

## **100GBASE-LR4 QSFP28 1310nm 10km DDM SMF Transceiver**

### **P/N: AE-QSFP28-LR4**

#### **Features**

- Hot pluggable QSFP28 MSA form factor
- Compliant to IEEE 802.3ba 100GBASE-LR4
- Up to 10km reach for G.652 SMF
- Single +3.3V power supply
- Operating case temperature: 0~70°C
- Transmitter: cooled 4x25Gb/s LAN WDM EML TOSA (1295.56, 1300.05, 1304.58, 1309.14nm)
- Receiver: 4x25Gb/s PIN ROSA
- 4x28G Electrical Serial Interface (CEI-28G-VSR)
- Maximum power consumption 3.5W
- Duplex LC receptacle
- RoHS-6 compliant

#### **Applications**

- 100GBASE-LR4 Ethernet Links
- Infiniband QDR and DDR interconnects
- Client-side 100G Telecom connections

## I. Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

| Parameter                            | Symbol | Min  | Max | Units | Notes |
|--------------------------------------|--------|------|-----|-------|-------|
| Storage Temperature                  | TS     | -40  | 85  | degC  |       |
| Operating Case Temperature           | TOP    | 0    | 70  | degC  |       |
| Power Supply Voltage                 | VCC    | -0.5 | 3.6 | V     |       |
| Relative Humidity (non-condensation) | RH     | 0    | 85  | %     |       |
| Damage Threshold, each Lane          | THd    | 5.5  |     | dBm   |       |

## II. Recommended Operating Conditions

| Parameter                  | Symbol | Min   | Typical  | Max   | Units |
|----------------------------|--------|-------|----------|-------|-------|
| Operating Case Temperature | TOP    | 0     |          | 70    | degC  |
| Power Supply Voltage       | VCC    | 3.135 | 3.3      | 3.465 | V     |
| Data Rate, each Lane       |        |       | 25.78125 |       | Gb/s  |
| Control Input Voltage High |        | 2     |          | Vcc   | V     |
| Control Input Voltage Low  |        | 0     |          | 0.8   | V     |
| Link Distance with G.652   | D      | 0.002 |          | 10    | km    |

## III. Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

| Parameter                                    | Symbol              | Min  | Typical | Max  | Units | Notes                         |
|--|---------------------|------|---------|------|-------|-------------------------------|
| Power Consumption                            |                     |      |         | 4.0  | W     |                               |
| Supply Current                               | Icc                 |      |         | 1.12 | A     |                               |
| Transceiver Power-on Initialization Time     |                     |      |         | 2000 | ms    | 1                             |
| Transmitter (each Lane)                      |                     |      |         |      |       |                               |
| Single-ended Input Voltage Tolerance (Note2) |                     | -0.3 |         | 4.0  | V     | Referred to TP1 signal common |
| AC Common Mode Input Voltage Tolerance       |                     | 15   |         |      | mV    | RMS                           |
| Differential Input Voltage Swing Threshold   |                     | 50   |         |      | mVpp  | LOSA Threshold                |
| Differential Input Voltage Swing             | V <sub>in,pp</sub>  | 190  |         | 700  | mVpp  |                               |
| Differential Input Impedance                 | Z <sub>in</sub>     | 90   | 100     | 110  | Ohm   |                               |
| Receiver (each Lane)                         |                     |      |         |      |       |                               |
| Single-ended Output Voltage                  |                     | -0.3 |         | 4.0  | V     | Referred to signal common     |
| AC Common Mode Output Voltage                |                     |      |         | 7.5  | mV    | RMS                           |
| Differential Output Voltage Swing            | V <sub>out,pp</sub> | 300  |         | 850  | mVpp  |                               |

|                               |      |    |     |     |     |  |
|-------------------------------|------|----|-----|-----|-----|--|
| Differential Output Impedance | Zout | 90 | 100 | 110 | Ohm |  |
|-------------------------------|------|----|-----|-----|-----|--|

**Notes:**

1. Power-on Initialization Time is the time from when the power supply voltages reach and remain above the minimum recommended operating supply voltages to the time when the module is fully functional.
2. The single ended input voltage tolerance is the allowable range of the instantaneous input signals.

