

## QSFP28-4SFP28-AOC10M-HPA-AO

HP® Compatible TAA 100GBase-AOC QSFP28 to 4xSFP28 Direct Attach Cable (850nm, MMF, 10m)

### Features

- QSFP28 and SFP28 MSA Compliant
- Supports 103.1Gbps Aggregate Bit Rate
- Four Independent Full-Duplex Channels
- 25G Electrical Interface (OIF CEI-28G-VSR) for SFP28 Terminal
- Maximum Power Consumption of 2.5W for QSFP28 Terminal and 1.0W for Each SFP28 Terminal
- 4x25G Electrical Interface (OIF CEI-28G-VSR) for QSFP28 Terminal
- Operating Temperature: 0 to 70 Celsius
- Single Power Supply of 3.3V
- RoHS Compliant and Lead-Free



### Applications

- Infiniband EDR
- 100G Ethernet

### Product Description

This is a HP® Compatible 100GBase-AOC QSFP28 to 4xSFP28 active optical cable that operates over active fiber with a maximum reach of 10m. It has been programmed, uniquely serialized, and data-traffic and application tested to ensure it is 100% compliant and functional. We stand behind the quality of our products and proudly offer a limited lifetime warranty. This cable is TAA (Trade Agreements Act) compliant and is built to comply with MSA (Multi-Source Agreement) standards.

AddOn'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."



### Absolute Maximum Ratings

| Parameter                    | Symbol | Min. | Max. | Unit | Notes |
|------------------------------|--------|------|------|------|-------|
| Storage Temperature          | Tstg   | -40  | 85   | °C   |       |
| Operating Case Temperature   | Tc     | 0    | 70   | °C   |       |
| Power Supply Voltage         | Vcc    | -0.5 | 3.6  | V    |       |
| Relative Humidity            | RH     | 0    | 85   | %    | 1     |
| Data Rate Accuracy           |        | -100 |      | 100  | ppm   |
| Control Input Voltage - High |        | 2    |      | Vcc  | V     |
| Control Input Voltage - Low  |        | 0    |      | 0.8  | V     |

### Notes:

1. Non-condensing.

## QSFP28 Electrical Characteristics

| Parameter                                                                                        | Symbol / Test Point | Min.                                | Typ.      | Max.                           | Unit | Notes |
|--------------------------------------------------------------------------------------------------|---------------------|-------------------------------------|-----------|--------------------------------|------|-------|
| Power Consumption                                                                                |                     |                                     |           | 2.5                            | W    |       |
| Data Rate Per Lane                                                                               |                     |                                     | 25.781235 |                                |      |       |
| Supply Current                                                                                   | I <sub>cc</sub>     |                                     |           | 757                            | mA   |       |
| Power Supply Voltage                                                                             | V <sub>cc</sub>     | 3.135                               | 3.3       | 3.465                          |      |       |
| <b>Transmitter</b>                                                                               |                     |                                     |           |                                |      |       |
| Overload Differential Voltage Pk-Pk                                                              | TP1a                | 900                                 |           |                                | mV   |       |
| Common-Mode Voltage (V <sub>cm</sub> )                                                           | TP1                 | -350                                |           | 2850                           | mV   | 1     |
| Differential Termination Resistance Mismatch                                                     | TP1                 |                                     |           | 10                             | %    | 2     |
| Differential Return Loss (SDD11)                                                                 | TP1                 |                                     |           | See CEI-28G-VSR Equation 13-19 | dB   |       |
| Common-Mode to Differential Conversion and Differential to Common-Mode Conversion (SDC11, SCD11) | TP1                 |                                     |           | See CEI-28G-VSR Equation 13-20 | dB   |       |
| Stressed Input Test                                                                              | TP1a                | See CEI-28G-VSR Section 13.3.11.2.1 |           |                                |      |       |
| <b>Receiver</b>                                                                                  |                     |                                     |           |                                |      |       |
| Differential Voltage Pk-Pk                                                                       | TP4                 |                                     |           | 900                            | mV   |       |
| Common-Mode Voltage (V <sub>cm</sub> )                                                           | TP4                 | -350                                |           | 2850                           | mV   | 1     |
| Common-Mode Noise (RMS)                                                                          | TP4                 |                                     |           | 17.5                           | mV   |       |
| Differential Termination Resistance Mismatch                                                     | TP4                 |                                     |           | 10                             | %    | 2     |
| Common-Mode to Differential Conversion and Differential to Common-Mode Conversion (SDC22, SCD22) | TP4                 |                                     |           | See CEI-28G-VSR Equation 13    |      |       |
| Common-Mode Return Loss (SCC22)                                                                  | TP4                 |                                     |           | -2                             | dB   | 3     |
| Transition Time (20-80%)                                                                         | TP4                 | 9.5                                 |           | 5.5                            | dB   |       |
| Vertical Eye Closure (VEC)                                                                       | TP4                 |                                     |           | 5.5                            | dB   |       |
| Eye Width at 10 <sup>-15</sup> Probability (EW15)                                                | TP4                 | 0.57                                |           |                                | UI   |       |
| Eye Width at 10 <sup>-15</sup> Probability (EH15)                                                | TP4                 | 228                                 |           |                                | mV   |       |

