



## QBPQL002E00FZNW

Juniper Networks® QDD-400G-FR4 Compatible 400GBase-FR4 QSFP-DD Transceiver (SMF, 1310nm, 2km, LC, DOM, 0 to 70C)

### Product Description

This Juniper Networks® QDD-400G-FR4 compatible QSFP-DD transceiver provides 400GBase-FR4 throughput up to 2km over single-mode fiber (SMF) using a wavelength of 1310nm via an LC connector. It can operate at temperatures between 0 and 70C. Our transceiver is built to meet or exceed OEM specifications and is guaranteed to be 100% compatible with Juniper Networks®. It has been programmed, uniquely serialized, and tested for data-traffic and application to ensure that it will initialize and perform identically. All of our transceivers comply with Multi-Source Agreement (MSA) standards to provide seamless network integration. Additional product features include Digital Optical Monitoring (DOM) support which allows access to real-time operating parameters. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

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

### Features:

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



### Applications:

- 400GBase Ethernet
- Access and Enterprise

---

*For your product safety, please read the following information carefully before any manipulation of the transceiver:*



#### **ESD**

This transceiver is specified as ESD threshold 1kV for SFI pins and 2kV for all others electrical input pins, tested per MIL-STD-883G, Method 3015.4 / JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module.



#### **LASER SAFETY**

This is a Class1 Laser Product according to IEC 60825-1:2007. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).

*The optical ports of the module need to be terminated with an optical connector or with a dust plug in order to avoid contamination.*

---

## 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               | V <sub>CC</sub>  | -0.5 | 3.6  | V    |
| Storage Temperature                | T <sub>stg</sub> | -40  | 85   | °C   |
| Operating Case Temperature         | T <sub>c</sub>   | 0    | 70   | °C   |
| Relative Humidity (non-condensing) | RH               | 0    | 85   | %    |

## Recommended Operating Conditions

| Parameter                  | Symbol          | Min.  | Typ.    | Max.                 | Unit | Notes |
|----------------------------|-----------------|-------|---------|----------------------|------|-------|
| Operating Case Temperature | T <sub>c</sub>  | 0     |         | 70                   | °C   |       |
| Power Supply Voltage       | V <sub>CC</sub> | 3.135 | 3.3     | 3.465                | V    |       |
| Data Rate Per Lane         |                 |       | 26.5625 |                      | GBd  | PAM4  |
| Data Rate Accuracy         |                 | -100  |         | 100                  | ppm  |       |
| Pre-FEC Bit Error Ratio    |                 |       |         | 2.4x10 <sup>-4</sup> |      |       |
| Post-FEC Bit Error Ratio   |                 |       |         | 1x10 <sup>-12</sup>  |      | 1     |
| Link Distance              | D               | 0.5   |         | 2000                 | m    | 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 Per Lane                            | TP1             | 26.5625 ± 100 ppm                |       |      | GBd   |       |
| Differential pk-pk Input Voltage Tolerance         | TP1a            | 900                              |       |      | mVp-p | 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 (Minimum)     | 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  | mVp-p |       |
| 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 is generated by the host. Specification includes effects of ground offset voltage.

