

# 100BASE-BX BiDi SFP 1310nm-TX/1550nm-RX 10km DOM LC SMF Transceiver

SFP-FE-BX



## Applications

- Fast Ethernet
- SDH STM-1/ SONET OC-03
- WDM Application

## Features

- Single Mode bi-directional Transmission
- SFP Multi-source Package with LC Receptacle
- Up to 155Mb/s Data Links
- Hot-Pluggable Capability
- Up to 10 km on 9/125 $\mu$ m SMF
- Single +3.3V Power Supply
- Built-in WDM
- Isolation > 30dB, Cross Talk < -45dB
- Metal Enclosure, Excellent EMI & ESD Protection
- Monitoring Interface Compliant with SFF-8472
- Compliant with Specifications for IEEE802.3
- Compliant with Bellcore TA-NWT-000983
- Eye Safety Designed to Meet Laser Class1, Compliant with IEC60825-1
- RoHS Compliant

## Description

Bi-Directional transceiver is a high performance, cost effective module, which is compliant with LC Optics interface with built in WDM for Bi-Directional serial optical data communication applications. This module is designed for Single-Mode single fiber, operates at the normal wavelength of 1310/1550nm.

## Product Specifications

### I. Absolute Maximum Ratings

| Parameter                  | Symbol       | Min. | Typical | Max. | Unit |    |
|----------------------------|--------------|------|---------|------|------|----|
| Storage Temperature        | $T_s$        | -40  |         | +85  | °C   |    |
| Supply Voltage             | $V_{CC,T,R}$ | -0.5 |         | 4    | V    |    |
| Relative Humidity          | RH           | 0    |         | 85   | %    |    |
| Case Operating Temperature | Industrial   | Top  | -40     |      | 85   | °C |
|                            | Extended     |      | -5      |      | 85   |    |
|                            | Commercial   |      | 0       |      | 70   |    |

### II. Recommended Operating Environment

| Parameter                  | Symbol       | Min. | Typical | Max. | Unit |    |
|----------------------------|--------------|------|---------|------|------|----|
| Case Operating Temperature | Industrial   | TC   | -40     |      | 85   | °C |
|                            | Extended     |      | -5      |      | 85   |    |
|                            | Commercial   |      | 0       |      | +70  |    |
| Supply Voltage             | $V_{CC,T,R}$ | 3.0  |         | 3.6  | V    |    |

### III. Electrical Characteristics (TOP = 0 to 70 ° C, $V_{CC} = 3.0$ to 3.60 Volts)

| Parameter                      | Symbol         | Min.         | Typical | Max.           | Unit  | Note |
|--------------------------------|----------------|--------------|---------|----------------|-------|------|
| Supply Voltage                 | $V_{CC}$       | 3.0          | 3.30    | 3.60           | V     |      |
| Supply Current                 | $I_{CC}$       |              |         | 300            | mA    |      |
| Inrush Current                 | $I_{surge}$    |              |         | $I_{CC}+30$    | mA    |      |
| Maximum Power                  | $P_{max}$      |              |         | 1.0            | W     |      |
| <b>Transmitter Section</b>     |                |              |         |                |       |      |
| Input Differential Impedance   | $R_{in}$       | 90           | 100     | 110            | W     | 1    |
| Single Ended Data Input Swing  | $V_{in,PP}$    | 200          |         | 1200           | mVp-p |      |
| Transmit Disable Voltage       | $V_D$          | $V_{CC}-1.3$ |         | $V_{CC}$       | V     | 2    |
| Transmit Enable Voltage        | $V_{EN}$       | $V_{ee}$     |         | $V_{ee}+0.8$   | V     |      |
| Transmit Disable Assert Time   | $T_{dessert}$  |              |         | 10             | us    |      |
| <b>Receiver Section</b>        |                |              |         |                |       |      |
| Single Ended Data Output Swing | $V_{out, pp}$  | 300          |         | 1000           | mv    | 3    |
| Data Output Rise Time          | $t_r$          |              |         | 1300           | ps    | 4    |
| Data Output Fall Time          | $t_f$          |              |         | 1300           | ps    | 4    |
| LOS Fault                      | $V_{losfault}$ | $V_{CC}-0.5$ |         | $V_{CC\_host}$ | V     | 5    |
| LOS Normal                     | $V_{los norm}$ | $V_{ee}$     |         | $V_{ee}+0.5$   | V     | 5    |
| Power Supply Rejection         | PSR            | 100          |         |                | mVpp  | 6    |

**Note:**

1. AC coupled.
2. Or open circuit.
3. Into 100 ohm differential termination.
4. 20 – 80 %
5. LOS is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
6. All transceiver specifications are compliant with a power supply sinusoidal modulation of 20 Hz to 1.5MHz up to specified value applied through the power supply filtering network shown on page 23 of the Small Form-factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 14, 2000.