### Notes:

1. V<sub>cm</sub> is generated by the host. Specification includes the effects of ground offset voltage.
2. At 1MHz.
3. From 250MHz to 30GHz.

## SFP28 Electrical Characteristics

| Parameter                                                                                        | Symbol / Test Point | Min.                                | Typ.      | Max.                           | Unit | Notes |
|--------------------------------------------------------------------------------------------------|---------------------|-------------------------------------|-----------|--------------------------------|------|-------|
| Power Consumption                                                                                |                     |                                     |           | 1.0                            | W    | 1     |
| Data Rate Per Lane                                                                               |                     |                                     | 25.781235 |                                |      |       |
| Supply Current                                                                                   | I <sub>cc</sub>     |                                     |           | 300                            | mA   | 1     |
| Power Supply Voltage                                                                             | V <sub>cc</sub>     | 3.135                               | 3.3       | 3.465                          |      |       |
| <b>Transmitter</b>                                                                               |                     |                                     |           |                                |      |       |
| Overload Differential Voltage Pk-Pk                                                              | TP1a                | 900                                 |           |                                | mV   |       |
| Common-Mode Voltage (V <sub>cm</sub> )                                                           | TP1                 | -350                                |           | 2850                           | mV   | 2     |
| Differential Termination Resistance Mismatch                                                     | TP1                 |                                     |           | 10                             | %    | 3     |
| Differential Return Loss (SDD11)                                                                 | TP1                 |                                     |           | See CEI-28G-VSR Equation 13-19 | dB   |       |
| Common-Mode to Differential Conversion and Differential to Common-Mode Conversion (SDC11, SCD11) | TP1                 |                                     |           | See CEI-28G-VSR Equation 13-20 | dB   |       |
| Stressed Input Test                                                                              | TP1a                | See CEI-28G-VSR Section 13.3.11.2.1 |           |                                |      |       |
| <b>Receiver</b>                                                                                  |                     |                                     |           |                                |      |       |
| Differential Voltage Pk-Pk                                                                       | TP4                 |                                     |           | 900                            | mV   |       |
| Common-Mode Voltage (V <sub>cm</sub> )                                                           | TP4                 | -350                                |           | 2850                           | mV   | 2     |
| Common-Mode Noise (RMS)                                                                          | TP4                 |                                     |           | 17.5                           | mV   | 3     |
| Differential Termination Resistance Mismatch                                                     | TP4                 |                                     |           | 10                             | %    |       |
| Differential Return Loss (SDD22)                                                                 | TP4                 |                                     |           | See CEI-28G-VSR Equation 13-19 |      |       |
| Common-Mode to Differential Conversion and Differential to Common-Mode Conversion (SDC22, SCD22) | TP4                 |                                     |           | See CEI-28G-VSR Equation 13-21 |      |       |
| Common-Mode Return Loss (SCC22)                                                                  | TP4                 |                                     |           | -2                             | dB   | 4     |
| Transition Time (20-80%)                                                                         | TP4                 | 9.5                                 |           | 5.5                            | dB   |       |
| Vertical Eye Closure (VEC)                                                                       | TP4                 |                                     |           | 5.5                            | dB   |       |
| Eye Width at 10 <sup>-15</sup> Probability (EW15)                                                | TP4                 | 0.57                                |           |                                | UI   |       |
| Eye Width at 10 <sup>-15</sup> Probability (EH15)                                                | TP4                 | 228                                 |           |                                | mV   |       |

### Notes:

1. Per terminal.
2. V<sub>cm</sub> is generated by the host. Specification includes the effects of ground offset voltage.
3. At 1MHz.
4. From 250MHz to 30GHz.

