

### **Q400G-4Q56G-AOC45M-C**

MSA and TAA Compliant 400GBase-AOC QSFP-DD to 4xQSFP56 PAM-4 Active Optical Cable (850nm, MMF, 45m)  
CMIS 3.0

#### **Features:**

- Low latency DSP-free electronics-based CDR
- Multi-data rate up to 56.15 Gb/s per lane
- PAM4 modulation
- Single 3.3 V power supply
- Low power consumption: 7.6W on 400G end, 2.3W on 100G end with all CDRs enabled
- QSFP-DD MSA compliant
- CMIS 4.0 compliant
- Commercial temperature 0 to 70 Celsius
- Hot pluggable
- RoHS compliant and lead-free
- LSZH-rated cable
- IEEE 802.3cm



#### **Applications:**

- 400GBase Ethernet
- Data center: Switches, servers, storages and NIC adapters

#### **Product Description**

This is an MSA and TAA compliant 400GBase-AOC QSFP-DD to 4xQSFP56 active optical cable that operates over multi-mode fiber with a maximum reach of 45.0m (147.6ft). At a wavelength of 850nm, it has been programmed, uniquely serialized, and data-traffic and application tested to ensure it is 100% compliant and functional. This active optical cable is TAA (Trade Agreements Act) compliant, and is built to comply with MSA (Multi-Source Agreement) standards. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

ProLabs' 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. | Typ. | Max. | Unit | Notes   |
|----------------------------|---------|------|------|------|------|---------|
| Supply Voltage             | VIN     | 0    |      | 4.0  | V    |         |
| Input Swing                | VIN-MAX |      |      | 1500 | mVpp |         |
| Storage Temperature        | TSTG    | −40  |      | 85   | °C   | Ambient |
| Operating Case Temperature | Top     | 0    |      | 70   | °C   |         |
| Relative Humidity          | RH      | 5    |      | 85   | %    |         |

### Electrical Specifications

| Parameter                        | Symbol   | Min. | Typ.    | Max.                 | Unit | Notes |
|----------------------------------|----------|------|---------|----------------------|------|-------|
| Data Rate (Per Channel)          | BR       |      | 26.5625 |                      | GBd  |       |
| Power Supply Voltage             | VCC      | 3.15 | 3.30    | 3.47                 | V    |       |
| Power Supply Current             | 400G End | ICC  | 2300    | 2500                 | mA   | 1     |
|                                  | 100G End | ICC  | 680     | 750                  | mA   | 1     |
| Power Consumption                | 400G End | P    | 7.6     | 8.0                  | W    | 1     |
|                                  | 100G End | P    | 2.3     | 2.5                  | W    | 1     |
| Transmitter                      |          |      |         |                      |      |       |
| Input Differential Impedance     | RIN      |      | 100     |                      | Ω    |       |
| Diff. Pk-Pk Input Vol. Tolerance | VINP-P   | 900  |         |                      | mV   |       |
| Receiver                         |          |      |         |                      |      |       |
| Output Differential Impedance    | ROUT     |      | 100     |                      | Ω    |       |
| Differential Data Output Swing   | VOU TP-P | 700  | 800     | 900                  | mV   |       |
| Bit Error Ratio (at 26.5625 GBd) |          |      |         | 2.4×10 <sup>-4</sup> |      | 3     |

#### Notes:

1. Per end, all channel CDRs are enabled.
2. Pre-FEC Bit Error Ratio with a PRBS 231 – 1 test pattern over a normal operating temperature range.