**IV. Optical Parameters (TOP = 0 to 70 ° C, V<sub>CC</sub> = 3.0 to 3.60 Volts)**

| Parameter                          | Symbol   | Min. | Typical | Max. | Unit  | Note |
|------------------------------------|--|------|---------|------|-------|------|
| <b>Transmitter Section</b>         |  |      |         |      |       |      |
| <b>Center Wavelength</b>           | $\lambda_c$  | 1270 | 1310    | 1360 | nm    | 1    |
| <b>Spectral Width</b>              | $\sigma$   |      |         | 3    | nm    |      |
| <b>Optical Output Power</b>        | $P_{out}$  | -15  |         | -8   | dBm   | 2    |
| <b>Optical Rise/Fall Time</b>      | $t_r/t_f$  |      |         | 1300 | ps    | 3    |
| <b>Extinction Ratio</b>            | ER   | 9.2  |         |      | dB    |      |
| <b>Eye Mask for Optical Output</b> | Compliant with Eye Mask Defined in IEEE 802.3 standard |      |         |      |       |      |
| <b>Relative Intensity Noise</b>    | RIN  |      |         | -120 | dB/Hz |      |
| <b>Receiver Section</b>            |  |      |         |      |       |      |
| <b>Optical Input Wavelength</b>    | $\lambda$  | 1480 | 1550    | 1580 | nm    |      |
| <b>Optical Input Power</b>         | $P_{in}$   | -34  |         | -3   | dBm   | 4.5  |
| <b>Receiver Reflectance</b>        |  | 12   |         |      | dB    |      |

| Parameter  | Symbol | Min. | Typical | Max.              | Unit | Note |
|--|--------|------|---------|-------------------|------|------|
| <b>Receiver Overload</b>                                 | Pol    |      |         | -3                | dBm  | 4.5  |
| <b>RX Sensitivity</b>                                    | Sen    |      |         | -34               | dBm  | 4.5  |
| <b>RX_LOS Assert</b>                                     | LOSA   | -45  |         |                   | dBm  |      |
| <b>RX_LOS Deassert</b>                                   | LOSD   |      |         | -35               | dBm  |      |
| <b>RX_LOS Hysteresis</b>                                 | LOSH   |      | 2       | 2.5               | dB   |      |
| <b>General Specifications</b>                            |        |      |         |                   |      |      |
| <b>Data Rate</b>   | BR     |      | 155     |                   | Mb/s |      |
| <b>Bit Error Rate</b>                                    | BER    |      |         | 10 <sup>-12</sup> |      |      |
| <b>Max.Supported Link Length on 9/125 μm SMF @ 1.25G</b> | LMAX   |      | 10      |                   | km   | 6    |
| <b>Total System Budget</b>                               | LB     | 19   |         |                   | dB   | 6    |

## Notes:

1. Also specified to meet curves in FC-PI 13.0 Figures 18 and 19, which allow trade-off between wavelength spectral width.
2. Class 1 Laser Safety per FDA/CDRH and EN (IEC) 60825 regulations.
3. Unfiltered, 20-80%. Complies with IEEE 802.3 (Gig. E), FC 1x and 2x eye masks when filtered.
4. Measured with conformance signals defined in FC-PI 13.0 specifications.
5. Measured with PRBS 231 -1at 10-12 BER
6. Dispersion limited per FC-PI Rev. 13
7. Attenuation of 0.45 dB/km is used for the link length calculations. Distances are indicative only. Please refer to the Optical Specifications in Table IV to calculate a more accurate link budget based on specific conditions in your application.

