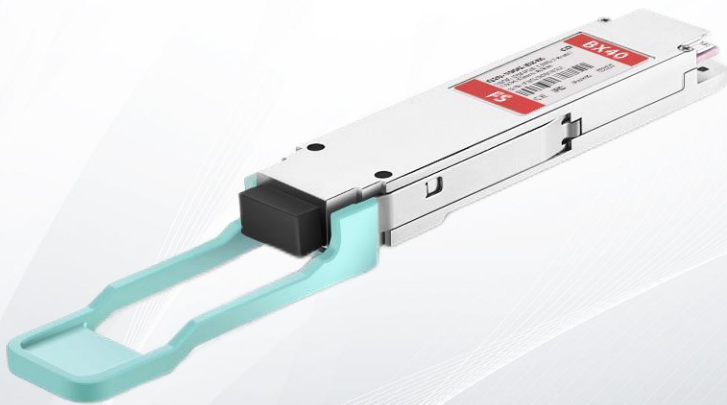


# 100G QSFP28 1304.58nm-TX/ 1309.14nm-RX 40km DOM Transceiver

QSFP-BX40-100G



## Application

- Transmission up to 40km
- Ethernet

## Features

- Hot-pluggable QSFP28 form factor
- Support Ethernet CAUI-4
- High Sensitivity APD Receiver
- Operation Case Temperature C-Temp
- Single 3.3V Power Supply
- Aligned with IEEE 802.3bs and 100G Lambda MSA
- Simplex LC Receptacles
- I2C Management Interface
- RoHS-6 Compliant

Description

The QSFP28 transceiver provides 100GBase-BX throughput up to 40km over single-mode fiber (SMF) using a wavelength of 1304.58nm-TX/1309.14nm-RX via an LC connector. This bidirectional unit must be used with another transceiver or network appliance of complimenting wavelengths. Digital diagnostics functions are also available via the I2C interface, as specified by the QSFP28 MSA, to allow access to real-time operating parameters. With these features, this easy to install, hot swappable transceiver is suitable to be used in various applications, such as 100G Ethernet, data center, and storage area networks applications.

Product Specifications

I. Absolute Maximum Ratings

| Parameter                           | Symbol          | Min. | Max. | Unit | Notes |
|-------------------------------------|-----------------|------|------|------|-------|
| Maximum Supply Voltage              | V <sub>CC</sub> | 0    | 3.6  | V    |       |
| Storage Temperature                 | T <sub>s</sub>  | -40  | 85   | °C   |       |
| Relative Humidity (no-condensation) | RH              | 0    | 85   | %    |       |
| Damage Threshold                    | THd             | -2.4 |      | dBm  |       |

II. Recommended Operating Conditions

| Parameter         | Symbol          | Min.  | Typical | Max.  | Unit | Notes |
|-------------------|-----------------|-------|---------|-------|------|-------|
| Supply Voltage    | V <sub>CC</sub> | 3.135 | 3.3     | 3.465 | V    |       |
| Supply Current    | I <sub>CC</sub> |       | 1.2     | 1.36  | A    |       |
| Power Consumption |                 |       | 4       | 4.5   | W    |       |
| Case Temperature  | C-Temp          | 0     |         | 70    | °C   |       |
| Link Distance     | D               |       |         | 40    | km   |       |

III. Optical Characteristics

| Parameter                                                  | Symbol           | Min.                     | Typical | Max. | Unit |
|------------------------------------------------------------|------------------|--------------------------|---------|------|------|
| Transmitter                                                |                  |                          |         |      |      |
| DataRate (each Lane)                                       |                  | 53.125 ± 100 ppm(CAUI-4) |         |      | GBd  |
| Modulation Format                                          |                  | PAM4                     |         |      |      |
| Wavelength                                                 | UP-LINK          | 1304.58+/- 1.0           |         |      | nm   |
|                                                            | DOWN-LINK        | 1309.14+/- 1.0           |         |      | nm   |
| Side-mode Suppression Ratio                                | SMSR             |                          |         |      | dB   |
| Average Launch Power <sup>1</sup>                          | PAVG             | 1.7                      |         | 7.1  | dBm  |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) |                  |                          |         |      |      |
| TECQ<1.4dB                                                 | P <sub>OMA</sub> | 4.7                      |         | 7.9  | dBm  |
| TECQ>1.4dB                                                 |                  | 3.3+TECQ                 |         |      | dBm  |
| Transmitter and Dispersion Penalty                         | TDECQ            |                          |         | 3.9  | dB   |
| TECQ                                                       | TECQ             |                          |         | 3.9  | dB   |
| TDECQ-TECQ  (max)                                          |                  |                          |         | 2.7  | dB   |
| Extinction Ratio                                           |                  | 5.0                      |         |      | dB   |
| Optical Return Loss Tolerance                              |                  |                          |         | 15   | dB   |
| Transmitter Reflectance <sup>2</sup>                       | RL               |                          |         | -26  | dB   |
| Average Launch Power OFF Transmitter                       | P <sub>OFF</sub> |                          |         | -15  | dBm  |

