

## LWO-QSFP28-LR4-BT

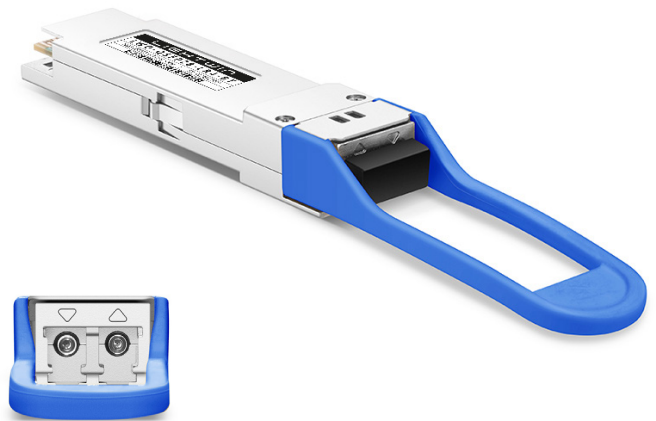
### 100Gbit QSFP28 LR4, 10km, DFB, LC-Duplex, Singlemode

#### Features

- Hot-pluggable QSFP28 MSA form factor
- Duplex LC receptacle optical interface
- Transmitter: cooled 4x25Gb/s DML laser
- Receiver: 4x25Gb/s PIN receiver
- Compliant with CEI-28G-VSR
- Single +3.3V power supply
- Low power dissipation (max: 4.0W)
- Built in digital diagnostic function
- Operating case temperature range 0°C to 70°C

#### Application

- 100GBASE-LR4
- InfinibandQDR and DDR interconnects
- Client-side 100G Telecom connections



#### Functional Description

The 100G QSFP28 LR4 optical transceiver integrates the transmit and receive path onto one module. On the transmit side, four lanes of serial data streams are recovered, retimed, and passed on to four laser drivers, which control four lasers with 1295.5, 1300.0, 1304.5, and 1309.1nm center wavelengths. The optical signals are then multiplexed into a single-mode fiber through an industry-standard LC connector. On the receive side, four lanes of optical data streams are optically demultiplexed by an integrated optical demultiplexer. Each data stream is recovered by a photodetector and transimpedance amplifier, retimed, and passed on to an output driver. This module features a hot-pluggable electrical interface, low power consumption, and 2-wire serial interface.

#### Transceiver Block Diagram

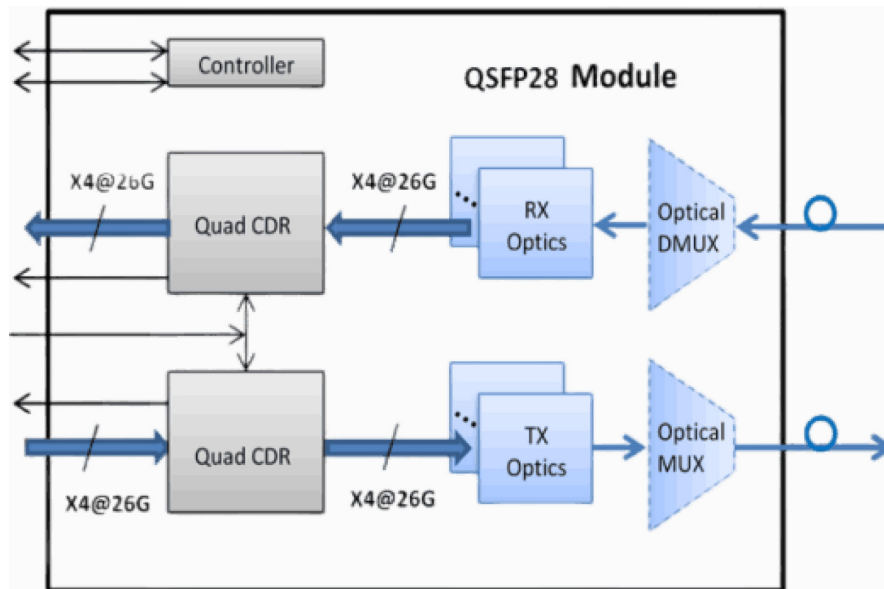


Figure 1. Transceiver Block Diagram

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### Recommended Power Supply Filter