### V. Digital Diagnostic Monitor Characteristics

The following digital diagnostic characteristics are defined over the Recommended Operating Environment unless otherwise specified. It is compliant to SFF8472 Rev10.2 with internal calibration mode. For external calibration mode please contact our sales staff.

| Parameter                             | Symbol    | Min. | Max. | Unit |
|---------------------------------------|-----------|------|------|------|
| Temperature Monitor Absolute Error    | DMI_Temp  | -3   | 3    | degC |
| Laser Power Monitor Absolute Error    | DMI_TX    | -3   | 3    | dB   |
| RX Power Monitor Absolute Error       | DMI_RX    | -3   | 3    | dB   |
| Supply Voltage Monitor Absolute Error | DMI_Vcc   | -0.1 | 0.1  | V    |
| Bias Current Monitor Absolute Error   | DMI_Ibias | -10% | 10%  | mA   |

### VI. Digital Diagnostic Monitor Characteristics

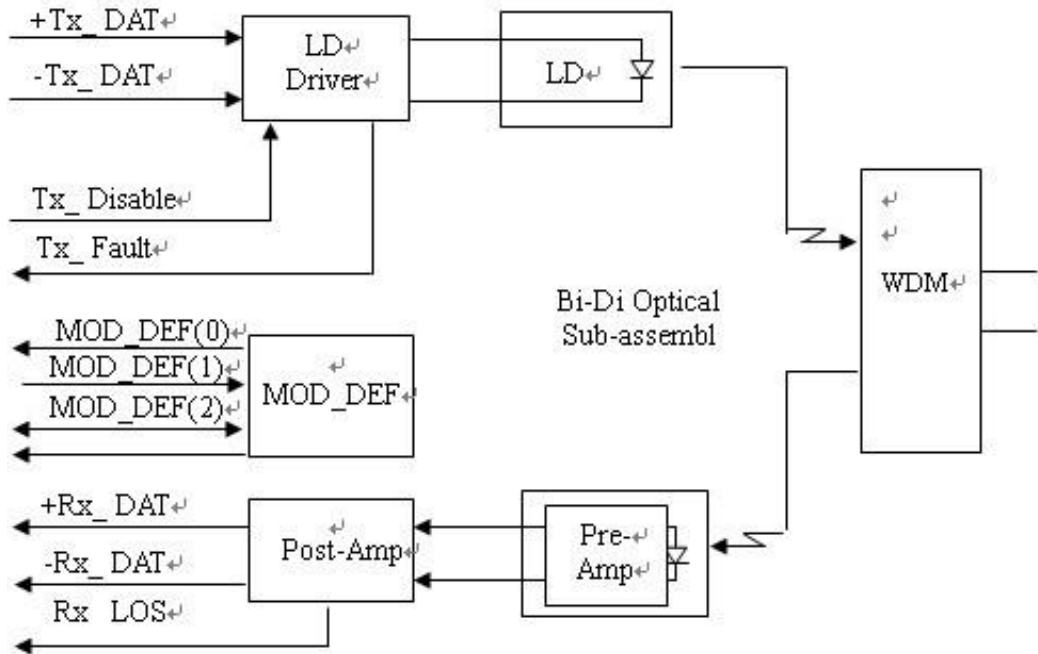


Figure1: Block Diagram

## VII. Pin Description

| Pin No | Name        | Function                     | Plug Seq | Notes |
|--------|-------------|------------------------------|----------|-------|
| 1      | $V_{eeT}$   | Transmitter Ground           | 1        | 1     |
| 2      | TX Fault    | Transmitter Fault Indication | 3        |       |
| 3      | TX Disable  | Transmitter Disable          | 3        | 2     |
| 4      | MOD-DEF2    | Module Definition            | 2        | 3     |
| 5      | MOD-DEF1    | Module Definition 1          | 3        | 3     |
| 6      | MOD-DEF0    | Module Definition 0          | 3        | 3     |
| 7      | Rate Select | Not Connected                | 3        | 4     |
| 8      | LOS         | Loss of Signal               | 3        | 5     |
| 9      | $V_{eeR}$   | Receiver Ground              | 1        | 1     |
| 10     | $V_{eeR}$   | Receiver Ground              | 1        | 1     |
| 11     | $V_{eeR}$   | Receiver Ground              |          | 1     |
| 12     | RD-         | Inv.Received Data Out        | 3        | 6     |
| 13     | RD+         | Received Data Out            | 3        | 6     |
| 14     | $V_{eeR}$   | Receiver Ground              | 3        | 1     |
| 15     | $V_{ccR}$   | Receiver Power               | 2        | 1     |
| 16     | $V_{ccT}$   | Transmitter Power            | 2        |       |

| Pin No | Name              | Function           | Plug Seq | Notes |
|--------|-------------------|--------------------|----------|-------|
| 17     | V <sub>ee</sub> T | Transmitter Ground | 1        |       |
| 18     | TD+               | Transmit Data In   | 3        | 6     |
| 19     | TD-               | Inv.TransmitIn     | 3        | 6     |
| 20     | V <sub>ee</sub> T | Transmitter Ground | 1        |       |

