

## Product Datasheet

### QSFP-4X10G-D-AOC-25M-C

H3C® Compatible 40GBASE-SR4 QSFP+ to 4x10GBASE-SR SFP+ Active Optical Breakout Cable, 25m

#### FEATURES

- Up to 25.78125Gbps Data rate per channel
- Maximum link length of 70m on OM3 MMF or 100m on OM4 MMF
- 850nm VCSEL transmitter
- PIN photo detector receiver
- Hot-pluggable QSFP28 & SFP28 form factor
- Internal CDR circuits on both receiver and Transmitter channels
- Support CDR bypass
- Built-in digital diagnostic functions
- Single +3.3V power supply
- Low power consumption<2.5W(QSFP28) &<1W(SFP28)
- Operating case temperature: 0~+70°C
- SFF-8436 compliant QSFP28 connector
- SFF-8431 compliant 4xSFP28 connectors

#### APPLICATIONS

- 100GBASE-SR4 100G Ethernet
- Infiniband EDR, FDR, QDR
- High-Performance Computing (HPC) clusters

#### DESCRIPTION

For typical applications, users can install this breakout or splitter cable between an available QSFP28 port on 100GE switch and feed up to 4 upstream SFP28 enabled 25GE switches. Each cable features a single SFF-8436 compliant QSFP28 connector rated for 103Gb/s on one end and 4 SFF-8431 compliant SFP28 connectors rated for 25.78Gb/s each on the other end.

The 100G QSFP28 to 4x25G SFP28 breakout Active Optical Cables (AOCs) offer IT professionals a cost-effective interconnect solution for merging 100G QSFP28 and 25G SFP28 enabled host adapters, switches and servers.

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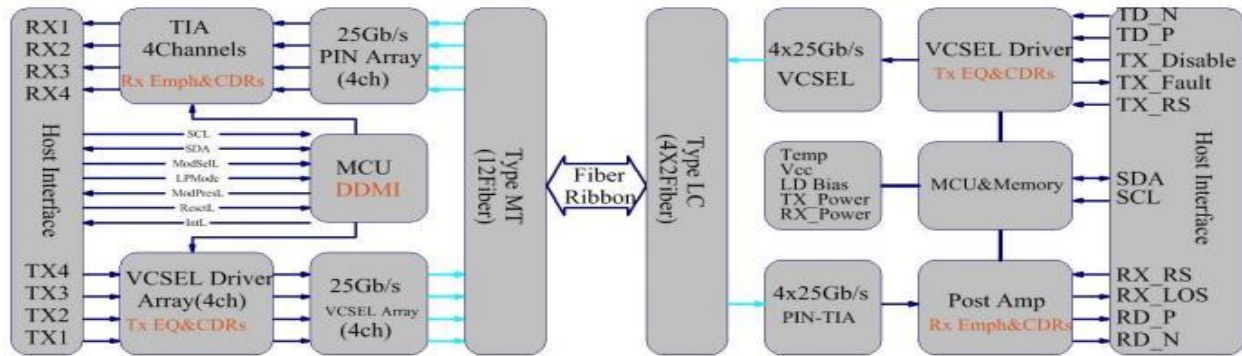


Figure 1. Transceiver functional Block Diagram

### Standard

- Compliant with SFF-8665 Specification
- Compliant with IEEE 802.3bm 100GBASE-SR4
- Compliant with IEEE 802.3by 25GBASE-SR
- Compliant with GR-468-CORE
- RoHS Compliant

### Regulatory Compliance

| Product Certificate | Certificate Number | Applicable Standard                    |
|---------------------|--------------------|----------------------------------------|
| TUV                 | R50135086          | EN 60950-1 :2006+A11+A1+A12+A2         |
|                     |                    | EN 60825-1 :2014                       |
|                     |                    | EN 60825-2 :2004+A1+A2                 |
| UL                  | E317337            | UL 60950-1<br>CSA C22.2 No. 60950-1-07 |
| EMC CE              | AE 50285865 0001   | EN 55022:2010<br>EN 55024:2010         |
| FCC                 | WTF14F0514417E     | 47 CFR PART 15 OCT., 2013              |
| FDA                 | /                  | CDRH 1040.10                           |
| ROHS                | /                  | 2011/65/ EU                            |

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### Absolute Maximum Ratings

| Parameter                  | Symbol | Min  | Typ | Max  | Unit |
|----------------------------|--------|------|-----|------|------|
| Maximum Supply Voltage     | VCC    | -0.5 | -   | +4.0 | V    |
| Storage Temperature        | TS     | -40  | -   | +85  | ° C  |
| Case Operating Temperature | TA     | -5   | -   | +75  | ° C  |
| Relative Humidity          | RH     | 5    | -   | 95   | %    |

#### Note:

1. The operation in excess of any absolute maximum ratings might cause permanent damage to this module
2. Non-condensing

### Recommended Operating Environment

| Parameter                      | Symbol | Min   | Typ      | Max   | Unit | Notes |
|--------------------------------|--------|-------|----------|-------|------|-------|
| Data Rate, each lane           | BR     | -     | 25.78125 | -     | Gbps |       |
| Data Rate Variation, each lane |        | - 100 | -        | + 100 | ppm  |       |
| Power Supply Voltage           | VCC    | 3.13  | 3.3      | 3.47  | V    |       |
| Power Supply Current (QSFP28)  | ICC    | -     | -        | 750   | mA   |       |
| Power Dissipation (QSFP28)     | PD     | -     | -        | 2.5   | W    |       |
| Power Supply Current (SFP28)   | ICC    | -     | -        | 300   | mA   |       |
| Power Dissipation (SFP28)      | PD     | -     | -        | 1.0   | W    |       |
| Case Operating Temperature     | TA     | 0     | -        | +70   | °C   |       |
| Relative Humidity              | RH     | 5     | -        | 85    | %    | 1     |
| Transmission Distance          | TD     | -     | -        | 100   | m    | 2     |
| Fiber Bend Radius              | Rb     | 30    | -        | -     | mm   |       |

