# QSFP-100G-LR1-XX
# 100GBASE-LR1 QSFP28 Single Lambda 1271/1291/1311/1331nm 10km DOM Duplex LC SMF Optical Transceiver Module


FIBERWDM's 100G LR1 single lambda 1271/1291/1311/1331nm 10km QSFP28 transceiver is designed to transmit and receive serial optical data links up to 106.25Gbps data rate by PAM4 modulation format over single-mode fiber. It is a small-form- factor hot pluggable transceiver module integrated with the high performance cooled EML(CWDM wavelength available) laser and high sensitivity PIN receiver.

## Features

- Up to 106.25Gbps data rate single channel
- 1x106.25Gbps PAM4 Line side, 4x25.78Gbps
- NRZ Host side or 4x26.56Gbps NRZ Host side (close Media-side KP1 FEC inside Module)
- 100Gbps hermetic TOSA with EML ( 1271,1291, 1311 or 1331nm )and PIN Detector
- Dual LC optical interface compliant
- DDM function implemented
- Maximum link length of 10km on SMF fiber
- Low power dissipation: <4W
- International class 1 laser safety certified
- Operating temperature range: 0C ~ +70 C
- Compliant with ROHS6

## Applications

- 100GBASE-LR

## Standards

- CEI-28G-VSR
- QSFP28 MSA
- 802.3cu
- SFF-8636

## Ordering Information

| Part No | Specifications | | | | | | | | | Application Code |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pack | Data rate | Tx | Pout | Rx | S(OMA) | Top | Reach | Others | |
| RQ-100G-LR1-27 | QSFP28 | 106.25Gb/s | 1271nm Cooled EMA DFB-LD | -1.9~4.8 dBm | PIN | <-6.1 dBm | 0~70°C | 10km | DDM | 100GBASE-LR |
| RQ-100G-LR1-29 | QSFP28 | 106.25Gb/s | 1291nm Cooled EMA DFB-LD | -1.9~4.8 dBm | PIN | <-6.1 dBm | 0~70°C | 10km | DDM | 100GBASE-LR |
| RQ-100G-LR1-31 | QSFP28 | 106.25Gb/s | 1311nm Cooled EMA DFB-LD | -1.9~4.8 dBm | PIN | <-6.1 dBm | 0~70°C | 10km | DDM | 100GBASE-LR |
| RQ-100G-LR1-33 | QSFP28 | 106.25Gb/s | 1331nm Cooled EMA DFB-LD | -1.9~4.8 dBm | PIN | <-6.1 dBm | 0~70°C | 10km | DDM | 100GBASE-LR |

## Absolute Maximum Ratings

| Parameter | Symbol | Unit | Min | Max |
|---|---|---|---|---|
| Storage Temperature Range | Ts | °C | -40 | +85 |
| Relative Humidity | RH | % | 5 | 85 |
| Power Supply Voltage | Vcc | V | -0.5 | +3.6 |
| Operating Case Temperature Range | Tc | °C | -5 | 75 |
| Receiver Damage Threshold Per Lane | $P_{dag}$ | dBm | 5.8 | |

## Recommended Operating Conditions

| Parameter | Units | MIN. | TYP. | MAX. | Notes |
|---|---|---|---|---|---|
| Recommended Operating Conditions | | | | | |
| Operating Case Temperature | °C | 0 | | +70 | |
| Power Supply Voltage | V | 3.135 | 3.3 | 3.465 | |
| Data Rate(Electrical) | Gbps | 25.781<br>25*4 | 26.5625*4 | | |
| Data Rate( Optical) | Gbps | | 106.25 | | |
| Link Distance with G.652 | Km | | | 10 | |

## High Speed Electrical Specification

100G LR1-10 QSFP28 high speed electrical interface compliant to **CEI-28G-VSR**.

| Parameter | Unit | Min | Typ | Max | Notes |
|---|---|---|---|---|---|
| Transmitter Electrical Input from Host at TP1 a | | | | | |
| Differential data input swing | mV | | | 900 | |
| differential impedance | Ω | | 100 | | |
| Differential termination mismatch | % | | | 10 | |
| Receiver Electrical Output to Host at TP4 | | | | | |
| Differential data input swing | mV | | | 900 | |
| Eye height, differential output | mV | 228 | | | |
| Eye width , output | UI | 0.57 | | | |
| differential impedance | Ω | | 100 | | |
| Differential termination mismatch | % | | | 10 | |

