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# 40G QSFP+ SR4 Transceiver
# Hot Pluggable, MPO / MTP, 850nm VCSEL, MMF 300M, DDM

## Part Number: FQFP-I9-M85-X3D

## Overview

FQFP-I9-M85-X3D is a Four-Channel Parallel Fibers QSFP+ transceiver for 40GbE and InfiniBand QDR, 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 10.3125Gbps operation for an aggregate data rate of 41.25Gbps up to MMF OM3 300m optical links.

## Applications

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

## Features

- Compliant with IEEE802.3ba 40GBASE-SR4
- Compliant with SFF-8436 QSFP+ MSA
- Support InfiniBand QDR
- 4 independent full-duplex channels
- Up to 11.2Gbps data rate per channel
- Hot Pluggable
- 850nm VCSEL 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 300m over MM OM3 fiber,
- 400m over MM OM4 fiber
- 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.



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## Absolute Maximum Ratings

| Parameters | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Storage Temperature | $T_{ST}$ | -10 | +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 |
| Supply Current | $I_{CC}$ | | | 450 | mA |
| Power Consumption | P | | | 1.5 | W |
| Transceiver Power-on Initialization Time | | | | 2000 | ms |



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## Transmitter Electro-optical Characteristics

**$V_{CC}$ = 3.13V to 3.47V, $T_{OP}$ = 0 °C to 70 °C**

| Parameters | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Operating Data Rate, per Lane | DR | 1.25 | 10.3125 | | Gb/s | |
| Average Optical Power, per Lane | $P_{AVG}$ | -6.0 | | +2.4 | dBm | |
| Optical Modulation Amplitude (OMA), per Lane | $P_{OMA}$ | -4.5 | | +3.0 | dBm | 1 |
| Launch Power in OMA minus Transmitter and Dispersion Penalty, per Lane | OMA-TDP | -6.5 | | | dB | 1 |
| Difference in Launch Power between any two Lanes (OMA) | Ptx,diff | | | 4.0 | dB | |
| Optical Center Wavelength | λc | 830 | 850 | 870 | nm | 1 |
| Spectral Width (RMS) | Δλ | | | 0.40 | nm | 1 |
| Optical Extinction Ratio | ER | 3 | | | dB | |
| Optical Eye Mask Definition { X1, X2, X3, Y1, Y2, Y3 } | | { 0.23, 0.34, 0.43, 0.27, 0.33, 0.4 } | | | | |
| Average Launch Power OFF, per Lane | $P_{OFF}$ | | | -30 | dBm | |
| Differential Input Impedance | $Z_{IN}$ | 80 | 100 | 120 | Ω | |
| Differential Data Input Swing | $V_{IN,pp}$ | 200 | | 1600 | mV | |
| Logic Input Voltage - High | $V_{IH}$ | 2.5 | | Vcc+0.3 | V | |
| Logic Input Voltage - Low | $V_{IL}$ | GND | | 0.8 | V | |
| Logic Output Voltage - High | $V_{OH}$ | 2.4 | | Vcc | V | |
| Logic Output Voltage - Low | $V_{OL}$ | GND | | 0.4 | V | |

**Note1:** Transmitter wavelength, RMS spectral width and power need to meet the OMA minus TDP specs to guarantee link performance.