#### Notes:

1. Non-condensing
2. Measured with ITU-T G.651 OM4 MMF

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Electrical Specifications (TOP = 0 to +70 °C, VCC = 3.13 to 3.47 V)

| Parameter                         | Symbol     | Min  | Typ | Max | Unit |
|-----------------------------------|------------|------|-----|-----|------|
| Differential Data Input Amplitude | VIN, P- P  | 180  | -   | 900 | mVpp |
| Input Differential Impedance      | ZIN        | 90   | 100 | 110 | Ω    |
| Transmitter Fault Output- High    | VOH        | 2.4  | -   | VCC | V    |
| Transmitter Fault Output- Low     | VOL        | -0.3 | -   | 0.4 | V    |
| Transmitter Disable Voltage- High | VIH        | 2.0  | -   | VCC | V    |
| Transmitter Disable Voltage- low  | VIL        | 0    | -   | 0.8 | V    |
| Differential output voltage swing | VOUT, P- P | 300  | -   | 900 | mVpp |
| Output Differential Impedance     | ZOUT       | 90   | 100 | 110 | Ω    |
| LOS Output Voltage- High          | VLOSH      | 2.0  | -   | VCC | V    |
| LOS Output Voltage- Low           | VLOSL      | -    | -   | 0.8 | V    |

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Optical Characteristics (TOP = 0 to +70 °C, VCC = 3.13 to 3.47 V)

| Parameter                                                   | Symbol                                                | Min    | Typ      | Max    | Unit | Notes |
|-------------------------------------------------------------|-------------------------------------------------------|--------|----------|--------|------|-------|
| Transmitter                                                 |                                                       |        |          |        |      |       |
| Optical Center Wavelength                                   | $\lambda_C$                                           | 840    | 850      | 860    | nm   |       |
| RMS Spectral Width                                          | $\sigma$                                              | -      | -        | 0.6    | nm   |       |
| Data Rate, each lane                                        | BR                                                    | -      | 25.78125 | -      | Gbps |       |
| Data Rate Variation, each lane                              |                                                       | - 100  | -        | + 100  | ppm  |       |
| Average Launch Power, each lane                             | PO                                                    | -8.4   | -        | 2.4    | dBm  | 1     |
| Optical Modulation Amplitude, each lane                     | POMA                                                  | -6.4   | -        | 3.0    | dBm  |       |
| Optical Extinction Ratio                                    | ER                                                    | 2.0    | -        | -      | dB   |       |
| Transmitter and dispersion eye closure, each lane           | TDEC                                                  | -      | -        | 4.3    | dBm  |       |
| Launch Power (OMA) minus TDEC, each lane                    | P-TDEC                                                | -7.3   | -        | -      | dBm  |       |
| Optical Return Loss Tolerance                               | ORL                                                   | -      | -        | 12     | dB   |       |
| Average Launch power of Tx OFF, each lane                   | POFF                                                  | -      | -        | -30    | dBm  |       |
| Transmitter Eye Mask coordinates:<br>X1, X2, X3, Y1, Y2, Y3 | SPECIFICATION VALUES<br>{0.3,0.38,0.45,0.35,0.41,0.5} |        |          |        |      | 2     |
| Receiver                                                    |                                                       |        |          |        |      |       |
| Center Wavelength Range                                     | $\lambda_C$                                           | 840    | 850      | 860    | nm   |       |
| Data Rate, each lane                                        | BR                                                    | -      | 25.78125 | -      | Gbps |       |
| Data Rate Variation, each lane                              |                                                       | - 100  | -        | + 100  | ppm  |       |
| Receiver Power (OMA), each lane                             | POMA                                                  | -      | -        | 3.0    | dBm  |       |
| Average Receive Power, each lane                            | RPO                                                   | - 10.3 | -        | 2.4    | dBm  | 1     |
| Receiver Sensitivity (OMA), each lane                       | RSEN                                                  | -      | -        | - 10.3 | dBm  | 3     |
| Stressed Receiver Sensitivity (OMA), each lane              | RSRS                                                  | -      | -        | -5.2   | dBm  |       |
| LOS Assert                                                  | LOSA                                                  | -30    | -        | -      | dBm  |       |
| LOS De-Assert                                               | LOSD                                                  | -      | -        | - 13   | dBm  |       |
| LOS Hysteresis                                              | LOSH                                                  | 0.5    | -        | 5.0    | dB   |       |
| Receiver Reflectance                                        | RR                                                    | -      | -        | - 12   | dB   |       |

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**Notes:**

1. Average launch/receive power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch/receive power below this value cannot be compliant; however, a value above this does not ensure compliance
2. Hit Ratio  $5 \times 10^{-5}$  hits/sample
3. Measured with worst ER=2.5d B, RPBS  $2^{31}-1$  test pattern @25.78125Gbps BER= $\leq 5E-5$

