

# 1000BASE-LX SFP 1310nm 10km DOM Industrial Transceiver

SFP1G-LX-31



## Application

- Gigabit Ethernet Switches and Routers
- Fiber Channel Switch Infrastructure

## Features

- Operating Data Rate up to 1.25Gbps
- 10km with 9/125  $\mu$ m SMF, 550m MMF
- Class 1 FDA and IEC60825-1 Laser Safety Compliant
- Hot-Pluggable SFP Footprint Duplex LC Connector Interface
- Single 3.3V Power Supply
- Operating Case Temperature : -40°C~+85°C
- Compliant with MSA SFP Specification
- Compliant with SFF-8472
- ROHS 2.0 Compatible

## Description

The SFP transceivers are high performance, cost effective modules supporting dual data-rate of 1.25Gbps/1.0625Gbps and 10km transmission distance with SMF. The transceiver consists of three sections: a FP laser transmitter, a PIN photodiode integrated with a trans-impedance preamplifier (TIA) and MCU control unit. All modules satisfy class I laser safety requirements. The transceivers are compatible with SFP Multi-Source Agreement (MSA) and SFF-8472. For further information, please refer to SFP MSA.

## Block Diagram

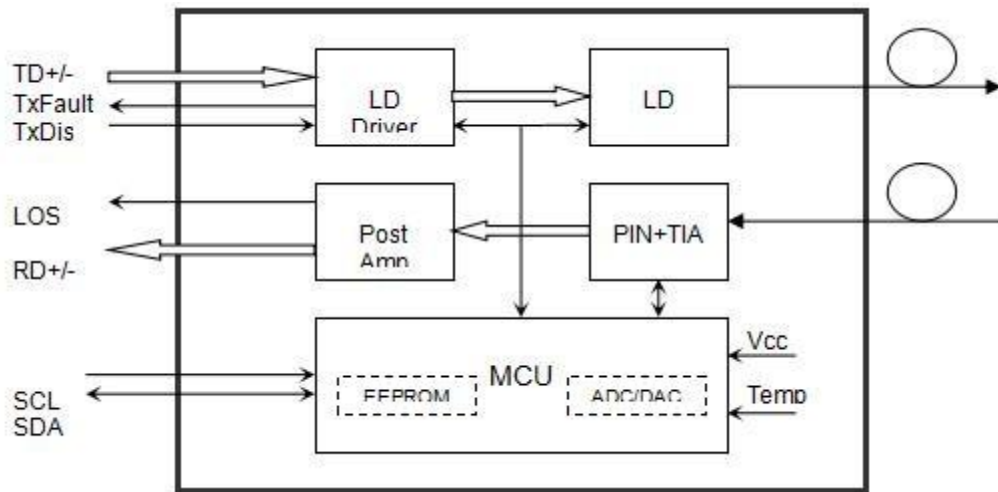


Figure 1 Transceiver Functional Diagram

## Product Specifications

### I. Absolute Maximum Ratings

| Parameter                        | Symbol | Unit | Min  | Max |
|----------------------------------|--------|------|------|-----|
| <b>Storage Temperature Range</b> | Ts     | °C   | -40  | 85  |
| <b>Relative Humidity</b>         | RH     | %    | 0    | 85  |
| <b>Supply Voltage</b>            | Vcc    | V    | -0.3 | +4  |

## II. Recommended Operating Conditions

| Parameter                         | Unit | Min | Type               | Max |
|-----------------------------------|------|-----|--------------------|-----|
| <b>Form Factor</b>                |      |     | SFP                |     |
| <b>Data Rate</b>                  | Gbps |     | 1.063/1.25         |     |
| <b>Applications</b>               |      |     | GBE , FC           |     |
| <b>Optical Receptacle Type</b>    |      |     | LC                 |     |
| <b>Fiber Type</b>                 |      |     | SMF, MMF           |     |
| <b>Fiber Distance</b>             | Km   |     | 10                 |     |
| <b>Power Consumption</b>          | W    |     |                    | 1   |
| <b>Operating Case Temperature</b> | °C   | -40 |                    | 85  |
| <b>DDM Calibration Type</b>       |      |     | Inside Calibration |     |
| <b>Rate Select Function</b>       |      |     | No Request         |     |
| <b>IIC Clock Frequency</b>        | KHz  | 100 |                    | 400 |
| <b>IIC Clock Stretching</b>       | us   |     |                    | 500 |
| <b>IIC THD: Data Hold Time</b>    | ns   | 300 |                    |     |