## Transmitter Optical Specification

| Parameter | Units | MIN. | TYP. | MAX. | Notes |
|---|---|---|---|---|---|
| Transmitter Rate | GBd | | 53.125+/-100ppm | | PAM4 |
| Lane center WL | nm | 1264.5 | | 1277.5 | RQ-100G-RL1-27 |
| | | 1284.5 | | 1297.5 | RQ-100G-RL1-29 |
| | | 1304.5 | | 1317.5 | RQ-100G-RL1-31 |
| | | 1324.5 | | 1337.5 | RQ-100G-RL1-33 |
| Side- mode suppression Ratio | dB | 30 | | | |
| Optical output power | dBm | -1.9 | | 4.8 | |
| Optical modulation amplitude | dBm | 1.1 | | 5 | For TDECQ < 1.4 dB |
| | | TDECQ-0.3 | | 5 | For 1.4 dB< TDECQ< TEDCQ( max) |
| Transmitter and dispersion penalty eye closure for PAM4 (TDECQ) | dB | | | 3.4 | |
| TECQ | dB | | | 3.4 | |
| TDECQ- TECQ | dB | | | 2.5 | |
| Extinction ratio | dB | 3.5 | | | |
| Average launch power of OFF transmitte | dB | | | -15 | |
| Transmitter over/ under- shoot | % | | | 22 | |
| Optical return loss tolerance | dB | | | 15.6 | |
| Transmitter reflectance | dB | | | -26 | |
| Transmitter transition time | ps | | | 17 | |
| RINx OMA (max) where x is the optical return loss tolerance (max) | dB/Hz | | | -136 | |

## Receiver Optical Specification

| Parameter | Units | MIN. | TYP. | MAX. | Notes |
|---|---|---|---|---|---|
| Receive Rate | GBd | | 53.125+/-100ppm | | PAM4 |
| Lane center WL | nm | 1260 | | 1610 | |
| Damage threshold | dBm | 5.8 | | | |

| | | | | | |
|---|---|---|---|---|---|
| Average receive power | dBm | -8.2 | | 4.8 | |
| Receiver power( OMA) | dBm | | | 5 | |
| Receive Sensitivity( OMA) | dBm | | | -6.1 | For TDECQ < 1.4 dB@BER 2.4e-4 |
| | | | | -7.5+TECQ | For 1.4dB<TDECQ <TEDCQ(max) @BER 2.4e-4 |
| Stressed Sensitivity ( OMA) | dBm | | | -4.1 | |
| Receiver reflectance | dB | | | -26 | |
| Conditions of stressed receiver sensitivity test: | | | | | |
| Stressed eye closure for PAM4(test conditions) | dB | | 3.4 | | SECQ |
| SECQ-10*lgC$_{eq}$ | dB | | | 3.4 | |