## QSFP28 Pin Descriptions

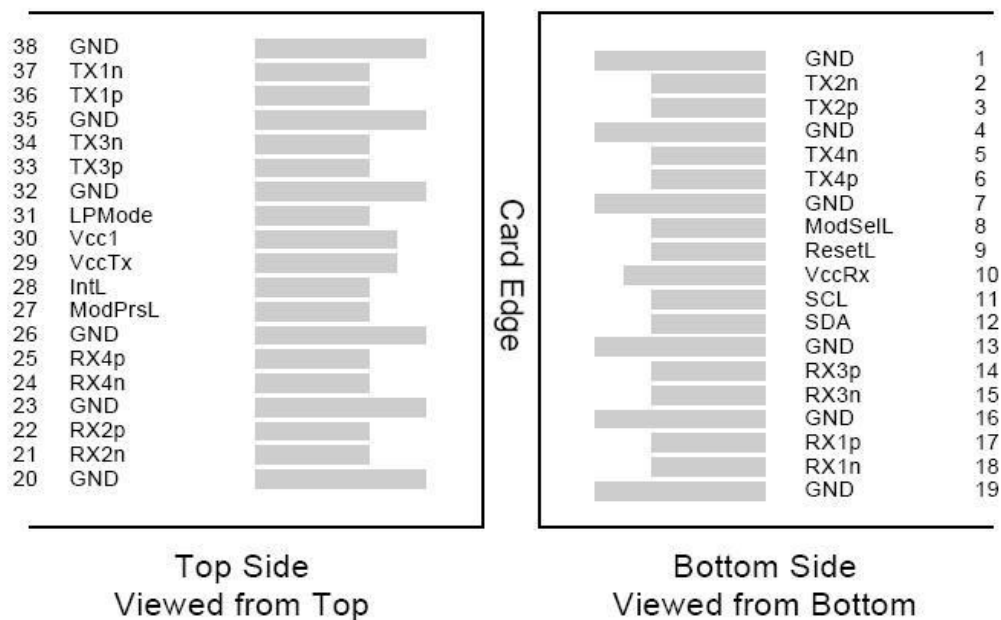
| Pin | Logic       | Symbol  | Name/Description                      | Notes |
|-----|-------------|---------|---------------------------------------|-------|
| 1   |             | GND     | Module Ground.                        | 1     |
| 2   | CML-I       | Tx2-    | Transmitter Inverted Data Input.      |       |
| 3   | CML-I       | Tx2+    | Transmitter Non-Inverted Data Output. |       |
| 4   |             | GND     | Module Ground.                        | 1     |
| 5   | CML-I       | Tx4-    | Transmitter Inverted Data Input.      |       |
| 6   | CML-I       | Tx4+    | Transmitter Non-Inverted Data Output. |       |
| 7   |             | GND     | Module Ground.                        | 1     |
| 8   | LVTTL-I     | ModSelL | Module Select.                        |       |
| 9   | LVTTL-I     | ResetL  | Module Reset.                         |       |
| 10  |             | VccRx   | +3.3V Receiver Power Supply.          | 2     |
| 11  | LVC MOS-I/O | SCL     | 2-Wire Serial Interface Clock.        |       |
| 12  | LVC MOS-I/O | SDA     | 2-Wire Serial Interface Data.         |       |
| 13  |             | GND     | Module Ground.                        |       |
| 14  | CML-O       | Rx3+    | Receiver Non-Inverted Data Output.    |       |
| 15  | CML-O       | Rx3-    | Receiver Inverted Data Output.        |       |
| 16  |             | GND     | Module Ground.                        | 1     |
| 17  | CML-O       | Rx1+    | Receiver Non-Inverted Data Output.    |       |
| 18  | CML-O       | Rx1-    | Receiver Inverted Data Output.        |       |
| 19  |             | GND     | Module Ground.                        | 1     |
| 20  |             | GND     | Module Ground.                        | 1     |
| 21  | CML-O       | Rx2-    | Receiver Inverted Data Output.        |       |
| 22  | CML-O       | Rx2+    | Receiver Non-Inverted Data Output.    |       |
| 23  |             | GND     | Module Ground.                        | 1     |
| 24  | CML-O       | Rx4-    | Receiver Inverted Data Output.        | 1     |
| 25  | CML-O       | Rx4+    | Receiver Non-Inverted Data Output.    |       |
| 26  |             | GND     | Module Ground.                        | 1     |
| 27  | LVTTL-O     | ModPrsL | Module Present.                       |       |
| 28  | LVTTL-O     | IntL    | Interrupt.                            |       |
| 29  |             | VccTx   | +3.3V Transmitter Power Supply.       | 2     |
| 30  |             | Vcc1    | +3.3V Power Supply.                   | 2     |
| 31  | LVTTL-I     | LPMode  | Low-Power Mode.                       |       |
| 32  |             | GND     | Module Ground.                        | 1     |
| 33  | CML-I       | Tx3+    | Transmitter Non-Inverted Data Input.  |       |
| 34  | CML-I       | Tx3-    | Transmitter Inverted Data Output.     |       |

