

## QDD-400GB-LR4-C

MSA and TAA Compliant 400GBase-LR4 QSFP-DD Transceiver (SMF, 1310nm, 10km, LC, DOM)

### Features:

- INF-8628 Compliance
- Duplex LC Connector
- Single-mode Fiber
- Commercial Temperature 0 to 70 Celsius
- Hot Pluggable
- Metal with Lower EMI
- Excellent ESD Protection
- RoHS Compliant and Lead Free



### Applications:

- 400GBase Ethernet
- Access and Enterprise

### Product Description

This MSA Compliant QSFP-DD transceiver provides 400GBase-LR4 throughput up to 10km over single-mode fiber (SMF) using a wavelength of 1310nm via an LC connector. It is built to MSA standards and is uniquely serialized and data-traffic and application tested to ensure that they will integrate into your network seamlessly. Digital optical monitoring (DOM) support is also present to allow access to real-time operating parameters. This transceiver is Trade Agreements Act (TAA) compliant. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

ProLabs's transceivers are RoHS compliant and lead-free.

TAA refers to the Trade Agreements Act (19 U.S.C. & 2501-2581), which is intended to foster fair and open international trade. TAA requires that the U.S. Government may acquire only "U.S. – made or designated country end products."



## Regulatory Compliance

- ESD to the Electrical PINs: compatible with MIL-STD-883E Method 3015.4
- ESD to the LC Receptacle: compatible with IEC 61000-4-3
- EMI/EMC compatible with FCC Part 15 Subpart B Rules, EN55022:2010
- Laser Eye Safety compatible with FDA 21CFR, EN60950-1& EN (IEC) 60825-1,2
- RoHS compliant with EU RoHS 2.0 directive 2015/863/EU

## Absolute Maximum Ratings

| Parameter                          | Symbol | Min. | Max. | Unit |
|------------------------------------|--------|------|------|------|
| Power Supply Voltage               | VCC    | -0.5 | 3.6  | V    |
| Storage Temperature                | Ts     | -40  | 85   | °C   |
| Case Operating Temperature         | Top    | 0    | 70   | °C   |
| Relative Humidity (non-condensing) | RH     | 0    | 85   | %    |

## Recommended Operating Conditions

| Parameter                  | Symbol | Min.  | Typ.    | Max.                 | Unit | Notes |
|----------------------------|--------|-------|---------|----------------------|------|-------|
| Operating Case Temperature | TOP    | 0     |         | 70                   | °C   |       |
| 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              | D      | 0.5   |         | 10                   | km   | 2     |

### Notes:

1. FEC provided by host system.
2. FEC required on host system to support maximum distance.

## Electrical Characteristics

| Parameter  | Symbol          | Min.                             | Typ.  | Max. | Unit | Notes |
|--|-----------------|----------------------------------|-------|------|------|-------|
| Power Consumption                                  |                 |                                  |       | 12   | W    |       |
| Supply Current                                     | I <sub>cc</sub> |                                  |       | 3.64 | A    |       |
| <b>Transmitter (each lane)</b>                     |                 |                                  |       |      |      |       |
| 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 Mode Input 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     |
| <b>Receiver (each lane)</b>                        |                 |                                  |       |      |      |       |
| 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 Return Loss                    | 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 (V <sub>cm</sub> )      | 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.

