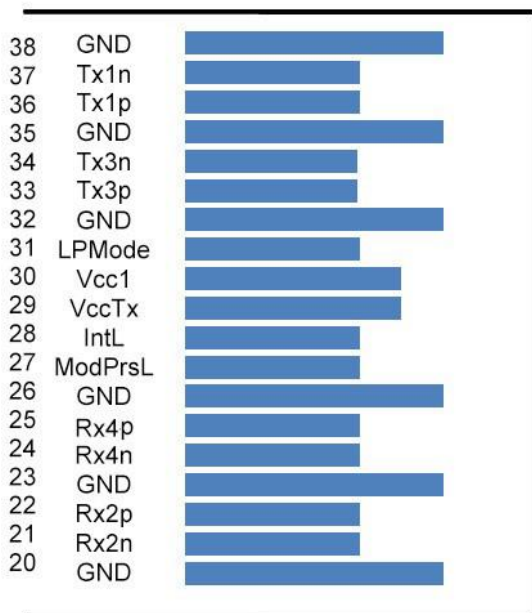
Note2: Measured with conformance test signal at receiver input for BER= 1×10^{-12} .



Transceiver Block Diagram

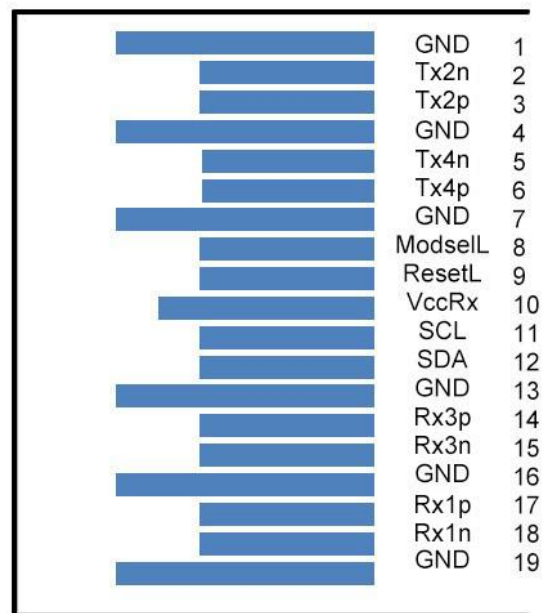


Pin Assignment



Top Side
Viewed From Top

Module Card Edge



Bottom Side
Viewed From Bottom



Pin Description

| Pin | Logic | Name | Function / Description |
|-----|-------------|---------|-------------------------------------|
| 1 | | GND | Module Ground |
| 2 | CML-I | Tx2n | Transmitter Inverted Data Input |
| 3 | CML-I | Tx2p | Transmitter Non-Inverted Data Input |
| 4 | | GND | Module Ground |
| 5 | CML-I | Tx4n | Transmitter Inverted Data Input |
| 6 | CML-I | Tx4p | Transmitter Non-Inverted Data Input |
| 7 | | GND | Module Ground |
| 8 | LVTLL-I | ModSelL | Module Select |
| 9 | LVTLL-I | ResetL | Module Reset |
| 10 | | VccRx | +3.3V Power Supply Receiver |
| 11 | LVC MOS-I/O | SCL | 2-Wire Serial Interface Clock |
| 12 | LVC MOS-I/O | SDA | 2-Wire Serial Interface Data |
| 13 | | GND | Module Ground |
| 14 | CML-O | Rx3p | Receiver Non-Inverted Data Output |
| 15 | CML-O | Rx3n | Receiver Inverted Data Output |
| 16 | | GND | Module Ground |
| 17 | CML-O | Rx1p | Receiver Non-Inverted Data Output |
| 18 | CML-O | Rx1n | Receiver Inverted Data Output |
| 19 | | GND | Module Ground |
| 20 | | GND | Module Ground |
| 21 | CML-O | Rx2n | Receiver Inverted Data Output |
| 22 | CML-O | Rx2p | Receiver Non-Inverted Data Output |
| 23 | | GND | Module Ground |
| 24 | CML-O | Rx4n | Receiver Inverted Data Output |
| 25 | CML-O | Rx4p | Receiver Non-Inverted Data Output |
| 26 | | GND | Module Ground |
| 27 | LVTLL-O | ModPrsL | Module Present |
| 28 | LVTLL-O | IntL | Interrupt |
| 29 | | VccTx | +3.3V Power Supply Transmitter |
| 30 | | Vcc1 | +3.3V Power Supply |
| 31 | LVTLL-I | LPMODE | Low Power Mode |
| 32 | | GND | Module Ground |



| | | | |
|----|-------|------|-------------------------------------|
| 33 | CML-I | Tx3p | Transmitter Non-Inverted Data Input |
| 34 | CML-I | Tx3n | Transmitter Inverted Data Input |
| 35 | | GND | Module Ground |
| 36 | CML-I | Tx1p | Transmitter Non-Inverted Data Input |
| 37 | CML-I | Tx1n | Transmitter Inverted Data Input |
| 38 | | GND | Module Ground |

Note1: GND is the symbol for signal and supply (power) common for QSFP+ modules. All are common within the QSFP+ module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground lane.