## Pin Descriptions

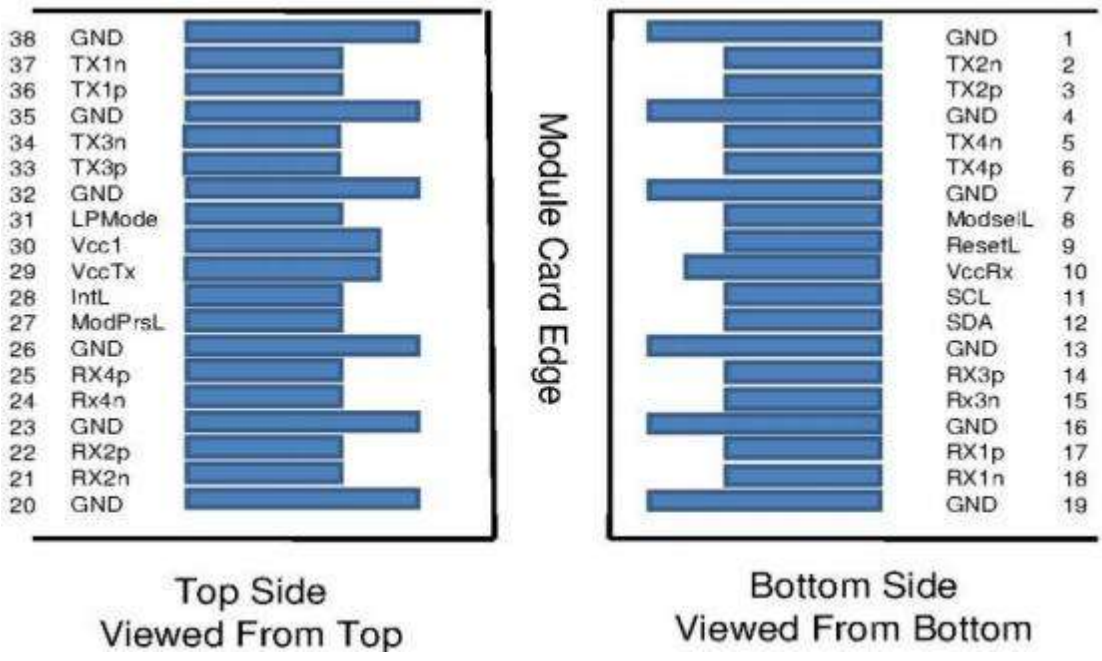
| NO | PIN | DEFINITION | DESCRIPTION | NOTE |
|---|---|---|---|---|
| 1 | 1 | GND | Ground | 1 |
| 2 | 2 | Tx2 n | Transmitter Inverted Data Input | |
| 3 | 3 | Tx2 p | Transmitter Non- Inverted Data Input | |
| 4 | 4 | GND | Ground | 1 |
| 5 | 5 | Tx4 n | Transmitter Inverted Data Input | |
| 6 | 6 | Tx4 p | Transmitter Non- Inverted Data Input | |
| 7 | 7 | GND | Ground | 1 |
| 8 | 8 | ModSelL | Module Select | |
| 9 | 9 | ResetL | Module Reset | |
| 10 | 10 | VccRx | + 3 . 3 V Power Supply Receiver | 2 |
| 11 | 11 | SCL | 2 - Wire Serial Interface Clock | |
| 12 | 12 | SDA | 2-Wire Serial Interface Data | |
| 13 | 13 | GND | Ground | 1 |
| 14 | 14 | Rx3 p | Receiver Non- Inverted Data Output | |
| 15 | 15 | Rx3 n | Receiver Inverted Data Output | |
| 16 | 16 | GND | Ground | 1 |
| 17 | 17 | Rx 1p | Receiver Non- Inverted Data Output | |
| 18 | 18 | Rx 1n | Receiver Inverted Data Output | |
| 19 | 19 | GND | Ground | 1 |
| 20 | 20 | GND | Ground | 1 |
| 21 | 21 | Rx2 n | Receiver Inverted Data Output | |
| 22 | 22 | Rx2 p | Receiver Non- Inverted Data Output | |

| | | | | |
|---|---|---|---|---|
| 23 | 23 | GND | Ground | 1 |
| 24 | 24 | Rx4n | Receiver Inverted Data Output | |
| 25 | 25 | Rx4 p | Receiver Non- Inverted Data Output | |
| 26 | 26 | GND | Ground | 1 |
| 27 | 27 | ModPrsL | Module Present | |
| 28 | 28 | IntL | Interrupt | |
| 29 | 29 | VccTx | +3.3 V Power Supply transmitter | 2 |
| 30 | 30 | Vcc1 | +3.3 V Power Supply | 2 |
| 31 | 31 | LPMode | Low Power Mode | |
| 32 | 32 | GND | Ground | 1 |
| 33 | 33 | Tx3 p | Transmitter Non- Inverted Data Input | |
| 34 | 34 | Tx3 n | Transmitter Inverted Data Input | |
| 35 | 35 | GND | Ground | 1 |
| 36 | 36 | Tx 1p | Transmitter Non- Inverted Data Input | |
| 37 | 37 | Tx 1n | Transmitter Inverted Data Input | |
| 38 | 38 | GND | Ground | 1 |

**Note:**

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.