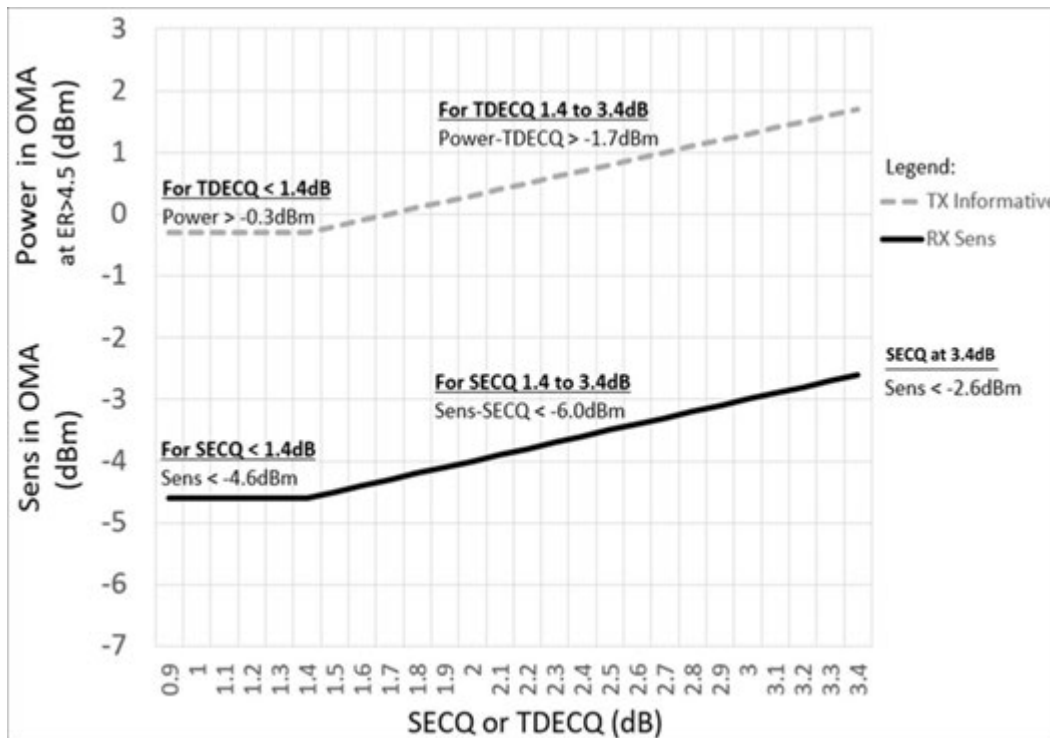
## Optical Characteristics

| Parameter  | Symbol           | Min.             | Typ. | Max.   | Unit  | Notes             |
|--|------------------|------------------|------|--------|-------|-------------------|
| Lane Wavelength  | L0               | 1264.5           | 1271 | 1277.5 | nm    |                   |
|  | L1               | 1284.5           | 1291 | 1297.5 |       |                   |
|  | L2               | 1304.5           | 1311 | 1317.5 |       |                   |
|  | L3               | 1324.5           | 1331 | 1337.5 |       |                   |
| <b>Transmitter</b>   |                  |                  |      |        |       |                   |
| Data Rate, each Lane   |                  | 53.125 ± 100 ppm |      |        | GBd   |                   |
| Modulation Format  |                  | PAM4             |      |        |       |                   |
| Side-mode Suppression Ratio  | SMSR             | 30               |      |        | dB    | Modulated         |
| Total Average Launch Power   | PT               |                  |      | 10     | dBm   |                   |
| Average Launch Power, each Lane  | PAVG             | -1.4             |      | 4.5    | dBm   | 1                 |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ), each Lane      | POMA             | 0.7              |      | 4.7    | dBm   | 2                 |
| Launch Power in OMA <sub>outer</sub> minus TDECQ, each Lane                |                  | -0.7             |      |        | dB    | For ER ≥4.5dB     |
| Launch Power in OMA <sub>outer</sub> minus TDECQ, each Lane                |                  | -0.6             |      |        | dB    | For ER <4.5dB     |
| Transmitter and Dispersion Eye Closer for PAM4, each Lane                  | TDECQ            |                  |      | 3.4    | dB    |                   |
| Extinction Ratio   | ER               | 3.5              |      |        | dB    |                   |
| Difference in Launch Power between any Two Lanes (OMA <sub>outer</sub> )   |                  |                  |      | 4      | dB    |                   |
| RIN <sub>17.1</sub> OMA  | RIN              |                  |      | -136   | dB/Hz |                   |
| Optical Return Loss Tolerance  | TOL              |                  |      | 15.6   | dB    |                   |
| Transmitter Reflectance  | TR               |                  |      | -26    | dB    |                   |
