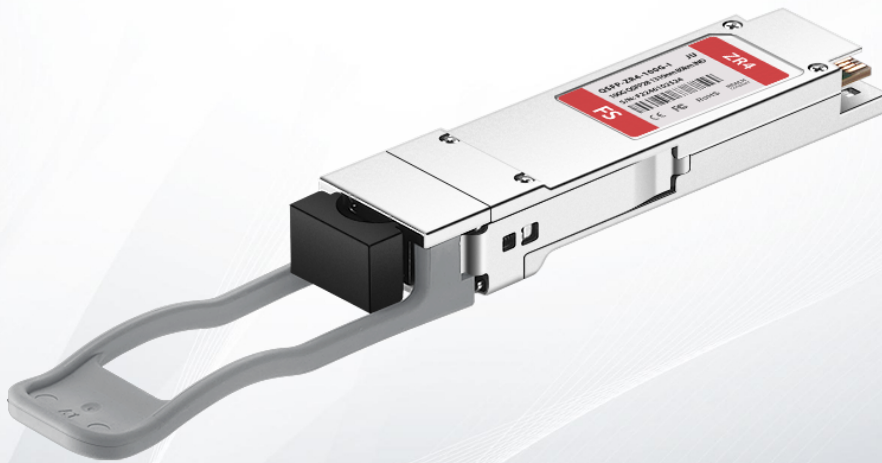


# 100G QSFP28 1310nm 80km Industrial DOM Transceiver

QSFP-ZR4-100G-I



## Application

- 100GBASE-ZR4

## Features

- Hot Pluggable QSFP28 MSA Form Factor
- Up to 80km Reach for G.652 SMF with FEC
- Single +3.3V Power Supply
- Temperature Range -40 to 85°C
- Transmitter: Cooled LANWDM EML TOSA
- Receiver: SOA+PIN
- Maximum Power Consumption 7W
- High Speed I/O Electrical Interface (CAUI-4)
- Duplex LC Receptacle
- Compatible with RoHS2.0

Description

The 100GBASE-ZR4 Optical Transceiver Module is designed for use in 100GBASE Ethernet throughput up to 80km over single mode fiber (SMF) using a wavelength of 1310nm via duplex LC connectors. Taking BOX+FPC+PCBA separate design, it has great reliability, airtightness and heat dissipation performance. This transceiver is compliant with IEEE 802.3ba 100GBASE-ZR4 standard.

Product Specifications

I. Absolute Maximum Ratings

| Parameter                            | Units | Min. | Max. | Notes |
|--------------------------------------|-------|------|------|-------|
| Storage Temperature                  | °C    | -40  | 85   |       |
| Operating Case Temperature           | °C    | -40  | 85   |       |
| Power Supply Voltage                 | V     | -0.3 | 3.6  |       |
| Relative Humidity (non-condensation) | %     | 5    | 85   |       |
| Damage Threshold, Each Lane          | dBm   | 5.5  |      |       |

II. Recommended Operating Conditions

| Parameter                  | Units | Min.  | Typ.     | Max.  | Notes                                           |
|----------------------------|-------|-------|----------|-------|-------------------------------------------------|
| Operating Case Temperature | °C    | -40   |          | 85    | -40°C cold start<br>/-20°C to 85°C mission mode |
| Relative Humidity          | %     | 5     |          | 85    |                                                 |
| Power Supply Voltage       | V     | 3.135 | 3.3      | 3.465 |                                                 |
| Data Rate, Each Lane       | Gbps  |       | 25.78125 |       |                                                 |
| Link Distance with G.652   | km    |       |          | 80    | with FEC                                        |

III. Low Speed Electrical Characteristics

| Parameter                 | Symbol   | Min.         | Typ. | Max.         | Unit | Notes    |
|---------------------------|----------|--------------|------|--------------|------|----------|
| LPMode, Reset and ModSelL | $V_{IL}$ | -0.3         |      | 0.8          | V    |          |
|                           | $V_{IH}$ | 2            |      | $V_{CC}+0.3$ | V    |          |
| ModPrsL and IntL          | $V_{OL}$ | 0            |      | 0.4          | V    | IOL=4mA  |
|                           | $V_{OH}$ | $V_{CC}-0.5$ |      | $V_{CC}+0.3$ | V    | IOL=-4mA |

IV. High Speed Electrical Characteristics

| Parameter | Points | Min. | Max. | Units | Conditions |
|-----------|--------|------|------|-------|------------|
|-----------|--------|------|------|-------|------------|