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### Pin Assignment

| Pin | Symbol  | Name/Description                     | Notes |
|-----|---------|--------------------------------------|-------|
| 1   | GND     | Ground                               | 1     |
| 2   | Tx2n    | Transmitter Inverted Data Input      |       |
| 3   | Tx2p    | Transmitter Non- Inverted Data Input |       |
| 4   | GND     | Ground                               | 1     |
| 5   | Tx4n    | Transmitter Inverted Data Input      |       |
| 6   | Tx4p    | Transmitter Non- Inverted Data Input |       |
| 7   | GND     | Ground                               | 1     |
| 8   | ModSelL | Module Select                        | 2     |
| 9   | ResetL  | Module Reset                         | 2     |
| 10  | Vcc Rx  | +3.3 V Power supply receiver         |       |
| 11  | SCL     | 2-wire serial interface clock        | 2     |
| 12  | SDA     | 2-wire serial interface data         | 2     |
| 13  | GND     | Ground                               | 1     |
| 14  | Rx3p    | Receiver Non- Inverted Data Output   |       |
| 15  | Rx3n    | Receiver Inverted Data Output        |       |
| 16  | GND     | Ground                               | 1     |
| 17  | Rx 1p   | Receiver Non- Inverted Data Output   |       |
| 18  | Rx 1n   | Receiver Inverted Data Output        |       |
| 19  | GND     | Ground                               | 1     |
| 20  | GND     | Ground                               |       |
| 21  | Rx2n    | Receiver Inverted Data Output        |       |
| 22  | Rx2p    | Receiver Non- Inverted Data Output   |       |
| 23  | GND     | Ground                               | 1     |
| 24  | Rx4n    | Receiver Inverted Data Output        |       |
| 25  | Rx4p    | Receiver Non- Inverted Data Output   |       |
| 26  | GND     | Ground                               | 1     |
| 27  | ModPrsL | Module Present                       |       |
| 28  | IntL    | Interrupt                            | 2     |
| 29  | Vcc Tx  | +3.3 V Power supply transmitter      |       |
| 30  | Vcc1    | +3.3 V Power Supply                  |       |
| 31  | LPMode  | Low Power Mode                       | 2     |
| 32  | GND     | Ground                               | 1     |

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|    |      |                                      |   |
|----|------|--------------------------------------|---|
| 33 | Tx3p | Transmitter Non- Inverted Data Input |   |
| 34 | Tx3n | Transmitter Inverted Data Input      |   |
| 35 | GND  | Ground                               | 1 |
| 36 | Tx1p | Transmitter Non- Inverted Data Input |   |
| 37 | Tx1n | Transmitter Inverted Data Input      |   |
| 38 | GND  | Ground                               | 1 |

### Notes:

1. Circuit ground is internally isolated from chassis ground
2. Open collector; should be pulled up with a 4.7kΩ to 10kΩ resistor on host board to a voltage between 3.15V and 3.6V

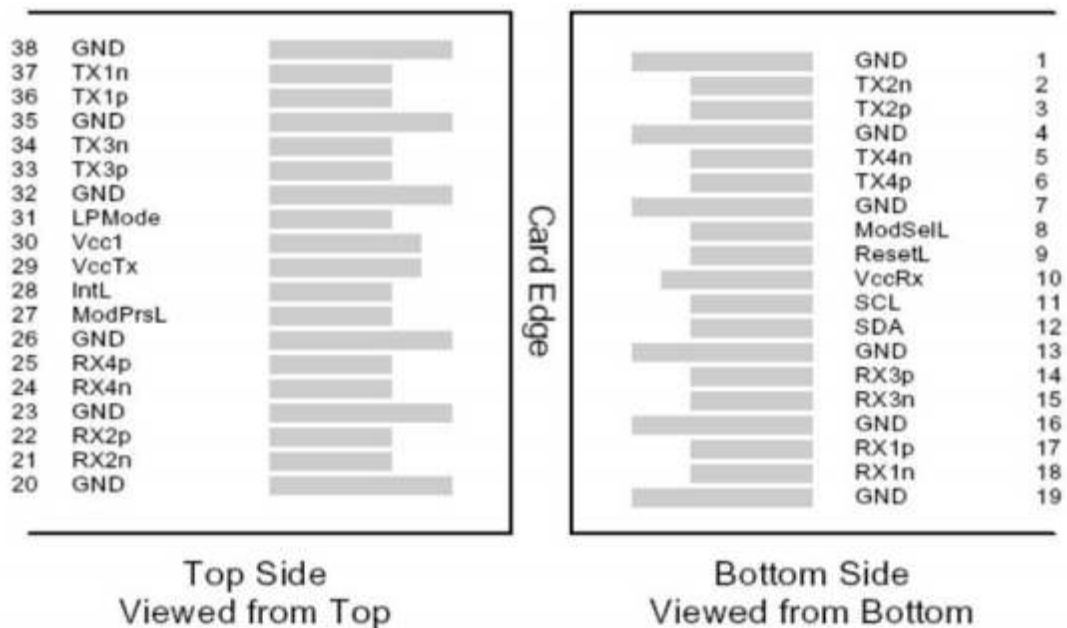
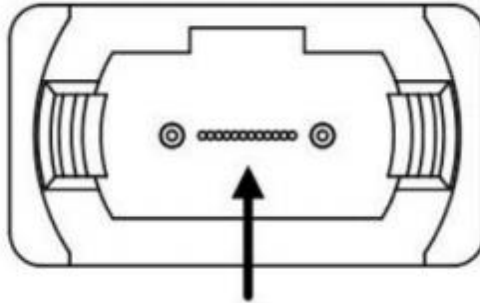


Figure 2. Host PCB QSFP28 pad assignment top view and Names

### Optical Interface Lanes and Assignment

The optical interface port is a male MPO connector, the keying feature of the MPO receptacle is on the top, then fibers are numbered left to right as 12 through 1 looking into the receptacle. The four fiber positions on the left (fibers 12, 11, 10, 9) are used for the optical transmit signals (Channel 1 through 4). The fiber positions on the right (fibers 4, 3, 2, 1) are used for the optical receive signals (Channel 4 through 1). The central four fibers (5, 6, 7, 8) may be physically present.