| Average Launch Power of OFF Transmitter, each Lane                         | P <sub>off</sub> |                  |      | -20    | dBm   |                   |
| <b>Receiver</b>  |                  |                  |      |        |       |                   |
| Data Rate, each Lane   |                  | 53.125 ± 100 ppm |      |        | GBd   |                   |
| Modulation Format  |                  | PAM4             |      |        |       |                   |
| Damage Threshold, each Lane  | TH <sub>d</sub>  | 5.5              |      |        | dBm   | 3                 |
| Average Receive Power, each Lane   |                  | -7.7             |      | 4.5    | dBm   | 4                 |
| Receive Power (OMA <sub>outer</sub> ), each Lane                           |                  |                  |      | 4.7    | dBm   |                   |
| Difference in Receiver Power between any Two Lanes (OMA <sub>outer</sub> ) |                  |                  |      | 4.1    | dB    |                   |
| Receiver Sensitivity (OMA <sub>outer</sub> ), each Lane                    | SEN              |                  |      | -6.6   | dBm   | For BER of 2.4E-4 |
| Stressed Receiver Sensitivity (OMA <sub>outer</sub> ), each Lane           | SRS              | See Figure Below |      |        | dBm   | 5                 |
| Receiver Reflectance   | RR               |                  |      | -26    | 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 6) |  |     |     |     |     |  |
|--|--|-----|-----|-----|-----|--|
| Stressed Eye Closure for PAM4 (SECQ), Lane under Test        |  | 0.9 |     | 3.4 | dB  |  |
| OMA <sub>outer</sub> of each Aggressor Lane                  |  |     | 1.5 |     | 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 < 1.4 dB for an extinction ratio of ≥ 4.5 dB or TDECQ < 1.3 dB for an extinction ratio of < 4.5 dB, the OMA<sub>outer</sub> (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. Measured with conformance test signal for BER = 2.4x10<sup>-4</sup>. A compliant receiver shall have stressed receiver sensitivity (OMA<sub>outer</sub>), each lane values below the mask of the figure below, for SECQ values between 0.9 and 3.4 dB.
6. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

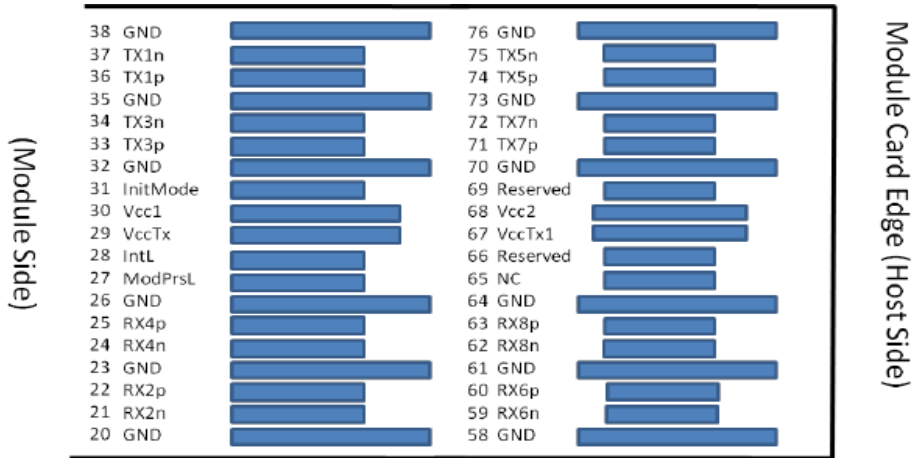


## Pin Descriptions

| Pin | Logic       | Symbol   | Name/Descriptions   | 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  | 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            |
| 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            |