## Pin Descriptions (QSFP-DD 400G End)

| PIN | Logic       | Symbol   | Description                                                                         | Notes |
|-----|-------------|----------|-------------------------------------------------------------------------------------|-------|
| 1   |             | GND      | Ground                                                                              | 1     |
| 2   | CML-I       | Tx2n     | Transmitter Inverted Data Input                                                     |       |
| 3   | CML-I       | Tx2p     | Transmitter Non-Inverted Data Input                                                 |       |
| 4   |             | GND      | Ground                                                                              | 1     |
| 5   | CML-I       | Tx4n     | Transmitter Inverted Data Input                                                     |       |
| 6   | CML-I       | Tx4p     | Transmitter Non-Inverted Data Input                                                 |       |
| 7   |             | GND      | Ground                                                                              | 1     |
| 8   | LVTTL-I     | ModSelL  | Module Select                                                                       |       |
| 9   | LVTTL-I     | ResetL   | Module Reset                                                                        |       |
| 10  |             | VccRx    | +3.3V Power Supply Receiver                                                         | 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      | Ground                                                                              | 1     |
| 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                                                       |       |
| 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    | +3.3V Power Supply Transmitter                                                      | 2     |
| 30  |             | VccI     | +3.3V Power Supply                                                                  | 2     |
| 31  | LVTTL-I     | InitMode | Initialization mode; In legacy QSFP applications, the InitMode pad is called LPMODE |       |
| 32  |             | GND      | Ground                                                                              | 1     |
| 33  | CML-I       | Tx3p     | Transmitter Non-Inverted Data Input                                                 |       |
| 34  | CML-I       | Tx3n     | Transmitter Inverted Data Input                                                     |       |
| 35  |             | GND      | Ground                                                                              | 1     |
| 36  | CML-I       | Tx1p     | Transmitter Non-Inverted Data Input                                                 |       |
| 37  | CML-I       | Tx1n     | Transmitter Inverted Data Input                                                     |       |
| 38  |             | GND      | Ground                                                                              | 1     |

| PIN |       | Symbol   | Description                         | Notes |
|-----|-------|----------|-------------------------------------|-------|
| 39  |       | GND      | Ground                              | 1     |
| 40  | CML-I | Tx6n     | Transmitter Inverted Data Input     |       |
| 41  | CML-I | Tx6p     | Transmitter Non-Inverted Data Input |       |
| 42  |       | GND      | Ground                              | 1     |
| 43  | CML-I | Tx8n     | Transmitter Inverted Data Input     |       |
| 44  | CML-I | Tx8p     | Transmitter Non-Inverted Data Input |       |
| 45  |       | GND      | Ground                              | 1     |
| 46  |       | Reserved | For future use                      | 3     |
| 47  |       | VSI      | Module Vendor Specific 1            | 3     |
| 48  |       | VccRx1   | 3.3V Power Supply                   | 2     |
| 49  |       | VS2      | Module Vendor Specific 2            | 3     |
| 50  |       | VS3      | Module Vendor Specific 3            | 3     |
| 51  |       | GND      | Ground                              | 1     |
| 52  | CML-O | Rx7p     | Receiver Non-Inverted Data Output   |       |
| 53  | CML-O | Rx7n     | Receiver Inverted Data Output       |       |
| 54  |       | GND      | Ground                              | 1     |
| 55  | CML-O | Rx5p     | Receiver Non-Inverted Data Output   |       |
| 56  | CML-O | Rx5n     | Receiver Inverted Data Output       |       |
| 57  |       | GND      | Ground                              | 1     |
| 58  |       | GND      | Ground                              | 1     |
| 59  | CML-O | Rx6n     | Receiver Inverted Data Output       |       |
| 60  | CML-O | Rx6p     | Receiver Non-Inverted Data Output   |       |
| 61  |       | GND      | Ground                              | 1     |
| 62  | CML-O | Rx8n     | Receiver Inverted Data Output       |       |
| 63  | CML-O | Rx8p     | Receiver Non-Inverted Data Output   |       |
| 64  |       | GND      | Ground                              | 1     |
| 65  |       | NC       | No Connect                          | 3     |
| 66  |       | Reserved | For future use                      | 3     |
| 67  |       | VccTx1   | 3.3V Power Supply                   | 2     |
| 68  |       | Vcc2     | 3.3V Power Supply                   | 2     |
| 69  |       | Reserved | For future use                      | 3     |
| 70  |       | GND      | Ground                              | 1     |
| 71  | CML-I | Tx7p     | Transmitter Non-Inverted Data Input |       |
| 72  | CML-I | Tx7n     | Transmitter Inverted Data Input     |       |
| 73  |       | GND      | Ground                              | 1     |
| 74  | CML-I | Tx5p     | Transmitter Non-Inverted Data Input |       |
| 75  | CML-I | Tx5n     | Transmitter Inverted Data Input     |       |
| 76  |       | GND      | Ground                              | 1     |

