

# TS-Q8BL-0409(0904)1H-40DC

## 100G QSFP28 BiDi ER1 Optical Transceiver

### Features

- QSFP28 MSA package with simplex LC connector
- Compliant to 100G Lambda MSA 100G-ER1 Optical Specifications
- Lane signaling rate 53.125GBd with PAM4
- High speed I/O electrical interface
- Two Wire Serial Interface with Digital Diagnostic Monitoring
- Operating case temperature range 0°C to +70°C
- Support KP4 FEC inside the module and KP4 FEC shutdown
- Reaches up to 40km on SMF
- Maximum power consumption 4.5W
- 3.3V power supply voltage
- compliant to RoHS2.0
- Class 1 Laser

### Applications

- 100 Gigabit Ethernet
- Data Center

### Absolute Maximum Ratings

| Parameter                      | Symbol | Conditions     | Min. | Max.                            | Unit |
|--------------------------------|--------|----------------|------|---------------------------------|------|
| Storage temperature (case)     | Tstg   | -              | -40  | +85                             | °C   |
| Relative Humidity              | RH     | Non-condensing | 5    | 85                              | %    |
| Supply voltage                 | VCC    |                | 0    | 3.6                             | V    |
| Low speed signal voltage range |        |                | -0.3 | 4.0                             | V    |
| Damage threshold               |        | Average        |      | -2.4                            | dBm  |
| ESD Sensitivity                |        | —              |      | ±500V for RF<br>±2kV for others | V    |

### Recommended Operating Conditions

| Parameter                  | Symbol | Min.  | Typical | Max.  | Unit |
|----------------------------|--------|-------|---------|-------|------|
| Operating Case Temperature | Tcase  | 0     | -       | 70    | °C   |
| Supply Voltage             | VCC    | 3.135 | 3.3     | 3.465 | V    |
| Relative Humidity          | RH     | 5     | -       | 85    | %    |

|                         |     |   |         |        |      |
|-------------------------|-----|---|---------|--------|------|
| Power Dissipation       | PD  | - | -       | 4.5    | W    |
| Data Rate (optical)     | DRO | - | 103.125 | 106.25 | Gbps |
| Data Rate (Electrical)  | DRE | - | 26.5625 | -      | Gbps |
| Operating Link Distance | LD  | - | -       | 40     | Km   |

## Optical Characteristics

| Parameter                              | Symbol           | Condition                       | Min.    | Typ.    | Max.    | Unit  | Note |
|----------------------------------------|------------------|---------------------------------|---------|---------|---------|-------|------|
| <b>Transmitter</b>                     |                  |                                 |         |         |         |       |      |
| Data Rate                              |                  |                                 |         | 103.125 | 106.25  | Gbps  |      |
| Data rate variation                    |                  |                                 | -100    |         | +100    | ppm   |      |
| Lane center wavelength                 |                  |                                 | 1304.06 | 1304.58 | 1305.1  | nm    |      |
|                                        |                  |                                 | 1308.61 | 1309.14 | 1309.66 | nm    |      |
| Launch power                           | P <sub>ech</sub> |                                 | 1.5     |         | 7.1     | dBm   | 1, 2 |
| Optical modulation amplitude           | POMA             | For TDECQ <1.4dB                | 4.5     |         | 7.9     | dBm   |      |
|                                        |                  | For 1.4dB < TDECQ < TDEC Q(max) | 3.1+    | TDEC Q  | 7.9     |       |      |
| Transmitter and Dispersion eye closure | TDECQ            |                                 |         |         | 3.9     | dBm   |      |
| Optical Extinction Ratio               | ER               |                                 | 6       |         |         | dB    |      |
| Side mode Suppression ratio            | SMSR             |                                 | 30      |         |         | dB    |      |
| Launch power of OFF Transmitter        |                  |                                 |         |         | -30     | dBm   |      |
| Relative Intensity Noise               | RIN              |                                 |         |         | -136    | dB/Hz |      |
| Optical return loss tolerance          |                  |                                 |         |         | 15.6    | dB    |      |
| Transmitter reflectance                |                  |                                 |         |         | -26     | dB    | 4    |
| <b>Receiver</b>                        |                  |                                 |         |         |         |       |      |
| Data Rate                              |                  |                                 |         | 103.125 | 106.25  | Gbps  |      |
| Data rate variation                    |                  |                                 | -100    |         | +100    | Ppm   |      |
| Lane center wavelength                 |                  |                                 | 1308.61 | 1309.14 | 1309.66 | nm    |      |
|                                        |                  |                                 | 1304.06 | 1304.58 | 1305.1  | nm    |      |
| Damage threshold                       | R <sub>dam</sub> |                                 | -2.4    |         |         | dBm   | 5    |