Host-to-Module Electrical Specifications(module input)

|                                              |      |      |      |    |         |
|----------------------------------------------|------|------|------|----|---------|
| Overload Differential Voltage, pk-pk         | TP1a | 900  |      | mV |         |
| Common Mode Voltage ( $V_{cm}$ )             | TP1  | -350 | 2850 | mV | 1       |
| Differential Termination Resistance Mismatch | TP1  |      | 10   | %  | At 1MHz |

Module-to-Host Electrical Specifications at TP4 (module output)

|                                  |     |      |      |    |   |
|----------------------------------|-----|------|------|----|---|
| Differential Voltage, pk-pk      | TP4 |      | 900  | mV |   |
| Common Mode Voltage ( $V_{cm}$ ) | TP4 | -350 | 2850 | mV | 1 |
| Common Mode Noise, RMS           | TP4 |      | 17.5 | mV |   |

| Parameter                                    | Points | Min. | Max. | Units | Conditions |
|----------------------------------------------|--------|------|------|-------|------------|
| Differential Termination Resistance Mismatch | TP4    |      | 10   | %     | At 1MHz    |
| Transition Time, 20 to 80%                   | TP4    | 12   |      | ps    |            |
| Vertical Eye Closure (VEC)                   | TP4    |      | 5.5  | dB    |            |
| Eye Width at 10-15 Probability (EW15)        | TP4    | 0.57 |      | UI    |            |
| Eye Height at 10-15 Probability (EH15)       | TP4    | 228  |      | mV    |            |

Notes:  
1.  $V_{cm}$  is generated by the host. Specification includes effects of ground offset voltage.2. Measured with a PRBS31Q test pattern @26.5625 GBd, BER≤2.4X10<sup>-4</sup>.  
2. From 250MHz to 30GHz.

V. Optical Characteristics

| Parameter                    | Symbol | Unit | Min.    | Typ.     | Max     | Notes |
|------------------------------|--------|------|---------|----------|---------|-------|
| Transmitter                  |        |      |         |          |         |       |
| Signaling Rate for Each Lane |        | Gbps |         | 25.78125 |         |       |
| Signaling Speed Accuracy     |        | ppm  | -100    |          | 100     |       |
| Four Lane Wavelength Range   | λ1     | nm   | 1294.53 | 1295.56  | 1296.59 |       |
|                              | λ2     |      | 1299.02 | 1300.05  | 1301.09 |       |
|                              | λ3     |      | 1304.58 | 1304.58  | 1305.63 |       |
|                              | λ4     |      | 1309.14 | 1309.14  | 1310.19 |       |
| Side Mode Suppression Ratio  | SMSR   |      | 30      |          |         |       |

| Parameter                                              | Symbol                      | Unit  | Min. | Typ. | Max  | Notes |
|--------------------------------------------------------|-----------------------------|-------|------|------|------|-------|
| Total Average Launch Power                             | Pt                          | dBm   |      |      | 13   |       |
| Average Launch Power for Each Lane                     | Pa                          | dBm   | 2    |      | 6.5  | 1     |
| Difference in Launch Power between any Two Lanes(OMA)  |                             | dB    |      |      | 3.6  |       |
| Transmitter and Dispersion Penalty for Each Lanes      | TDP                         | dB    |      |      | 2.5  |       |
| Average Launch Power of Off Transmitter for Each Lanes | Poff                        | dBm   |      |      | -30  |       |
| Extinction Ratio                                       | EX                          | dB    | 6    |      |      |       |
| RIN20OMA                                               |                             | dB/Hz |      |      | -130 |       |
| Optical Return Loss Tolerance                          |                             | dB    |      |      | 20   |       |
| Transmitter Reflectance                                |                             | dB    |      |      | -26  | 3     |
| Eye Diagram Hit ratio 5E-5 hits per sample             | Compliant with IEEE 802.3ba |       |      |      |      |       |

