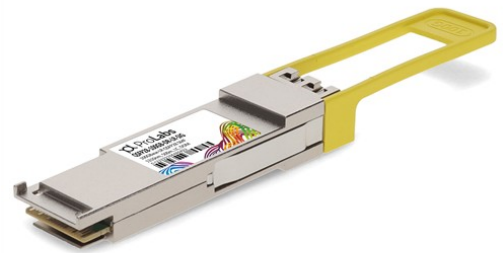


## QSFP28-100GB-DR-LR-SIG

MSA and TAA 100GBase-LR QSFP28 Transceiver Single Lambda (SMF, 1310nm, 500m, LC, DOM, with FEC)

### Features:

- SFF-8665 Compliance
- Duplex LC Connector
- Single-mode Fiber
- Commercial Temperature 0 to 70 Celsius
- Hot Pluggable
- Metal with Lower EMI
- Excellent ESD Protection
- RoHS Compliant and Lead Free



### Applications:

- 100GBase-LR Ethernet
- Access and Enterprise

### Product Description

This MSA compliant QSFP28 transceiver provides 100GBase-LR throughput up to 500m over single-mode fiber (SMF) using a wavelength of 1310nm via an LC connector. It is built to MSA standards and is uniquely serialized and data-traffic and application tested to ensure that they will integrate into your network seamlessly. Digital optical monitoring (DOM) support is also present to allow access to real-time operating parameters. This transceiver is Trade Agreements Act (TAA) compliant. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

ProLabs' transceivers are RoHS compliant and lead-free.

TAA refers to the Trade Agreements Act (19 U.S.C. & 2501-2581), which is intended to foster fair and open international trade. TAA requires that the U.S. Government may acquire only "U.S.-made or designated country end products.")



## Absolute Maximum Ratings

| Parameter                             | Symbol | Min. | Typ.     | Max.                 | Unit | Notes |
|---------------------------------------|--------|------|----------|----------------------|------|-------|
| Maximum Supply Voltage                | Vcc    | -0.5 |          | 3.6                  | V    |       |
| Storage Temperature                   | TS     | -40  |          | +85                  | °C   |       |
| Operating Case Temperature            | Tc     | 0    |          | 70                   | °C   |       |
| Relative Humidity (non-condensing)    | RH     | 0    |          | 85                   | %    |       |
| Damage Threshold                      | THd    | 5    |          |                      | dBm  |       |
| Electrical Data Rate, each Lane (NRZ) |        |      | 25.78125 |                      | Gb/s |       |
| Optical Data Rate (PAM4)              |        |      | 53.125   |                      | GBd  |       |
| Data Rate Accuracy                    |        | -100 |          | 100                  | ppm  |       |
| Pre-FEC Bit Error Ratio               |        |      |          | $2.4 \times 10^{-4}$ |      |       |
| Post-FEC Bit Error Ratio              |        |      |          | $1 \times 10^{-12}$  |      | 1     |
| Control Input Voltage High            |        | 2    |          | Vcc                  | V    |       |
| Control Input Voltage Low             |        | 0    |          | 0.8                  | V    |       |
| Link Distance with G.652              | D      | 2    |          | 500                  | m    | 2     |