|                                                   |                     |                       |       |  |             |     |            |
|---------------------------------------------------|---------------------|-----------------------|-------|--|-------------|-----|------------|
| Average receiver power                            | Rpow                |                       | -16.2 |  | -3.4        | dBm | 6          |
| Receiver power(OMA)                               | Rovl                |                       |       |  | -2.6        | dBm |            |
| Receiver sensitivity (OMA), (max)                 | SOMA                | For TDECQ <1.4dB      |       |  | -14.0       | dBm | @BER2.4e-4 |
|                                                   |                     | For 1.4dB< TDECQ <3.9 |       |  | -15.4+ TECQ | dBm |            |
| Stressed Sensitivity                              | SRS                 |                       |       |  | -11.5       | dBm | 8          |
| Receiver reflectance                              |                     |                       |       |  | -26         | dB  |            |
| LOSS assert                                       | Optical power alarm |                       | -26   |  | -18         | dBm |            |
| LOSS de-assert                                    |                     |                       |       |  | -16         | dBm |            |
| Conditions of stressed receiver sensitivity test: |                     |                       |       |  |             |     |            |
| Stressed eye closure for PAM4 (SECQ),             |                     |                       |       |  | 3.9         | dB  | 8          |

Note1. As the total average launch power limit has to be met, not all of the lanes can operate at the maximum average launch power ,each lane.

Note2. Average launch power, each lane(min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value can not be compliant: however, a value above this does not ensure compliance.

Note4. Transmitter reflectance is defined looking into the transmitter.

Note5. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

Note6. Average receiver power, each lane(min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

Note7. Measured with conformance test signal at TP3 for the BER specified in 《100G-FR and 100G-LR1 Technical Specifications Rev 2.0》

Note8. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

## Electrical Specifications

| Transmitter (Module Input)        |            |      |         |      |      |
|-----------------------------------|------------|------|---------|------|------|
| Parameter                         | Symbol     | Min. | Typical | Max. | Unit |
| Input Differential Impedance      | Rin        | -    | 100     | -    | Ohm  |
| Differential termination mismatch | D-mismatch | -    | -       | 10   | %    |

|                                         |            |         |     |         |      |
|-----------------------------------------|------------|---------|-----|---------|------|
| (max)                                   |            |         |     |         |      |
| Differential Data Input Amplitude       | VIN,P-P    | -       | -   | 900     | mVpp |
| LPMode, Reset and ModSelL               | VIL        | -0.3    | -   | 0.8     | V    |
|                                         | VIH        | 2.0     | -   | VCC+0.3 | V    |
| <b>Receiver (Module Output)</b>         |            |         |     |         |      |
| Output Differential Impedance           | Rout       | -       | 100 | -       | Ohm  |
| Differential termination mismatch (max) | D-mismatch | -       | -   | 10      | %    |
| Differential Data Output Amplitude      | VOU,P-P    | -       | -   | 900     | mVpp |
| ModPrsL and IntL                        | VOL        | 0       | -   | 0.4     | V    |
|                                         | VOH        | VCC-0.5 | -   | VCC+0.3 | V    |