### III. Electrical Characteristics (Tc=-40°C to 85°C and Vcc= 3.135 to 3.465V)

| Parameter                               | Unit | Min   | Type | Max     |
|---|------|-------|------|---------|
| Supply Voltage                          | V    | 3.135 | 3.30 | 3.465   |
| Supply Current                          | mA   |       |      | 300     |
| Maximum Sustained Peak Current (<500ms) | mA   |       |      | 600     |
| Input Differential Impedance            | Ω    |       | 100  |         |
| Differential Data Input Swing           | mV   | 400   |      | 2400    |
| Differential Data Output Swing          | mV   | 700   |      | 1000    |
| LOS Squelch (Yes&No)                    |      |       | Yes  |         |
| Tx Fault, LOS Output                    | High | V     | 2.0  | Vcc     |
| Voltage                                 | Low  | V     | Vee  | Vee+0.8 |
| Tx Disable                              | VIL  | V     | 2.0  | Vcc     |
|   | VIH  | V     | Vee  | Vee+0.8 |

### IV. Optical Characteristics (Tc=-40°C to 85°C, Vcc= 3.14 to 3.46V, Data rate: 1.25Gb/s)

| Parameter | Unit | Min | Type | Max |
|-----------|------|-----|------|-----|
|-----------|------|-----|------|-----|

#### Transmitter Optical Characteristics

|                      |     |    |      |    |
|----------------------|-----|----|------|----|
| Laser Type           |     |    | FP   |    |
| Output Average Power | dBm | -9 |      | -3 |
| Center Wavelength    | nm  |    | 1310 |    |

| Parameter  | Unit              | Min                       | Type | Max  |
|--|-------------------|---------------------------|------|------|
| <b>Wavelength Range</b>  | nm                | 1260                      |      | 1360 |
| <b>Spectral Width</b>  | nm                |                           |      | 4    |
| <b>Extinction Ratio (ER)</b>   | dB                | 8.2                       |      |      |
| <b>Eye Mask Margin<br/>(1000 consecutive snapshots at typical rate and room temperature)</b> |                   | Compliant with IEEE 802.3 |      |      |
| <b>Transmitter and Dispersion Penalty</b>  | dB                |                           |      | 1    |
| <b>RIN12OMA</b>  | dB/Hz             |                           |      | -128 |
| <b>Optical Power for TX DISABLE</b>  | dBm               |                           |      | -40  |
| <b>Optical Return Loss Tolerance</b>   | dB                |                           |      | 12   |
| <b>Receiver Optical Characteristics</b>  |                   |                           |      |      |
| <b>Operating Wavelength</b>  | nm                | 1260                      |      | 1620 |
| <b>Sensitivity</b>   | dBm               |                           |      | -21  |
| <b>Saturation Power</b>  | dBm               | -3                        |      |      |
| <b>Max Input Power</b>   | dBm               | 0                         |      |      |
| <b>LOS</b>   | <b>Assert</b>     | dBm                       | -35  |      |
|  | <b>De-assert</b>  | dBm                       |      | -22  |
|  | <b>Hysteresis</b> | dB                        | 0.5  |      |
| <b>Optical Return Loss</b>   | dB                | 12                        |      |      |