| Parameter                                                               | Symbol    | Min. | Typical                  | Max.                   | Unit  |
|-------------------------------------------------------------------------|-----------|------|--------------------------|------------------------|-------|
| RIN <sub>15.6OMA</sub>                                                  | RIN       |      |                          | -136                   | dB/Hz |
| Receiver                                                                |           |      |                          |                        |       |
| Data Rate (each Lane)                                                   |           |      | 53.125 ± 100 ppm(CAUI-4) |                        | GBd   |
| Modulation Format                                                       |           |      | PAM4                     |                        |       |
| Lane Wavelength                                                         | UP-LINK   |      | 1309.14+/- 1.0           |                        | nm    |
|                                                                         | DOWN-LINK |      | 1304.58+/- 1.0           |                        | nm    |
| Damage Threshold <sup>3</sup>                                           |           | -2.4 |                          |                        | dBm   |
| Average Receive Power <sup>4</sup>                                      |           | - 16 |                          | -3.4                   | dBm   |
| Receive Power (OMAouter)                                                |           |      |                          | -2.6                   | dBm   |
| Receiver Reflectance                                                    |           |      |                          | -26                    | dB    |
| Receiver Sensitivity (OMAouter) <sup>5</sup>                            |           |      |                          | Max(- 13.8, TECQ-15.2) | dBm   |
| Stressed Receiver Sensitivity (OMAouter), Each Laned (max) <sup>6</sup> | SRS       |      |                          | - 10                   | dBm   |
| Transmitter Reflectance                                                 |           |      |                          | -26                    | dB    |
| LOS Assert                                                              | LOSA      | -30  |                          | -19.5                  | dBm   |
| LOS De-assert                                                           | LOSD      |      |                          | -16.5                  | dBm   |
| LOS Hysteresis                                                          | LOSH      | 0.5  |                          |                        | dB    |
| Conditions of Stress Receiver Sensitivity Test                          |           |      |                          |                        |       |
| Stressed Eye Closure for PAM4(SECQ), Lane under Test                    |           |      |                          | 3.9                    | 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. Transmitter Reflectance is defined looking into the transmitter.
3. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane.
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. CAUI4 mode, the Pre-FEC BER level is 2E-4.
6. Measured with conformance test signal at TP3 for the BER specified in IEEE Std 802.3cd.

### III. Electrical Characteristics

| Parameter                                              | Symbol | Min. | Typical        | Max.            | Unit |
|--------------------------------------------------------|--------|------|----------------|-----------------|------|
| Transmitter                                            |        |      |                |                 |      |
| Signaling Rate                                         | Rate   |      | 25.78 (CAUI-4) |                 | Gbps |
| Differential Input Impedance                           | Zd     | -    | 100            | -               | Ω    |
| Differential Input Voltage Per Lane                    | -      | -    | -              | 900             | mV   |
| Input Impedance Mismatch                               | -      | -    | -              | 10              | %    |
| Input High Voltage                                     | VIH    | 2    | -              | Vcc+0.3         | V    |
| Input LOW Voltage                                      | VIL    | -0.3 |                | 0.8             | V    |
| Receiver                                               |        |      |                |                 |      |
| Signaling Rate                                         | Rate   |      | 25.78 (CAUI-4) |                 | Gbps |
| Common Mode Voltage                                    | Vcm    | -350 | -              | 2850            | mV   |
| Common Mode Noise, rms                                 | -      | -    | -              | 17.5            | mV   |
| Differential Termination Resistance Mismatch (at 1MHz) | -      | -    | -              | 10              | %    |
| Differential Return Loss (SDD22)                       | -      | -    | -              | Per CEI-28G-VSR | dB   |

