

# 100G-QSFP28-ZR4

## 100G-ZR4 QSFP28 Transceiver

### Features:

Compliant with QSFP28 Standard:

SFF-8661 Rev 2.5, SFF-8636 Rev 2.10a

High speed I/O electrical interface (CAUI-4) compliant with IEEE 802.3bm-2015

100GBASE-ZR4 point-to-point Ethernet links

Rx sensitivity of -28dBm with enabled KR4 FEC in host for up to 80km SMF

Single 3.3V Supply Voltage

Maximum power consumption 5.5W

0-70 °C Case Operating Temperature

LAN WDM EML laser and SOA+PIN Receiver

Universal QSFP28 MSA package with duplex LC connector

Two Wire Serial Interface with Digital Diagnostic Monitoring

Complies with EU Directive 2011/65/EU (RoHS compliant)

Class 1 Laser



### Module Characteristics

Table 1 – Absolute Maximum Ratings

| Parameter                          | Symbol              | Min. | Max.         | Unit | Notes |
|------------------------------------|---------------------|------|--------------|------|-------|
| Storage Temperature                | $T_S$               | -40  | 85           | °C   |       |
| Supply Voltage                     | $V_{CC}$            | -0.5 | 3.6          | V    |       |
| Relative Humidity (non-condensing) | RH                  | 5    | 95           | %    |       |
| Data Input Voltage Differential    | $ V_{DIP}-V_{DIN} $ | -    | 1            | V    |       |
| Control Input Voltage              | $V_I$               | -0.3 | $V_{CC}+0.5$ | V    |       |
| Control Output Current             | $I_O$               | -20  | 20           | mA   |       |

Table 2 – Recommended Operating Conditions

| Parameter                                 | Symbol    | Min.         | Typical | Max.         | Unit | Notes |
|---|-----------|--------------|---------|--------------|------|-------|
| Operating Case Temperature                | $T_{OPR}$ | 0            | -       | 70           | °C   |       |
| Power Supply Voltage                      | $V_{CC}$  | 3.135        | 3.3     | 3.465        | V    |       |
| Maximum Power Dissipation                 | $P_D$     | -            | -       | 6            | W    |       |
| Maximum Power Dissipation, Low Power Mode | $P_{DLP}$ | -            | -       | 1.5          | W    |       |
| Aggregate Bit Rate                        | ABR       | -            | 103.125 | -            | Gb/s |       |
| Data Rate per Lane                        | DRL       | -            | 25.78   | -            | Gb/s |       |
| Control Input Voltage High                | $V_{IH}$  | $V_{CC}*0.7$ | -       | $V_{CC}+0.3$ | V    |       |
| Control Input Voltage Low                 | $V_{IL}$  | -0.3         | -       | $V_{CC}*0.3$ | V    |       |
| Two Wire Serial Interface Clock Rate      | -         | -            | -       | 400          | kHz  |       |

| Parameter   | Symbol | Min. | Typical | Max.   | Unit | Notes |
|---|--------|------|---------|--------|------|-------|
| Module power supply noise tolerance 10 Hz - 10 MHz (peak-to-peak) | -      | -    | -       | 66     | mVpp |       |
| Rx Differential Data Output Load                                  | -      | -    | 100     | -      | ohms |       |
| Operating Distance  | -      | -    | -       | 80,000 | m    | Note  |

Note : 80km with FEC.

## Functional Characteristics (Optical)

The following tables list the performance specifications for the various functional blocks of the integrated optical transceiver module.