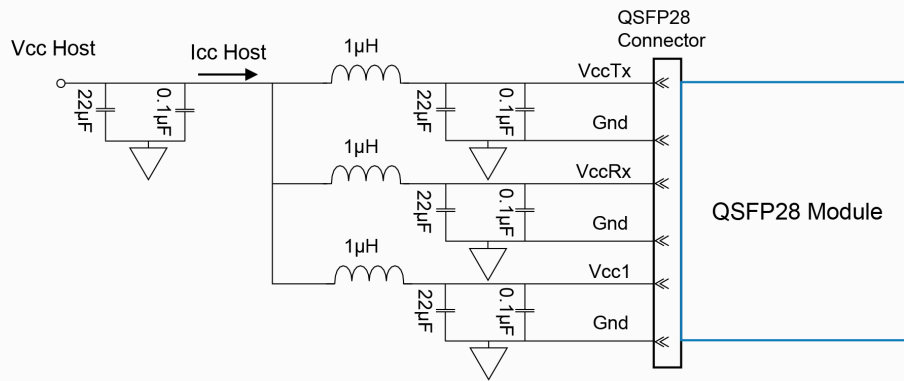


Figure 3. Recommended Power Supply Filter

### Pin Assignment and Description



Figure 2. MSA Compliant Connector

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### 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   | 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                                                            | 1     |
| 25  | CML-O       | Rx4p          | Receiver Non-Inverted Data Output                                                        |       |
| 26  |             | GND           | Ground                                                                                   | 1     |
| 27  | LVTTL-O     | ModPrsL       | Module Present                                                                           |       |
| 28  | LVTTL-O     | IntL/RxLOSL   | Interrupt. Optionally configurable as RxLOSL via the management interface (SFF-8636)     |       |
| 29  |             | VccTx         | +3.3V Power Supply transmitter                                                           | 2     |
| 30  |             | Vcc1          | +3.3 V Power Supply                                                                      | 2     |
| 31  | LVTTL-I     | LP MODE/TxDis | Low Power Mode. Optionally configurable as TxDis via the management interface (SFF-8636) |       |
| 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 Output                                                         |       |
| 38  |             | GND           | Ground                                                                                   | 1     |

### Notes

- 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.
- 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.

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#### Electrical Characteristics

Tested under recommended operating conditions, unless otherwise noted

| Parameter                      | Symbol                | Min.                  | Typical | Max.                  | Units | Notes |
|--------------------------------|-----------------------|-----------------------|---------|-----------------------|-------|-------|
| Supply Voltage                 | V <sub>cc</sub>       | 3.13                  | 3.3     | 3.47                  | V     |       |
| <b>Transmitter</b>             |                       |                       |         |                       |       |       |
| Input differential impedance   | R <sub>in</sub>       |                       | 100     |                       | Ω     | 1     |
| Differential data input swing  | V <sub>in</sub> , pp  | 180                   |         | 1000                  | mV    |       |
| Transmit Disable Voltage       | VD                    | V <sub>cc</sub> - 1.3 |         | V <sub>cc</sub>       | V     | 2     |
| Transmit Enable Voltage        | VEN                   | V <sub>ee</sub>       |         | V <sub>ee</sub> + 0.8 | V     |       |
| <b>Receiver</b>                |                       |                       |         |                       |       |       |
| Differential data output swing | V <sub>out</sub> , pp | 300                   |         | 850                   | mV    | 3     |
| LOS Fault                      | VLOS <sub>fault</sub> | V <sub>cc</sub> - 1.3 |         | V <sub>cc</sub> HOST  | V     | 4     |
| LOS Normal                     | VLOS <sub>norm</sub>  | V <sub>ee</sub>       |         | V <sub>ee</sub> +0.8  | V     | 4     |

#### Notes

1. Connected directly to TX data input pins. AC coupled thereafter.
2. Optional for TX disable
3. Into 100 ohms differential termination
4. Loss Of Signal is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.