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Fiber Number: 12 11 10 9 x x x x 4 3 2 1  
Transmit Channels: 1 2 3 4  
Receive Channels: 4 3 2 1

Figure 3. QSFP28 Optical Receptacle and Channel Orientation

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### Pin Descriptions (SFP28)

| PIN | Name       | Function/Description                                          |
|-----|------------|---------------------------------------------------------------|
| 1   | VeeT       | Module Transmitter Ground                                     |
| 2   | Tx_Fault   | Module Transmitter Fault                                      |
| 3   | Tx_Disable | Transmitter Disable, Turns off transmitter laser output       |
| 4   | SDA        | Two wire serial interface Data input/output (SDA)             |
| 5   | SCL        | Two wire serial interface Clock input (SCL)                   |
| 6   | MOD_ABS    | Module Absent, connected to VeeT or VeeR in the module        |
| 7   | RS0        | Receiver Rate Select                                          |
| 8   | Rx_LOS     | Loss of Signal indication, Logic 0 indicates normal operation |
| 9   | RS1        | Transmitter Rate Select, not used for this product            |
| 10  | VeeR       | Module Receiver Ground                                        |
| 11  | VeeR       | Module Receiver Ground                                        |
| 12  | RD-        | Receiver Inverted DATA output, AC Coupled                     |
| 13  | RD+        | Receiver Non-inverted DATA output, AC Coupled                 |
| 14  | VeeR       | Module Receiver Ground                                        |
| 15  | VccR       | Module Receiver 3.3V Supply                                   |
| 16  | VccT       | Module Transmitter 3.3V Supply                                |
| 17  | VeeT       | Module Transmitter Ground                                     |
| 18  | TD+        | Transmitter Non-Inverted DATA input, AC Coupled               |
| 19  | TD-        | Transmitter Inverted DATA input, AC Coupled                   |
| 20  | VeeT       | Module Transmitter Ground                                     |

### Notes:

1. Open collector/drain output, which should be pulled up with a 4.7kΩ to 10kΩ resistor on the host board if intended for use. Pull up voltage should be between 2.0V to 3.6V. A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to <0.8V.
2. Laser output disabled on Tx\_Disable >2.0V or open, enabled on Tx\_Disable <0.8V.
3. LOS is open collector output. Should be pulled up with 4.7kΩ to 10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.
4. RD-/+: These are the differential receiver outputs. They are internally AC-coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES.
5. TD-/+: These are the differential transmitter inputs. They are internally AC-coupled, differential lines with 100Ω differential termination inside the module.

## Product Datasheet

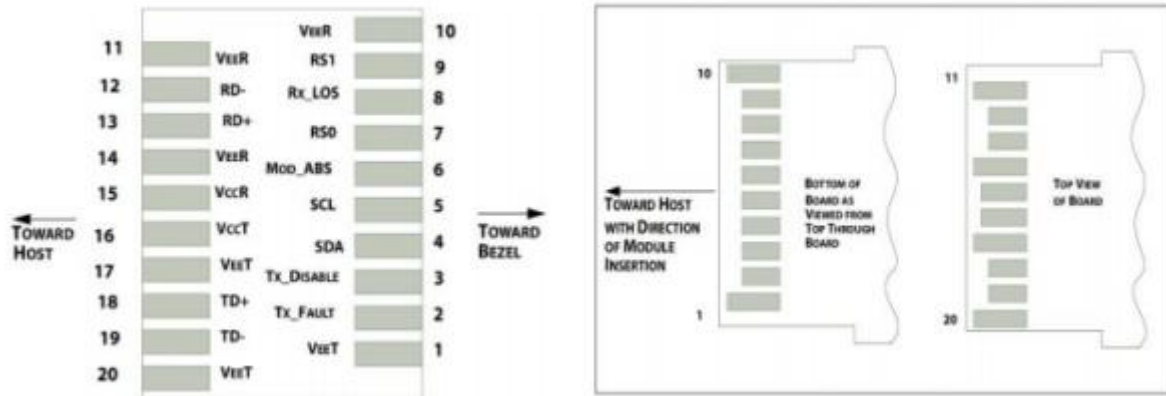


Figure 4. Host PCB SFP+ pad assignment top view and Names

### Digital Diagnostic Monitoring Interface (QSFP28)

Digital diagnostics monitoring function is available on all QSFP28 module. A 2-wire serial interface provides user to contact with module. The structure of the memory is shown in Figure 4. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space pages. This structure permits timely access to addresses in the lower page, such as Interrupt Flags and Monitors. Less time critical time entries, such as serial ID information and threshold settings, are available with the Page Select function. The interface address used is A0xh and is mainly used for time critical data like interrupt handling in order to enable a one-time- read for all data related to an interrupt situation. After an interrupt, IntL, has been asserted, the host can read out the flag field to determine the affected channel and type of flag.