|    |       |      |                                      |   |
|----|-------|------|--------------------------------------|---|
| 35 |       | GND  | Module Ground.                       | 1 |
| 36 | CML-I | Tx1+ | Transmitter Non-Inverted Data Input. |   |
| 37 | CML-I | Tx1- | Transmitter Inverted Data Output.    |   |
| 38 |       | GND  | Module Ground.                       | 1 |

**Notes:**

1. GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 module, and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.
2. VccRx, Vcc1, and VccTx are the receiving and transmission power supplies and shall be applied concurrently. Recommended host board power supply filtering is shown below. VccRx, Vcc1, and VccTx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

**QSFP28 Connector**



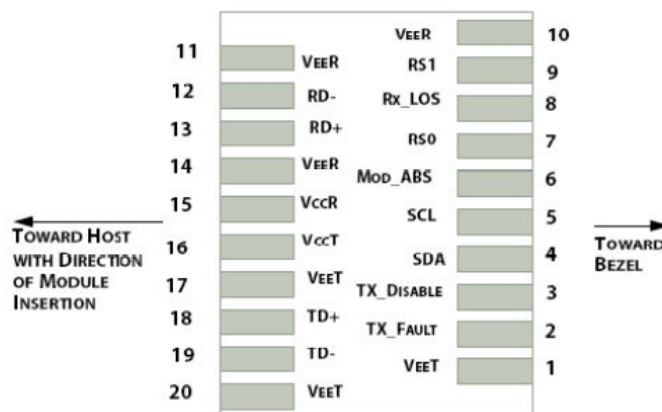
## SFP28 Pin Descriptions

| Pin | Logic     | Symbol     | Name/Description                                               | Notes |
|-----|-----------|------------|----------------------------------------------------------------|-------|
| 1   |           | VeeT       | Module Transmitter Ground.                                     | 1     |
| 2   | LVTTL-O   | Tx_Fault   | Module Transmitter Fault.                                      |       |
| 3   | LVTTL-I   | Tx_Disable | Transmitter Disable. Turns off the transmitter's laser output. |       |
| 4   | LVTTL-I/O | SDA        | 2-Wire Serial Interface Data.                                  | 2     |
| 5   | LVTTL-I   | SCL        | 2-Wire Serial Interface Clock.                                 | 2     |
| 6   |           | MOD_DEF0   | Module Definition 0. Grounded within the module.               |       |
| 7   | LVTTL-I   | RS0        | Receiver Rate Select.                                          |       |
| 8   | LVTTL-O   | Rx_LOS     | Receiver Loss of Signal Indication. Active LOW.                |       |
| 9   | LVTTL-I   | RS1        | Transmitter Rate Select. Not Used.                             |       |
| 10  |           | VeeR       | Module Receiver Ground.                                        | 1     |
| 11  |           | VeeR       | Module Receiver Ground.                                        | 1     |
| 12  | CML-O     | RD-        | Receiver Inverted Data Output.                                 |       |
| 13  | CML-O     | RD+        | Receiver Data Output.                                          |       |
| 14  |           | VeeR       | Module Receiver Ground.                                        | 1     |
| 15  |           | VccR       | Module Receiver +3.3V Supply.                                  |       |
| 16  |           | VccT       | Module Receiver +3.3V Supply.                                  |       |
| 17  |           | VeeT       | Module Transmitter Ground.                                     | 1     |
| 18  | CML-I     | TD+        | Transmitter Non-Inverted Data Input.                           |       |
| 19  | CML-I     | TD-        | Transmitter Inverted Data Input.                               |       |
| 20  |           | VeeT       | Module Transmitter Ground.                                     | 1     |

