

# 10GBASE-ER SFP+ 1550nm 40km Industrial DOM Duplex LC Transceiver

SFP-10GER-55-I



## Application

- 10GBASE-LR at 10.31Gbps
- 10GBASE-LW at 9.95Gbps

## Standards

- SFF-8431
- SFF-8432
- SFF-8472
- 10GFC Rev 4.0
- 10GBASE-ER

## Features

- High Sensitivity Receiver
- 1550nm EML Transmitter
- Power Dissipation<1.8W
- Hot-pluggable Duplex LC Connector Interface
- Single 3.3V Power Supply and TTL Logic Interface
- 2-Wire Interface with Integrated Digital Diagnostic Monitoring
- Industrial Temperature Range: -40~ 85°C

Description

The 10G ER SFP+ Optical Transceiver Module supports up to 40km link lengths over SMF. The transceiver is compliant with SFF-8431,SFF-8432, 10GFC Rev 4.0, and 10GBASE-ER. Digital diagnostics functions are available via a 2-wire serial interface, as specified in the SFF-8472.

The SFP-10GER-55-I is for industrial operating temperature range and can work in harsh industrial environments, such as telecommunication, data processing and management, the application of industrial and factory automation, outdoor applications, rail and intelligent transportation systems (ITSs), marine, oil and gas, mining etc.

Product Specifications

I. Absolute Maximum Ratings

| Parameter                   | Symbol          | Min. | Max. | Unit |
|-----------------------------|-----------------|------|------|------|
| Storage Temperature         | T <sub>S</sub>  | -40  | 85   | °C   |
| Operating Relative Humidity | RH              |      | 95   | %    |
| Maximum Supply Voltage      | V <sub>CC</sub> | -0.5 | 3.6  | V    |

Note

1. Exceeding any one of these values may destroy the device immediately.

II. Optical Characteristics

| Parameter                                 | Symbol           | Min. | Typ.          | Max. | Unit |
|-------------------------------------------|------------------|------|---------------|------|------|
| Power Budget                              |                  | 14   |               |      | dB   |
| Data Rate                                 |                  | 0.6  | 9.953/10.3125 |      | Gbps |
| Transmitter                               |                  |      |               |      |      |
| Center Wavelength                         | λ <sub>C</sub>   | 1528 | 1550          | 1565 | nm   |
| Spectral Width (-20dB)                    | Δλ               |      |               | 1    | nm   |
| Average Output Power <sup>①</sup> (Note1) | P <sub>out</sub> | -2   |               | 4    | dBm  |

| Parameter                        | Symbol            | Min. | Typ. | Max. | Unit  |
|----------------------------------|-------------------|------|------|------|-------|
| Extinction Ratio                 | ER                | 7.5  |      |      | dB    |
| Average Power of OFF Transmitter | P <sub>off</sub>  |      |      | -30  | dBm   |
| Relative Intensity Noise         | RIN               |      |      | -128 | dB/Hz |
| Side Mode Suppression Ratio      | SMSR              | 30   |      |      | dB    |
| Transmitter Dispersion Penalty   | TDP               |      |      | 3    | dB    |
| TX_Disable Assert Time           | T <sub>off</sub>  |      |      | 10   | us    |
| Receiver                         |                   |      |      |      |       |
| Center Wavelength                | λ <sub>C</sub>    | 1260 | 1550 | 1600 | nm    |
| Receiver Sensitivity*(Note2)     | P <sub>min.</sub> |      |      | -16  | dBm   |
| Receiver Overload                | P <sub>max.</sub> | 0    |      |      | dBm   |
| LOS De-assert                    | LOS <sub>D</sub>  |      |      | -18  | dBm   |
| LOS Assert                       | LOS <sub>A</sub>  | -30  |      |      | dBm   |
| LOS-Hysteresis                   | Phys              | 0.5  |      |      | dB    |

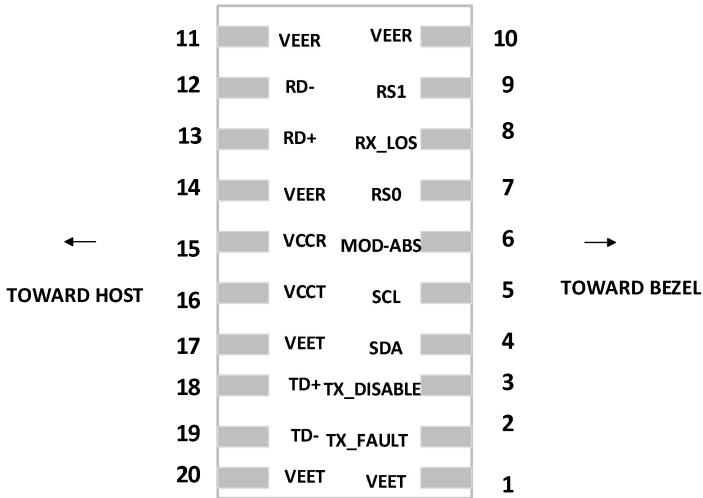
Notes

- 1. Output is coupled into a 9/125um SMF.
- 2. Measured with worst ER, BER less than 1E-12 and PRBS 2^31-1 at 10.3125Gbps.