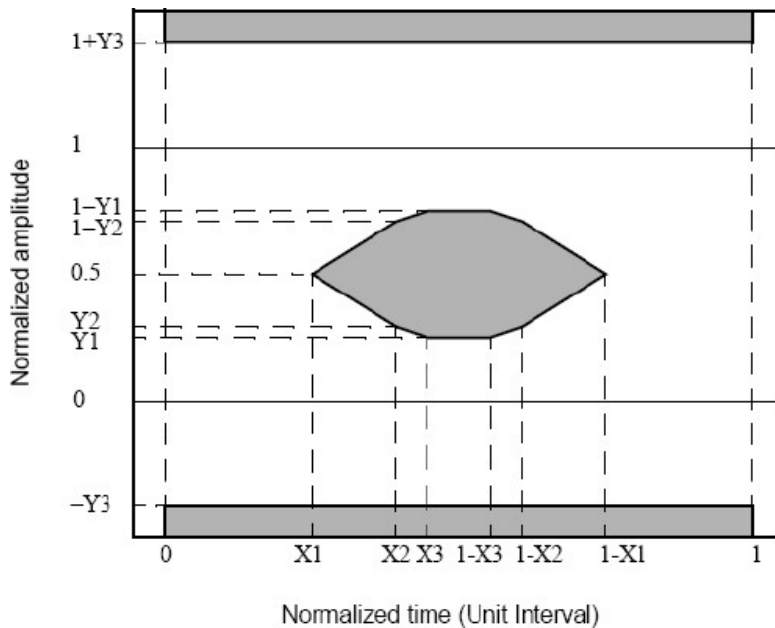
**IV. Optical Characteristics**

| QSFP28 100GBASE-LR4   |          |                                    |         |         |       |       |
|---|----------|------------------------------------|---------|---------|-------|-------|
| Parameter   | Symbol   | Min                                | Typical | Max     | Unit  | Notes |
| Lane Wavelength   | L0       | 1294.53                            | 1295.56 | 1296.59 | nm    |       |
|   | L1       | 1299.02                            | 1300.05 | 1301.09 | nm    |       |
|   | L2       | 1303.54                            | 1304.58 | 1305.63 | nm    |       |
|   | L3       | 1308.09                            | 1309.14 | 1310.19 | nm    |       |
| Transmitter   |          |                                    |         |         |       |       |
| Side Mode Suppression Ratio   | SMSR     | 30                                 |         |         | dB    |       |
| Total Average Launch Power  | PT       |                                    |         | 10.5    | dBm   |       |
| Average Launch Power, each Lane   | PAVG     | -4.3                               |         | 4.5     | dBm   |       |
| OMA, each Lane  | POMA     | -1.3                               |         | 4.5     | dBm   | 1     |
| Difference in Launch Power between any Two Lanes (OMA)                        | Ptx,diff |                                    |         | 5       | dB    |       |
| Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane |          | -2.3                               |         |         | dBm   |       |
| TDP, each Lane  | TDP      |                                    |         | 2.2     | dB    |       |
| Extinction Ratio  | ER       | 4                                  |         |         | dB    |       |
| RIN20OMA  | RIN      |                                    |         | -130    | dB/Hz |       |
| Optical Return Loss Tolerance   | TOL      |                                    |         | 20      | dB    |       |
| Transmitter Reflectance   | RT       |                                    |         | -12     | dB    |       |
| Eye Mask{X1, X2, X3, Y1, Y2, Y3}  |          | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4} |         |         |       | 2     |
| Average Launch Power OFF Transmitter, each Lane                               | Poff     |                                    |         | -30     | dBm   |       |
| Receiver  |          |                                    |         |         |       |       |
| Damage Threshold, each Lane   | THd      | 5.5                                |         |         | dBm   | 3     |
| Total Average Receive Power   |          |                                    |         | -10.6   | dBm   |       |
| Average Receive Power, each Lane  |          | -10.6                              |         | 4.5     | dBm   |       |
| Receive Power (OMA), each Lane  |          |                                    |         | 4.5     | dBm   |       |
| Receiver Sensitivity (OMA), each Lane   | SEN      |                                    |         | -8.6    | dBm   |       |
| Stressed Receiver Sensitivity (OMA), each Lane                                |          |                                    |         | -6.8    | dBm   | 4     |
| Receiver Reflectance  | RR       |                                    |         | -26     | dB    |       |
| Difference in Receive Power between any Two Lanes (OMA)                       | Prx,diff |                                    |         | 5.5     | dB    |       |
| LOS Assert  | LOSA     |                                    | -25     |         | dBm   |       |