**Notes:**

1. Circuit ground is internally isolated from chassis ground.
2. Laser output disabled on TDIS >2.0V or open, enabled on TDIS <0.8V.
3. Should be pulled up with 4.7k - 10 kohms on host board to a voltage between 2.0V and 3.6V.MOD\_DEF(0) pulls line low to indicate module is plugged in.
4. Rate select is not used.
5. LOS is open collector output. Should be pulled up with 4.7k – 10 kohms on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.
6. AC Coupled.

**VII. Recommended Circuit**

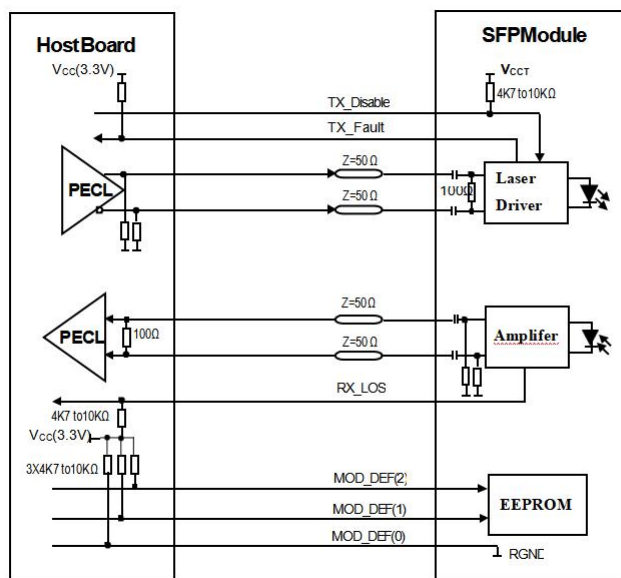


Figure 2 . SFP Host Recommended Circuit



| Data Address          | Length(Byte) | Name of Length  | Description and Contents                                 |
|-----------------------|--------------|-----------------|--|
| <b>Base ID Fields</b> |              |                 |  |
| <b>0</b>              | 1            | Identifier      | Type of Serial transceiver (03h=SFP)                     |
| <b>1</b>              | 1            | Reserved        | Extended identifier of type serial transceiver(04h)      |
| <b>2</b>              | 1            | Connector       | Code of optical connector type (07=LC)                   |
| <b>3-10</b>           | 8            | Transceiver     | Fast Ethernet 100Base-BX                                 |
| <b>11</b>             | 1            | Encoding        | 4B 5B(02h)   |
| <b>12</b>             | 1            | BR, Nominal     | Nominal baud rate, unit of 100Mbps                       |
| <b>13</b>             | 1            | Reserved        | (0000h)  |
| <b>14</b>             | 1            | Length (9um,km) | Link length supported for 9/125um fiber, units of km     |
| <b>15</b>             | 1            | Length (9um)    | Link length supported for 9/125um fiber, units of 100m   |
| <b>16</b>             | 1            | Length (50um)   | Link length supported for 50/125um fiber, units of 10m   |
| <b>17</b>             | 1            | Length (62.5um) | Link length supported for 62.5/125um fiber, units of 10m |
| <b>18</b>             | 1            | Length (Copper) | Link length supported for copper, units of meters        |
| <b>19</b>             | 1            | Reserved        |  |
| <b>20-35</b>          | 16           | Vendor Name     | SFP vendor name:   |
| <b>36</b>             | 1            | Reserved        |  |
| <b>37-39</b>          | 3            | Vendor OUI      | SFP transceiver vendor OUI ID                            |

