# Product Specification Sheet

## TNSQ004X1C-CNMXX

## 40G QSFP+ to 4x SFP+ Active Optical Cable

## Features

### QSFP+ AOC end:

- Compliant to the 40GBASE-SR4 and XLPPI

  Specification per IEEE 802.3ba-2010 and supporting

  40G-IB-QDR / 20G-IB-DDR / 10G-IB-SDR applications

- Compliant to the industry standard SFF-8436

QSFP+ Specification

- Power Level 1: Max Power < 1.5 W

- Operate at 10.3125 Gbps per channel with 64b/66b

  encoded data for 40GbE application and at 10 Gbps

  with 8b/10b compatible encoded data for 40G-IB-QDR application

### Each 4× SFP+ end:

- Compliant to the electrical specifications per SFF-8431 Specifications for Enhanced Small Form Factor Pluggable Module

- Mechanical specifications per SFF Committee SFF-8432 Improved Pluggable Form factor "IPF"

- Maximum power dissipation 0.35W per end.

### Active Optical Cable Assembly:

- 0 to 70 C degree case temperature operating range

- Proven High Reliability 850 nm technology:  VCSEL transmitter and PIN receiver

- Hot pluggable for ease of servicing and installation

- Two Wire Serial interface

- Utilizes optical fiber for high density and thin, lightweight cable management

## Applications

- 40GbE and 10GbE break-out applications for Datacom switch and router connections

- 40G to 4×10G density applications for Datacom and Proprietary protocol applications • Datacenter

## Description

The TRUSTNUO TNSQ004X1C-CNMXX is a Four-Channel, Pluggable, Parallel, Fiber-Optic QSFP+ Active Optical Cable (AOC) to 4× SFP+ Active Optical Cable break-out solution. This Breakout cable is intended for 40G to 4× 10G applications.

This AOC is a high performance cable for short-range multi-lane data communication and interconnect applications. It integrates four data lanes in each direction with 40 Gbps aggregate bandwidth. Each lane can operate at 10.3125 Gbps. These cables also support 4 x 10G InfiniBand QDR applications and are backwards compatible to the 4 × 5G IB DDR and 4 × 2.5G IB single IB SDR applications.

This product is leveraged from TRUSTNUO QSFP+ to QSFP+ Active Optical Cable product and SFP+ Active Optical Cable product. Where applicable, consult these respective datasheets

This AOC incorporates the proven integrated circuit and VCSEL technology to provide reliable long life, high performance, and consistent service.

## Absolute Maximum Ratings

The operation in excess of any absolute maximum ratings might cause permanent damage to this module.

| Parameter | Symbol | Min | Max | Unit | Note |
|-----------|--------|-----|-----|------|------|
| Storage Temperature | TST | -40 | 85 | degC | |
| Relative Humidity(non-condensing) | RH | 0 | 85 | % | |
| Operating Case Temperature | TOPC | 0 | 70 | degC | |
| Supply Voltage | VCC | -0.3 | 3.6 | V | |
| Input Voltage | Vin | -0.3 | Vcc+0.3 | V | |

## Recommended Operating Conditions and Supply Requirements

| Parameter | Symbol | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Operating Case Temperature | TOPC | 0 | | 70 | degC |
| Power Supply Voltage | VCC | 3.13 | 3.3 | 3.47 | V |
| Data Rate | DR | | 10.3 | 11.3 | Gbps |
| Data Speed Tolerance | DR | | +100 | | ppm |
| Link Distance with OM3 fiber | | 0 | | 100 | m |
| Control* Input Voltage High | Vih | 2 | | VCC+0.3 | V |
| Control* Input Voltage Low | Vil | -0.3 | | 0.8 | V |
| I2C Serial Interface frequence | fs | | | 400k | Hz |
| Power Supply Noise | | | | 50 | mVpp |
| Receiver Differential Data Output Load | | | | 100 | mVpp |

## Active Cable-End Electrical Characteristics

The following characteristics are defined over the Recommended Operating

Conditions unless otherwise noted. Typical values are for Tc = 40 °C, Vcc =

3.3 V

| Parameter | Symbol | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| QSFP+ 40G Active Cable-End | | | | | |
| Power Consumption QSFP+ 40G Active Cable-End | | | | 1.5 | W |
| Power Supply Current SFP+ 10G Active Cable-End | | | | 300 | mA |
| Power Consumption SFP+ 10G Active Cable-End | | | | 0.35 | W |
| Power Supply Current | | | | 100 | mA |