**Table 3 – Transmitter Optical Specifications**

| Parameter  | Symbol          | Min.                               | Typical | Max.    | Unit  | Notes |
|--|-----------------|------------------------------------|---------|---------|-------|-------|
| Wavelength L0  | $\lambda_{C0}$  | 1294.53                            | 1295.56 | 1296.59 | nm    |       |
| Wavelength L1  | $\lambda_{C1}$  | 1299.02                            | 1300.05 | 1301.09 | nm    |       |
| Wavelength L2  | $\lambda_{C2}$  | 1303.54                            | 1304.58 | 1305.63 | nm    |       |
| Wavelength L3  | $\lambda_{C3}$  | 1308.09                            | 1309.14 | 1310.19 | nm    |       |
| Side-mode suppression ratio                            | SMSR            | 30                                 |         |         | dB    |       |
| Average Launch Power Tx_Off (Each Lane)                | $P_{OUT\_OFF}$  | -                                  | -       | -30     | dBm   |       |
| Average Optical Launch Power (Each Lane)               | $P_{OUTL}$      | 1.5                                | -       | 7       | dBm   |       |
| Extinction Ratio                                       | ER              | 8                                  | -       | -       | dB    |       |
| Spectral Width   | $\Delta\lambda$ | -                                  | -       | 1       | nm    |       |
| Difference in launch power between any two lanes (OMA) | DT_OMA          | -                                  | -       | 3.6     | dB    |       |
| Optical Return Loss Tolerance                          | ORLT            | -                                  | -       | 20      | dB    |       |
| RIN <sub>20OMA</sub>                                   | RIN             | -                                  | -       | -130    | dB/Hz |       |
| Transmitter Reflectance                                | $T_R$           | -                                  | -       | -20     | dB    |       |
| Transmitter Eye Mask Definition                        | -               | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4} |         |         |       |       |

**Table 4 – Receiver Optical Specifications**

| Parameter                         | Symbol           | Min.    | Typical | Max.    | Unit | Notes |
|-----------------------------------|------------------|---------|---------|---------|------|-------|
| Wavelength L0                     | $\lambda_{C0}$   | 1294.53 | 1295.56 | 1296.59 | nm   |       |
| Wavelength L1                     | $\lambda_{C1}$   | 1299.02 | 1300.05 | 1301.09 | nm   |       |
| Wavelength L2                     | $\lambda_{C2}$   | 1303.54 | 1304.58 | 1305.63 | nm   |       |
| Wavelength L3                     | $\lambda_{C3}$   | 1308.09 | 1309.14 | 1310.19 | nm   |       |
| Receiver Sensitivity per lane     |                  | -       | -       | -28     | dBm  | Note  |
| Damage Threshold for Receiver     | $P_{in\_damage}$ | 5       | -       | -       | dBm  |       |
| Average Receive Power (Each Lane) | -                | -28     | -       | 4.5     | dBm  | Note  |

Note: Measured with conformance test signal at TP3 for the BER =  $5 \times 10^{-5}$

## Functional Characteristics (Electrical)

Table 5 – Electrical Specification

**High-Speed Signal:** Compliant to IEEE802.3 CAUI-4  
**C2M Low-Speed Signal:** Compliant to SFF-8679

| Receiver (Module Output)           |               |              |         |              |      |               |
|------------------------------------|---------------|--------------|---------|--------------|------|---------------|
| Parameter                          | Symbol        | Min.         | Typical | Max.         | Unit | Notes         |
| Differential Data Input Amplitude  | $V_{IN,P-P}$  | 95           | -       | 900          | mVpp |               |
| Differential Termination Mismatch  |               | -            | -       | 10           | %    |               |
| LPMode, Reset and ModSelL          | $V_{IL}$      | -0.3         | -       | 0.8          | V    |               |
|                                    | $V_{IH}$      | 2            | -       | $V_{CC}+0.3$ | V    |               |
| Transmitter (Module Input)         |               |              |         |              |      |               |
| Parameter                          | Symbol        | Min.         | Typical | Max.         | Unit | Notes         |
| Differential Data Output Amplitude | $V_{OUT,P-P}$ | -            | -       | 900          | mVpp |               |
| Differential Termination Mismatch  |               | -            | -       | 10           | %    |               |
| Output Rise/Fall Time, 20%~80%     | $T_R$         | 12           | -       | -            | ps   |               |
| ModPrsL and IntL                   | $V_{OL}$      | 0            | -       | 0.4          | V    | $I_{OL}=4mA$  |
|                                    | $V_{OH}$      | $V_{CC}-0.5$ | -       | $V_{CC}+0.3$ | V    | $I_{OL}=-4mA$ |