Note2: VccRx, Vcc1 and VccTx are the receiver and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. VccRx, Vcc1 and VccTx may be internally connected within the QSFP+ transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.

Digital Diagnostic Functions

As defined by the QSFP+ MSA, Ficer's QSFP+ transceivers provide digital diagnostic functions via a 2-wire serial interface, which allows real-time access to the following operating parameters:

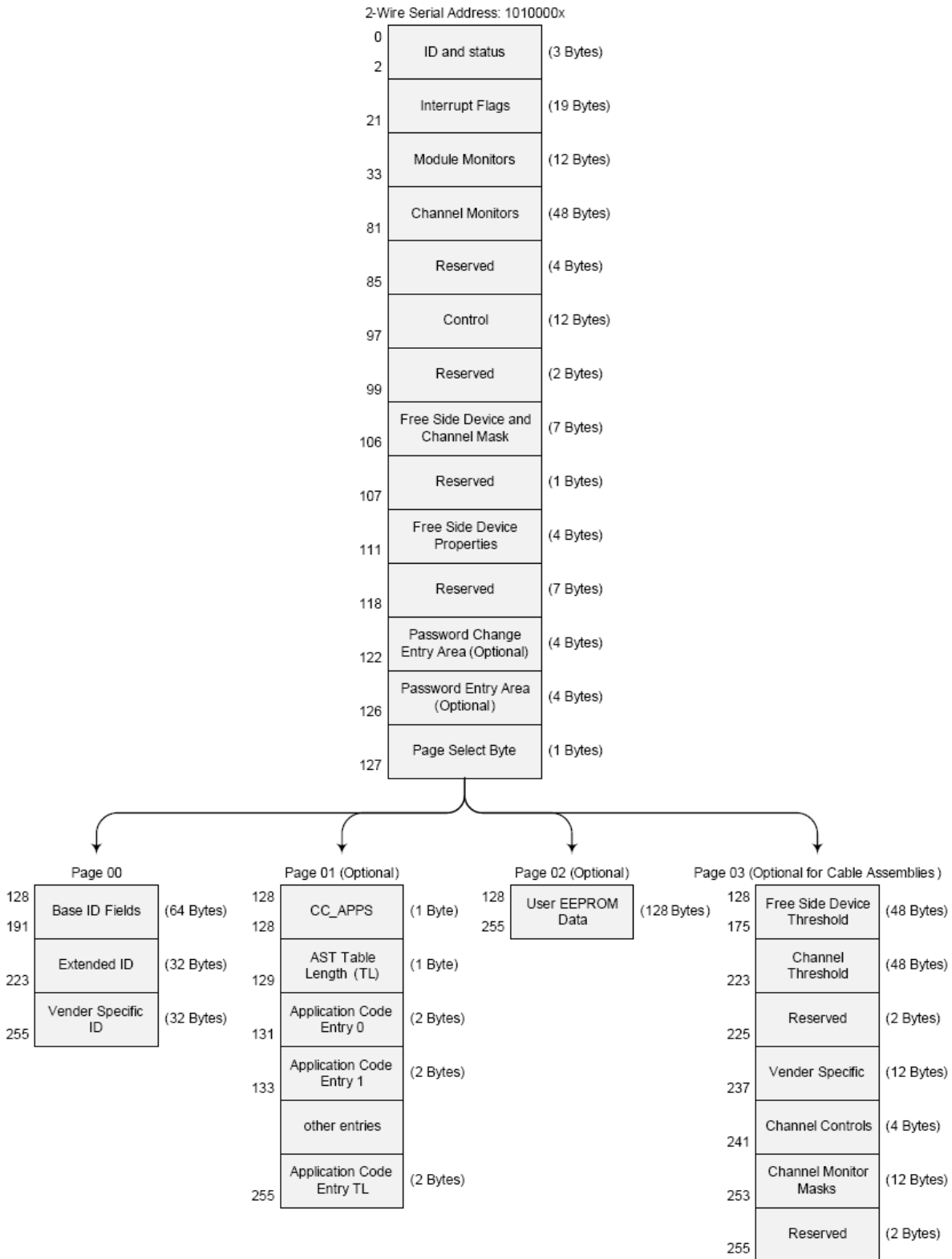
- Transceiver temperature
- Laser bias current (4-Channel)
- Transmitted optical power (4-Channel)
- Received optical power (4-Channel)
- Transceiver supply voltage

It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Controller (DDC) inside the transceiver, which is accessed through the 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL pin) is generated by the host. The positive edge clocks data into the QSFP+ transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the QSFP+ transceiver. The serial data signal (SDA pin) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially. The 2-wire serial interface provides sequential or random access to the 8 bit parameters, addressed from 000h to the maximum address of the memory.