Receiver

|                            |      |      |         |          |         |   |
|----------------------------|------|------|---------|----------|---------|---|
| Receive Rate for Each Lane |      | Gbps |         | 25.78125 |         |   |
| Signaling Speed Accuracy   |      | ppm  | -100    |          | 100     |   |
| 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 |   |
| Damage threshold           | Pmax | dBm  | 5.5     |          |         | 4 |

| Parameter                                                                 | Symbol | Unit | Min.  | Typ. | Max  | Notes |
|---------------------------------------------------------------------------|--------|------|-------|------|------|-------|
| Average Receive Power for Each Lane                                       | Pin    | dBm  | -28.0 |      | -5.0 | 6     |
| Receive Power, Each Lane (OMA)                                            | PinOMA | dBm  |       |      | -3.5 |       |
| Difference in Receive Power between Any Two Lanes (Average and OMA) (max) |        | dB   |       |      | 5.5  |       |
| Receiver Reflectance                                                      |        | dB   |       |      | -26  |       |
| Receiver Sensitivity(Average optical power), Each Lane                    | S      | dBm  |       |      | -28  | 7     |
| Los Assert                                                                |        | dBm  | -40   |      |      |       |
| Los De-assert                                                             |        | dBm  |       |      | -28  |       |
| Los Hysteresis                                                            |        | dBm  | 0.5   |      |      |       |

Conditions of Stress Receiver Sensitivity Test

|                                         |  |    |  |      |  |   |
|-----------------------------------------|--|----|--|------|--|---|
| Vertical Eye Closure Penalty, Each Lane |  | dB |  | 3.5  |  | 9 |
| Stressed Eye J2 Jitter, Each Lane       |  | UI |  | 0.3  |  | 9 |
| Stressed Eye J9 Jitter, Each Lane       |  | UI |  | 0.47 |  | 9 |

Notes:

1. Average launch power, each lane (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 TDP < 1 dB, the OMA (min) must exceed this value. 3.Transmitter reflectance is defined looking into the transmitter.

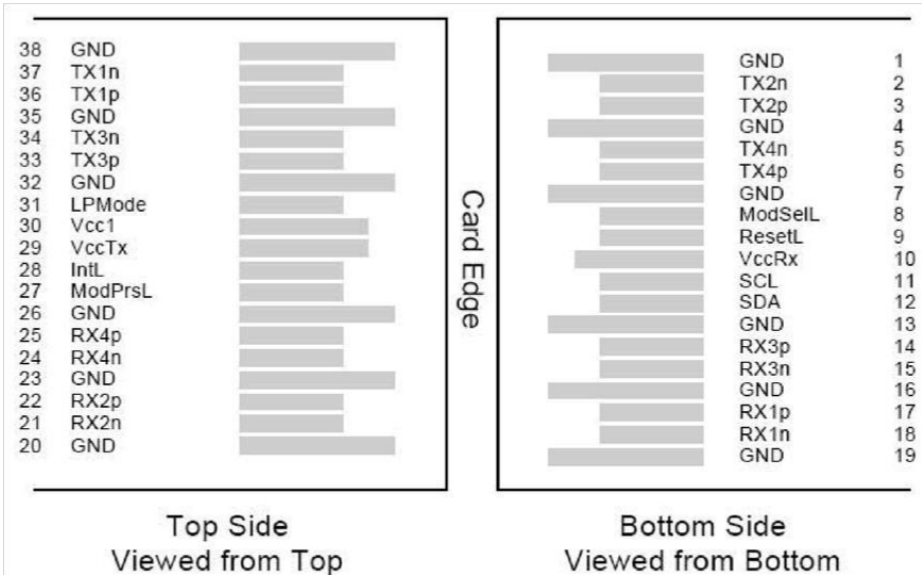
4. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

6. Average receive 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.

7. Receiver sensitivity (Average optical power), each lane (max) is informative.Pre-FEC BER is 5E-5.

9. Vertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J9 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

VI. Pin Descriptions



VII. Pin Definitions

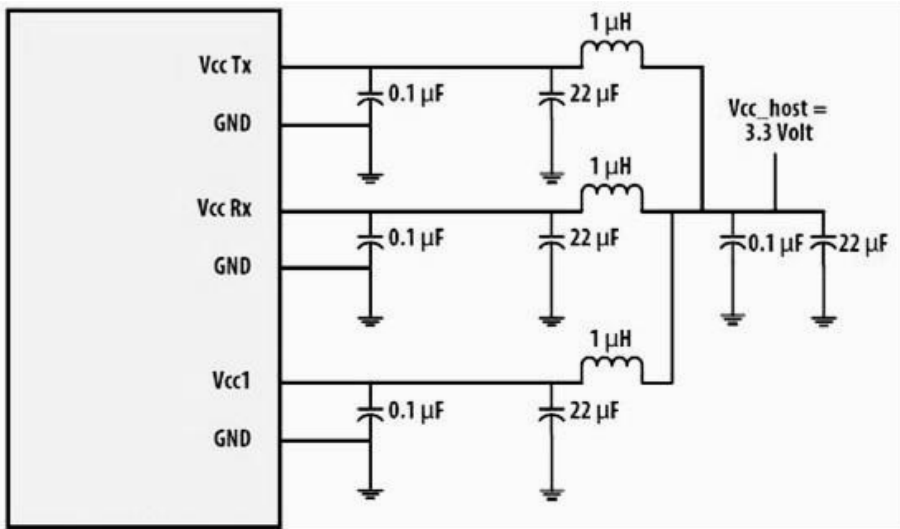
| Pin | Logic   | Symbol  | Description                         | Plug Sequence | Notes |
|-----|---------|---------|-------------------------------------|---------------|-------|
| 1   |         | GND     | Ground                              | 1             | 1     |
| 2   | CML-I   | Tx2n    | Transmitter 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             |       |