### Pin Definitions

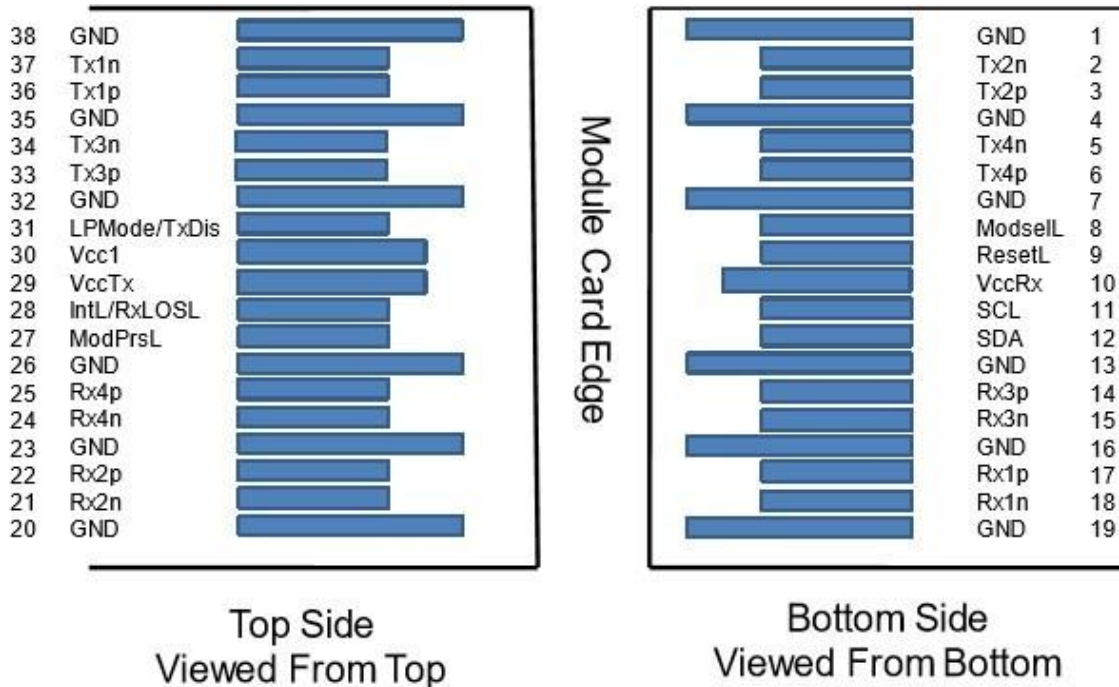


Figure 1 – Pinout definitions of QSFP28 module inputs/outputs

**Table 7 – Module Pin Definitions**

| Pin | Logic       | Symbol            | Description   | Plug Sequence | Notes |
|-----|-------------|-------------------|---|---------------|-------|
| 1   |             | GND               | Ground  | 1             | 1     |
| 2   | CML-I       | Tx2n              | Transmitter Inverted Data Input   | 3             |       |
| 3   | CML-I       | Tx2p              | Transmitter Non-Inverted Data Input   | 3             |       |
| 4   |             | GND               | Ground  | 1             | 1     |
| 5   | CML-I       | Tx4n              | Transmitter Inverted Data Input   | 3             |       |
| 6   | CML-I       | Tx4p              | Transmitter Non-Inverted Data Input   | 3             |       |
| 7   |             | GND               | Ground  | 1             | 1     |
| 8   | LVTTL-I     | ModselL           | Module Select   | 3             |       |
| 9   | LVTTL-I     | ResetL            | Module Reset  | 3             |       |
| 10  |             | Vcc Rx            | +3.3V Power Supply Receiver   | 2             | 2     |
| 11  | LVC MOS-I/O | SCL               | 2-wire serial interface clock   | 3             |       |
| 12  | LVC MOS-I/O | SDA               | 2-wire serial interface data  | 3             |       |
| 13  |             | GND               | Ground  | 1             | 1     |
| 14  | CML-O       | Rx3p              | Receiver Non-Inverted Data Output   | 3             |       |
| 15  | CML-O       | Rx3n              | Receiver Inverted Data Output   | 3             |       |
| 16  |             | GND               | Ground  | 1             | 1     |
| 17  | CML-O       | Rx1p              | Receiver Non-Inverted Data Output   | 3             |       |
| 18  | CML-O       | Rx1n              | Receiver Inverted Data Output   | 3             |       |
| 19  |             | GND               | Ground  | 1             | 1     |
| 20  |             | GND               | Ground  | 1             | 1     |
| 21  | CML-O       | Rx2n              | Receiver Inverted Data Output   | 3             |       |
| 22  | CML-O       | Rx2p              | Receiver Non-Inverted Data Output   | 3             |       |
| 23  |             | GND               | Ground  | 1             | 1     |
| 24  | CML-O       | Rx4n              | Receiver Inverted Data Output   | 3             |       |
| 25  | CML-O       | Rx4p              | Receiver Non-Inverted Data Output   | 3             |       |
| 26  |             | GND               | Ground  | 1             | 1     |
| 27  | LVTTL-O     | ModPrsL           | Module Present  | 3             |       |
| 28  | LVTTL-O     | IntL/RxLOS<br>S L | Interrupt. Optionally configurable as RxLOS via the management interface (SFF-8636). Interrupt. Optionally configurable as RxLOS via the management interface (SFF-8636). | 3             |       |
| 29  |             | Vcc Tx            | +3.3V Power supply transmitter  | 2             | 2     |
| 30  |             | Vcc1              | +3.3V Power supply  | 2             | 2     |
| 31  | LVTTL-I     | LPMode/T<br>xD is | Low Power Mode. Optionally configurable as TxDis via the management interface (SFF-8636).   | 3             |       |
| 32  |             | GND               | Ground  | 1             | 1     |
| 33  | CML-I       | Tx3p              | Transmitter Non-Inverted Data Input   | 3             |       |
| 34  | CML-I       | Tx3n              | Transmitter Inverted Data Input   | 3             |       |
| 35  |             | GND               | Ground  | 1             | 1     |
| 36  | CML-I       | Tx1p              | Transmitter Non-Inverted Data Input   | 3             |       |
| 37  | CML-I       | Tx1n              | Transmitter Inverted Data Input   | 3             |       |
| 38  |             | GND               | Ground  | 1             | 1     |