## Pin Function Definitions

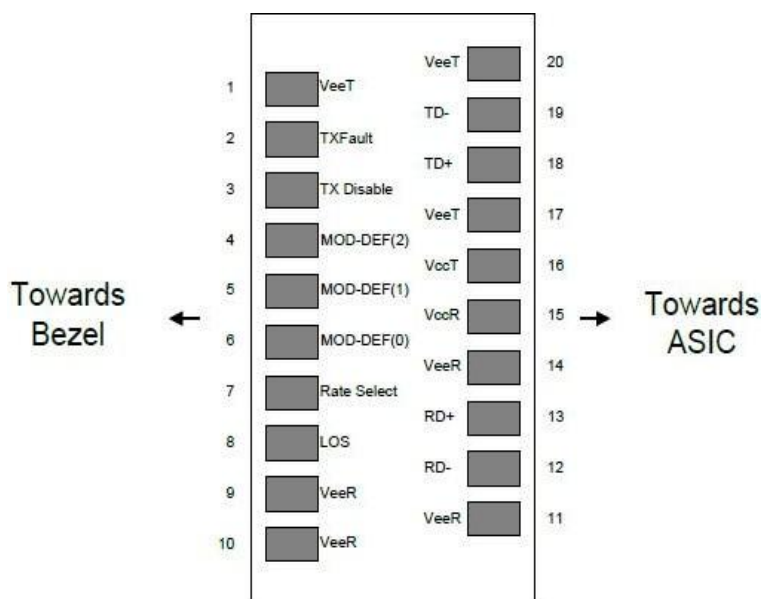


Figure 2 Pin Function Definitions

## Transceiver Pin Descriptions

| Pin Number     | Symbol     | Name                           | Description  |
|----------------|------------|--------------------------------|--|
| <b>1,17,20</b> | VeeT       | Transmitter Signal Ground      | These pins should be connected to signal ground on the host board.   |
| <b>2</b>       | TX Fault   | Transmitter Fault Out (OC)     | Logic "1" Output = Laser Fault (Laser off before t_fault) Logic "0" Output = Normal Operation This pin is open collector compatible, and should be pulled up to Host Vcc with a 10kΩ resistor. |
| <b>3</b>       | TX Disable | Transmitter Disable In (LVTTL) | Logic "1" Input (or no connection) = Laser off Logic "0" Input = Laser on This pin is internally pulled up to VccT with a 10 kΩ resistor.  |
| <b>4</b>       | SDA        | Module Definition Identifiers  | Serial ID with SFF 8472 Diagnostics Module Definition pins should be pulled up to Host Vcc with 10 kΩ resistors.   |
| <b>5</b>       | SCL        |                                |  |
| <b>6</b>       | MOD-ABS    |                                |  |

| Pin Number  | Symbol | Name                       | Description  |
|-------------|--------|----------------------------|--|
| 7           | RS0    | Not Connect                | Not Connect  |
| 8           | LOS    | Loss of Signal Out (OC)    | Sufficient optical signal for potential BER <math>1 \times 10^{-12}</math> = Logic "0"<br>Insufficient optical signal for potential BER <math>1 \times 10^{-12}</math> = Logic "1"<br>This pin is open collector compatible, and should be pulled up to Host Vcc with a 10kΩ resistor. |
| 9, 10,11,14 | VeeR   | Receiver Signal Ground)    | These pins should be connected to signal ground on the host board.   |
| 12          | RD     | Receiver Negative DATA Out | Light on = Logic "0" Output Receiver DATA output is internally AC coupled and series terminated with a 50Ω resistor.   |
| 13          | RD+    | Receiver Negative DATA Out | Light on = Logic "1" Output Receiver DATA output is internally AC coupled and series terminated with a 50Ω resistor.   |
| 15          | VccR   | Receiver Power Supply      | This pin should be connected to a filtered +3.3V power supply on the host board. See Figure 3.Recommended power supply filter  |
| 16          | VccT   | Receiver Power Supply      | This pin should be connected to a filtered +3.3V power supply on the host board. See Figure 3.Recommended power supply filter  |
| 18          | TD+    | Transmitter Positive DATA  | Logic "1" Input = Light on Transmitter DATA inputs are internally AC coupled and terminated with a differential 100Ω resistor.   |
| 19          | TD-    | Transmitter Negative       | Logic "0" Input = Light on Transmitter DATA inputs are internally AC coupled and terminated with a differential 100Ω resistor.   |

### Typical Application Circuit

\*Recommended "Typical Application Schematics"are shown in Figure 3.