### Notes:

1. FEC feature is embedded in the module.
2. FEC required to be turned on to support maximum transmission distance.

## Electrical Characteristics

| Parameter                                                                                        | Symbol | Min.                                | Typ. | Max.                            | Unit | Notes   |
|--------------------------------------------------------------------------------------------------|--------|-------------------------------------|------|---------------------------------|------|---------|
| Power Supply Voltage                                                                             | Vcc    | 3.135                               | 3.3  | 3.465                           | V    |         |
| Power Consumption                                                                                |        |                                     |      | 4.5                             | W    |         |
| Supply Current                                                                                   | Icc    |                                     |      | 1.36                            | A    |         |
| <b>Transmitter (Each Lane)</b>                                                                   |        |                                     |      |                                 |      |         |
| Overload Differential Voltage pk-pk                                                              | TP1a   | 900                                 |      |                                 | mV   |         |
| Common Mode Voltage (Vcm)                                                                        | TP1    | -350                                |      | 2850                            | mV   | 1       |
| Differential Termination Resistance Mismatch                                                     | TP1    |                                     |      | 10                              | %    | At 1MHz |
| Differential Return Loss (SDD11)                                                                 | TP1    |                                     |      | See CEI- 28G-VSR Equation 13-19 | dB   |         |
| Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC11, SCD11) | TP1    |                                     |      | See CEI- 28G-VSR Equation 13-20 | dB   |         |
| Stressed Input Test                                                                              | TP1a   | See CEI- 28G-VSR Section 3.3.11.2.1 |      |                                 |      |         |
| <b>Receiver (Each Lane)</b>                                                                      |        |                                     |      |                                 |      |         |
| Differential Voltage, pk-pk                                                                      | TP4    |                                     |      | 900                             | mV   |         |
| Common Mode Voltage (Vcm)                                                                        | TP4    | -350                                |      | 2850                            | mV   | 1       |
| Common Mode Noise, RMS                                                                           | TP4    |                                     |      | 17.5                            | mV   |         |
| Differential Termination Resistance Mismatch                                                     | TP4    |                                     |      | 10                              | %    | At 1MHz |
| Differential Return Loss (SDD22)                                                                 | TP4    |                                     |      | See CEI- 28G-VSR Equation 13-19 | dB   |         |
| Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC22, SCD22) | TP4    |                                     |      | See CEI- 28G-VSR Equation 13-21 | dB   |         |
| Common Mode Return Loss (SCC22)                                                                  | TP4    |                                     |      | -2                              | dB   | 2       |
| Transition Time, 20 to 80%                                                                       | TP4    | 9.5                                 |      |                                 | ps   |         |
| Vertical Eye Closure (VEC)                                                                       | TP4    |                                     |      | 5.5                             | dB   |         |
| Eye Width at 10 <sup>-15</sup> probability (EW15)                                                | TP4    | 0.57                                |      |                                 | UI   |         |
| Eye Height at 10 <sup>-15</sup> probability (EH15)                                               | TP4    | 228                                 |      |                                 | mV   |         |

### Notes:

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. From 250MHz to 30GHz.

## Optical Characteristics

| Parameter                                                                        | Symbol           | Min.         | Typ. | Max.         | Unit  | Notes |
|----------------------------------------------------------------------------------|------------------|--------------|------|--------------|-------|-------|
| <b>Transmitter</b>                                                               |                  |              |      |              |       |       |
| Center Wavelength                                                                | $\lambda_t$      | 1304.5       |      | 1317.5       | nm    |       |
| Side Mode Suppression Ratio                                                      | SMSR             | 30           |      |              | dB    |       |
| Average Launch Power                                                             | PAVG             | -2.9         |      | 4            | dBm   | 1     |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> )                       | POMA             | -0.8         |      | 4.2          | dBm   | 2     |
| Launch Power in OMA <sub>outer</sub> minus TDECQ<br>for ER ≥ 5dB<br>for ER < 5dB |                  | -2.2<br>-1.9 |      |              | dBm   |       |
| Transmitter and Dispersion Eye Closure for PAM4 (TDECQ)                          | TDECQ            |              |      | 3.4          | dB    |       |
| TDECQ – 10*log <sub>10</sub> (C <sub>eq</sub> )                                  |                  |              |      | 3.4          | dB    | 3     |
| Extinction Ratio                                                                 | ER               | 3.5          |      |              | dB    |       |
| RIN <sub>15.5OMA</sub>                                                           | RIN              |              |      | -136         | dB/Hz |       |
| Optical Return Loss Tolerance                                                    | TOL              |              |      | 15.5         | dB    |       |
| Transmitter Reflectance                                                          | RT               |              |      | -26          | dB    |       |
| Transmitter Transition Time                                                      |                  |              |      | 17           | ps    |       |
| Average Launch Power of OFF Transmitter                                          | P <sub>off</sub> |              |      | -15          | dBm   |       |
| <b>Receiver</b>                                                                  |                  |              |      |              |       |       |
| Center Wavelength                                                                | $\lambda_r$      | 1304.5       |      | 1317.5       | nm    |       |
| Damage Threshold                                                                 | TH <sub>d</sub>  | 5            |      |              | dBm   | 4     |
| Average Receive Power                                                            |                  | -5.9         |      | 4            | dBm   | 5     |
| Receive Power (OMA <sub>outer</sub> )                                            |                  |              |      | 4.2          | dBm   |       |
| Receiver Sensitivity (OMA <sub>outer</sub> )                                     | SEN              |              |      | Equation (1) | dBm   | 6     |
| Stressed Receiver Sensitivity (OMA <sub>outer</sub> )                            | SRS              |              |      | -1.9         | dBm   | 7     |
| Receiver Reflectance                                                             | RR               |              |      | -26          | dB    |       |
| LOS Assert                                                                       | LOSA             | -15          |      |              | dBm   |       |
| LOS Deassert                                                                     | LOSD             |              |      | -8.9         | dBm   |       |
| LOS Hysteresis                                                                   | LOSH             | 0.5          |      |              | dB    |       |
| <b>Conditions of Stress Receiver Sensitivity Test (Note 8)</b>                   |                  |              |      |              |       |       |
| Stressed Eye Closure for PAM4 (SECQ)                                             |                  |              | 3.4  |              | dB    |       |
| SECQ – 10*log <sub>10</sub> (C <sub>eq</sub> )                                   |                  |              |      | 3.4          | dB    |       |