## Pin layout

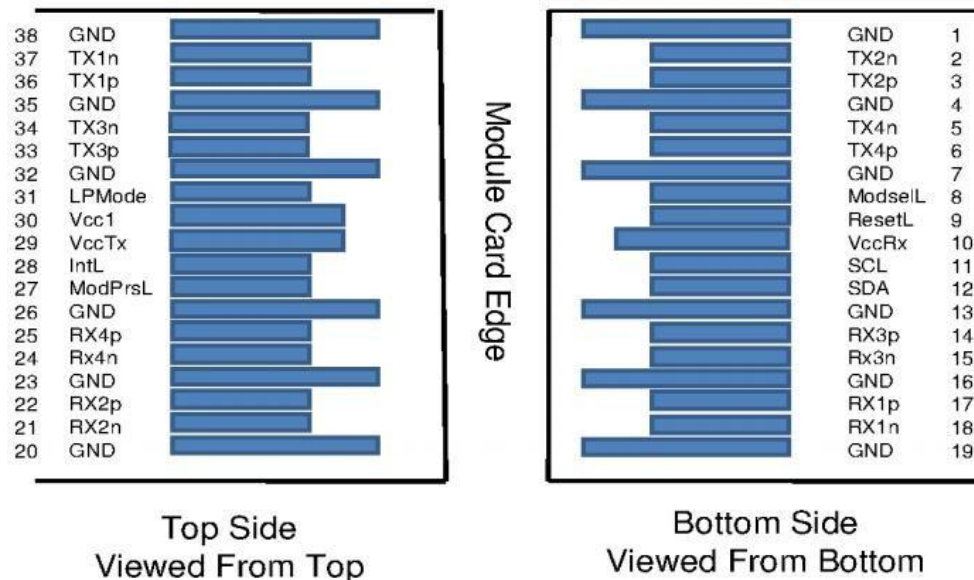


Figure1 Top Side and Bottom Side of QSFP28

## Pin Definitions

| Pin no. | Logic   | Symbol  | Description                         | Note |
|---------|---------|---------|-------------------------------------|------|
| 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       | LVTLL-I | ModSelL | Module Select                       | 3    |
| 9       | LVTLL-I | ResetL  | Module Reset                        | 4    |
| 10      |         | VccRx   | +3.3V Power Supply Receiver         | 2    |

|    |            |               |                                     |   |
|----|------------|---------------|-------------------------------------|---|
| 11 | LVCMOS-I/O | SCL           | 2-Wire Serial Interface Clock       | 3 |
| 12 | LVCMOS-I/O | SDA           | 2-Wire Serial Interface Data        | 3 |
| 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/RX_LOS   | Interrupt/Rx LOS                    | 5 |
| 29 |            | VccTx         | +3.3 V Power Supply transmitter     | 2 |
| 30 |            | Vcc1          | +3.3 V Power Supply                 | 2 |
| 31 | LVTTL-I    | LPMODE/Tx_DIS | Low Power mode/Tx Disable           | 5 |
| 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 |

Note1.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.

Note2. Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power suppliers and shall be applied concurrently. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

Note3.Timing for SCL, SDA and ModSelL shall comply with the common management interface document SFF-8636 and SFF-8679.

Note4.The QSFP28 module must support hardware reset operation.

Note5.Two Multi-Purpose PIN for supporting Tx\_DIS and Rx\_LOS function in the 100G QSFP28 module.The IIC interface must function normally when the QSFP28 module is in the LP mode.