| Parameter                                                                                       | Symbol | Min. | Typical | Max.             | Unit |
|-------------------------------------------------------------------------------------------------|--------|------|---------|------------------|------|
| Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC22,SCD22) |        |      |         | Per CEI- 28G-VSR | dB   |
| Common Mode Return Loss(SCC22) - from 250 MHz to 30 GHz                                         | -      | -    | -       | -2               | -    |
| TransitionTime: 20/80%                                                                          | -      | 9.5  | -       | -                | ps   |
| Vertical Eye Closure                                                                            | VEC    | -    | -       | 6.5              | dB   |
| Eye Width at 10-15 Robability                                                                   | EW15   | 0.57 | -       | -                | UI   |
| Eye Height at 10- 15 Probability                                                                | EH15   | 228  | -       | -                | mV   |

VI. Pin Assignment

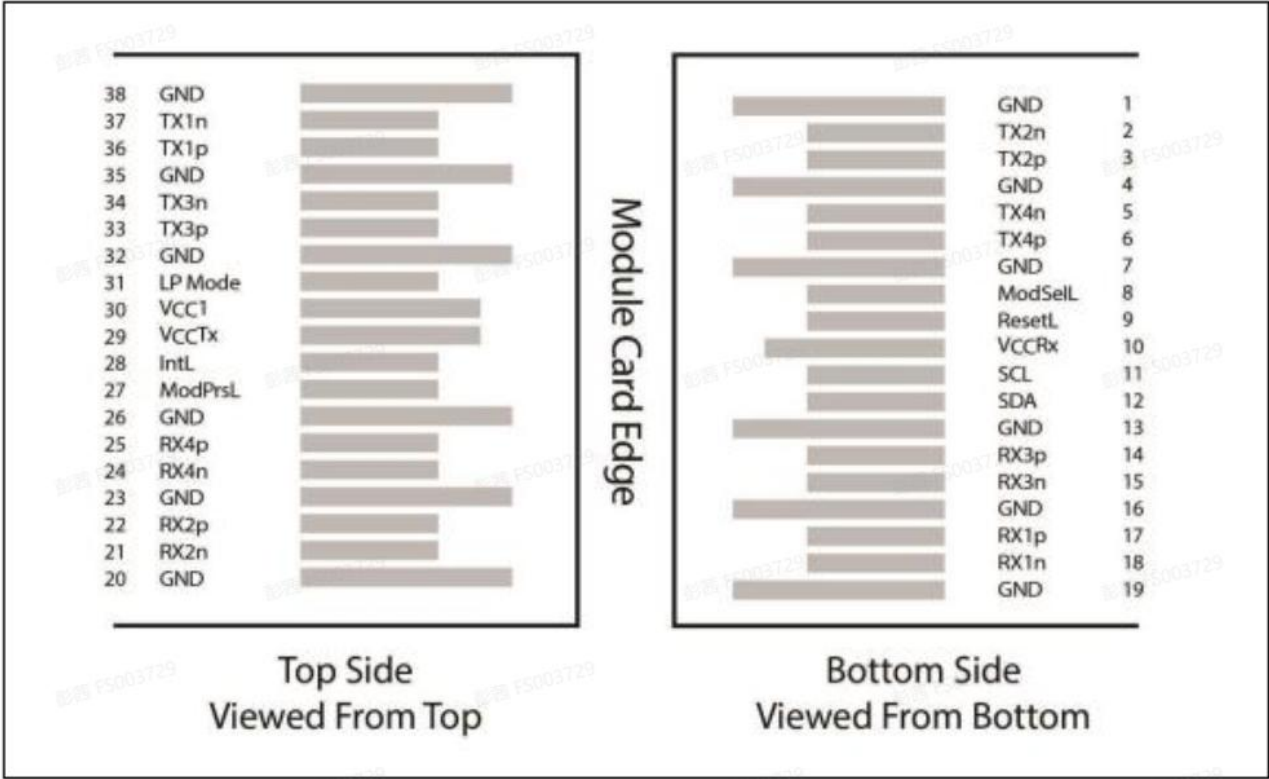


Figure1. QSFP28 Connector Pad layout

### VII. Pin Description

| PIN | Logic   | Symbol  | Name/Description                    |
|-----|---------|---------|-------------------------------------|
| 1   | GND     | GND     | Ground                              |
| 2   | CML     | Tx2n    | Transmitter Inverted Data Input     |
| 3   | CML     | Tx2p    | Transmitter Non-Inverted Data Input |
| 4   | GND     | GND     | Ground                              |
| 5   | CML     | Tx4n    | Transmitter Inverted Data Input     |
| 6   | CML     | Tx4p    | Transmitter Non-Inverted Data Input |
| 7   | GND     | GND     | Ground                              |
| 8   | LVTTL   | ModSelL | Module Select                       |
| 9   | LVTTL   | ResetL  | Module Reset                        |
| 10  | VCC     | VCC_Rx  | +3.3V Receiver Power Supply         |