**Notes:**

1. Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
2. Even if the TDECQ < 1.4dB for an extinction ratio of ≥ 5dB or TDECQ < 1.1dB for an extinction ratio of < 5dB, the OMA<sub>outer</sub> (min) must exceed the minimum value specified here.
3. Ceq is a coefficient defined in IEEE Std 802.3-2018 clause 121.8.5.3 which accounts for reference equalizer noise enhancement.
4. Average receive power (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.
5. 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.
6. Receiver sensitivity (OMA<sub>outer</sub>) (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB. It should meet Equation (1), which is illustrated in the figure below.

$$RRRR = \max\{-3.9, RRSSSSS - 5.3\} \quad (1)$$

Where:

RS is the receiver sensitivity, and  
SECQ is the SECQ of the transmitter used to measure the receiver sensitivity.

7. Measured with conformance test signal at TP3 for the BER equal to  $2.4 \times 10^{-4}$ .
8. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.



**Illustration of Receiver Sensitivity Mask for 100G-DR**

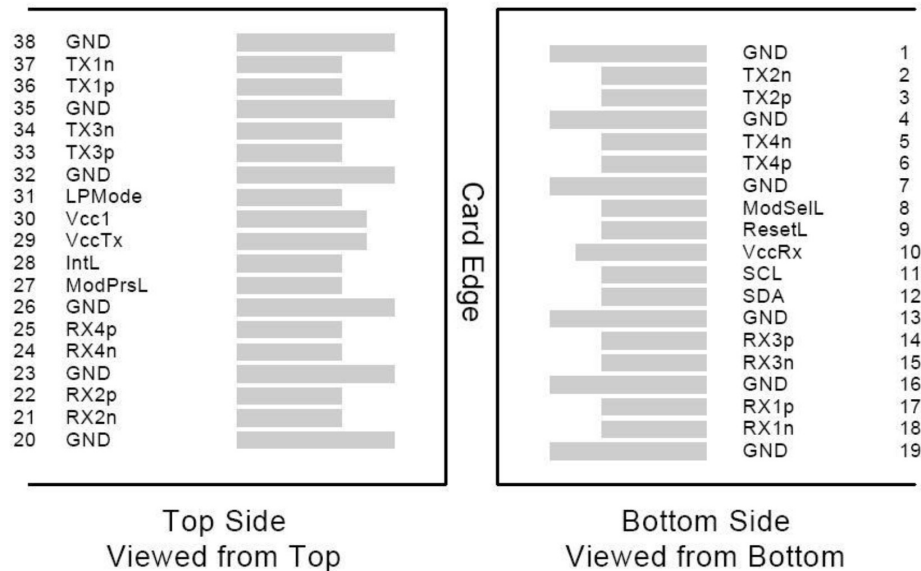
## Pin Descriptions

| Pin | Logic       | Symbol            | Name/Descriptions                                   | Ref. |
|-----|-------------|-------------------|-----------------------------------------------------|------|
| 1   |             | GND               | Module Ground                                       | 1    |
| 2   | CML-I       | Tx2-              | Transmitter inverted data input                     |      |
| 3   | CML-I       | Tx2+              | Transmitter non-inverted data input                 |      |
| 4   |             | GND               | Module Ground                                       | 1    |
| 5   | CML-I       | Tx4-              | Transmitter inverted data input                     |      |
| 6   | CML-I       | Tx4+              | Transmitter non-inverted data input                 |      |
| 7   |             | GND               | Module Ground                                       | 1    |
| 8   | LVTTL-I     | MODSEIL           | Module Select                                       |      |
| 9   | LVTTL-I     | ResetL            | Module Reset                                        |      |
| 10  |             | VCCR <sub>x</sub> | +3.3v Receiver Power Supply                         | 2    |
| 11  | LVC MOS-I   | SCL               | 2-wire Serial interface clock                       |      |
| 12  | LVC MOS-I/O | SDA               | 2-wire Serial interface data                        |      |
| 13  |             | GND               | Module Ground                                       | 1    |
| 14  | CML-O       | RX3+              | Receiver non-inverted data output                   |      |
| 15  | CML-O       | RX3-              | Receiver inverted data output                       |      |