## QSFP+ AOC-end Electrical Characteristics Electrical Specifications

| Parameter | Symbol | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Differential input impedance | Zin | 90 | 100 | 110 | ohm |
| Differential Output impedance | Zout | 90 | 100 | 110 | ohm |
| Differential input voltage amplitude | ΔVin | 300 | | 1100 | mVp-p |
| Differential output voltage amplitude | ΔVout | 400 | | 800 | mVp-p |
| Bit Error Rate | BR | | | E-12 | |
| Input Logic Level High | VIH | 2.0 | | VCC | V |
| Input Logic Level Low | VIL | 0 | | 0.8 | V |
| Output Logic Level High | VOH | VCC-0.5 | | VCC | V |
| Output Logic Level Low | VOL | 0 | | 0.4 | V |

## QSFP+ AOC-end Pin Descriptions

| PIN | Logic | Symbol | Name/Description | Note |
|---|---|---|---|---|
| 1 | | GND | Ground | |
| 2 | CML-I | Tx2n | Transmitter Inverted Data Input | |
| 3 | CML-I | Tx2p | Transmitter Non-Inverted Data output | |
| 4 | | GND | Ground | |
| 5 | CML-I | Tx4n | Transmitter Inverted Data Input | |
| 6 | CML-I | Tx4p | Transmitter Non-Inverted Data output | |
| 7 | LVTLL-I | GND | Ground | |
| 8 | LVTLL-I | ModSelL | Module Select | |
| 9 | | ResetL | Module Reset | |
| 10 | LVCMOS-I/O | VccRx | + 3.3V Power Supply Receiver | |
| 11 | LVCMOS-I/O | SCL | 2-Wire Serial Interface Clock | |
| 12 | | SDA | 2-Wire Serial Interface Data | |

| 13 | | GND | Ground | |
|----|------|------|--------|---|
| 14 | CML-O | Rx3p | Receiver Non-Inverted Data Output | |
| 15 | CML-O | Rx3n | Receiver Inverted Data Output | |
| 16 | | GND | Ground | 1 |
| 17 | CML-O | Rx1p | Receiver Non-Inverted Data Output | |
| 18 | CML-O | Rx1n | Receiver Inverted Data Output | |
| 19 | | GND | Ground | 1 |
| 20 | | GND | Ground | 1 |
| 21 | CML-O | Rx2n | Receiver Inverted Data Output | |
| 22 | CML-O | Rx2p | Receiver Non-Inverted Data Output | |
| 23 | | GND | Ground | 1 |
| 24 | CML-O | Rx4n | Receiver Inverted Data Output | 1 |
| 25 | CML-O | Rx4p | Receiver Non-Inverted Data Output | |
| 26 | | GND | Ground | 1 |
| 27 | LVTTL-O | ModPrsL | Module Present | |
| 28 | LVTTL-O | IntL | Interrupt | |
| 29 | | VccTx | +3.3 V Power Supply transmitter | 2 |
| 30 | | Vcc1 | +3.3 V Power Supply | 2 |
| 31 | LVTTL-I | LPMode | Low Power Mode | |
| 32 | | GND | Ground | 1 |
| 33 | CML-I | Tx3p | Transmitter Non-Inverted Data Input | |
| 34 | CML-I | Tx3n | Transmitter Inverted Data Output | |
| 35 | | GND | Ground | 1 |
| 36 | CML-I | Tx1p | Transmitter Non-Inverted Data Input | |
| 37 | CML-I | Tx1n | Transmitter Inverted Data Output | |
| 38 | | GND | Ground | 1 |

**Notes:**

1) Module circuit ground is isolated from module chassis ground within the module. GND is the symbol for signal and supply (power) common for QSFP modules.

| 38 | GND |
| 37 | TX1n |
| 36 | TX1p |
| 35 | GND |
| 34 | TX3n |
| 33 | TX3p |
| 32 | GND |
| 31 | LPMode |
| 30 | Vcc1 |
| 29 | VccTx |
| 28 | IntL |
| 27 | ModPrsL |
| 26 | GND |
| 25 | RX4p |
| 24 | RX4n |
| 23 | GND |
| 22 | RX2p |
| 21 | RX2n |
| 20 | GND |