**Notes:**

1. QSFP-DD uses common ground (GND) for all signals and supply (power). All are common within the QSFP-DD 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, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 shall be applied concurrently. Requirements defined for the host side of the Host Card Edge Connector are listed in Table 6. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 may be internally connected within the module in any combination. The connector Vcc pins are each rated for a maximum current of 1000 mA.
3. All Vendor Specific, Reserved and No Connect pins may be terminated with 50 ohms to ground on the host. Pad 65 (No Connect) shall be left unconnected within the module. Vendor specific and Reserved pads shall have an impedance to GND that is greater than 10 kOhms and less than 100 pF.
4. Plug Sequence specifies the mating sequence of the host connector and module. The sequence is 1A, 2A, 3A, 1B, 2B, 3B. (see Figure 2 for pad locations) Contact sequence A will make, then break contact with additional QSFP-DD pads. Sequence 1A, 1B will then occur simultaneously, followed by 2A, 2B, followed by 3A, 3B.

Electrical Pin-out Details (QSFP-DD 400G End)



## Pin Descriptions (QSFP56 100G End)

| PIN | Logic       | Symbol  | Description                         | Notes |
|-----|-------------|---------|-------------------------------------|-------|
| 1   |             | GND     | Ground                              | 1     |
| 2   | CML-I       | Tx2n    | Transmitter Inverted Data Input     |       |
| 3   | CML-I       | Tx2p    | Transmitter Non-Inverted Data Input |       |
| 4   |             | GND     | Ground                              | 1     |
| 5   | CML-I       | Tx4n    | Transmitter Inverted Data Input     | 3     |
| 6   | CML-I       | Tx4p    | Transmitter Non-Inverted Data Input | 3     |
| 7   |             | GND     | Ground                              | 1     |
| 8   | LVTTL-I     | ModSelL | Module Select                       |       |
| 9   | LVTTL-I     | ResetL  | Module Reset                        |       |
| 10  |             | Vcc Rx  | +3.3V Power supply receiver         | 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     | Ground                              | 1     |
| 14  | CML-O       | Rx3p    | Receiver Non-Inverted Data Output   | 3     |
| 15  | CML-O       | Rx3n    | Receiver Inverted Data Output       | 3     |
| 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       | 3     |
| 25  | CML-O       | Rx4p    | Receiver Non-Inverted Data Output   | 3     |
| 26  |             | GND     | Ground                              | 1     |
| 27  | LVTTL-O     | ModPrsL | Module Present                      |       |
| 28  | LVTTL-O     | IntL    | Interrupt                           |       |
| 29  |             | Vcc Tx  | +3.3V Power supply transmitter      | 2     |
| 30  |             | Vcc 1   | +3.3V Power Supply                  | 2     |
| 31  | LVTTL-I     | LPMode  | Low Power Mode                      |       |
| 32  |             | GND     | Ground                              | 1     |
| 33  | CML-I       | Tx3p    | Transmitter Non-Inverted Data Input | 3     |
| 34  | CML-I       | Tx3n    | Transmitter Inverted Data Input     | 3     |
| 35  |             | GND     | Ground                              | 1     |
| 36  | CML-I       | Tx1p    | Transmitter Non-Inverted Data Input |       |
| 37  | CML-I       | Tx1n    | Transmitter Inverted Data Input     |       |
| 38  |             | GND     | Ground                              | 1     |