## Receiver Electro-optical Characteristics

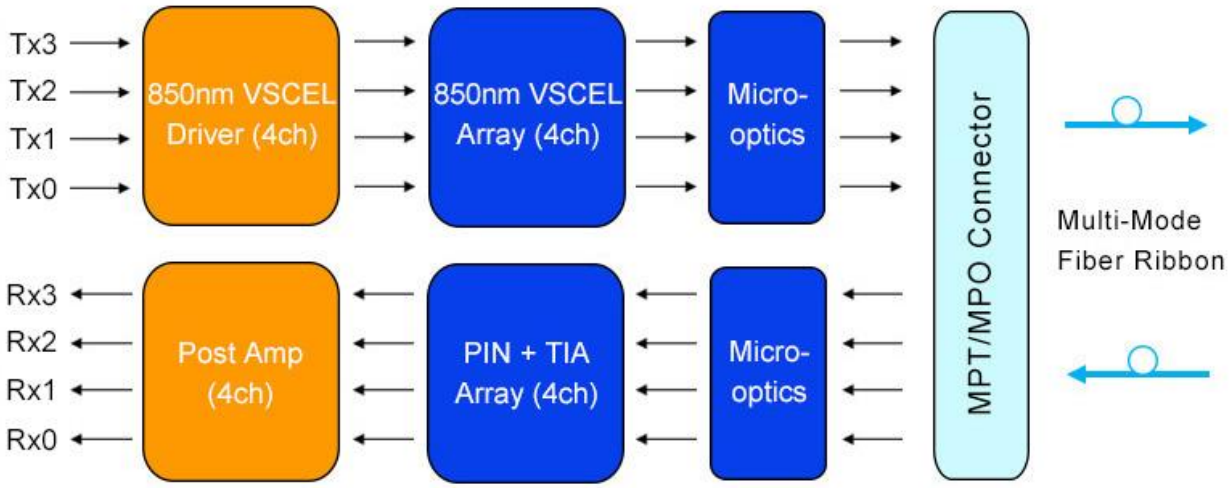
**$V_{CC}$ = 3.13V to 3.47V, $T_{OP}$ = 0 °C to 70 °C**

| Parameters | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Operating Data Rate, per Lane | DR | 1.25 | 10.3125 | | Gb/s | |
| Damage Threshold, per Lane | $D_{TH}$ | +3.4 | | | dBm | 1 |
| Overload, per Lane | $P_{RX-OVL}$ | +2.4 | | | dBm | |
| Receiver Sensitivity, per Lane (OMA) | $P_{RX-OMA}$ | | | -10.2 | dBm | 2 |
| Optical Center Wavelength | λc | 820 | 850 | 880 | nm | |
| LOS De-Assert | $LOS_D$ | | | -12 | dBm | |
| LOS Assert | $LOS_A$ | -30 | | | dBm | |
| LOS Hysteresis | $LOS_{HY}$ | 0.5 | | | dB | |
| Differential Output Impedance | $Z_{OUT}$ | 80 | 100 | 120 | Ω | |
| Differential Data Output Swing | $V_{OUT,pp}$ | 350 | | 1000 | mV | |