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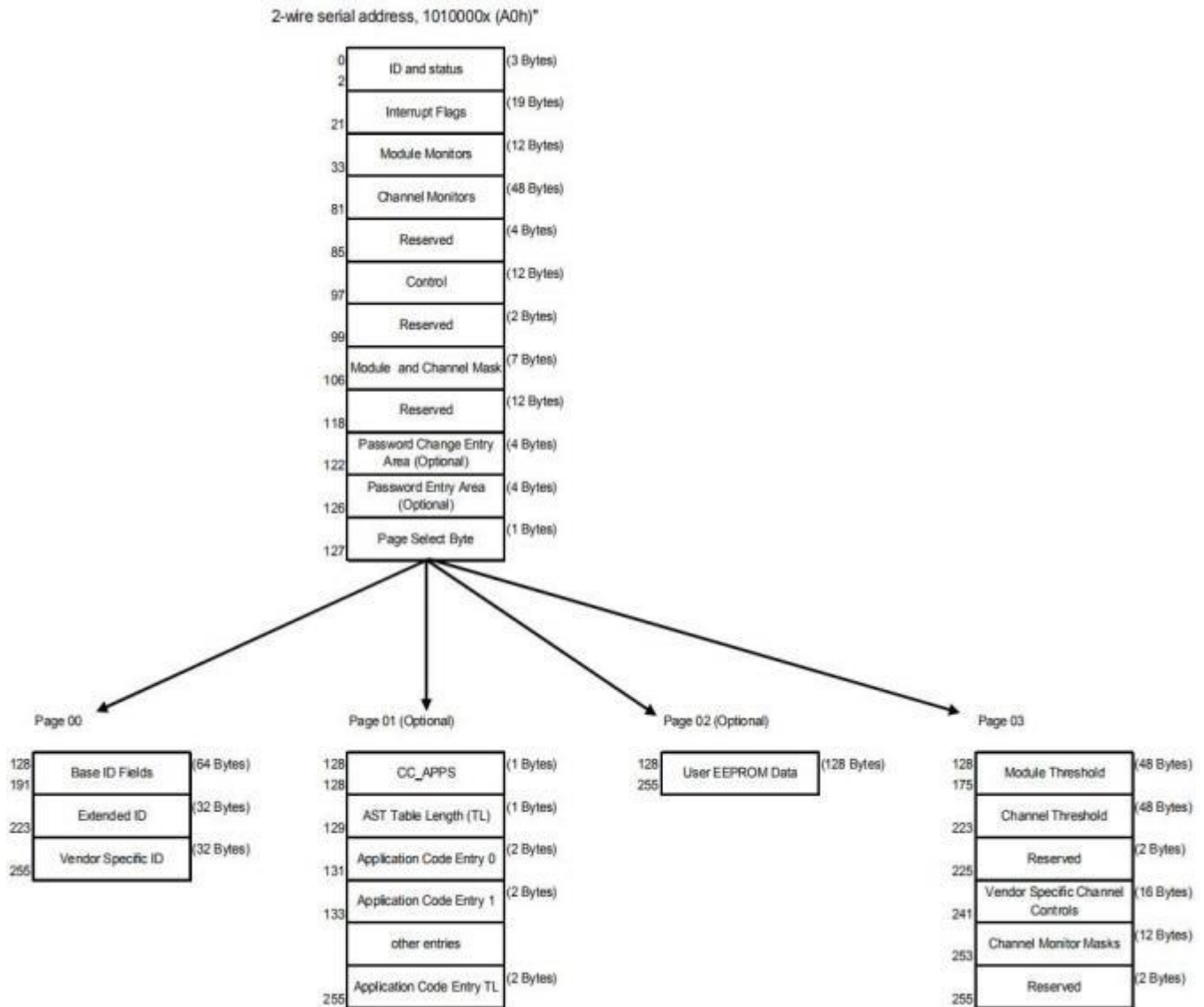


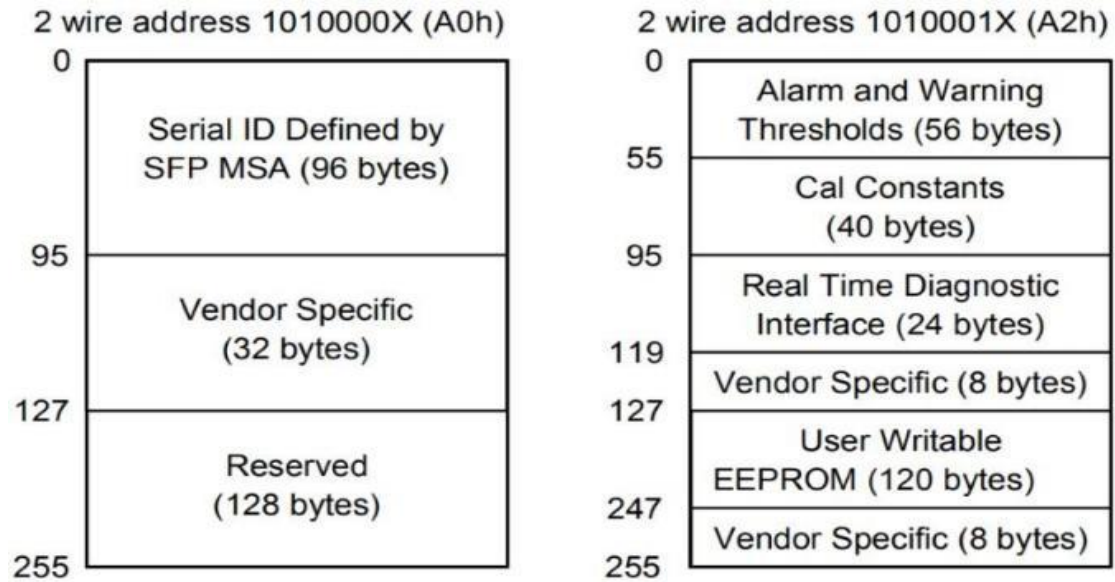
Figure 5. QSFP28 Memory Map (Specific Data Field Descriptions)

### Digital Diagnostic Memory Map (SFP28)

The transceivers provide serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA). The diagnostic information with internal calibration or external calibration all are implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring. The digital diagnostic memory map specific data field defines as following.