#### 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                   | T <sub>s</sub>    | -40  | 85   | degC  |       |
| Operating Case Temperature            | T <sub>OP</sub>   | 0    | 70   | degC  |       |
| Power Supply Voltage                  | V <sub>cc</sub>   | -0,5 | 3,6  | V     |       |
| Relative Humidity (non- condensation) | RH                | 0    | 85   | %     |       |
| Rx Damage Threshold, per Lane         | P <sub>Rdmg</sub> | 5,5  |      | dBm   |       |

#### Recommended Operating Conditions and Power Supply Requirements

| Parameter                  | Symbol          | Min.  | Typical | Max.  | Units |
|----------------------------|-----------------|-------|---------|-------|-------|
| Operating Case Temperature | T <sub>OP</sub> | 0     |         | 70    | degC  |
| Power Supply Voltage       | V <sub>cc</sub> | 3.135 | 3.3     | 3.465 | V     |
| Data Rate                  |                 |       | 103.1   |       | Gb/s  |
| Supply Current             | I <sub>cc</sub> |       |         | 1.2   | A     |

#### Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the Recommended Operating Environment unless otherwise specified.  
It is compliant to SFF-8436.

| Parameter                               | Symbol       | Min.  | Max. | Units | Notes                            |
|-----------------------------------------|--------------|-------|------|-------|----------------------------------|
| Temperature monitor absolute error      | DMI_Temp     | -3    | 3    | degC  | Over operating temperature range |
| Supply voltage monitor absolute error   | DMI_VCC      | -0.15 | 0.15 | V     | Over full operating range        |
| Channel RX power monitor absolute error | DMI_RX_Ch    | -2    | 2    | dB    | 1                                |
| Channel Bias current monitor            | DMI_Ibias_Ch | -10%  | 10%  | mA    | Ch1~Ch4                          |
| Channel TX power monitor absolute error | DMI_TX_Ch    | -2    | 2    | dB    | 1                                |

#### Notes

1. Due to measurement accuracy of different single mode fibers, there could be an additional +/-1 dB fluctuation, or a +/-3 dB total accuracy.

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### Optical Characteristics

Tested under recommended operating conditions, unless otherwise noted

| Parameter                                         | Symbol                         | Unit  | Min.                               | Typical | Max.    | Notes |
|---------------------------------------------------|--------------------------------|-------|------------------------------------|---------|---------|-------|
| Transmitter                                       |                                |       |                                    |         |         |       |
| Signaling rate, each lane                         | DR <sub>PL</sub>               | Gb/s  | 25.78125 ±100 ppm                  |         |         | 1     |
| Four Lane Wavelength Range                        | λ1                             | nm    | 1294.53                            | 1295.56 | 1296.59 |       |
|                                                   | λ2                             |       | 1299.02                            | 1300.05 | 1301.09 |       |
|                                                   | λ3                             |       | 1303.54                            | 1304.58 | 1305.63 |       |
|                                                   | λ4                             |       | 1308.09                            | 1309.14 | 1310.19 |       |
| Total launch power                                | P <sub>out</sub>               | dBm   | -                                  | -       | 10.5    |       |
| Average launch power, each lane                   | P <sub>avg</sub>               | dBm   | -4.3                               | -       | 4.5     | 2     |
| Optical modulation amplitude, each lane (OMA)     | OMA                            | dBm   | -1.3                               | -       | 4.5     |       |
| Extinction ratio                                  | ER                             | dB    | 4                                  | -       | -       |       |
| Side-mode suppression ratio                       | SMSR                           | dB    | 30                                 | -       | -       |       |
| Average launch power of OFF transmitter, per lane | P <sub>OFF</sub>               | dBm   | -                                  | -       | -30     |       |
| Relative Intensity Noise                          | RIN                            | dB/Hz |                                    | -       | -130    |       |
| Optical return loss tolerance                     | ORLT                           | dB    | -                                  | -       | 20      |       |
| Transmitter reflectance                           | TR                             | dB    | -                                  | -       | -12     |       |
| Transmitter eye mask {X1, X2, X3, Y1, Y2, Y3}     | Mt                             |       | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4} |         |         | 3     |
| Receiver                                          |                                |       |                                    |         |         |       |
| Receive Rate for Each Lane                        | DRPL                           | Gb/s  | 25.78125 ±100 ppm                  |         |         | 4     |
| Four Lane Wavelength Range                        | λ1                             | nm    | 1294.53                            | 1295.56 | 1296.59 |       |
|                                                   | λ2                             |       | 1299.02                            | 1300.05 | 1301.09 |       |
|                                                   | λ3                             |       | 1303.54                            | 1304.58 | 1305.63 |       |
|                                                   | λ4                             |       | 1308.09                            | 1309.14 | 1310.19 |       |
| Overload Input Optical Power                      | P <sub>max</sub>               | dBm   | 5.5                                | -       | -       |       |
| Average Receive Power for Each Lane               | P <sub>in</sub>                | dBm   | -10.6                              | -       | 4.5     |       |
| Receiver sensitivity (OMA), each lane             | P <sub>sens</sub>              | dBm   | -                                  | -       | -8.6    | 5     |
| Return Loss                                       | RL                             | dB    | -26                                | -       | -       |       |
| Los De-Assert                                     | P <sub>d</sub>                 | dBm   | -                                  | -       | -11.6   |       |
| Los Assert                                        | P <sub>a</sub>                 | dBm   | -23.6                              | -       | -       |       |
| Loss Hysteresis                                   | P <sub>d</sub> -P <sub>a</sub> | dBm   | 0.5                                | -       | 6       |       |