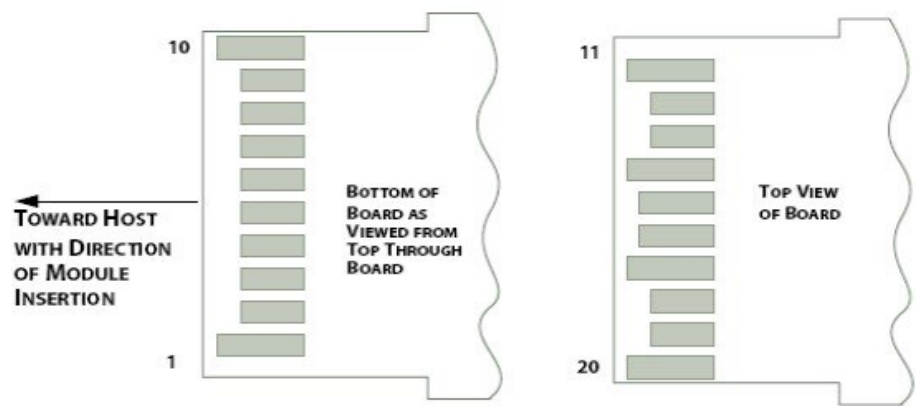
### Notes:

1. Module ground pins (GND) are isolated from the module case.
2. Shall be pulled up with 4.7kΩ to 10kΩ to a voltage between 3.15V and 3.45V on the host board.