Top Side
Viewed from Top

Card Edge

| GND | 1 |
| TX2n | 2 |
| TX2p | 3 |
| GND | 4 |
| TX4n | 5 |
| TX4p | 6 |
| GND | 7 |
| ModSelL | 8 |
| ResetL | 9 |
| VccRx | 10 |
| SCL | 11 |
| SDA | 12 |
| GND | 13 |
| RX3p | 14 |
| RX3n | 15 |
| GND | 16 |
| RX1p | 17 |
| RX1n | 18 |
| GND | 19 |

Bottom Side
Viewed from Bottom
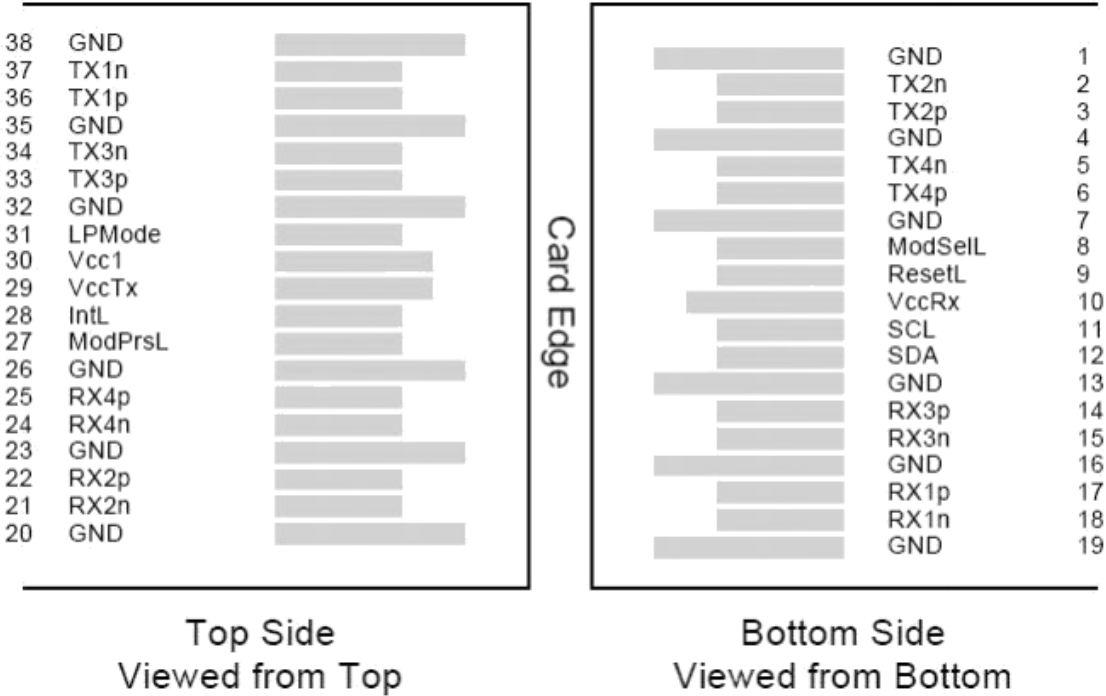
**ModSelL Pin**

The ModSelL is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple QSFP modules on a single 2-wire interface bus. When the ModSelL is "High" , the module will not respond to any 2-wire interface communication from the host. ModSelL has an internal pull-up in the module.

**ResetL Pin**

Reset. LPMode_Reset has an internal pull-up in the module. A low level on the ResetL pin for longer than the minimum pulse length (t_Reset_init) initiates a complete module reset, returning all user module settings to their default state. Module Reset Assert Time (t_init) starts on the rising edge after the low level on the ResetL pin is released. During the execution of a reset (t_init) the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by posting an IntL signal with the Data_Not_Ready bit

negated. Note that on power up (including hot insertion) the module will post this completion of reset interrupt without requiring a reset.

## LPMode Pin

QSFP+ SR4 operate in the low power mode (less than 1.5 W power consumption) This pin active high will decrease power
consumption to less than 1W.

## ModPrsL Pin

ModPrsL is pulled up to Vcc on the host board and grounded in the module. The ModPrsL is asserted "Low" when the module is inserted and deasserted "High" when the module is physically absent from the host connector.