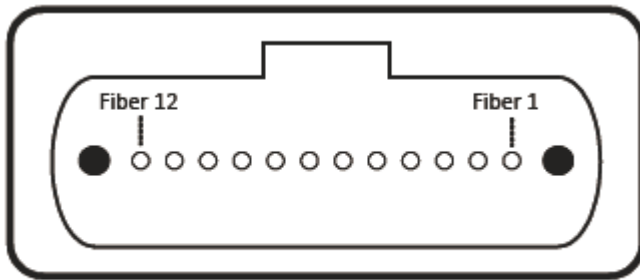
For more detailed information including memory map definitions, please see the QSFP+ MSA Specification.

Digital Diagnostic Memory Map





Optical Interface Lanes and Assignment



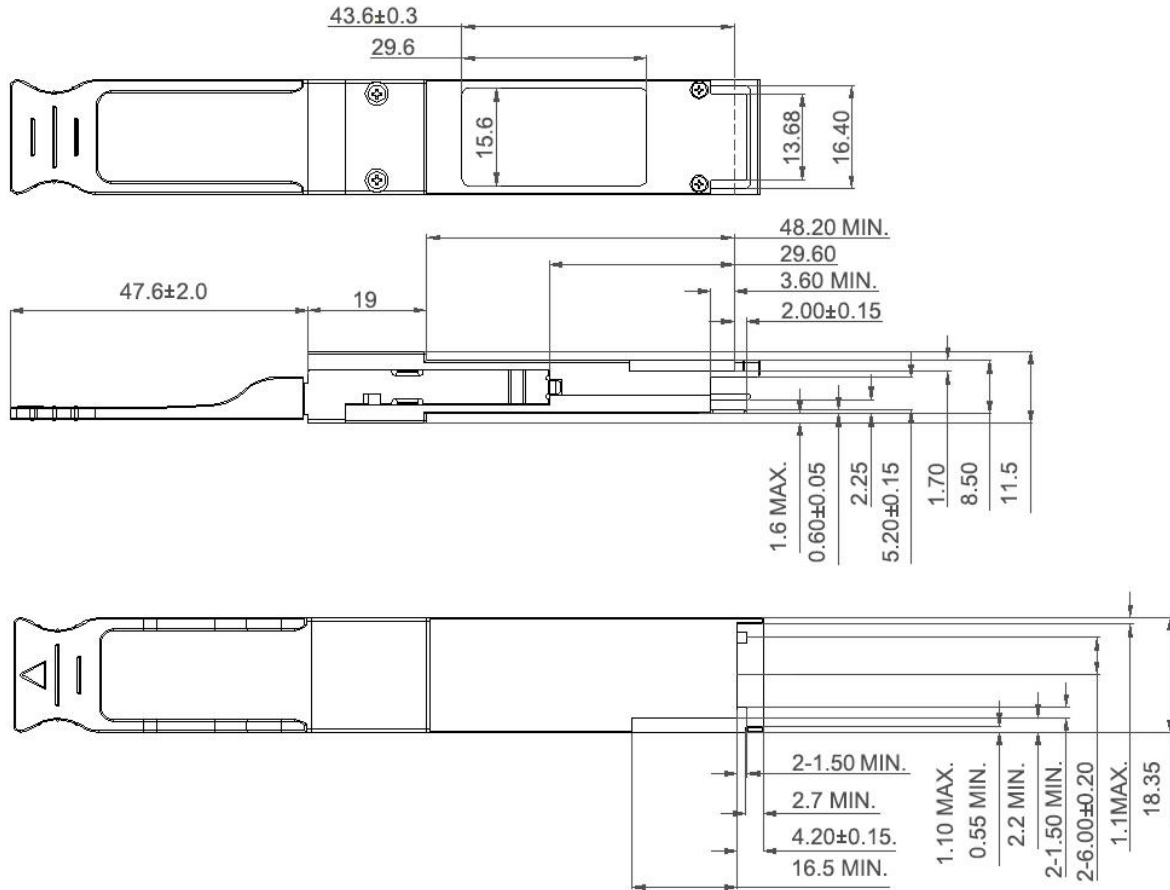
Outside view of the QSFP module MPO

| Fiber # | Lane Assignment |
|---------|-----------------|
| 1 | Rx0 |
| 2 | Rx1 |
| 3 | Rx2 |
| 4 | Rx3 |
| 5,6,7,8 | Not used |
| 9 | Tx3 |
| 10 | Tx2 |
| 11 | Tx1 |
| 12 | Tx0 |

lane assignment



Mechanical Dimensions



(All Dimensions are $\pm 0.20\text{mm}$ Unless Otherwise Specified, Unit: mm)

Ordering Information

| Part No. | Tx | Rx | Link | DDM | Temp. |
|-----------------|---------|---------|------------|-----|--------|
| FQFP-I9-S13-02D | 1310 nm | 1310 nm | SMF 2km | Yes | 0~70°C |

Note: Distances are indicative only. To calculate a more precise link budget based on specific conditions in your application, please refer to the optical characteristics.