III. Electrical Characteristics

| Parameter                       |      | Symbol           | Min. | Typ. | Max.                 | Unit | Notes                                       |
|---------------------------------|------|------------------|------|------|----------------------|------|---------------------------------------------|
| Transmitter                     |      |                  |      |      |                      |      |                                             |
| CML Inputs (Differential)       |      | V <sub>in</sub>  | 150  |      | 1200                 | mVpp | AC Coupled Inputs                           |
| Input AC Common Mode Voltage    |      |                  | 0    |      | 25                   | mV   | RMS                                         |
| Input Impedance (Differential)  |      | Z <sub>in</sub>  | 85   | 100  | 115                  | ohms | R <sub>in</sub> >100kohms @DC               |
| TX_DIS                          | High |                  | 2    |      | V <sub>CC</sub>      | V    |                                             |
|                                 | Low  |                  | 0    |      | 0.8                  |      |                                             |
| TX_FAULT                        | High |                  | 2    |      | V <sub>CC</sub> +0.3 | V    | I <sub>o</sub> =400μA; Host V <sub>CC</sub> |
|                                 | Low  |                  | 0    |      | 0.5                  |      | I <sub>o</sub> = -4.0mA                     |
| Receiver                        |      |                  |      |      |                      |      |                                             |
| CML Outputs (Differential)      |      | V <sub>out</sub> | 350  |      | 700                  | mVpp | AC Coupled Outputs                          |
| Output Impedance (Differential) |      | Z <sub>out</sub> | 85   | 100  | 115                  | ohms |                                             |
| RX_LOS                          | High |                  | 2    |      | V <sub>CC</sub> +0.3 |      | I <sub>o</sub> =400μA; Host V <sub>CC</sub> |
|                                 | Low  |                  | 0    |      | 0.8                  |      | I <sub>o</sub> = -4.0mA                     |
| MOD_DEF (0.2)                   |      | VoH              | 2.5  |      |                      | V    | With Serial ID                              |
|                                 |      | VoL              | 0    |      | 0.5                  |      |                                             |

IV. Pin Definitions



| Pin | Name              | Function                     | Plug Seq. | Notes                                                                                                                        |
|-----|-------------------|------------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------|
| 1   | V <sub>EE</sub> T | Transmitter Ground           | 1         | 5)                                                                                                                           |
| 2   | TX Fault          | Transmitter Fault Indication | 3         | 1)                                                                                                                           |
| 3   | TX Disable        | Transmitter Disable          | 3         | 2) Module Disables on High or Open                                                                                           |
| 4   | SDA               | Transmitter Disable          | 3         | 3) 2 Wire Serial ID Interface.                                                                                               |
| 5   | SCL               | Module Definition 2          | 3         | 3) 2 Wire Serial ID Interface.                                                                                               |
| 6   | MOD-ABS           | Module Definition 1          | 3         | 3)                                                                                                                           |
| 7   | RS0               | RX Rate Select (LVTTTL)      | 3         | Rate Select 0, optionally controls SFP+ module receiver. This pin is pulled low to V <sub>EE</sub> T with a >30K resistor.   |
| 8   | LOS               | Loss of Signal               | 3         | 4)                                                                                                                           |
| 9   | RS1               | TX Rate Select (LVTTTL).     | 1         | Rate Select1, optionally controls SFP+ Module transmitter. This pin is pulled low to V <sub>EE</sub> T with a >30K resistor. |
| 10  | V <sub>EE</sub> R | Receiver Ground              | 1         | 5)                                                                                                                           |
| 11  | V <sub>EE</sub> R | Receiver Ground              | 1         | 5)                                                                                                                           |
| 12  | RD-               | Inv. Received Data Out       | 3         | 6)                                                                                                                           |

| Pin | Name              | Function              | Plug Seq. | Notes        |
|-----|-------------------|-----------------------|-----------|--------------|
| 13  | RD+               | Received Data Out     | 3         | 6)           |
| 14  | V <sub>EE</sub> R | Receiver Ground       | 1         | 5)           |
| 15  | V <sub>CC</sub> R | Receiver Power        | 2         | 7) 3.3V ± 5% |
| 16  | V <sub>CC</sub> T | Transmitter Power     | 2         | 7) 3.3V ± 5% |
| 17  | V <sub>EE</sub> T | Transmitter Ground    | 1         | 5)           |
| 18  | TD+               | Transmit Data In      | 3         | 8)           |
| 19  | TD-               | Inv. Transmit Data In | 3         | 8)           |
| 20  | V <sub>EE</sub> T | Transmitter Ground    | 1         | 5)           |