## IntL Pin

IntL is an output pin. When "Low", it indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt by using the 2-wire serial interface.
The IntL pin is an open collector output and must be pulled up to Vcc on the host board.

## QSFP+ AOC-end Power Supply Filtering

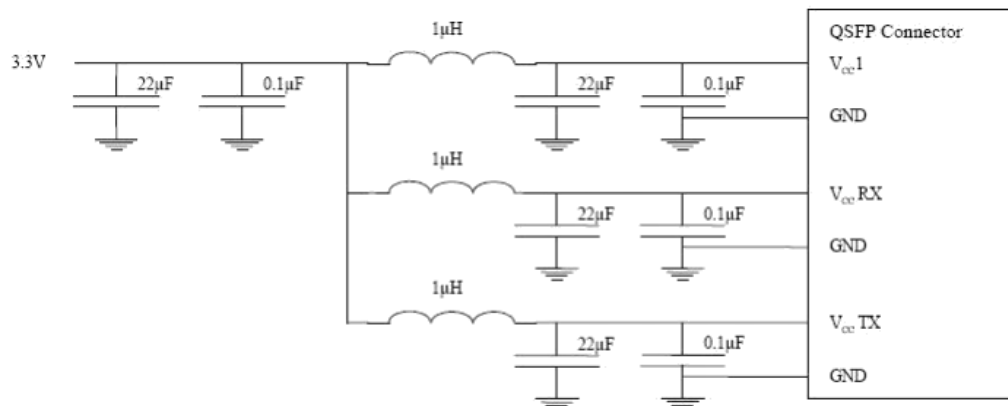The host board should use the power supply filtering shown in Figure1.



**Figure1. Host Board Power Supply Filtering**

## QSFP+ AOC-end EEPROM Serial ID Memory Contents:

Compliant to the industry standard SFF-8436 QSFP+ Specification

## SFP+ AOC-end Electrical Specifications

| Parameter | Symbol | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Differential input impedance | Zin | 90 | 100 | 110 | ohm |
| Differential Output impedance | Zout | 90 | 100 | 110 | ohm |
| Differential input voltage amplitude aAmplitude | ΔVin | 100 | | 1800 | mVp-p |
| Differential output voltage amplitude | ΔVout | 400 | | 800 | mVp-p |
| Bit Error Rate | BR | | | E-12 | |
| Input Logic Level High | VIH | 2.0 | | VCC | V |
| Input Logic Level Low | VIL | 0 | | 0.8 | V |

## SFP+ AOC-end Pin Descriptions

| PIN | Symbol | Name/Description | Note |
|---|---|---|---|
| 1 | VeeT | Transmitter | Note1 |
| 2 | TX_FAULT | Transmitter Fault (LVTTL-O) – Not | Note2 |
| 3 | TX_DISABLE | Transmitter Disable (LVTTL-I) – High | Note3 |
| 4 | SDA | Two Wire Serial Interface Data Line (LVCMOS – I/O) | Note4 |

| | | | |
|---|---|---|---|
| **5** | SCL | Two Wire Serial Interface Clock Line (LVCMOS – I/O) (same as MOD-DEF1 in INF-8074) | Note 4 |
| 6 | MOD_ABS | Module Absent (Output), connected to VeeT or VeeR in the module | Note 5 |
| 7 | RS0 | Rate Select 0 - Not used, Presents high input impedance. | |
| 8 | RX_LOS | Receiver Loss of Signal (LVTTL-O) | Note 2 |
| 9 | RS1 | Rate Select 1 - Not used, Presents high input impedance. | |
| 10 | VeeR | Receiver Signal Ground | Note 1 |
| 11 | VeeR | Receiver Signal Ground | Note 1 |
| 12 | RD- | Receiver Data Out Inverted (CML-O) | |
| 13 | RD+ | Receiver Data Out (CML-O) | |
| 14 | VeeR | Receiver Signal Ground | |
| 15 | VccR | Receiver Power + 3.3 V | |
| 16 | VccT | Transmitter Power + 3.3 V | |
| 17 | VeeT | Transmitter Signal Ground | Note 1 |
| 18 | TD+ | Transmitter Data In (CML-I) | |
| 19 | TD- | Transmitter Data In Inverted (CML-I) | |
| 20 | VeeT | Transmitter Signal Ground | Note 1 |

**Notes:**

1. Module circuit ground is isolated from module chassis ground within the module. GND is the symbol for signal and supply (power) common for SFP modules.