### Notes

1. Transmitter consists of 4 lasers operating at 25.78Gb/s each.
2. Minimum value is informative.
3. Hit ratio 5x10<sup>-5</sup>.
4. Receiver consists of 4 photodetectors operating at 25.78Gb/s each.
5. Measured with a PRBS 2<sup>31</sup>-1 test pattern, @25.78Gb/s

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### Mechanical Dimensions

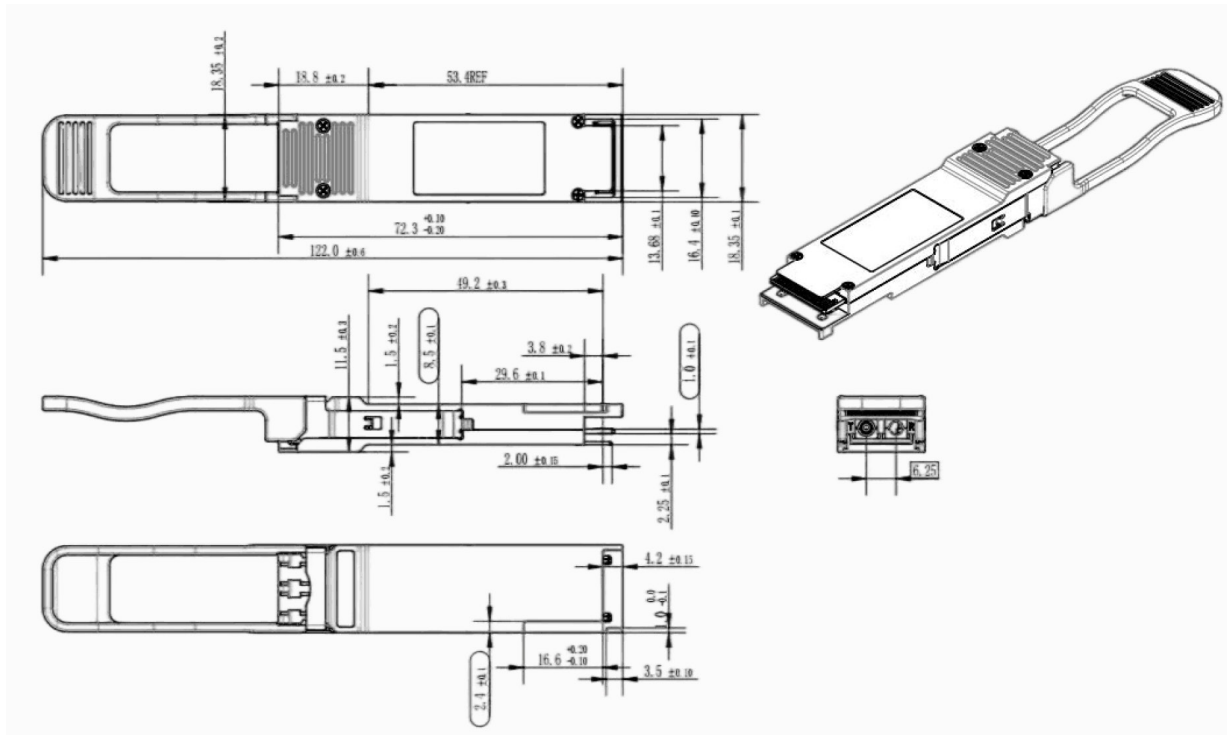


Figure 4. Mechanical Outline

### ESD

This transceiver is specified as ESD threshold 1kV for high speed data pins and 2kV for all other 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 module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

### Laser Safety

This is a Class 1 Laser Product according to EN 60825-1:2014. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).

Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.