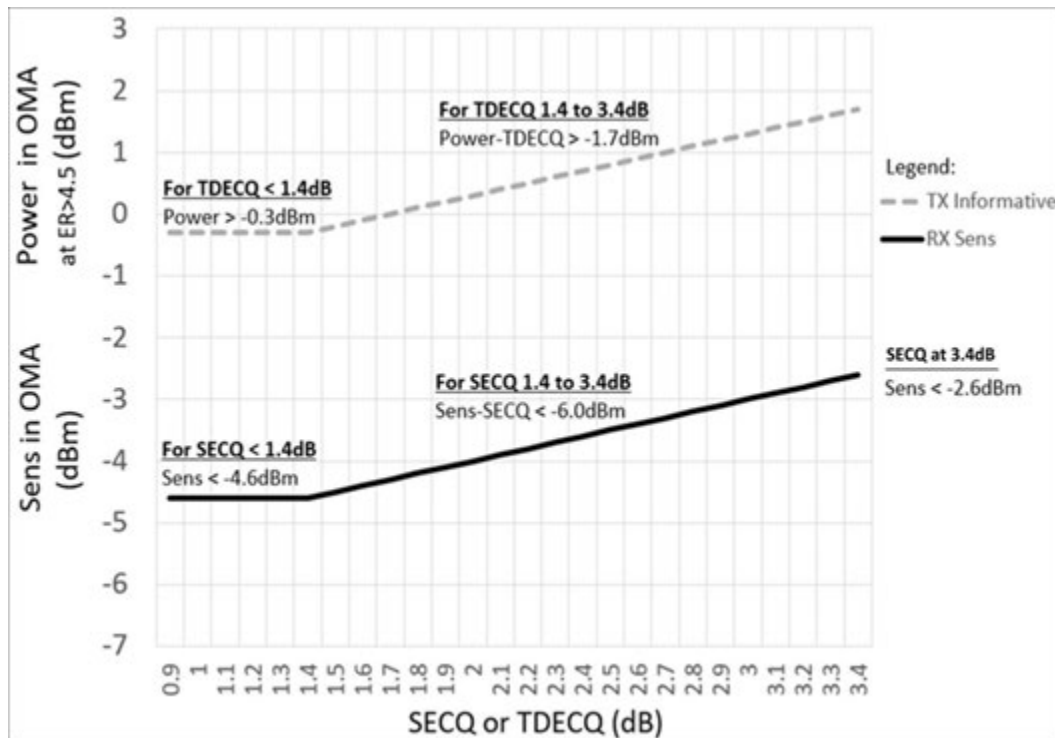
## Optical Characteristics

| 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 |       |                               |
| Transmitter                                                                |                  |                  |      |        |       |                               |
| Data Rate Per Lane                                                         |                  | 53.125 ± 100 ppm |      |        | GBd   |                               |
| Modulation Format                                                          |                  | PAM4             |      |        |       |                               |
| Side-Mode Suppression Ratio                                                | SMSR             | 30               |      |        | dB    | Modulated                     |
| Total Average Launch Power                                                 | PT               |                  |      | 9.3    | dBm   |                               |
| Average Launch Power Per Lane                                              | Pavg             | -3.3             |      | 3.5    | dBm   | 1                             |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) Per Lane        | POMA             | -0.3             |      | 3.7    | dBm   | 2                             |
| Launch Power in OMA <sub>outer</sub> minus TDECQ Per Lane                  |                  | -1.7             |      |        | dB    | For ER ≥4.5dB                 |
| Launch Power in OMA <sub>outer</sub> minus TDECQ Per Lane                  |                  | -1.6             |      |        | dB    | For ER <4.5dB                 |
| Transmitter and Dispersion Eye Closer for PAM4 Per 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              |                  |      | 17.1   | dB    |                               |
| Transmitter Reflectance                                                    |                  |                  |      | -26    | dB    |                               |
| Average Launch Power of OFF Transmitter Per Lane                           | P <sub>off</sub> |                  |      | -20    | dBm   |                               |
| Receiver                                                                   |                  |                  |      |        |       |                               |
| Data Rate Per Lane                                                         |                  | 53.125 ± 100 ppm |      |        | GBd   |                               |
| Modulation Format                                                          |                  | PAM4             |      |        |       |                               |
| Damage Threshold Per Lane                                                  | TH <sub>d</sub>  | 4.5              |      |        | dBm   | 3                             |
| Average Receive Power Per Lane                                             |                  | -7.3             |      | 3.5    | dBm   | 4                             |
| Receive Power (OMA <sub>outer</sub> ) Per Lane                             |                  |                  |      | 3.7    | dBm   |                               |
| Difference in Receiver Power Between Any Two Lanes (OMA <sub>outer</sub> ) |                  |                  |      | 4.1    | dB    |                               |
| Receiver Sensitivity (OMA <sub>outer</sub> ) Per Lane                      | S                |                  |      | -5.0   | dBm   | For BER of 2.4E <sup>-4</sup> |
| Stressed Receiver Sensitivity (OMA <sub>outer</sub> ) Per Lane             | SRS              | See Figure Below |      |        | dBm   | 5                             |
| Receiver Reflectance                                                       |                  |                  |      | -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 (minimum), 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  $\geq 4.5$ dB or TDECQ<1.3dB for an extinction ratio of <4.5 dB, the OMA<sub>outer</sub> (minimum) 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 (minimum) 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 =  $2.4 \times 10^{-4}$ . 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.