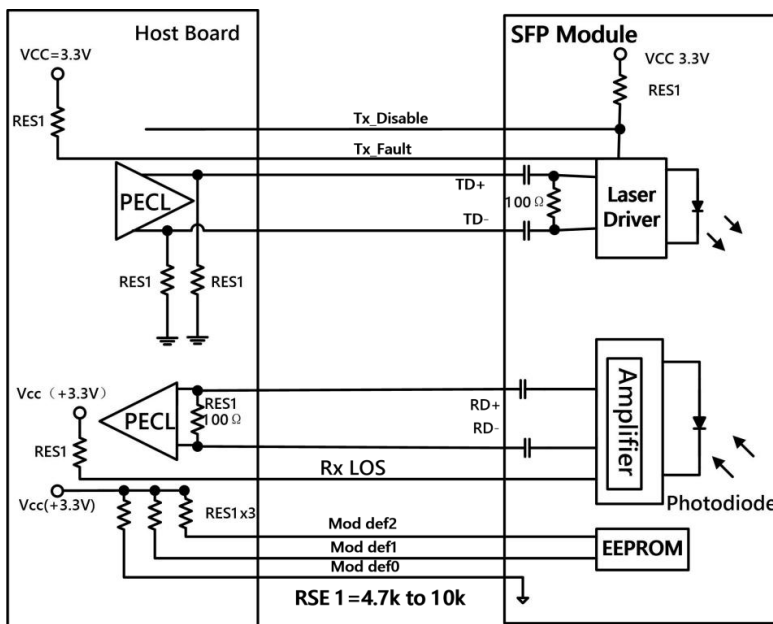


Figure 3 Typical Application Schematics

## Electrostatic Discharge (ESD)

The 1G LX -I is compatible with ESD levels found in typical manufacturing and operating environments as described in Table Regulatory compliance. In the normal handling and operation of optical transceivers, ESD is of concern in two circumstances. The first case is during handling of the transceiver prior to insertion into an SFP compliant cage. To protect the device, it's important to use normal ESD handling pre-cautions. These include use of grounded wrist straps, work-benches and floor wherever a transceiver is handled. The second case to consider is static discharges to the exterior of the host equipment chassis after installation. If the optical interface is exposed to the exterior of host equipment cabinet, the transceiver may be subject to system level ESD requirements.

## Electromagnetic Interference (EMI)

Equipment incorporating gigabit transceivers is typically subject to regulation by the FCC in the United States, CENELEC EN55022 (CISPR 22) in Europe. The 1G LX -I compliance to these standards is detailed in Table Regulatory compliance. The metal housing and shielded design of the 1G LX -I minimizes the EMI challenge facing the equipment designer.

## EMI Immunity (Susceptibility)

Due to its shielded design, the EMI immunity of the 1G LX -I exceeds typical industry standards.

## Regulatory Compliance

| Feature  | Test Method   | Performance  |
|--|---|--|
| <b>Electrostatic Discharge (ESD) to the Electrical Pins</b>      | MIL-STD-883C Method 3015.7                            | Class 1 (> 1500 Volts)   |
| <b>Electrostatic Discharge (ESD) to the Duplex LC Receptacle</b> | Variation of IEC 61000-4-2                            | Typically, no damage occurs with 15 kV when the duplex LC connector receptacle is contacted by a Human Body Model probe.               |
| <b>Electromagnetic Interference (EMI)</b>                        | CISPR22 ITE Class B<br>EN55022 Class B<br>FCC Class B | Compliant with standards   |
| <b>Immunity</b>  | IEC61000-4-3 Class 2<br>EN55024                       | Typically show no measurable effect from a 3V/m field swept from 80 to 1000MHz applied to the transceiver without a chassis enclosure. |



## Digital Diagnostic Interface Definition

\*The 2-wire serial interface addresses of the SFP module are 1010000x (A0h) and 1010001x (A2h). They are shown in Figure 4.