| Pin | Logic        | Symbol | Description                       | Plug Sequence | Notes |
|-----|--------------|--------|-----------------------------------|---------------|-------|
| 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             |       |

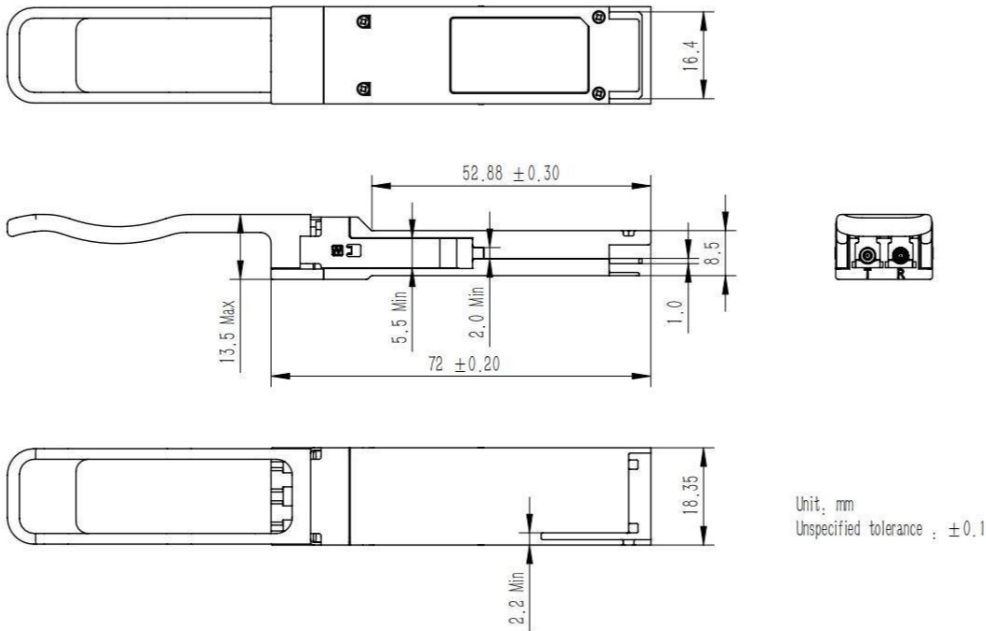
| Pin | Logic   | Symbol        | Description                                                                             | Plug Sequence | Notes |
|-----|---------|---------------|-----------------------------------------------------------------------------------------|---------------|-------|
| 25  | 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/RxLO SL  | Interrupt. Optionally Configurable as RxLOSL 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 xDis | 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     |

**Notes:**  
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. V<sub>cc</sub>Rx, V<sub>cc</sub>1 and V<sub>cc</sub>Tx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 below. V<sub>cc</sub> Rx, V<sub>cc</sub>1 and V<sub>cc</sub> Tx may be internally connected within the module in any combination. The connector pins are each rated for a maximum current of 1000mA.

VIII. Principle Diagram



IX. Mechanical Dimensions



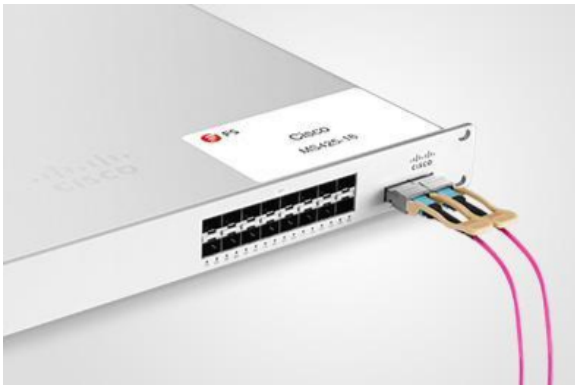
Test Center

I. Compatibility Testing

Each fiber optical transceiver has been tested in host device on site in FS Assured Program to ensure full compatibility with over 200 vendors.