Note 1: GND is the symbol for signal and supply (power) common for the 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.

Note 2: VccRx, Vcc1 and VccTx are applied concurrently and may be internally connected within the module in any combination. Vcc contacts in SFF-8662 and SFF-8672 each have a steady state current rating of 1 A.

## Recommended Host Board Power Supply Filtering

See SFF-8679

**Table 8 – Timing for Soft Control and Status Functions**

| Parameter                                   | Symbol       | Min. | Max. | Unit | Notes |
|---|--------------|------|------|------|-------|
| Initialization Time                         | t_init       | -    | 5    | s    |       |
| Reset Init Assert Time                      | t_reset_init | 10   | -    | μs   |       |
| Serial Bus Hardware Ready Time              | t_serial     | -    | 2000 | ms   |       |
| Monitor Data Ready Time                     | t_data       | -    | 2000 | ms   |       |
| Reset Assert Time                           | t_reset      | -    | 5    | s    |       |
| LPMODE Assert Time                          | ton_LPMODE   | -    | 100  | ms   |       |
| LPMODE De-assert Time                       | toff_LPMODE  | -    | 5    | s    |       |
| IntL Assert Time                            | ton_IntL     | -    | 200  | ms   |       |
| IntL Deassert Time                          | toff_IntL    | -    | 500  | μs   |       |
| Rx LOS Assert Time                          | ton_lol      | -    | 100  | ms   |       |
| RxLOS Assert Time (Optional Fast Mode)      | ton_f_LOS    | -    | 1    | ms   |       |
| RxLOS Deassert Time (Optional Fast Mode)    | toff_f_LOS   | -    | 3    | ms   |       |
| Tx Fault Assert Time                        | ton_Txfault  | -    | 200  | ms   |       |
| Flag Assert Time                            | ton_flag     | -    | 200  | ms   |       |
| Mask Assert Time                            | ton_mask     | -    | 100  | ms   |       |
| Mask Deassert Time                          | toff_mask    | -    | 100  | ms   |       |
| Application or Rate Select Change Time      | t_ratesel    | -    | N/A  | ms   |       |
| Power_over-ride or Power-set Assert Time    | ton_Pdown    | -    | 100  | ms   |       |
| Power_over-ride or Power-set De-assert Time | toff_Pdown   | -    | 5    | s    |       |