| Data Address                     | Length(Byte) | Name of Length   | Description and Contents  |
|----------------------------------|--------------|------------------|---|
| <b>40-55</b>                     | 16           | Vendor PN        | PartNumber: "FSXXXXXX" (ASCII)  |
| <b>56-59</b>                     | 4            | Vendor rev       | Revision level for part number  |
| <b>60-61</b>                     | 2            | Wavelength       | Laser wavelength  |
| <b>62</b>                        | 1            | Reserved         |   |
| <b>63</b>                        | 1            | CCID             | Least significant byte of sum of data in address 0-62   |
| <b>Extended ID Fields</b>        |              |                  |   |
| <b>64-65</b>                     | 2            | Option           | Indicates which optical SFP signals are implemented (001Ah=LOS, TX_FAULT, TX_DISABLE all supported) |
| <b>66</b>                        | 1            | BR, max          | Upper bit rate margin, units of %   |
| <b>67</b>                        | 1            | BR, min          | Lower bit rate margin, units of %   |
| <b>68-83</b>                     | 16           | Vendor SN        | Serial number (ASCII)   |
| <b>84-91</b>                     | 8            | Date code        | Manufacturing date code   |
| <b>92</b>                        | 1            | Diagnostic Type  | Diagnostics   |
| <b>93</b>                        | 1            | Enhanced Options | Diagnostics   |
| <b>94</b>                        | 1            | SFF-8472         | Diagnostics   |
| <b>95</b>                        | 1            | CCEX             | Check code for the extended ID Fields (addresses 64 to 94)  |
| <b>Vendor Specific ID Fields</b> |              |                  |   |
| <b>96-127</b>                    | 32           | Readable         | Vendor specific data, readonly  |

## VIII. Diagnostics Memory Contents(A2h)

| Data Address                                | Length (Byte) | Name of Length    | Description and Contents   |
|---|---------------|-------------------|--|
| <b>Diagnostic and control/status fields</b> |               |                   |  |
| <b>0-39</b>                                 | 40            | A/W Thresholds    | Diagnostic Flag Alarm and Warning Thresholds                       |
| <b>40-55</b>                                | 16            | Unallocated       |  |
| <b>56-91</b>                                | 16            | Ext Cal Constants | Diagnostic calibration constants for optional External Calibration |
| <b>92-94</b>                                | 3             | Unallocated       |  |
| <b>95</b>                                   | 1             | CC_DMI            | Check code for Base Diagnostic Fields (addresses 0 to 94)          |
| <b>96-105</b>                               | 10            | Diagnostics       | Diagnostic Monitor Data (internally orexternally calibrated)       |
| <b>106-109</b>                              | 4             | Unallocated       |  |
| <b>110</b>                                  | 1             | Status/Control    | Optional Status and Control Bits                                   |
| <b>111</b>                                  | 1             | Reserved          | Reserved for SFF-8079  |
| <b>112-113</b>                              | 2             | Alarm Flags       | Diagnostic Alarm Flag Status Bits                                  |
| <b>114-115</b>                              | 2             | Unallocated       |  |
| <b>116-117</b>                              | 2             | Warning Flags     | Diagnostic Warning Flag Status Bits                                |
| <b>118-119</b>                              | 2             | ExtStatus/Control | Extended module control and status bytes                           |
| <b>General Use Fields</b>                   |               |                   |  |
| <b>120-127</b>                              | 8             | Vendor Specific   | Vendor specific memory addresses                                   |

| Data Address | Length (Byte) | Name of Length | Description and Contents          |
|--------------|---------------|----------------|-----------------------------------|
| 128-247      | 120           | User EEPROM    | User writable non-volatile memory |
| 248-255      | 8             | Vendor Control | Vendor specific control addresses |