**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= $1x10^{-12}$.

## Transceiver Block Diagram



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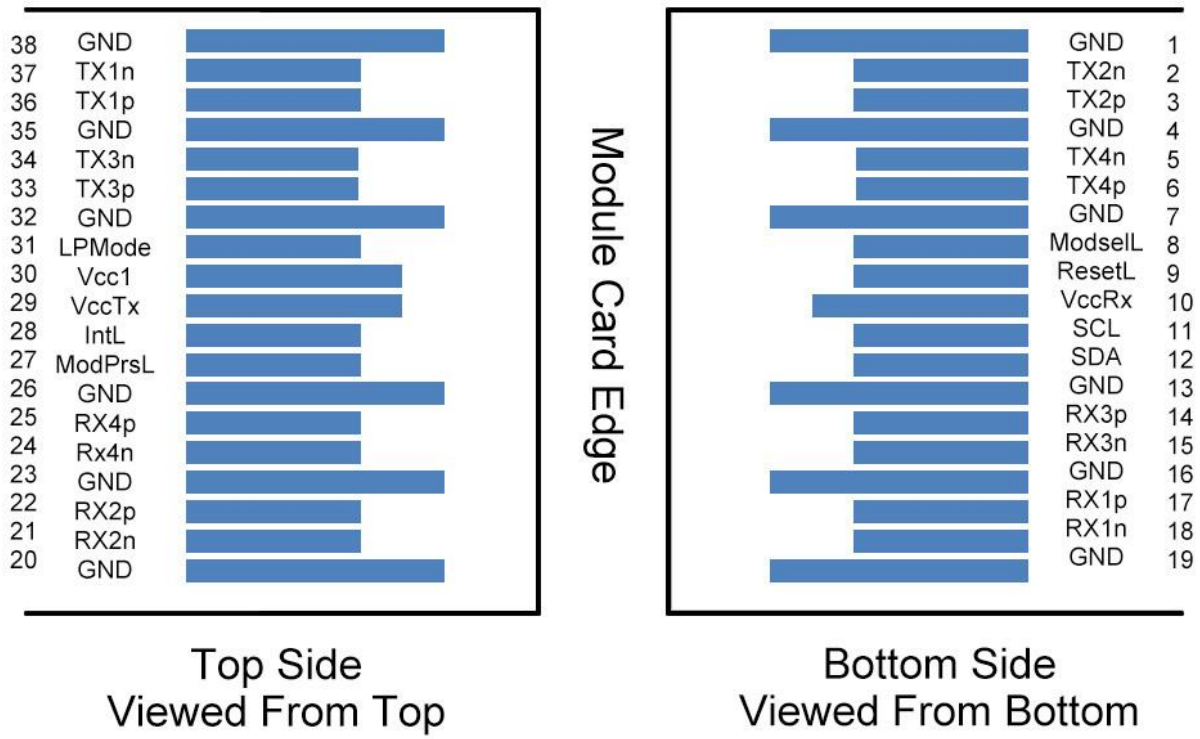
## Pin Assignment




Top Side
Viewed From Top

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 | LVCMOS-I/O | SCL | 2-Wire Serial Interface Clock |
| 12 | LVCMOS-I/O | SDA | 2-Wire Serial Interface Data |



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| | | | |
|---|---|---|---|
| 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 transmitter power suppliers and shall be applied concurrently. Vcc Rx, Vcc1 and Vcc Tx 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:

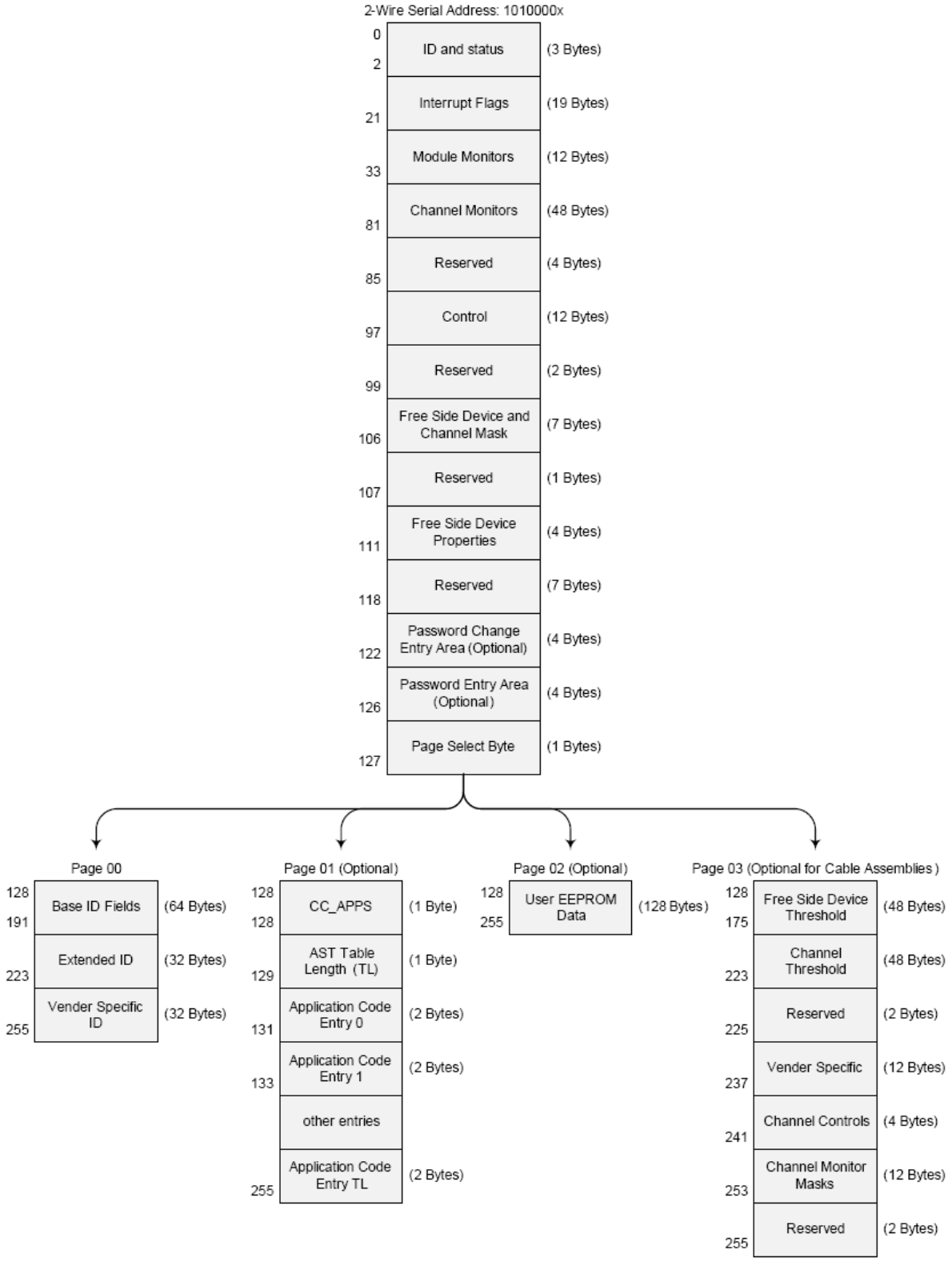
- Transceiver temperature
- Laser bias current (4-Channel)
- Transmitted optical power (4-Channel)
- Received optical power (4-Channel)
- Transceiver supply voltage

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


2-Wire Serial Address: 1010000x
0
2
ID and status
(3 Bytes)
21
Interrupt Flags
(19 Bytes)
33
Module Monitors
(12 Bytes)
81
Channel Monitors
(48 Bytes)
85
Reserved
(4 Bytes)
97
Control
(12 Bytes)
99
Reserved
(2 Bytes)
106
Free Side Device and Channel Mask
(7 Bytes)
107
Reserved
(1 Bytes)
111
Free Side Device Properties
(4 Bytes)
118
Reserved
(7 Bytes)
122
Password Change Entry Area (Optional)
(4 Bytes)
126
Password Entry Area (Optional)
(4 Bytes)
127
Page Select Byte
(1 Bytes)
Page 00
128
191
Base ID Fields
(64 Bytes)
223
Extended ID
(32 Bytes)
255
Vender Specific ID
(32 Bytes)
Page 01 (Optional)
128
128
CC_APPS
(1 Byte)
129
AST Table Length (TL)
(1 Byte)
131
Application Code Entry 0
(2 Bytes)
133
Application Code Entry 1
(2 Bytes)
other entries
255
Application Code Entry TL
(2 Bytes)
Page 02 (Optional)
128
255
User EEPROM Data
(128 Bytes)
Page 03 (Optional for Cable Assemblies)
128
175
Free Side Device Threshold
(48 Bytes)
223
Channel Threshold
(48 Bytes)
225
Reserved
(2 Bytes)
237
Vender Specific
(12 Bytes)
241
Channel Controls
(4 Bytes)
253
Channel Monitor Masks
(12 Bytes)
255
Reserved
(2 Bytes)