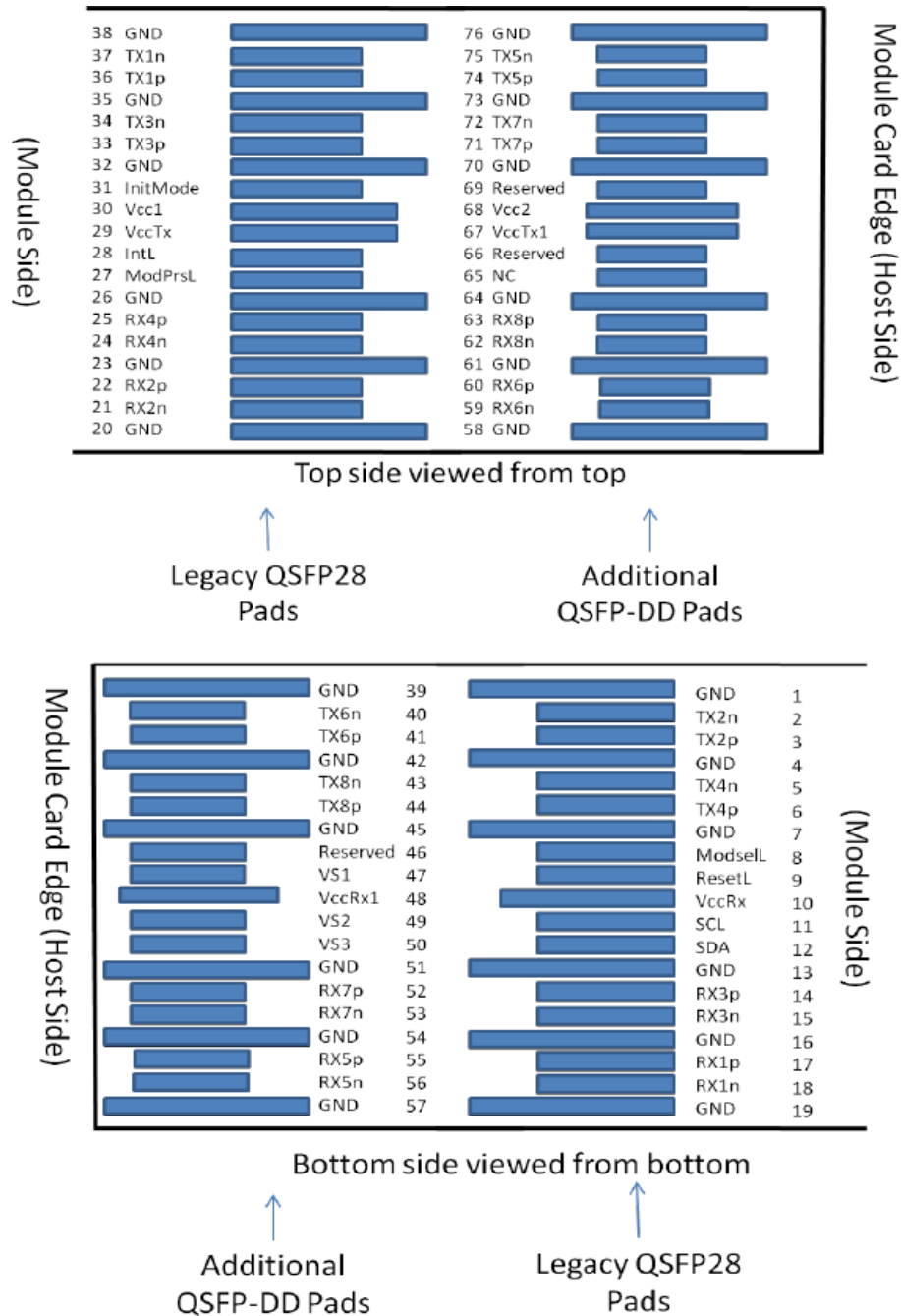


## Pin Descriptions

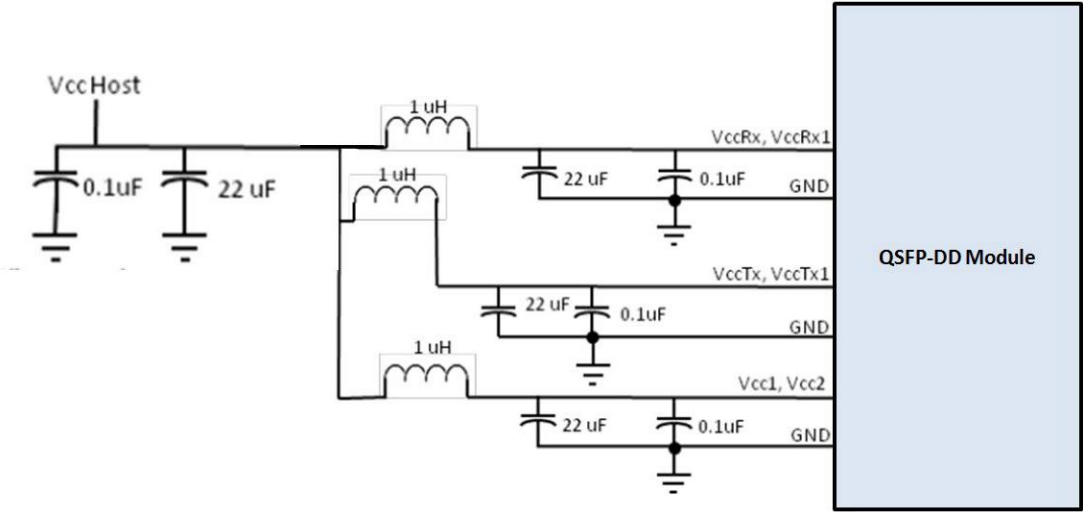
| Pin | Logic       | Symbol   | Name/Descriptions                                                                    | Plug Sequence |
|-----|-------------|----------|--------------------------------------------------------------------------------------|---------------|
| 1   |             | GND      | Module Ground.                                                                       | 1B            |
| 2   | CML-I       | Tx2-     | Transmitter Inverted Data Input.                                                     | 3B            |
| 3   | CML-I       | Tx2+     | Transmitter Non-Inverted Data Input.                                                 | 3B            |
| 4   |             | GND      | Module Ground.                                                                       | 1B            |
| 5   | CML-I       | Tx4-     | Transmitter Inverted Data Input.                                                     | 3B            |
| 6   | CML-I       | Tx4+     | Transmitter Non-Inverted Data Input.                                                 | 3B            |
| 7   |             | GND      | Module 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      | Module Ground.                                                                       | 1B            |
| 14  | CML-O       | Rx3+     | Receiver Non-Inverted Data Output.                                                   | 3B            |
| 15  | CML-O       | Rx3-     | Receiver Inverted Data Output.                                                       | 3B            |
| 16  | GND         | Ground   | Module Ground.                                                                       |               |
| 17  | CML-O       | Rx1+     | Receiver Non-Inverted Data Output.                                                   | 3B            |
| 18  | CML-O       | Rx1-     | Receiver Inverted Data Output.                                                       | 3B            |
| 19  |             | GND      | Module Ground.                                                                       | 1B            |