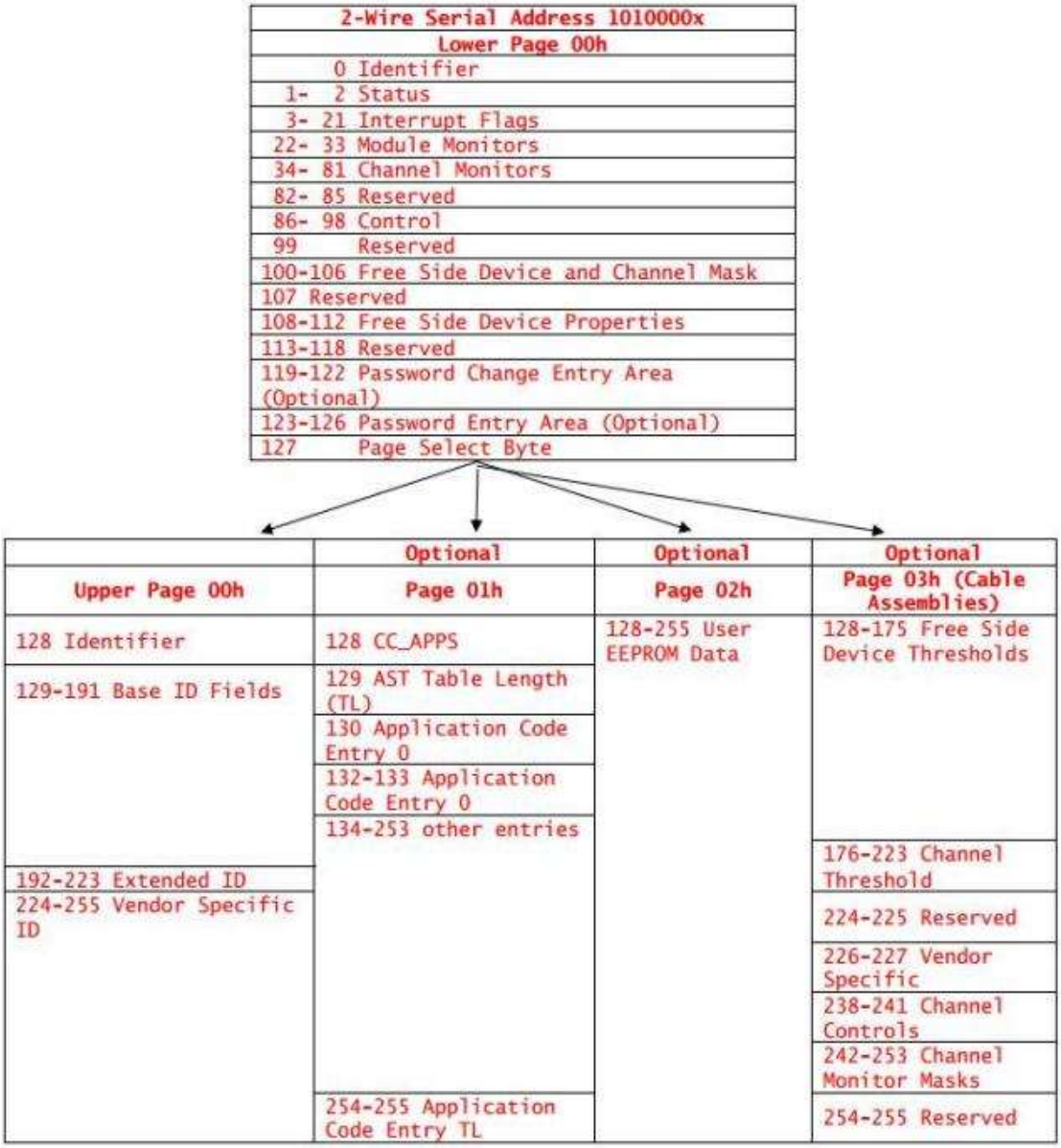
2. VccRx, Vcc1 and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 below. Vcc Rx, Vcc1 and VccTx may be internally connected within the module in any combination. The connector pins are each rated for a maximum current of 1000mA.



# Digital Diagnostic Memory Map

The common memory map is compliant to SFF-8636 Rev 2.10.