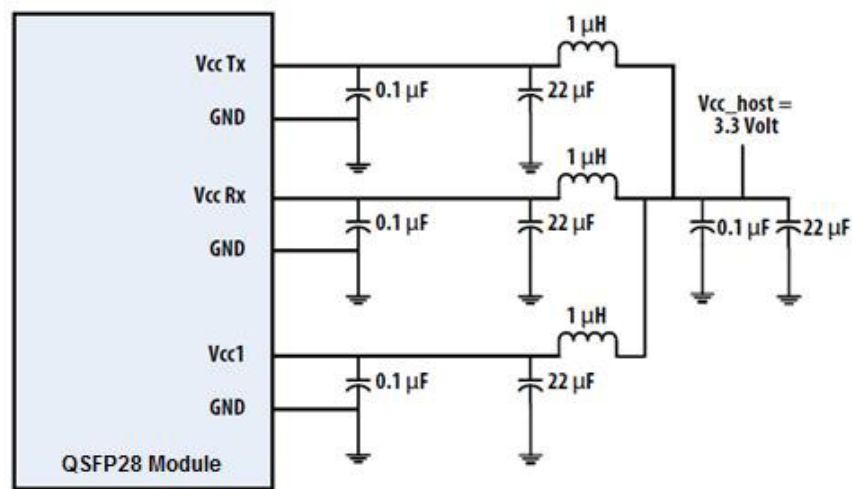
## SFP28 Module Interface



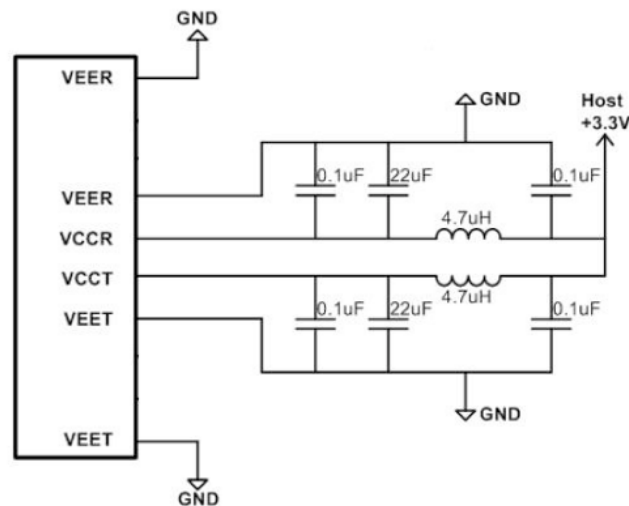
SFP28 Module Contact Assignment



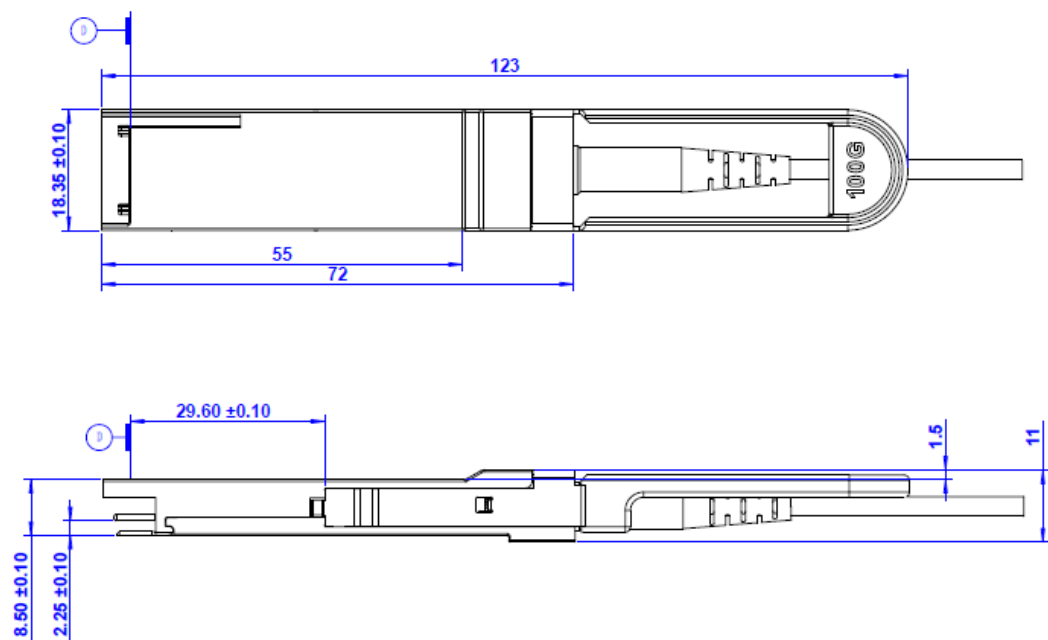
QSFP28 Recommended Power Supply



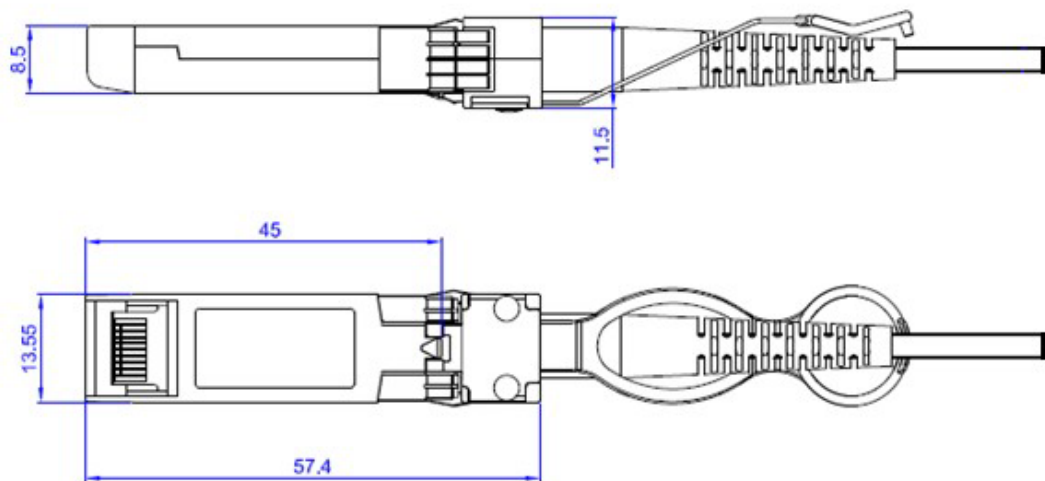
SFP28 Recommended Power Supply



QSFP28 Mechanical Specifications



SFP28 Mechanical Specifications



## About AddOn Networks

In 1999, AddOn Networks entered the market with a single product. Our founders fulfilled a severe shortage for compatible, cost-effective optical transceivers that compete at the same performance levels as leading OEM manufacturers. Adhering to the idea of redefining service and product quality not previously had in the fiber optic networking industry, AddOn invested resources in solution design, production, fulfillment, and global support.

Combining one of the most extensive and stringent testing processes in the industry, an exceptional free tech support center, and a consistent roll-out of innovative technologies, AddOn has continually set industry standards of quality and reliability throughout its history.

Reliability is the cornerstone of any optical fiber network and is ingrained in AddOn's DNA. It has played a key role in nurturing the long-term relationships developed over the years with customers. AddOn remains committed to exceeding industry standards with certifications from ranging from NEBS Level 3 to ISO 9001:2005 with every new development while maintaining the signature reliability of its products.



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