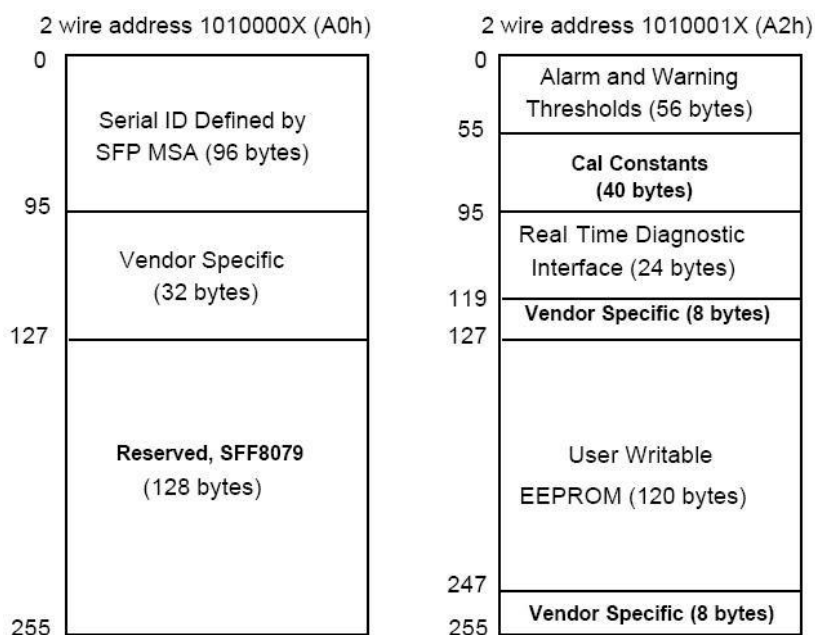


Figure 4 Digital Diagnostic Memory Map

## Diagnostic Monitor Functions

Diagnostic Monitor Functions interface uses the 2-wire address 1010001X (A2). Memory contents of Diagnostic Monitor Functions are shown in table below.

### I. Memory Contents of Diagnostic Monitor Function

#### (1)DDM Threshold

| Parameters         | High Alarm | Low Alarm | High Warning | Low Warning |
|--------------------|------------|-----------|--------------|-------------|
| <b>Temperature</b> | 95         | -50       | 85           | -40         |
| <b>Voltage</b>     | 3.6        | 3         | 3.5          | 3.1         |
| <b>Ibias</b>       | 75         | 1         | 70           | 2           |
| <b>Tx Power</b>    | -1         | -11       | -3           | -9          |
| <b>Rx Power</b>    | -1         | -23       | -3           | -21         |