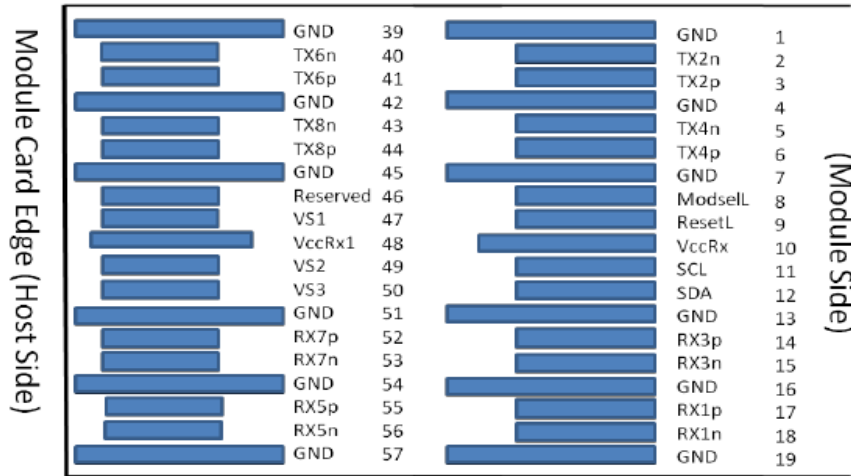
|    |       |          |                                     |    |
|----|-------|----------|-------------------------------------|----|
| 41 | CML-I | Tx6p     | Transmitter Non-Inverted Data Input | 3A |
| 42 |       | GND      | Ground                              | 1A |
| 43 | CML-I | Tx8n     | 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 |
| 67 |       | GND      | Ground                              | 1A |
| 68 |       | NC       | No Connect                          | 3A |
| 69 |       | Reserved | For future use                      | 3A |
| 70 |       | VccTx1   | 3.3V Power Supply                   | 2A |
| 71 |       | Vcc2     | 3.3V Power Supply                   | 2A |
| 72 |       | Reserved | For Future Use                      | 3A |
| 73 |       | GND      | Ground                              | 1A |
| 74 | CML-I | Tx7p     | Transmitter Non-Inverted Data Input | 3A |
| 75 | CML-I | Tx7n     | Transmitter Inverted Data Input     | 3A |
| 76 |       | GND      | Ground                              | 1A |