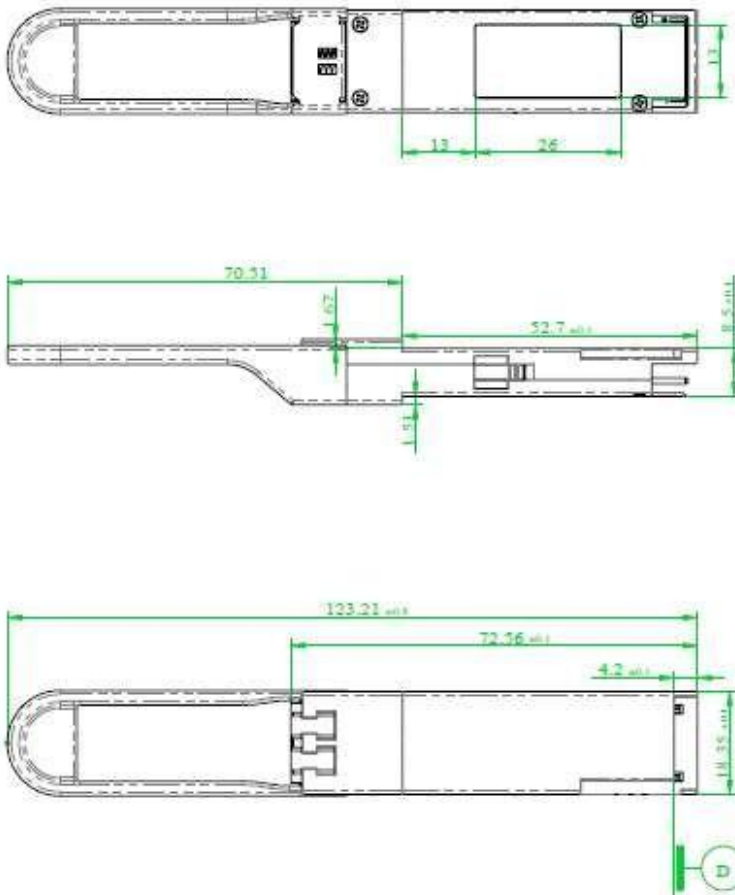
**Table 9 – I/O Timing for Squelch and Disable**

| Parameter                            | Symbol      | Min. | Max. | Unit | Notes |
|--------------------------------------|-------------|------|------|------|-------|
| Rx Squelch Assert Time               | ton_Rxsq    | -    | 15   | ms   |       |
| Rx Squelch Deassert Time             | toff_Rxsq   | -    | 15   | ms   |       |
| Tx Squelch Assert Time               | ton_Txsq    | -    | 400  | ms   |       |
| Tx Squelch Deassert Time             | toff_Txsq   | -    | 400  | ms   |       |
| Tx Disable Assert Time (fast mode)   | ton_Txdisf  | -    | 3    | ms   |       |
| Tx Disable Deassert Time (fast mode) | toff_Txdisf | -    | 10   | ms   |       |
| Rx Output Disable Assert Time        | ton_Rxdis   | -    | 100  | ms   |       |
| Rx Output Disable Deassert Time      | toff_Rxdis  | -    | 100  | ms   |       |
| Squelch Disable Assert Time          | ton_sqdis   | -    | 100  | ms   |       |
| Squelch Disable Deassert Time        | toff_sqdis  | -    | 100  | ms   |       |

**Table 10 – Digital Diagnostics**

| Parameter                    | Range                | Accuracy | Unit | Calibration |
|------------------------------|----------------------|----------|------|-------------|
| Temperature                  | 0 to 70              | ±3       | °C   | Internal    |
| Voltage                      | 0 to V <sub>CC</sub> | ±3%      | V    | Internal    |
| Tx Bias Current (Each Lane)  | 0 to 120             | 10%      | mA   | Internal    |
| Tx Output Power (Each Lane)  | 1.5 to 7             | ±3       | dB   | Internal    |
| Rx Receive Power (Each Lane) | -28 to 4.5           | ±3       | dB   | Internal    |

## Mechanical Diagram



## Ordering Information

Table 11 - Ordering Information

| Part No.        | Application  | Data Rate      | Laser Source | Fiber Type        |
|-----------------|--------------|----------------|--------------|-------------------|
| 100G-QSFP28-ZR4 | 100GBASE-ZR4 | 100Gb Ethernet | EML          | Single Mode Fiber |

## Warnings

**Handling Precautions:** This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

**Laser Safety:** Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.