| 20  |             | GND      | Module Ground.                                                                       | 1B            |
| 21  | CML-O       | Rx2-     | Receiver Inverted Data Output.                                                       | 3B            |
| 22  | CML-O       | Rx2+     | Receiver Non-Inverted Data Output.                                                   | 3B            |
| 23  |             | GND      | Module Ground.                                                                       | 1B            |
| 24  | CML-O       | Rx4-     | Receiver Inverted Data Output.                                                       | 3B            |
| 25  | CML-O       | Rx4+     | Receiver Non-Inverted Data Output.                                                   | 3B            |
| 26  |             | GND      | Module 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      | Module Ground.                                                                       | 1B            |
| 33  | CML-I       | Tx3+     | Transmitter Non-Inverted Data Input.                                                 | 3B            |
| 34  | CML-I       | Tx3-     | Transmitter Inverted Data Input.                                                     | 3B            |
| 35  |             | GND      | Module Ground.                                                                       | 1B            |
| 36  | CML-I       | Tx1+     | Transmitter Non-Inverted Data Input.                                                 | 3B            |
| 37  | CML-I       | Tx1-     | Transmitter Inverted Data Input.                                                     | 3B            |
| 38  |             | GND      | Module Ground.                                                                       | 1B            |
| 39  |             | GND      | Module Ground.                                                                       | 1A            |
| 40  | CML-I       | Tx6-     | Transmitter Inverted Data Input.                                                     | 3A            |