## Host Board Power Supply Filtering

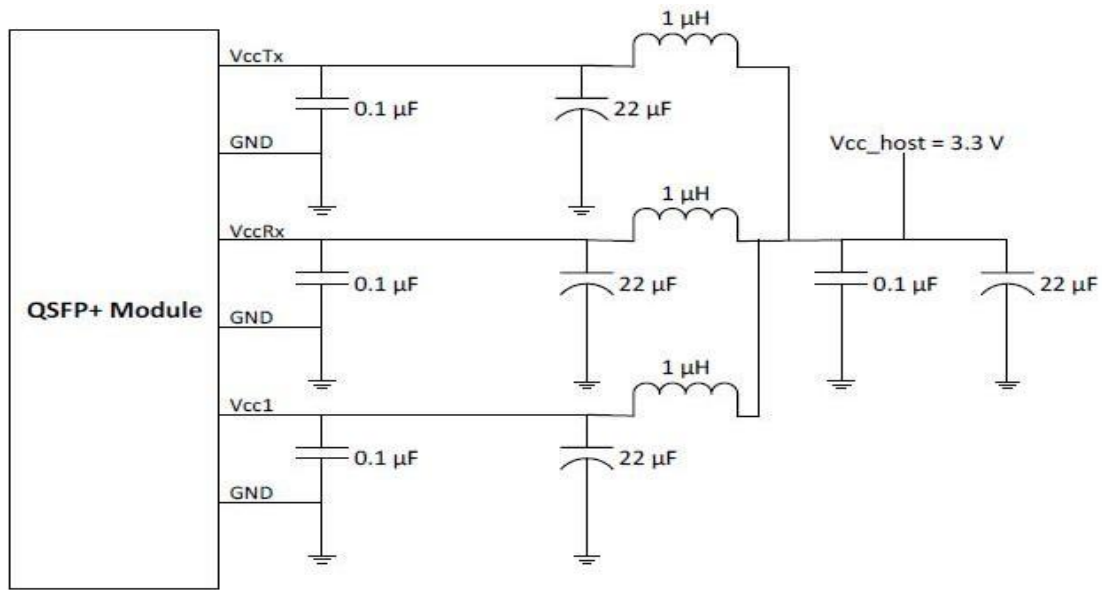


Figure2 Recommended host board power supply filtering

## Mechanical Specifications

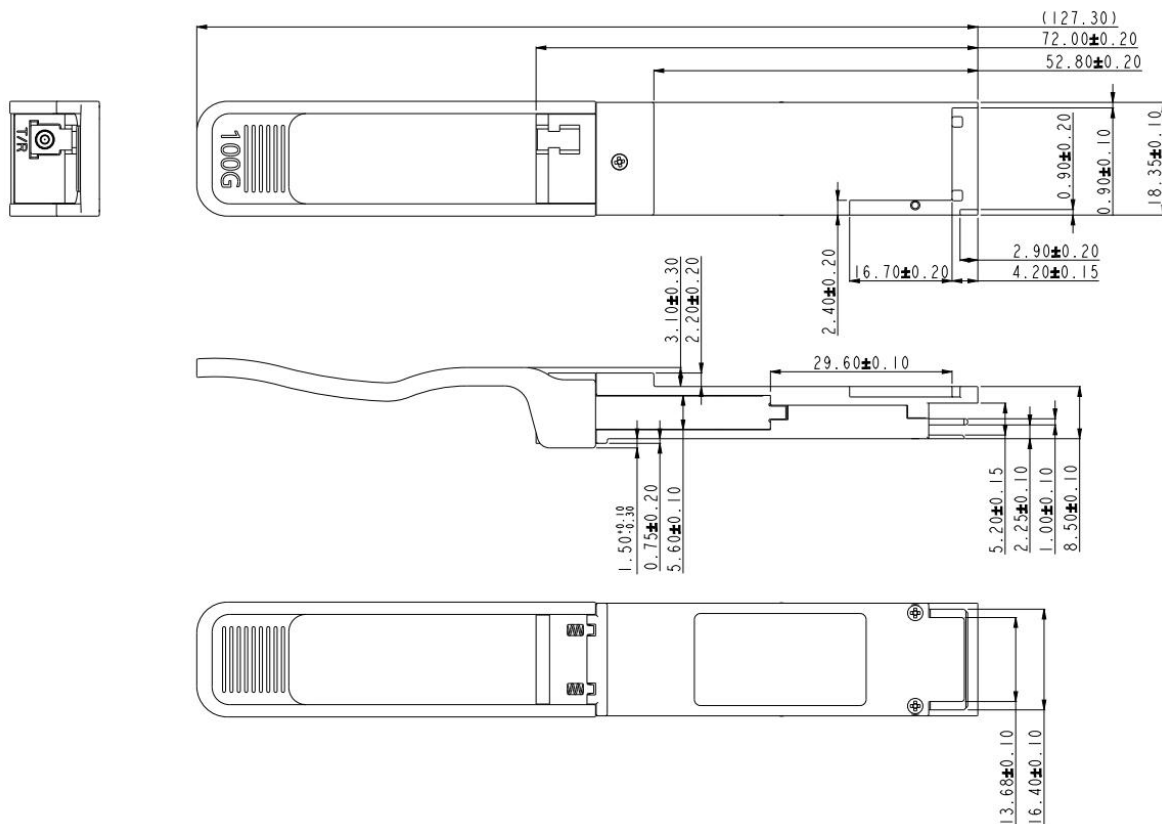


Figure3 100G ER1 BIDI QSFP28 Mechanical Dimensions

## **ESD and Reliability**

The module meet ESD requirements given in EN61000-4-2, criterion B test specification when installed in a properly grounded cage and chassis. The units are subjected to 15kV air discharges during operation and 8kV direct contact discharges to the case. The module high speed signal contacts shall withstand 500 V electrostatic discharge based on Human Body Model per JEDEC JESD22-A114-B。

The module reliability test and ESD test comply with MIL-STD-883H and Telcordia GR-468-CORE (2004) 。