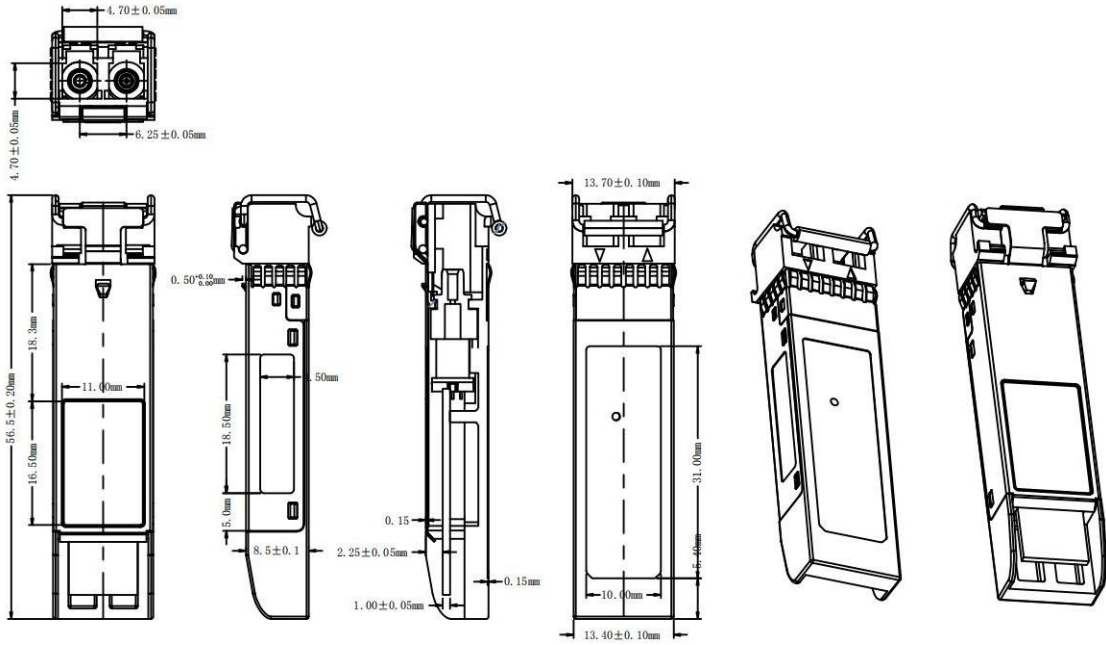
## (2)DDM Accuracy Requirements

| Parameters  | Unit | Requirements |
|-------------|------|--------------|
| Temperature | °C   | +/-3         |
| Voltage     | V    | +/-3%        |
| Ibias       | mA   | +/-10%       |
| Tx Power    | dB   | +/-3dB       |
| Rx Power    | dB   | +/-3dB       |

## (3)DDM Enhanced Options

| Parameters      | Requirements |
|-----------------|--------------|
| Soft Tx-disable | support      |
| Soft Tx-fault   | support      |
| Soft Rx-los     | support      |

## Package Outline



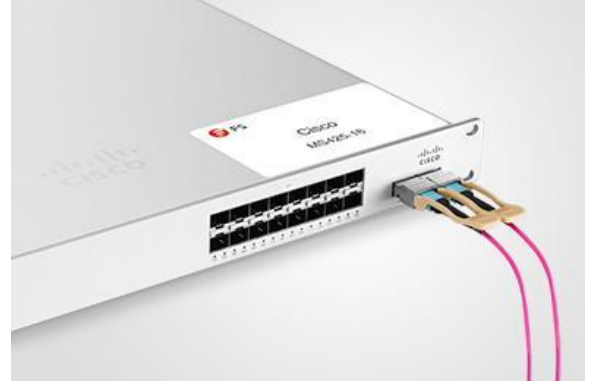
## Test Center

### I. Compatibility Testing

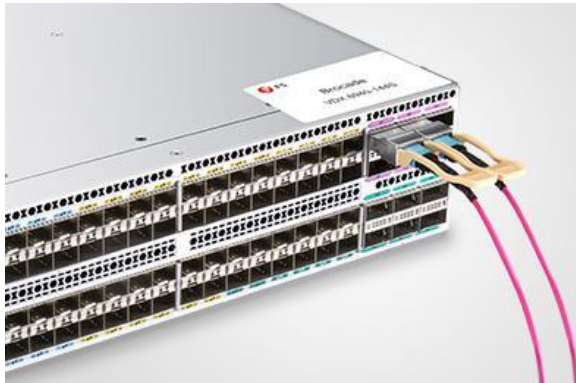
Each fiber optical transceiver has been tested in host device on site in FS Assured Program to ensure full compatibility with over 200 vendors.