| 11  | LVC MOS | SCL     | 2-wire Serial Interface Clock       |
| 12  | LVC MOS | SDA     | 2-wire Serial Interface Data        |
| 13  | GND     | GND     | Ground                              |
| 14  | CML     | Rx3p    | Receiver Non-Inverted Data Output   |
| 15  | CML     | Rx3n    | Receiver Inverted Data Output       |
| 16  | GND     | GND     | Ground                              |
| 17  | CML     | Rx1p    | Receiver Non-Inverted Data Output   |
| 18  | CML     | Rx1n    | Receiver Inverted Data Output       |
| 19  | GND     | GND     | Ground                              |

| PIN | Logic  | Symbol  | Name/Description                           |
|-----|--------|---------|--------------------------------------------|
| 20  | GND    | GND     | Ground                                     |
| 21  | CML    | Rx2n    | Receiver Inverted Data Output              |
| 22  | CML    | Rx2p    | Receiver Non-Inverted Data Output          |
| 23  | GND    | GND     | Ground                                     |
| 24  | CML    | Rx4n    | Receiver Inverted Data Output              |
| 25  | CML    | Rx4p    | Receiver Non-Inverted Data Output          |
| 26  | GND    | GND     | Ground                                     |
| 27  | LVTTTL | ModPrsL | Module Present, grounded inside the module |
| 28  | LVTTTL | IntL    | Interrupt                                  |
| 29  | VCC    | VCC_Tx  | +3.3V Transmitter Power Supply             |
| 30  | VCC    | VCC1    | +3.3V Power Supply                         |
| 31  | LVTTTL | LPMode  | Low Power Mode, active high                |
| 32  | GND    | GND     | Ground                                     |
| 33  | CML    | Tx3p    | Transmitter Non-Inverted Data Input        |
| 34  | CML    | Tx3n    | Transmitter Inverted Data Input            |
| 35  | GND    | GND     | Ground                                     |
| 36  | CML    | Tx1p    | Transmitter Non-Inverted Data Input        |
| 37  | CML    | Tx1n    | Transmitter Inverted Data Input            |
| 38  | GND    | GND     | Ground                                     |