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### Digital Diagnostic Memory Map (Specific Data Field Descriptions)



### Digital Diagnostic Monitor Characteristics

| Parameter                        | Calibration | Range           | Accuracy | Unit |
|----------------------------------|-------------|-----------------|----------|------|
| Transceiver Internal Temperature | Internal    | 0 to +70°C      | ± 5.0    | °C   |
| VCC Internal Supply Voltage      | Internal    | 3.0 to 3.6V     | ± 3.0    | %    |
| Laser Bias Current, each lane    | Internal    | 0 to 15mA       | ± 10     | %    |
| Tx Output Power, each lane       | Internal    | -8.4 to 3d Bm   | ± 3.0    | dBm  |
| Rx Input Power, each lane        | Internal    | - 12.0 to 3d Bm | ± 3.0    | dBm  |

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### Timing and Electrical

| Parameter                                  | Symbol       | Min | Typ | Max  | Unit |
|--------------------------------------------|--------------|-----|-----|------|------|
| Initialization Time                        | t_init       | -   | -   | 2000 | ms   |
| Reset Init Assert Time                     | t_reset_init | -   | -   | 2    | us   |
| Serial Bus Hardware Ready Time             | t_serial     | -   | -   | 2000 | ms   |
| Monitor Data Ready Time                    | t_data       | -   | -   | 2000 | ms   |
| Reset Assert Time                          | t_reset      | -   | -   | 2000 | ms   |
| LPMode Assert Time                         | ton_LPMode   | -   | -   | 100  | us   |
| IntL Assert Time                           | ton_IntL     | -   | -   | 200  | ms   |
| IntL Deassert Time                         | toff_IntL    | -   | -   | 500  | us   |
| Rx LOS Assert Time                         | ton_los      | -   | -   | 100  | ms   |
| Tx Fault Assert Time                       | ton_Txfault  | -   | -   | 200  | ms   |
| Flag Assert Time                           | ton_flag     | -   | -   | 200  | ms   |
| Mask Assert Time                           | ton_mask     | -   | -   | 100  | ms   |
| Mask Deassert Time                         | toff_mask    | -   | -   | 100  | ms   |
| ModSelL Assert Time                        | ton_ModSelL  | -   | -   | 100  | us   |
| ModSelL Deassert Time                      | toff_ModSelL | -   | -   | 100  | us   |
| Power over-ride or Power-set Assert Time   | ton_Pdown    | -   | -   | 100  | ms   |
| Power over-ride or Power-set Deassert Time | toff_Pdown   | -   | -   | 300  | ms   |

### Recommended Circuit

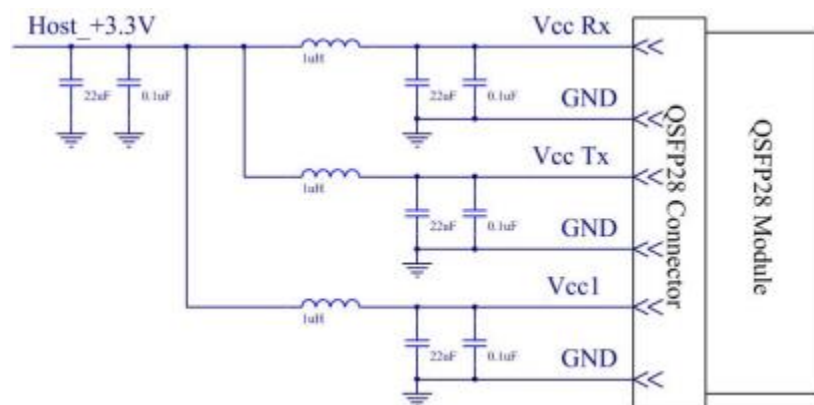


Figure 6. Recommended Host Board Power Supply Circuit (QSFP28)