|    |       |          |                                      |    |
|----|-------|----------|--------------------------------------|----|
| 41 | CML-I | Tx6+     | Transmitter Non-Inverted Data Input. | 3A |
| 42 |       | GND      | Module Ground.                       | 1A |
| 43 | CML-I | Tx8-     | Transmitter Inverted Data Input.     | 3A |
| 44 | CML-I | Tx8+     | Transmitter Non-Inverted Data Input. | 3A |
| 45 |       | GND      | Module 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      | Module Ground.                       | 1A |
| 52 | CML-O | Rx7+     | Receiver Non-Inverted Data Output.   | 3A |
| 53 | CML-O | Rx7-     | Receiver Inverted Data Output.       | 3A |
| 54 |       | GNZ      | Module Ground.                       | 1A |
| 55 | CML-O | Rx5+     | Receiver Non-Inverted Data Output.   | 3A |
| 56 | CML-O | Rx5-     | Receiver Inverted Data Output.       | 3A |
| 57 |       | GND      | Module Ground.                       | 1A |
| 58 |       | GND      | Module Ground.                       | 1A |
| 59 | CML-O | Rx6-     | Receiver Inverted Data Output.       | 3A |
| 60 | CML-O | Rx6+     | Receiver Non-Inverted Data Output.   | 3A |
| 61 |       | GND      | Module Ground.                       | 1A |
| 62 | CML-O | Rx8-     | Receiver Inverted Data Output.       | 3A |
| 63 | CML-O | Rx8+     | Receiver Non-Inverted Data Output.   | 3A |
| 67 |       | GND      | Module 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      | Module Ground.                       | 1A |
| 74 | CML-I | Tx7+     | Transmitter Non-Inverted Data Input. | 3A |
| 75 | CML-I | Tx7-     | Transmitter Inverted Data Input.     | 3A |
| 76 |       | GND      | Module Ground.                       | 1A |

MSA Compliant Connector



Recommended Power Supply Filter



Digital Diagnostic Functions

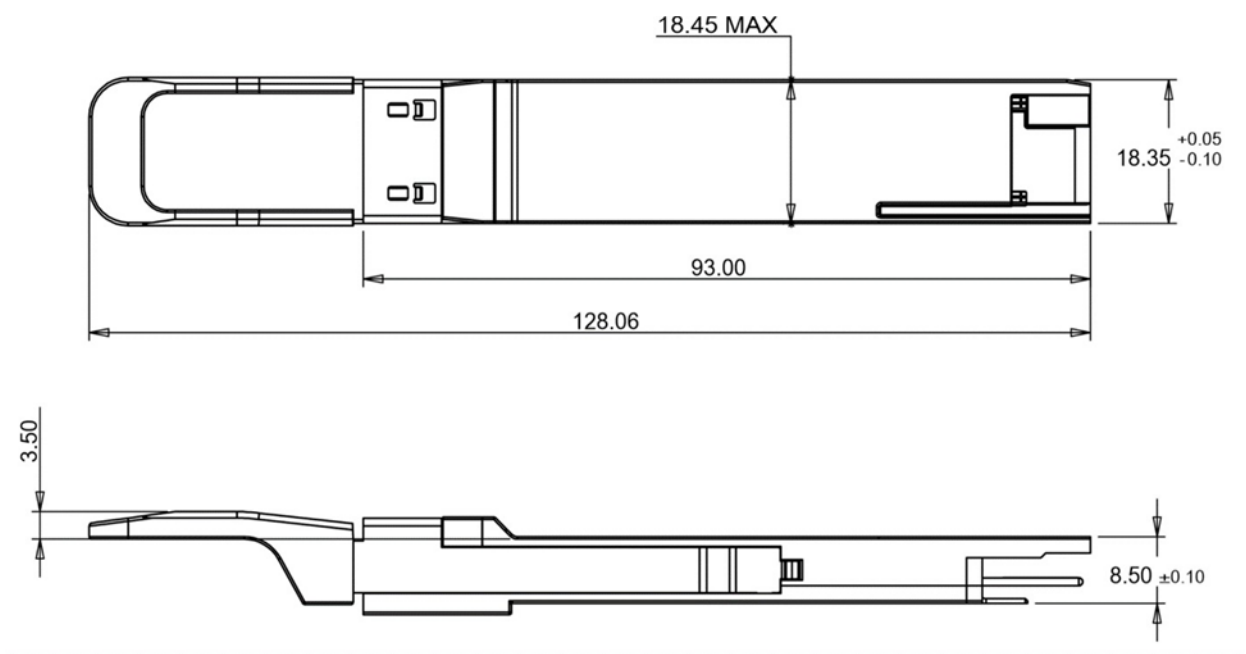
The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

| 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 Skylane Optics

Skylane is a leading provider of transceivers for optical communication.

We offer an extensive portfolio for the enterprise, access, datacenter and metropolitan fiber optical market as well as for smart home applications and home networks.

We cover the European, South American and North American market with a strong partner network and have offices in Belgium, Brazil, Sweden and USA.

Our offerings are characterized by high quality and performance. In combination with our strong technical support, we enable our customers to build cost optimized network solutions.

We offer an extensive range of high-quality products including transceivers (Optical and copper), Active Optical Cable (AOC), Direct Attach Cable (DAC), Mux/Demux, Coding Box.