Cisco Catalyst C9500-24Y4C



Cisco MS425-16



Brocade VDX 6940-144S



Dell EMC Networking Z9100-ON



Force@tm S60-44T

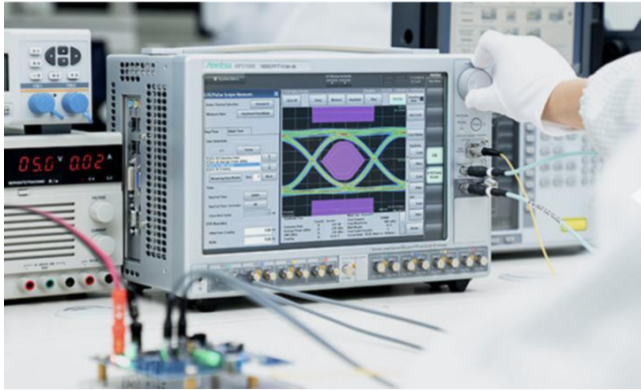


HUAWEI S6720-30L-HI-24S

Above is part of our test bed network equipment. For more information, please click the Test Bed PDF. It will be updated in real time as we expand our portfolio.

## II. Performance Testing

Each fiber optical transceiver has been fully tested in FS Assured Program equipped with world's most advanced analytical equipment to ensure that our transceivers work perfectly on your device.



### 1. TX/RX Signal Quality Testing

Equipped with the all-in-one tester integrated 4ch BERT & sampling oscilloscope, and variable optical attenuator to ensure the input and output signal quality.

- Eye Pattern Measurements: jitter, Mask Margin, etc
- Average Output Power
- OMA
- Extinction Ratio
- Receiver Sensitivity
- BER Curve

### 2. Reliability and Stability Testing

Subject the transceivers to dramatic changes in temperature on the thermal shock chamber to ensure reliability and stability of the transceivers.

- Commercial: 0 °C to 70 °C
- Extended: -5 °C to 85 °C
- Industrial: -40 °C to 85 °C



### 3. Transfer Rate and Protocol Testing

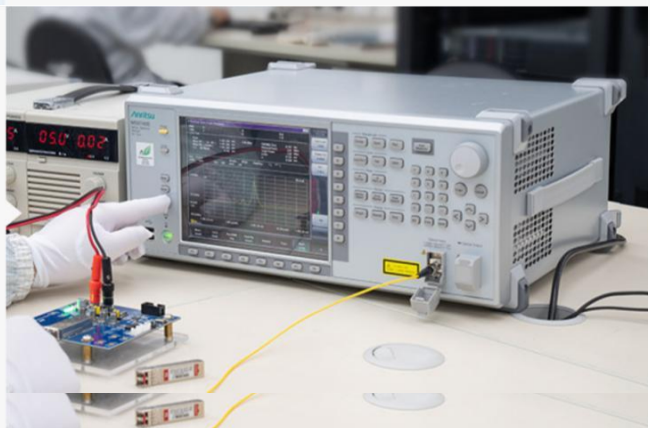
Test the actual transfer data rate and the transmission ability under different protocols with Network Master Pro.

- Ethernet
- Fibre Channel
- SDH/SONET
- CPRI

### 4. Optical Spectrum Evaluation

Evaluate various important parameters with the Optical Spectrum Analyzer to meet the industry standards.

- Center Wavelength, Level
- OSNR
- SMSR
- Spectrum Width



Order Information

| Part Number       | Description                                                   |
|-------------------|---------------------------------------------------------------|
| QSFP-SR4-100G-I   | 100GBASE-SR4 QSFP28 Transceiver, MTP/MPO-12, 100m over MMF    |
| QSFP-CWDM4-100G-I | 100GBASE-CWDM4 QSFP28 Transceiver, Duplex LC, 2km over SMF    |
| QSFP-LR4-100G-I   | 100GBASE-LR4 QSFP28 Transceiver, Duplex LC, 10km over SMF     |
| QSFP-4W40-100G-I  | 100GBASE-4WDM-40 QSFP28 Transceiver, Duplex LC, 10km over SMF |
| QSFP-4W20-100G-I  | 100GBASE-CWDM4 QSFP28 Transceiver, Duplex LC, 20km over SMF   |
| QSFP-4W40-100G-E  | 100GBASE-ER4L QSFP28 Transceiver, Duplex LC, 40km over SMF    |