## Product Datasheet

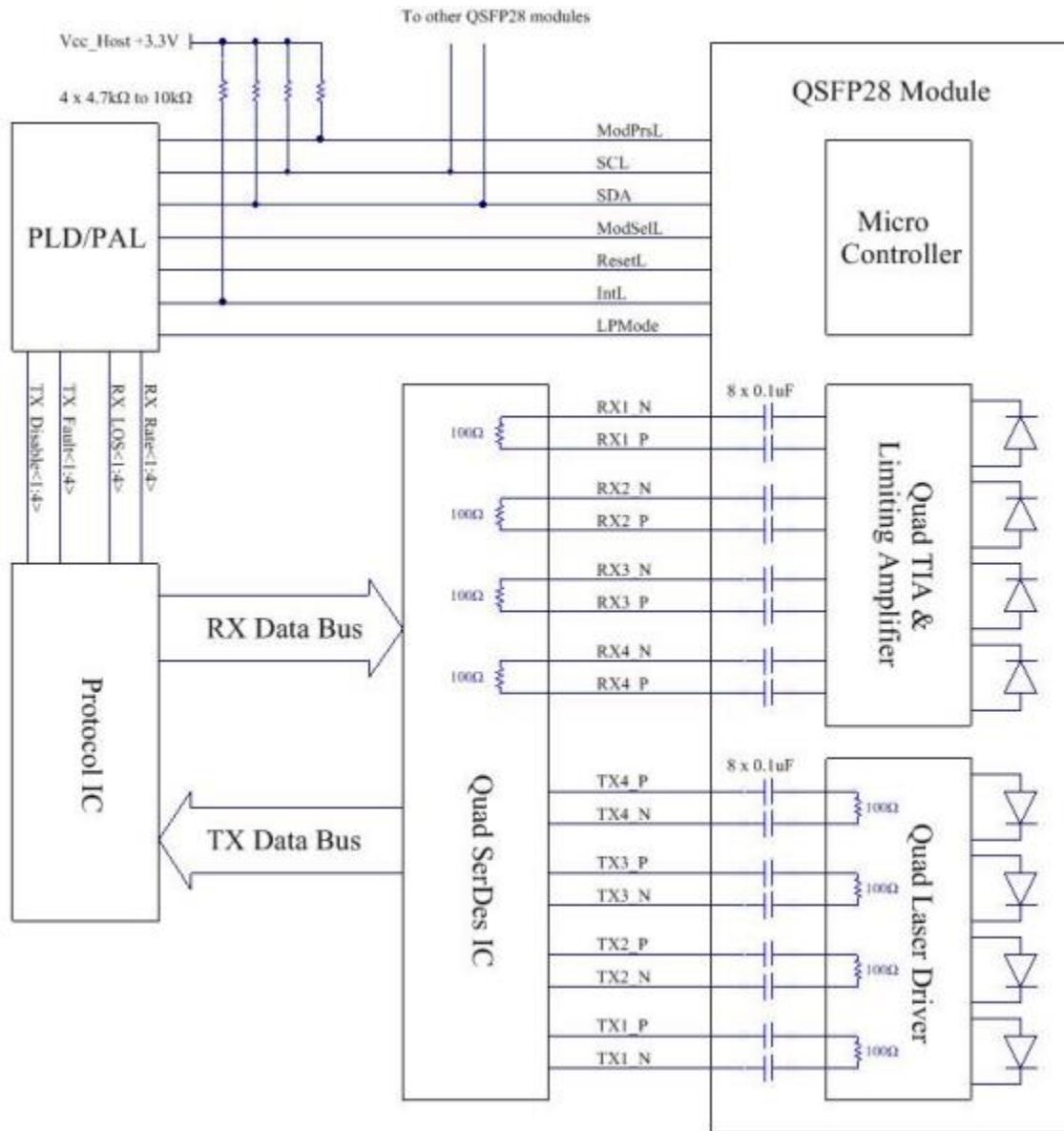


Figure 7. Recommended Interface Circuit (QSFP28)

## Product Datasheet

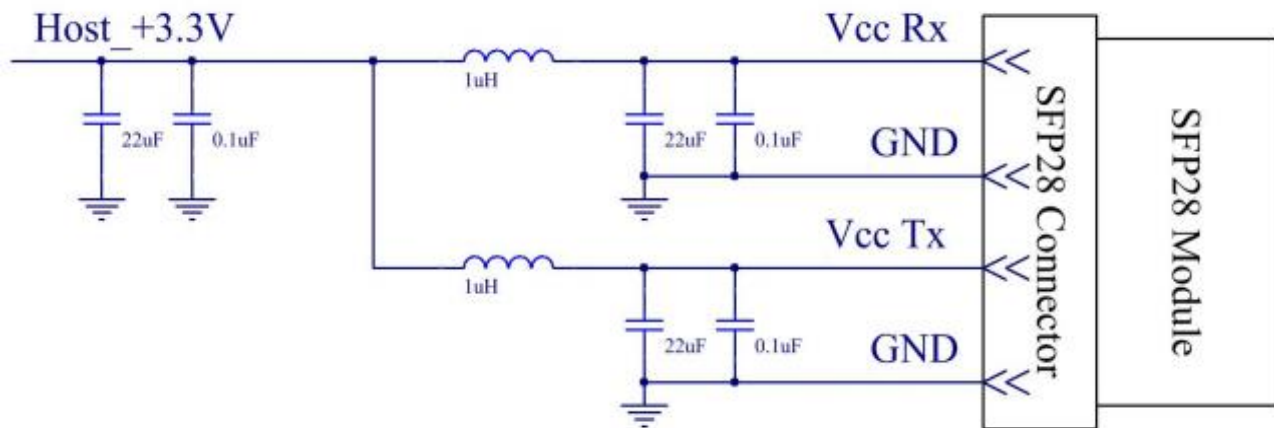


Figure 8. Recommended Host Board Power Supply Circuit (SFP28)