|  |      |     |      |    |     |  |
|--|------|-----|------|----|-----|--|
| LOS Deassert   | LOSD |     | -13  |    | dBm |  |
| LOS Hysteresis   | LOSH | 0.5 |      |    | dB  |  |
| Receiver Electrical 3 dB upper Cutoff Frequency, each Lane | Fc   |     |      | 31 | GHz |  |
| Conditions of Stress Receiver Sensitivity Test (Note 5)    |      |     |      |    |     |  |
| Vertical Eye Closure Penalty, each Lane                    |      |     | 1.8  |    | dB  |  |
| Stressed Eye J2 Jitter, each Lane                          |      |     | 0.3  |    | UI  |  |
| Stressed Eye J9 Jitter, each Lane                          |      |     | 0.47 |    | UI  |  |

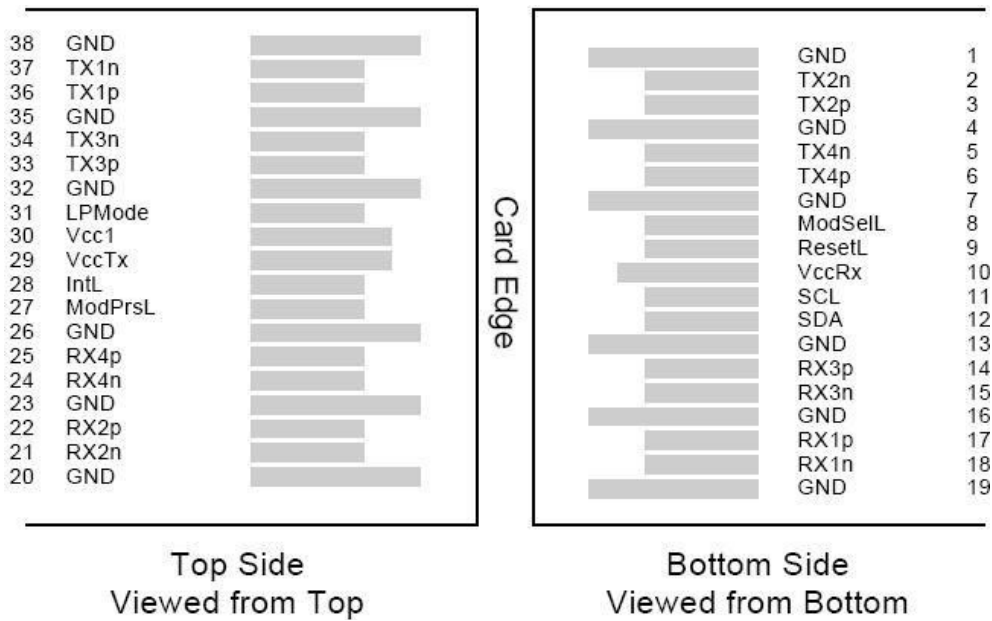
**Notes:**

1. Even if the TDP < 1 dB, the OMA min must exceed the minimum value specified here.
2. See Figure 4 below.
3. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
4. Measured with conformance test signal at receiver input for BER = 1x10<sup>-12</sup>.
5. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.



**Figure 4. Eye Mask Definition**

## V. Pin Assignment and Description



## VI. Pin Definition

| PIN | Logic       | Symbol  | Name/Description                     | Notes |
|-----|-------------|---------|--------------------------------------|-------|
| 1   |             | GND     | Ground                               | 1     |
| 2   | CML-I       | Tx2n    | Transmitter Inverted Data Input      |       |
| 3   | CML-I       | Tx2p    | Transmitter Non-Inverted Data output |       |
| 4   |             | GND     | Ground                               | 1     |
| 5   | CML-I       | Tx4n    | Transmitter Inverted Data Input      |       |
| 6   | CML-I       | Tx4p    | Transmitter Non-Inverted Data output |       |
| 7   |             | GND     | Ground                               | 1     |
| 8   | LVTLL-I     | ModSelL | Module Select                        |       |
| 9   | LVTLL-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                               |       |
| 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. GND is the symbol for signal and supply (power) common for the QSFP28 module. All are common within the 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 suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the module in any combination. The connector pins are each rated for a maximum current of 1000mA.

**VII. Ordering information**

| Part Number   | Product Description  |
|---------------|--|
| AE-QSFP28-LR4 | QSFP28, 100Gb/s, 1310nm, SMF, 10KM, DDM, LC connector, 0°C ~ +70°C |