VIII. Schematic Diagram

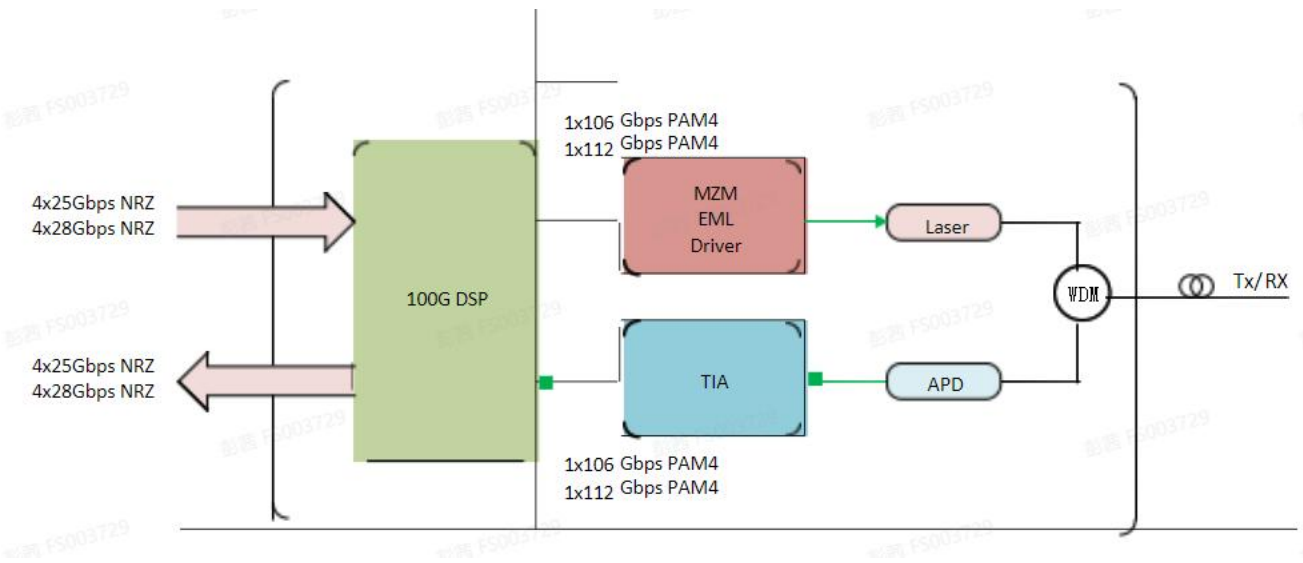


Figure2. Block Diagram

VIII. Digital Diagnostic Memory Map

| Address | Size | Subject Area             | Description                                                                                                                                                                                        |
|---------|------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0-3     | 4    | ID and Status Area       | Module ID from SFF-8024 list, version number, Type and status<br><br>Flat mem indication, CLEI present indicator, MaximumT WIspeed, Current state of Module, Current state of the Interrupt signal |
| 4-7     | 4    | Lane Flag Summary        | Flag summary of all lane flags on pages10h-1Fh                                                                                                                                                     |
| 8- 13   | 6    | Module- Level Flags      | All flags that are not lane or data pathspecific                                                                                                                                                   |
| 14-25   | 12   | Module- Level Monitors   | Monitors that are not lane or data pathspecific                                                                                                                                                    |
| 26-30   | 5    | Module Global Controls   | Controls applicable to the module as awhole                                                                                                                                                        |
| 31-36   | 6    | Module- Level Flag Masks | Masking bits for the Module- Level flags                                                                                                                                                           |
| 37-38   | 2    | CDB Status Area          | Status of most recent CDB command                                                                                                                                                                  |
| 39-40   | 2    | Module Firmware Version  | Module Firmware Version                                                                                                                                                                            |

| Address | Size | Subject Area              | Description                                                                                     |
|---------|------|---------------------------|-------------------------------------------------------------------------------------------------|
| 41-63   | 23   | Reserved Area             | Reserved for future standardization                                                             |
| 64-82   | 19   | Custom Area               | Vendor or module type specific use                                                              |
| 83-84   | 2    | Inactive Firmware Version | Version Number of Inactive Firmware.Values of 00 indicate smodule supports only a single image. |
| 85- 117 | 33   | Application Advertising   | Combinations of host and media interfaces that are supported by module datapath(s)              |
| 118-125 | 8    | Password Entryand Change  |                                                                                                 |
| 126     | 1    | Bank Select Byte          | Bank address of currently visible Page                                                          |
| 127     | 1    | Page Select Byte          | Page address of currently visible Page                                                          |

VIII. Digital Diagnostic

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

| 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        |
| Channel RX power Monitor Absolute Error | DMI_RX_Ch    | -3   | 3    | dB    | 1                                |
| Channel Bias Current Monitor            | DMI_Ibias_Ch | -10% | 10%  | mA    |                                  |
| Channel TXpower Monitor Absolute Error  | DMI_TX_Ch    | -3   | 3    | 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.