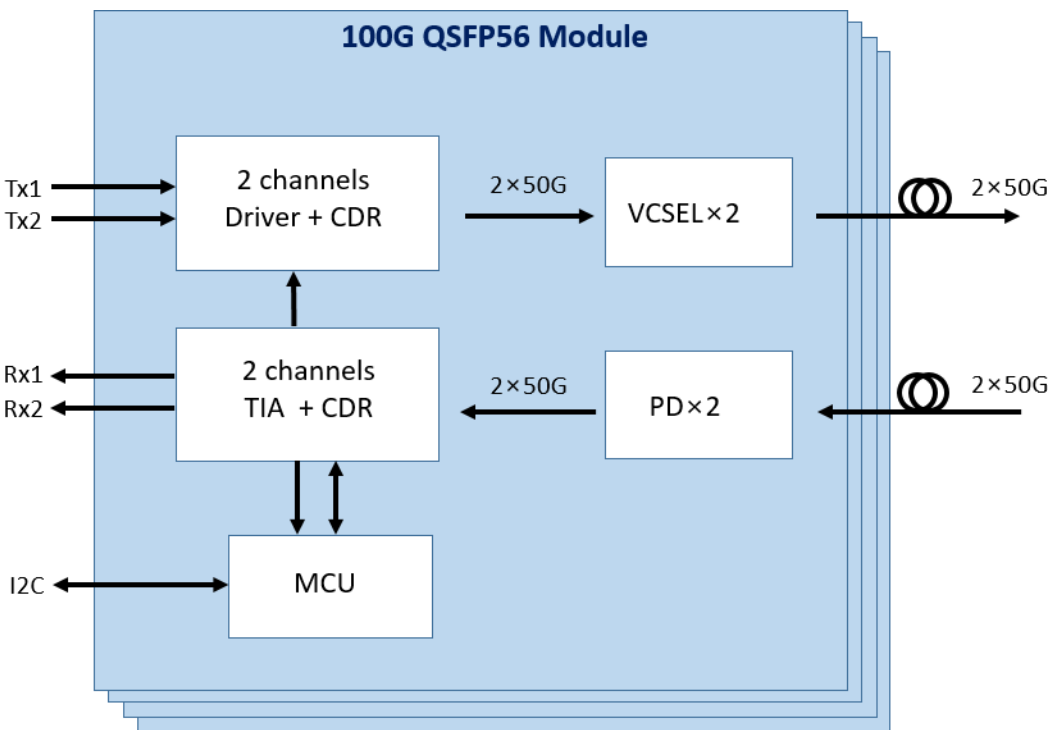
**Notes:**

1. GND is the symbol for signal and supply (power) common for the QSFP module. All are common within the QSFP 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. Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP transceiver module in any combination. The connector pins are each rated for a maximum current of 500 mA.
3. Not used

**Electrical Pin-out Details (QSFP56 100G End)**



**Block Diagram**



Active Optical Cable Specifications

| Parameter           | Value                            | Unit | Note            |
|---------------------|----------------------------------|------|-----------------|
| Cable Diameter      | LSZH: $\varnothing 3.0 \pm 0.15$ | mm   |                 |
| Minimum Bend Radius | 30                               | mm   | Without tension |
| Length Tolerance    | +300 / -0                        | mm   |                 |
| Cable Jacket        | LSZH, Aqua                       |      |                 |

Mechanical Specifications



QSFP-DD 400G End



**QSFP56 100G End**



## About ProLabs

Our extensive experience comes as standard. For over 20 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 more than 100 optical switching and transport platforms.

## A 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 1.6T 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.

## The Trusted Partner

Customer service is our number one value. ProLabs has invested in people, labs and manufacturing capacity to ensure compatible products, and immediate answers to your questions. 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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