2. This is an open collector/drain output that on the host board requires a 4.7 kΩ to 10 kΩ pullup resistor to VccHost. See Figure 2.

3. This input is internally biased high with a 4.7 kΩ to 10 kΩ pullup resistor to VccT.

4. Two-Wire Serial interface clock and data lines require an external pullup resistor dependent on the capacitance load.

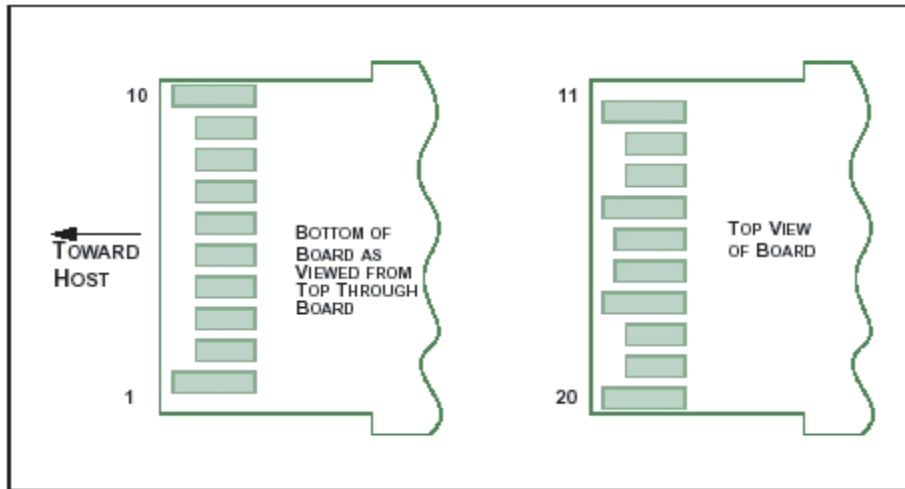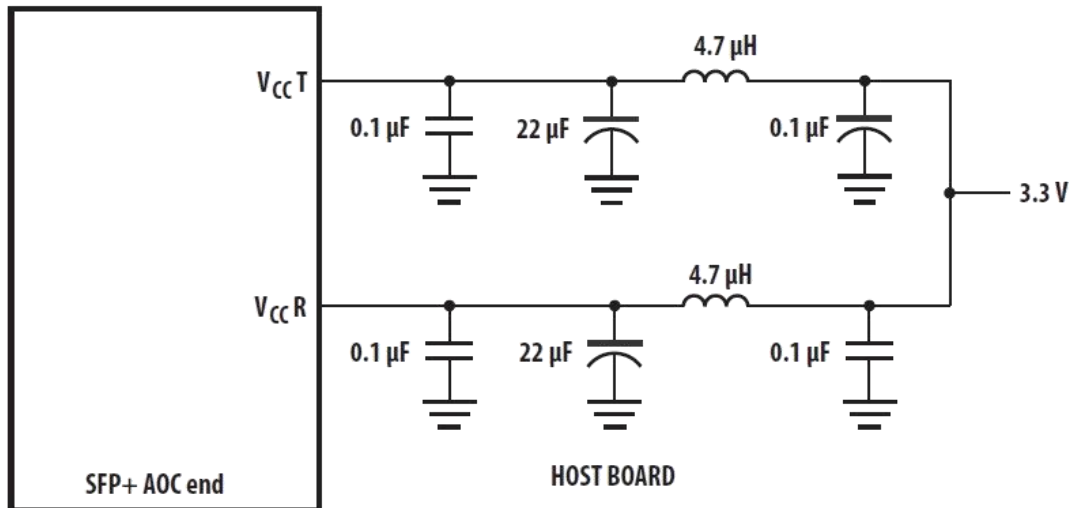5. This is a ground return that on the host board requires a 4.7 kΩ to 10 kΩ pullup resistor to VccHost.

**Figure 2**

## QSFP+ AOC-end Power Supply Filtering



NOTE: INDUCTORS MUST HAVE LESS THAN 1Ω SERIES RESISTANCE TO LIMIT VOLTAGE DROP TO THE SFP MODULE.