| 16  |             | GND               | Module Ground                                       | 1    |
| 17  | CML-O       | RX1+              | Receiver non-inverted data output                   |      |
| 18  | CML-O       | RX1-              | Receiver inverted data output                       |      |
| 19  |             | GND               | Module Ground                                       | 1    |
| 20  |             | GND               | Module Ground                                       | 1    |
| 21  | CML-O       | RX2-              | Receiver inverted data output                       |      |
| 22  | CML-O       | RX2+              | Receiver non-inverted data output                   |      |
| 23  |             | GND               | Module Ground                                       | 1    |
| 24  | CML-O       | RX4-              | Receiver inverted data output                       |      |
| 25  | CML-O       | RX4+              | Receiver non-inverted data output                   |      |
| 26  |             | GND               | Module Ground                                       | 1    |
| 27  | LVTTL-O     | ModPrsL           | Module Present, internal pulled down to GND         |      |
| 28  | LVTTL-O     | IntL              | Interrupt output, should be pulled up on host board |      |
| 29  |             | VCCT <sub>x</sub> | +3.3v Transmitter Power Supply                      | 2    |
| 30  |             | VCC1              | +3.3v Power Supply                                  | 2    |
| 31  | LVTTL-I     | LPMode            | Low Power Mode                                      |      |
| 32  |             | GND               | Module Ground                                       | 1    |
| 33  | CML-I       | Tx3+              | Transmitter non-inverted data input                 |      |
| 34  | CML-I       | Tx3-              | Transmitter inverted data input                     |      |
| 35  |             | GND               | Module Ground                                       | 1    |
| 36  | CML-I       | Tx1+              | Transmitter non-inverted data input                 |      |
| 37  | CML-I       | Tx1-              | Transmitter inverted data input                     |      |
| 38  |             | GND               | Module Ground                                       | 1    |

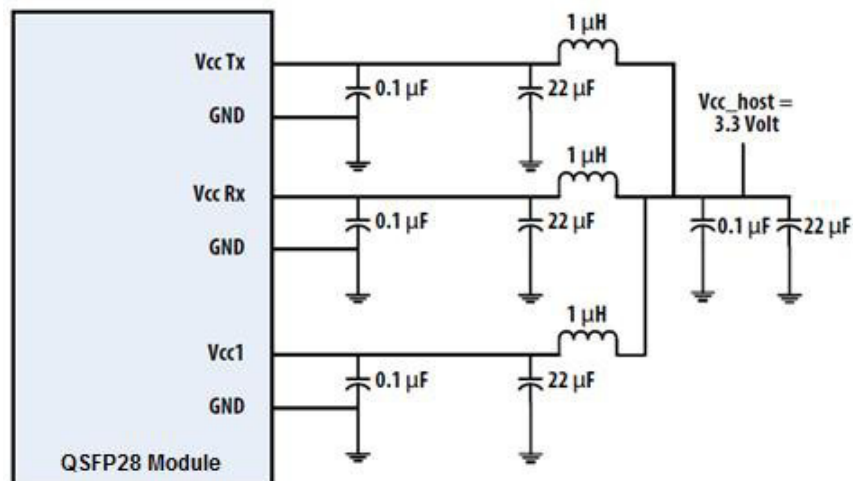
## Notes:

1. GND is the symbol for signal and supply (power) common for the QSFP28 module. 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. Open collector; should be pulled up with 4.7k-10k ohms on host board to a voltage between 3.15V and 3.6V.
2. Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Vcc Rx Vcc1 and Vcc Tx may be internally connected within the QSFP28 Module in any combination. The connector pins are each rated for a maximum current of 1000mA.