#### Notes

- 1). TX Fault is an open collector/drain output, which should be pulled up with a 4.7K-10K resistor on the host board. Pull up voltage between 2.0V and V<sub>CC</sub>T, R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
- 2). TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7-10 K resistor. It states are Low(0-0.8V): Transmitter on.(>0.8, < 2.0V): Undefined High (2.0 – 3.465V): Transmitter Disabled Open: Transmitter Disabled.
- 3). Modulation Absent, connected to VEET or VEER in the module.
- 4). LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K 10K resistor. Pull up voltage between 2.0V and VCCT, R+0.3V. When high, this output indicates the received optical power is below the worst-case receiver Sensitivity (as defined by the Standard in use).Low indicates normal operation .
- 5). VEER and VEET may be internally connected within the SFP module.
- 6). RD-/+ : These are the differential receiver outputs. They are AC coupled 100 differential Lines which should be terminated with 100 (differential) at the user SERDES.The AC coupling is done inside the module and is thus not required on the host board. The voltage swing on these lines will be between 400 and 2000 mV differential (200 –1000 mV single ended) when properly terminated.
- 7). VCCR and VCCT are the receiver and transmitter power supplies. They are defined as 3.3V ± 5% at the SFP connector pin. Maximum supply current is 300mA. Reco-mmended host board power supply filtering is shown below. Inductors with DC resistance of less than 1 ohm should be used in order to maintain the required voltage at the SFP input pin with 3.3V supply voltage When the recommended supply-filtering network is used, hot plugging of the SFP transceiver module will result in an inrush current of no more than 30mA greater than the steady state value. VCCR and VCCT may be internally connected within the SFP transceiver module.
- 8). TD-/+ : These are the differential transmitter inputs. They are AC-coupled, differential lines with 100 differential termination inside the module.

V. Digital Diagnostic Specifications

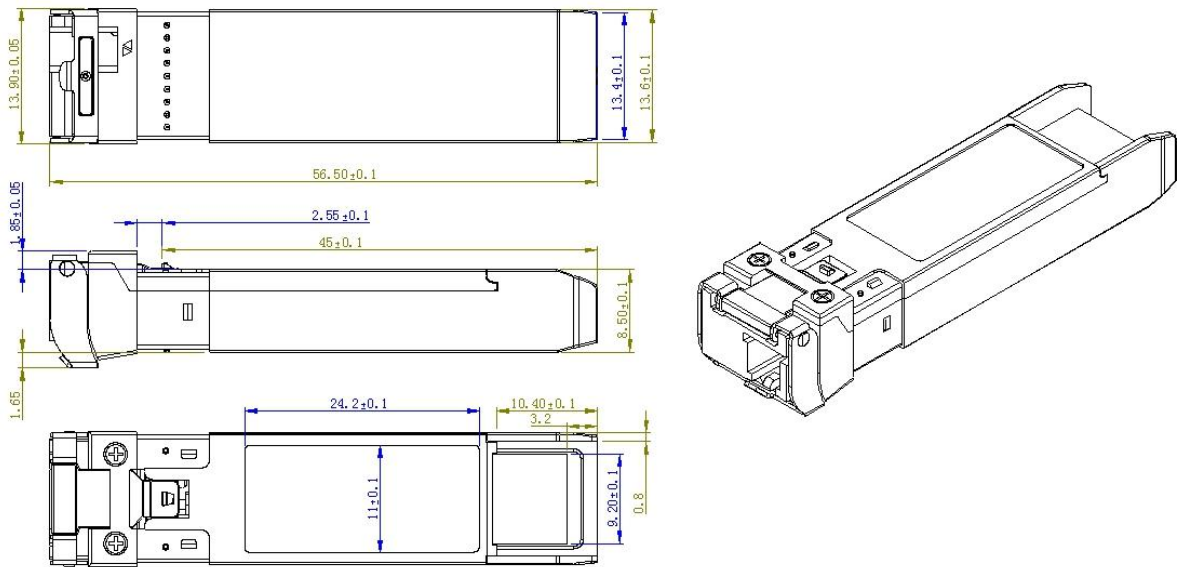
| DDM                    | HAlarm | HWarm | LAlarm | LWarm |
|------------------------|--------|-------|--------|-------|
| Temperature (°C)       | 95     | 85    | -50    | -40   |
| V <sub>cc</sub> (V)    | 3.6    | 3.5   | 3.0    | 3.1   |
| I <sub>bias</sub> (mA) | 120    | 100   | 20     | 30    |
| Tx Power (dBm)         | 6      | 4     | -4     | -2    |
| Rx Power (dBm)         | 2      | 0     | -18    | -16   |

Note

The transceivers provide serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA). The diagnostic information with internal calibration or external calibration all are implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring.