## Product Datasheet

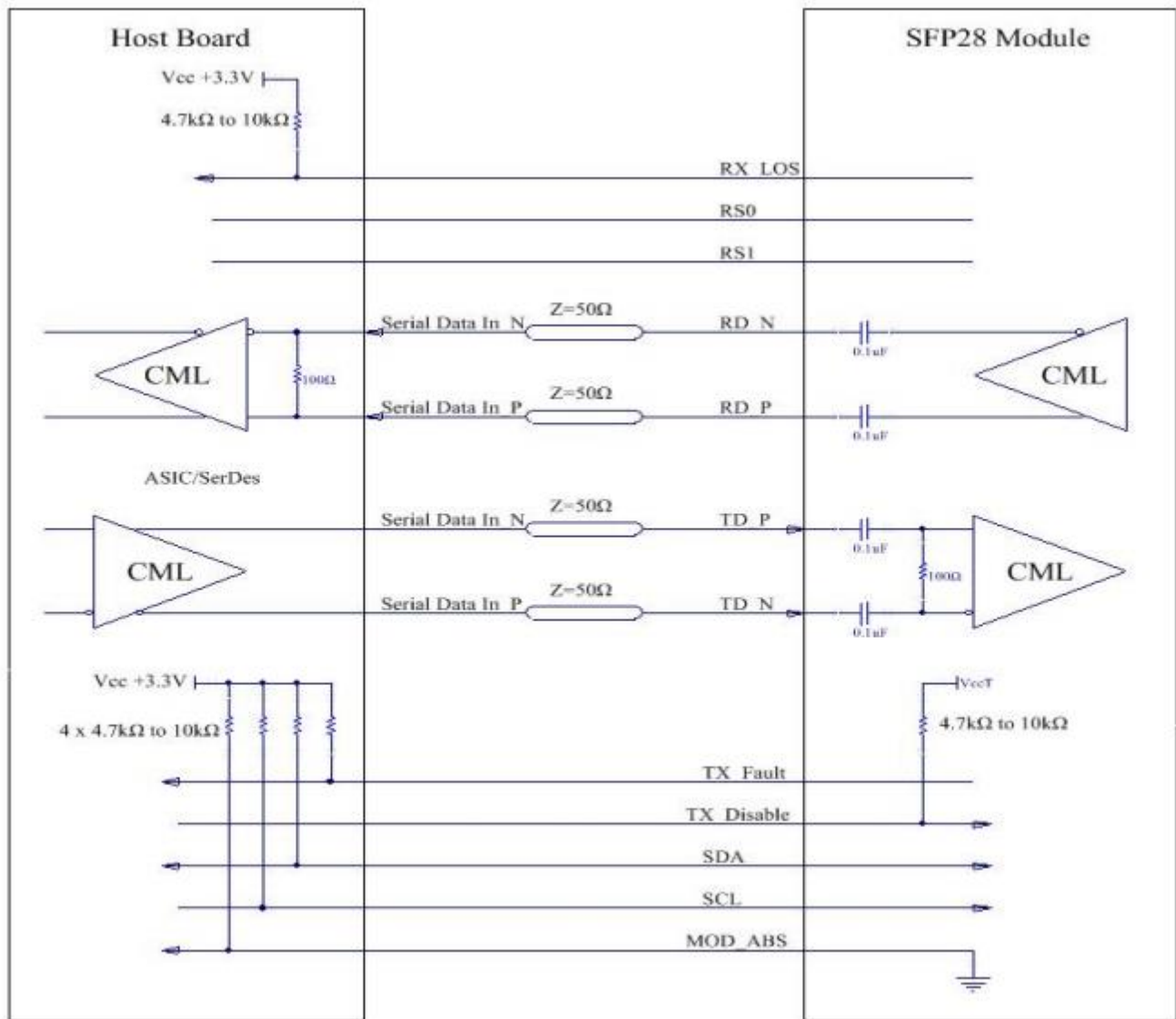


Figure 9. Recommended Interface Circuit (SFP28)

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### Technical Dimensions

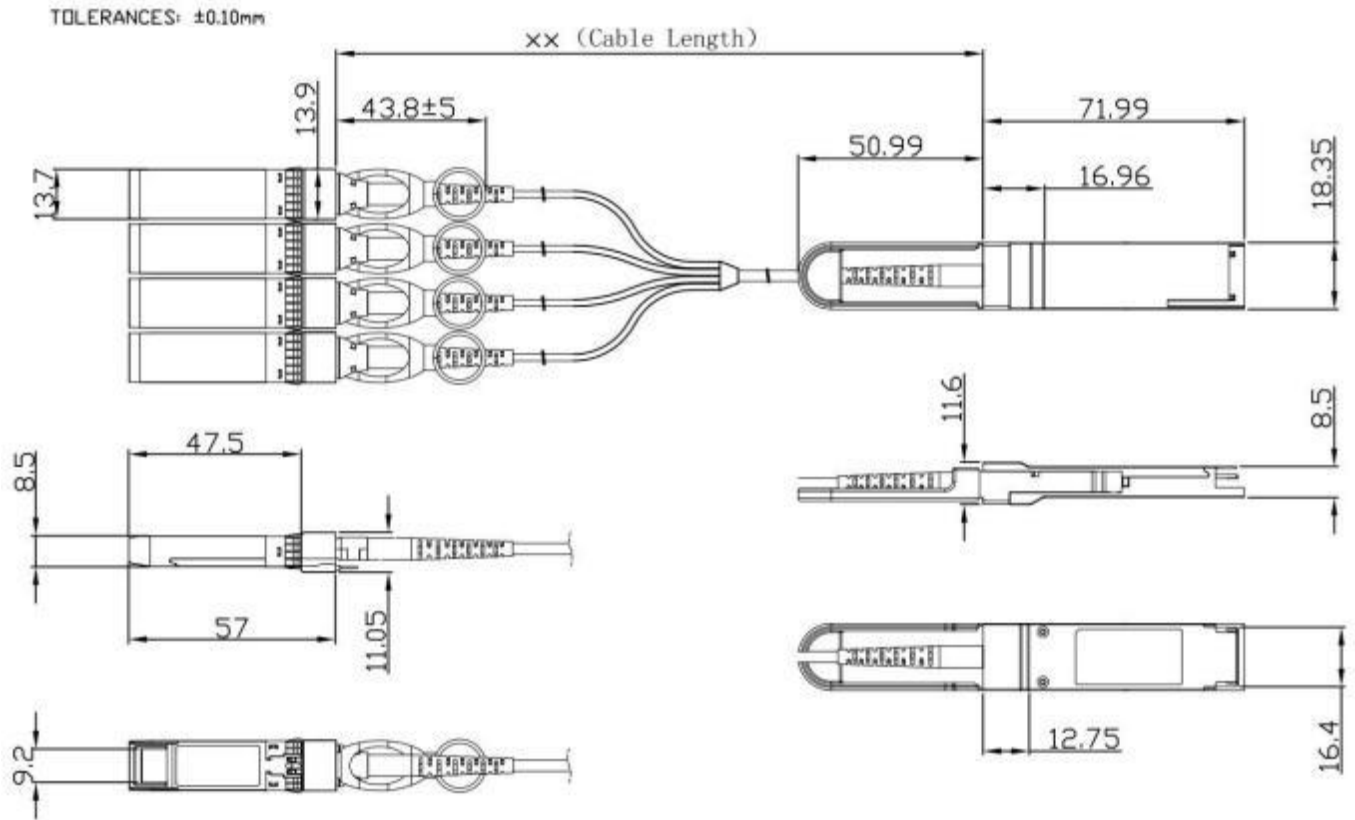


Figure 10. Mechanical Dimensions