## Electrical Pin-out Details



## Recommended Power Supply Filter



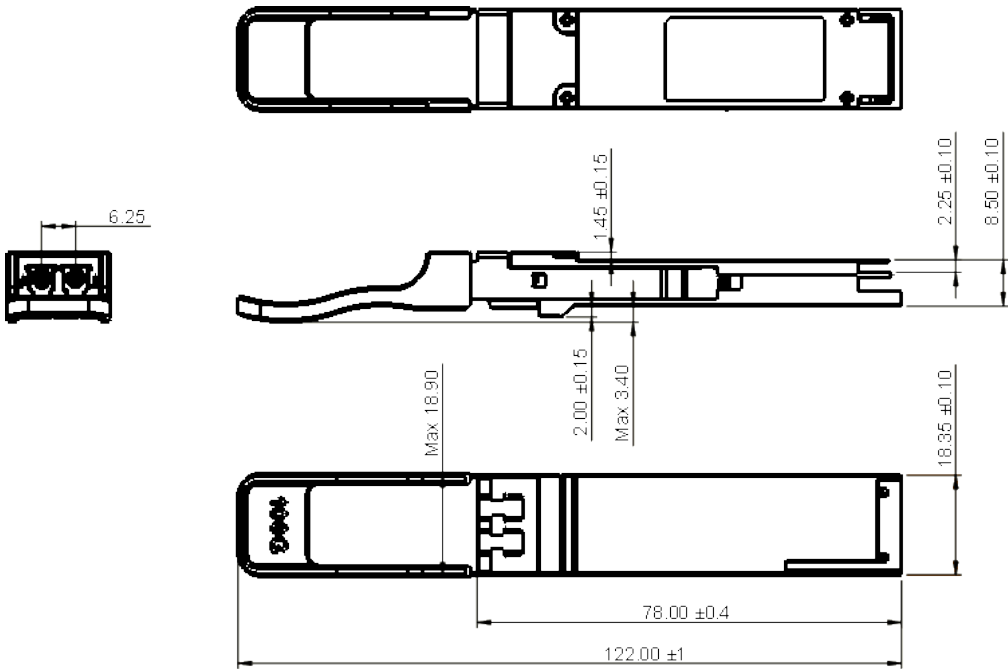
Digital Diagnostic Functions

| 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   | -0.1 | 0.1 | V     | Over full operating range        |
| RX Power Monitor Absolute Error       | DMI_RX    | -2   | 2   | dB    | 1                                |
| Bias Current Monitor                  | DMI_Ibias | -10% | 10% | mA    |                                  |
| TX Power Monitor Absolute Error       | DMI_TX    | -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.

Mechanical Specifications



## About ProLabs

Our experience comes as standard; for over 15 years ProLabs has delivered optical connectivity solutions that give our customers freedom and choice through our ability to provide seamless interoperability. At the heart of our company is the ability to provide state-of-the-art optical transport and connectivity solutions that are compatible with over 90 optical switching and transport platforms.

## Complete Portfolio of Network Solutions

ProLabs is focused on innovations in optical transport and connectivity. The combination of our knowledge of optics and networking equipment enables ProLabs to be your single source for optical transport and connectivity solutions from 100Mb to 400G while providing innovative solutions that increase network efficiency. We provide the optical connectivity expertise that is compatible with and enhances your switching and transport equipment.

## Trusted Partner

Customer service is our number one value. ProLabs has invested in people, labs and manufacturing capacity to ensure that you get immediate answers to your questions and compatible product when needed. With Engineering and Manufacturing offices in the U.K. and U.S. augmented by field offices throughout the U.S., U.K. and Asia, ProLabs is able to be our customers best advocate 24 hours a day.



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