## Optical Fiber Specifications

| Parameter | Specification |
|---|---|
| Tight buffer color | Blue |
| Tight buffer material | PVC |
| Fiber type | 62.5/125 (OFS)<br>Bandwith:160 MHz.km @ 850 nm |
| Jacket material | PVC |
| Cable diameter mm | 3.0 ± 0.1 |
| Cable weight Kg/km | 7.0 |
| Min. bending radius mm | 30 |
| Attenuation dB/km | ≤ 3.5 at 850 nm<br>≤ 1.5 at 1300 nm |
| Short tension N | 120 |
| Operation temperature °C | -20~70 |

## SFP+ AOC end Mechanical Specifications
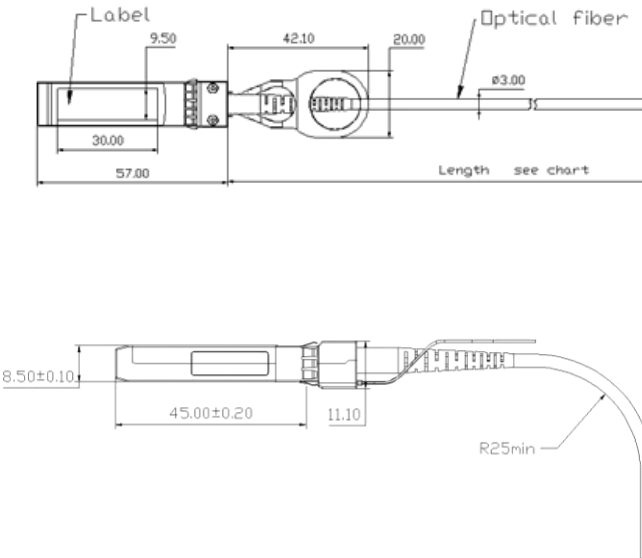
## QSFP+ AOC end Mechanical Specifications
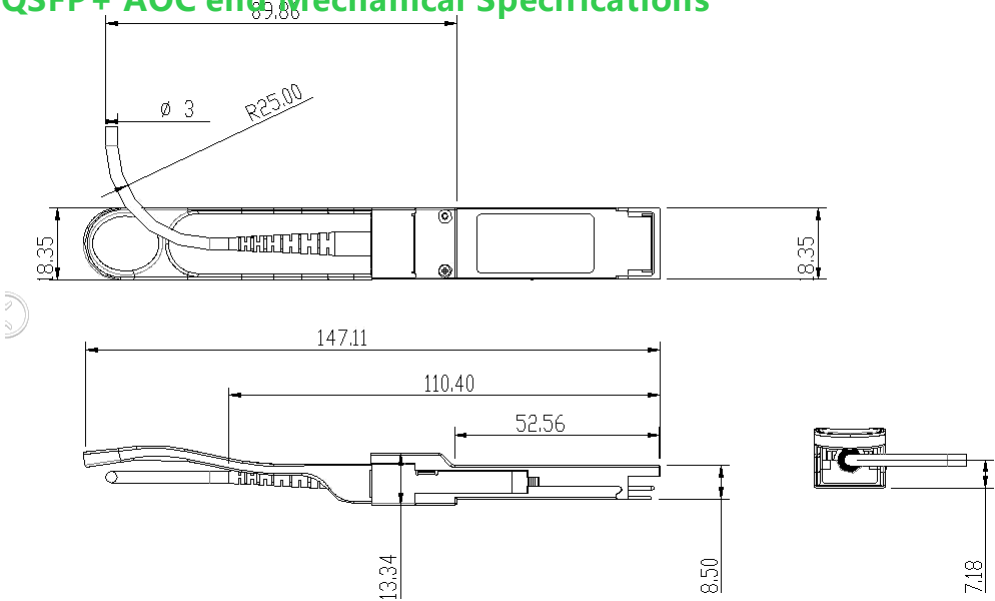


### ESD

This product is specified as ESD threshold 1KV for high speed data pins and 2KV for all others electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM).   However, normal ESD precautions are still required during the handling of this product. This product is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

### Order Information

| Part Number | Product Description |
|---|---|
| TNSQ004X1C-CNMXX | 40Gb/s QSFP+ −4x10G SFP+ Active Optical Cable |

**Notes:**

where "xx" denotes cable length in meters. Examples are as follows:

xx = 03 for 3m,     xx = 10 for 10m,     xx = 50 for 50m,     xx = A0 for 100m