VIII. Mechanical Dimensions

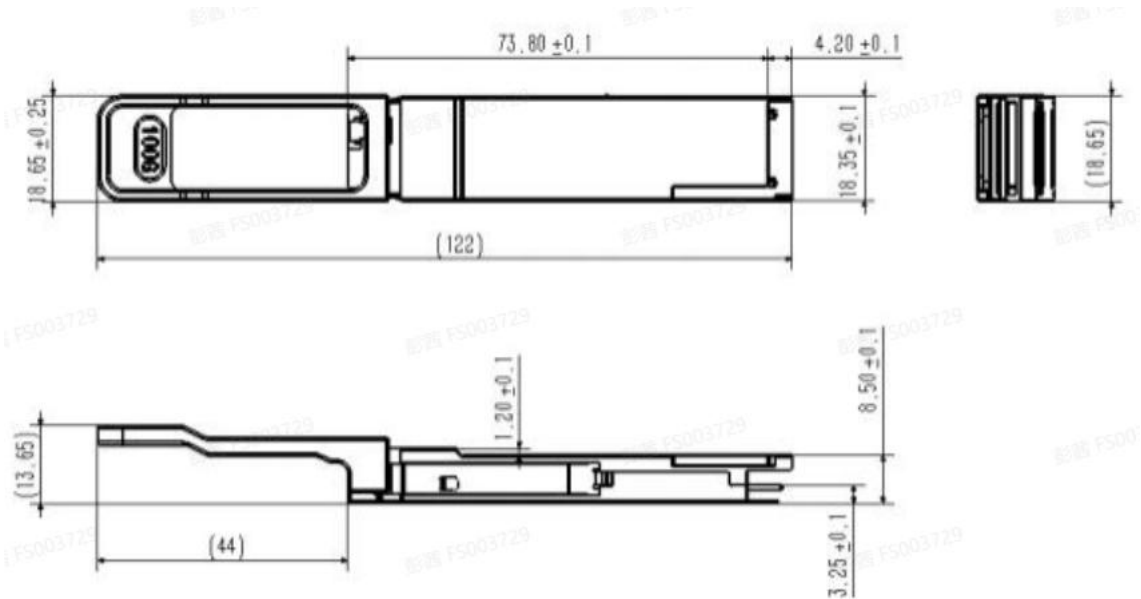


Figure3. Mechanical Outline

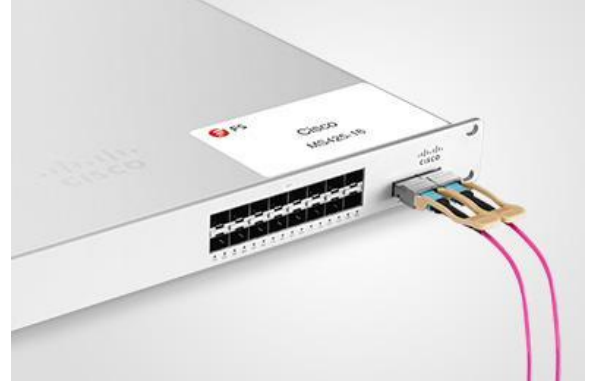
## Test Center

### 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

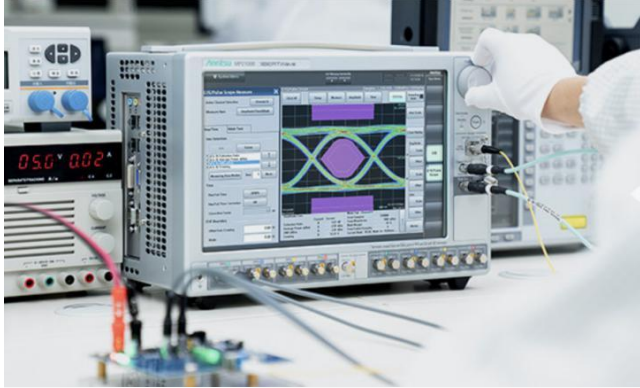


HUAWEI S6720-30L-HI-24S

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                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| QSFP28-BIDI-100G | 100GBASE SR BiDi QSFP28 Transceiver, Duplex LC, 100m over MMF                          |
| Q28-100G-BX10    | 100GBASE BX10 QSFP28 Transceiver, Simplex LC, 1271nm-TX/1331nm-RX, 10km over SMF       |
| Q28-100G-BX10    | 100GBASE BX10 QSFP28 Transceiver, Simplex LC, 1331nm-TX/1271nm-RX, 10km over SMF       |
| QSFP28-100G-BX20 | 100GBASE BX20 QSFP28 Trasnsceiver, Simplex LC, 1280nm-TX/1310nm-RX, 20km over SMF      |
| QSFP28-100G-BX20 | 100GBASE BX20 QSFP28 Transceiver, Simplex LC, 1310nm-TX/1280nm-RX, 20km over SMF       |
| Q28-100G-BX30    | 100GBASE BX30 QSFP28 Transceiver, Simplex LC, 1304.58nm-Tx/1309.14nm-Rx, 30km over SMF |
| Q28-100G-BX30    | 100GBASE BX30 QSFP28 Transceiver, Simplex LC, 1309.14nm-Tx/1304.58nm-Rx, 30km over SMF |
| Q28-100G-BX40    | 100GBASE BX40 QSFP28 Transceiver, Simplex LC, 1304.58nm-TX/1309.14nm-RX, 40km over SMF |
| Q28-100G-BX40    | 100GBASE BX40 QSFP28 Transceiver, Simplex LC, 1309.14nm-Tx/1304.58nm-Rx, 40km over SMF |