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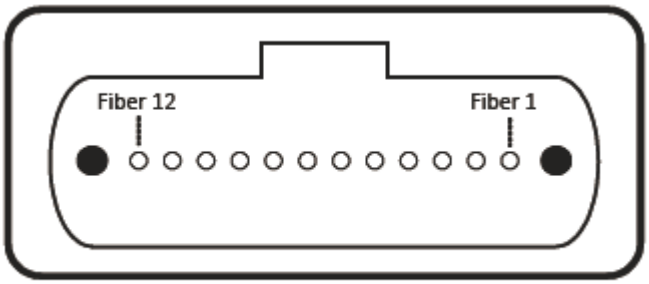
## Optical Interface Lanes and Assignment




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



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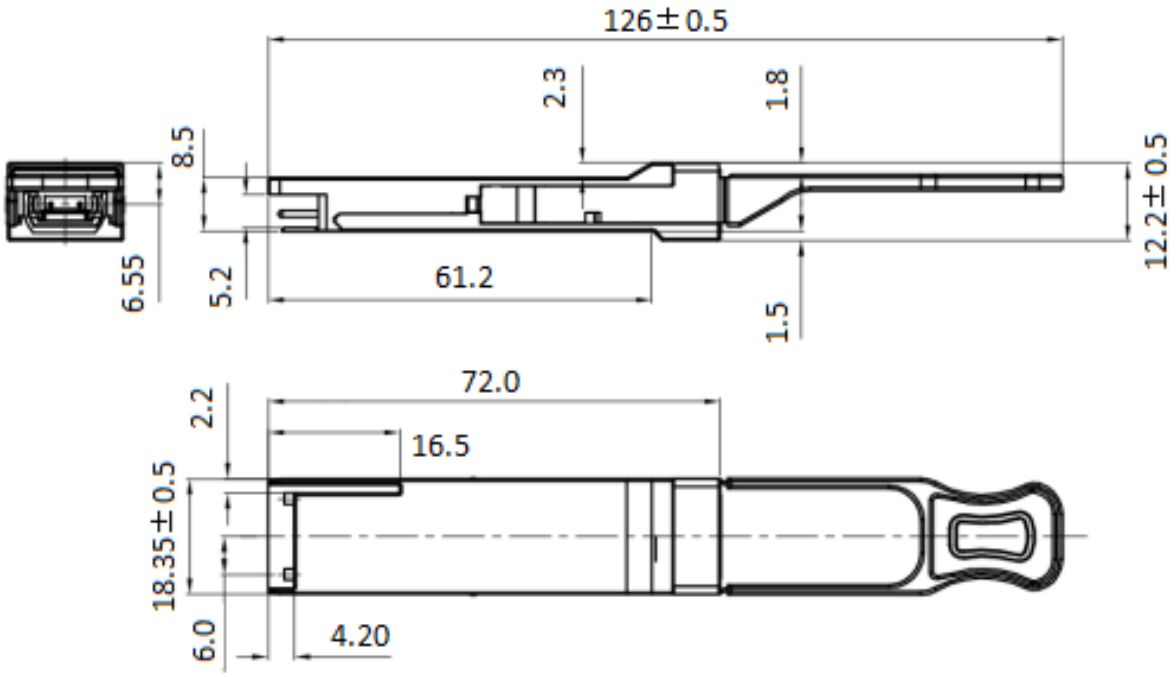
## Mechanical Dimensions




**(All Dimensions are ±0.20mm Unless Otherwise Specified, Unit: mm)**

## Ordering Information

| Part No. | Tx | Rx | Link | DDM | Temp. |
|---|---|---|---|---|---|
| FQFP-I9-M85-X3D | 850 nm | 850 nm | MM OM3 300m<br>MM OM4 400m | Yes | 0~70°C |

**Note1:** Distances are indicative only. To calculate a more precise link budget based on specific conditions in your application, please refer to the optical characteristics.



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