SFF-8636 defines a common management interface for 4-lane pluggable transceiver modules, direct attach modules and shielded cable assemblies. It sets the EEPROM memory space as follows:



FEC Enable register

| 03h | Bit | Name | Description |
|---|---|---|---|
| 230 | 7 | Host-Side FEC enable | 0b: disable 1b:enable. Default=0 |
| | 6 | Media-Side FEC enable | 0b: enable 1b:disable. Default=0 |
| | 5-0 | Reserved | |

DDM accuracy:

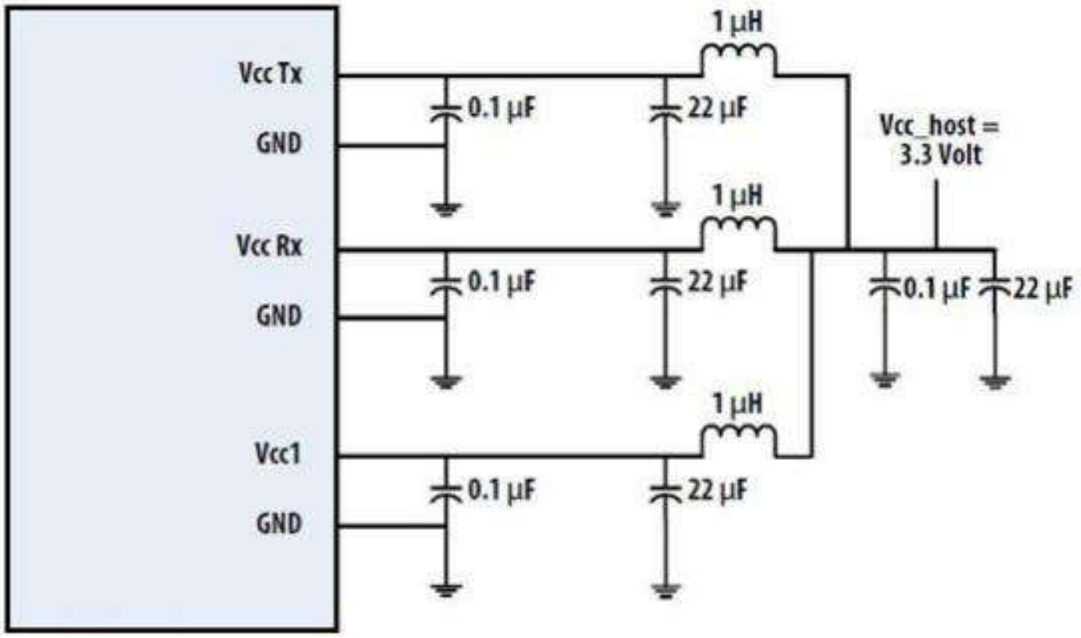
| Parameters | Unit | Requirements | Note |
|---|---|---|---|
| Temperature | ℃ | ±3 | |
| Voltage | V | ±3% | |
| Bias Current | mA | ±10% | |
| Rx Power | dB | ±3 | Range from the LOS assert power to the overload power<br>The value of Rx DDM=-40 dBm ,when there is no power input |
| Tx Power | dB | ±3 | The value of Tx DDM =-40dBm ,when tx-disable is asserted |

DDM Alarm & warning threshold is listed below:

| Parameters | Unit | Requirements | Description |
|---|---|---|---|
| Temp low warning | ℃ | 0 | Min. Case temperature |
| Temp high warning | ℃ | 70 | Max. Case temperature |
| Voltage low warning | V | 3.135 | -5% Vcc Target |
| Voltage high warning | V | 3.465 | +5% Vcc Target |
| Tx Power low warning | dBm | -1.9 | Min optical power |
| Tx Power high warning | dBm | 5.8 | Max optical power+1dBm |
| Rx Power low warning | dBm | -8.2 | Min receiver power |
| Rx Power high warning | dBm | 4.8 | Max receiver power |
| Temp low alarm | ℃ | -5 | Warning - 5℃ |
| Temp high alarm | ℃ | +75 | Warning + 5℃ |
| Voltage low alarm | V | 2.97 | -10% Vcc Target |
| Voltage high alarm | V | 3.63 | +10% Vcc Target |
| Tx Power low alarm | dBm | -3.9 | Min optical power -2dBm |
| Tx Power high alarm | dBm | 6.8 | Max optical power+2 dBm |
| Rx Power low alarm | dBm | -11.2 | Min receiver power-3 dBm |

| | | | |
|---|---|---|---|
| Rx Power high alarm | dBm | 5.8 | Damage threshold |

## Host Board Power Supply Filtering




## Mechanical Specifications