# MSA Compliant Connector



Top side viewed from top

Legacy QSFP28 Pads      Additional QSFP-DD Pads

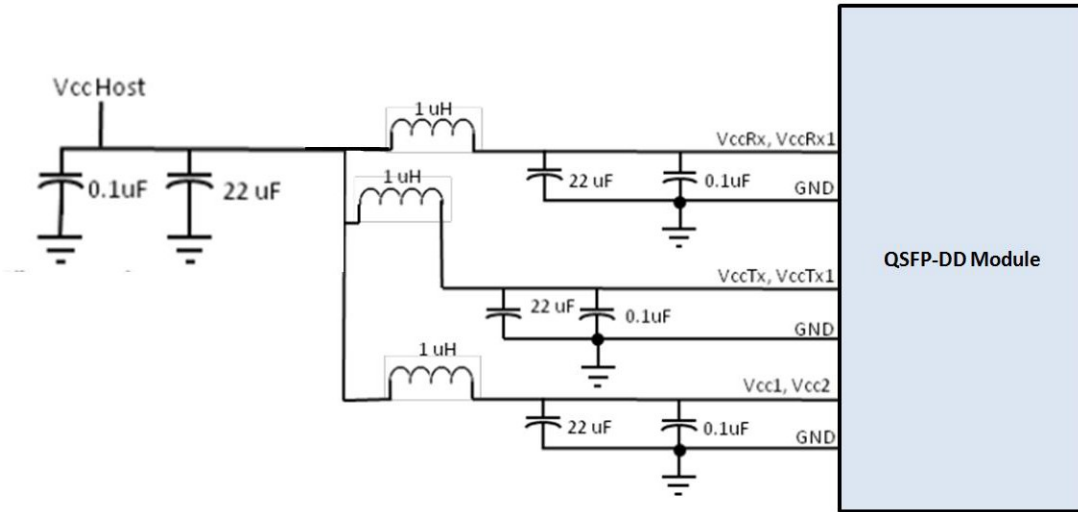


Bottom side viewed from bottom

Additional QSFP-DD Pads      Legacy QSFP28 Pads



## Recommended Power Supply Filter



## Digital Diagnostic Functions

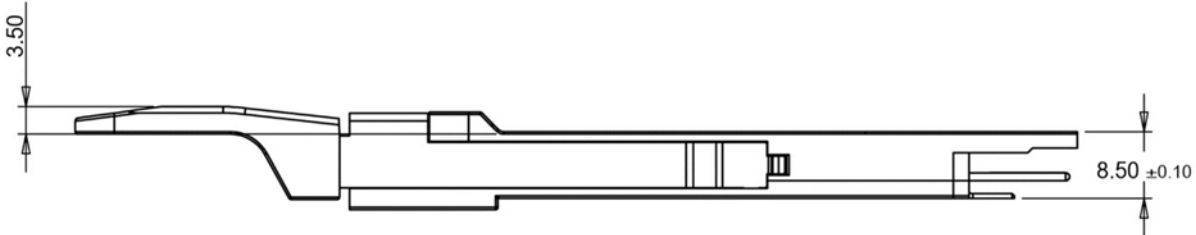
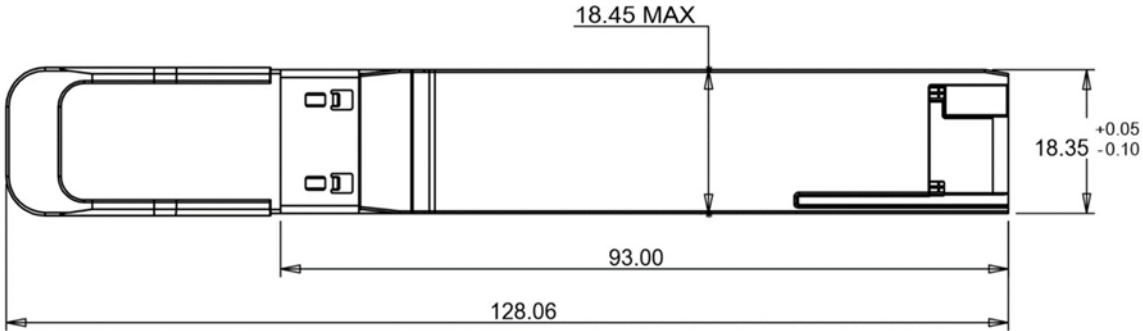
The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

| 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    | -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 single mode fibers, there could be an additional +/- 1 dB fluctuation, or a +/- 3 dB total accuracy.

**Mechanical Specifications**



## **About ProLabs**

Our experience comes as standard; for over 15 years ProLabs has delivered optical connectivity solutions that give our customers freedom and choice through our ability to provide seamless interoperability. At the heart of our company is the ability to provide state-of-the-art optical transport and connectivity solutions that are compatible with over 90 optical switching and transport platforms.

## **Complete Portfolio of Network Solutions**

ProLabs is focused on innovations in optical transport and connectivity. The combination of our knowledge of optics and networking equipment enables ProLabs to be your single source for optical transport and connectivity solutions from 100Mb to 400G while providing innovative solutions that increase network efficiency. We provide the optical connectivity expertise that is compatible with and enhances your switching and transport equipment.

## **Trusted Partner**

Customer service is our number one value. ProLabs has invested in people, labs and manufacturing capacity to ensure that you get immediate answers to your questions and compatible product when needed. With Engineering and Manufacturing offices in the U.K. and U.S. augmented by field offices throughout the U.S., U.K. and Asia, ProLabs is able to be our customers best advocate 24 hours a day.

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