Cisco Catalyst C9500-24Y4C



Cisco MS425-16



Brocade VDX 6940-144S



Dell EMC Networking Z9100-ON



Force@tm S60-44T

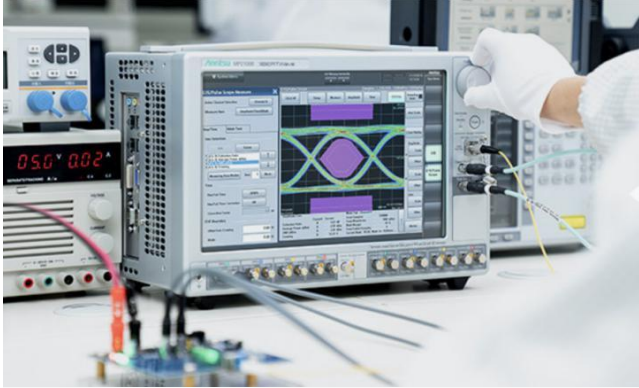


HUAWEI S6720-30L-HI-24S

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

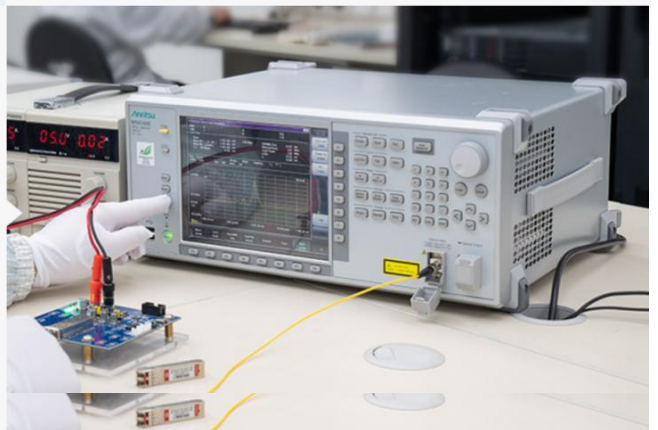
Test the actual transfer data rate and the transmission ability under different protocols with Network Master Pro.

- 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  |
|----------------|--|
| SFP1G-SX- 85-I | SFP, 1000BASE-SX, 850nm, MMF, 550m, LC, -40 to 85°C(IND), DOM    |
| SFP1G-SX-31    | SFP, 1000BASE-SX,1310nm, SMF, 2km, LC, 0 to 70°C(COM), DOM       |
| SFP1G-LX-31-I  | SFP, 1000BASE-LX/LH,1310nm, SMF, 10km, LC, -40 to 85°C(IND), DOM |
| SFP1G-LX-31    | SFP, 1000BASE-LX/LH,1310nm, SMF, 10km, LC, -40 to 85°C(IND), DOM |
| SFP1G-LX-31-I  | SFP, 1000BASE-LX/LH,1310nm, SMF, 20km, LC, -40 to 85°C(IND), DOM |
| SFP1G-LH-31    | SFP, 1000BASE-EX, 1310nm, SMF, 40km, LC, 0 to 70°C(COM), DOM     |
| SFP1G-EX-55    | SFP, 1000BASE-EX, 1550nm, SMF, 40km, LC, 0 to 70°C(COM), DOM     |
| SFP1G-ZX-55    | SFP, 1000BASE-EX, 1550nm, SMF, 60km, LC, 0 to 70°C(COM), DOM     |
| SFP1G-ZX-55    | SFP, 1000BASE-ZX, 1550nm, SMF, 80km, LC, 0 to70°C(COM), DOM      |
| SFP1G-EZX-55   | SFP, 1000BASE-EZX, 1550nm, SMF, 100km, LC, 0 to70°C(COM), DOM    |
| SFP1G-EZX-55   | SFP, 1000BASE-EZX, 1550nm, SMF, 120km, LC, 0 to70°C(COM), DOM    |
| SFP-GB-T       | SFP, 10/100/1000Base-T, 0 to70°C(COM), SERDES/SGMII Interface    |
| SFP-GB-T       | SFP, 10/100/1000Base-T, 0 to70°C(COM), SERDES Interface          |

### Note:

1G SFP transceiver module is individually tested on corresponding equipment such as Cisco, Arista, Juniper, Dell, Brocade and other brands, and passes the monitoring of FS.COM intelligent quality control system.



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