VI. Mechanical Specifications

Unit: mm



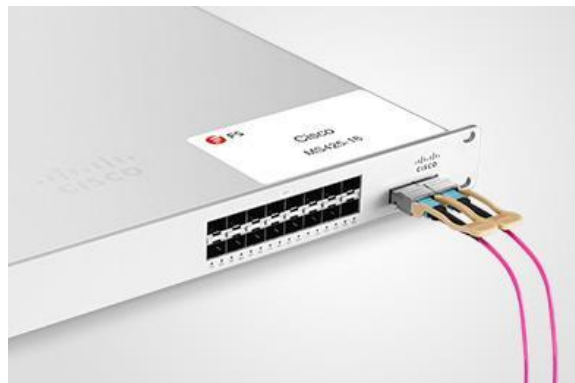
## Test Center

### 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



Force10 S60-44T

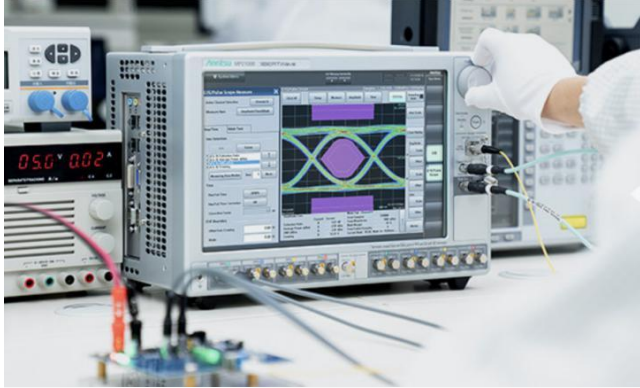


HUAWEI S6720-30L-HI-24S

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                                                           |
|----------------|-----------------------------------------------------------------------|
| SFP-10G-T      | 10GBASE-T SFP+ Copper RJ-45 30m Transceiver                           |
| SFP-10GLRM-31  | 10GBASE-LRM SFP+ 1310nm 220m DOM Duplex LC Transceiver                |
| XFP-10GLRM-31  | 10GBASE-ER SFP+ 1550NM 40KM INDUSTRIAL DOM DUPLEX LC TRANSCEIVER      |
| SFP-10GSR-85   | 10GBASE-SR SFP+ 850nm 300m DOM Duplex LC Transceiver                  |
| SFP-10GLR-31   | 10GBASE-LR SFP+ 1310nm 10km DOM Duplex LC Transceiver                 |
| SFP-10GER-55   | 10GBASE-ER SFP+ 1550nm 40km DOM Duplex LC Transceiver                 |
| SFP-10GZR-55   | 10GBASE-ZR SFP+ 1550nm 80km DOM Duplex LC Transceiver                 |
| XFP-10GZR-55   | 10GBASE-ZR XFP 1550nm 80km DOM Duplex LC Transceiver                  |
| SFP-10GZRC-55  | 10GBASE-ZR SFP+ 1550nm 100km DOM Transceiver                          |
| SFP-10GSR-85   | Dual-Rate 1000BASE-SX and 10GBASE-SR SFP+ 850nm 300m DOM Transceiver  |
| SFP-10GLR-31   | Dual-Rate 1000BASE-LX and 10GBASE-LR SFP+ 1310nm 10km DOM Transceiver |
| SFP-10G-T-I    | 10GBASE-T SFP+ Copper RJ-45 30m Industrial Transceiver                |
| SFP-10GSR-85-I | 10GBASE-SR SFP+ 850nm 300m Industrial DOM Transceiver                 |
| SFP-10GLR-31-I | 10GBASE-LR SFP+ 1310nm 10km Industrial DOM Transceiver                |
| SFP-10GER-31-I | 10GBASE-ER SFP+ 1550nm 40km Industrial DOM Transceiver                |
| SFP-10GZR-55-I | 10GBASE-ZR SFP+ 1550nm 80km Industrial DOM Transceiver                |