### IX. Mechanical Dimensions

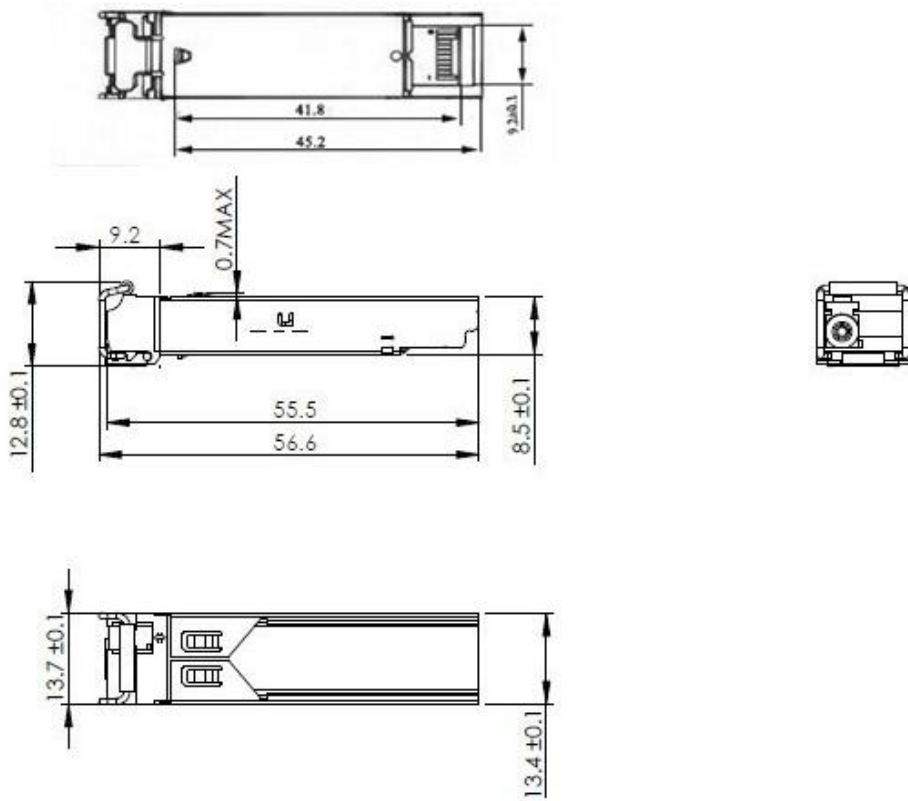


Figure 3. Mechanical Drawing

## 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<sup>10</sup> S60-44T

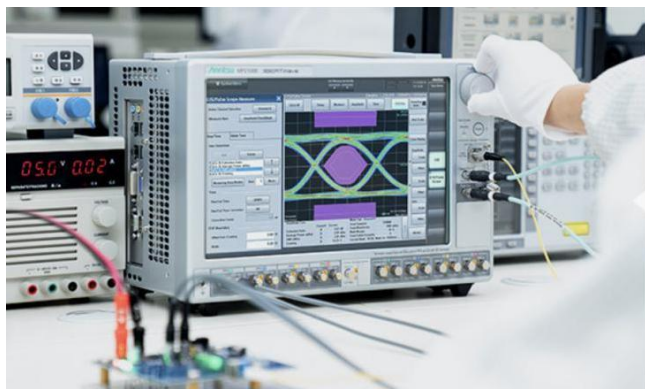


HUAWEI S6720-30L-HI-24S

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

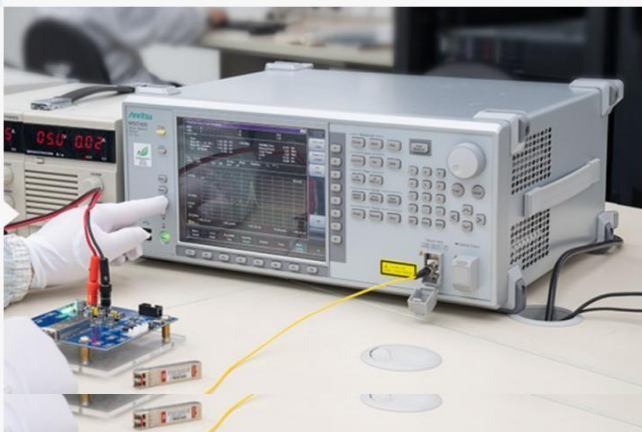
Test the actual transfer data rate and the transmission ability under different protocols with Network Master Pro.

- 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



## Ordering Information

| Part Number  | Description  |
|--------------|--|
| SFP-FB-GE-T  | 100BASE-T SFP SGMII Copper RJ-45 100m DOM Transceiver Module               |
| SFP-GE-100FX | 100BASE-FX SFP SGMII 1310nm 2km DOM LC MMF Transceiver Module              |
| SFP-100LX-31 | 100BASE-LX SFP 1310nm 15km DOM LC SMF Transceiver Module                   |
| SFP-100EX-31 | 100BASE-EX SFP 1310nm 40km DOM LC SMF Transceiver Module                   |
| SFP-100ZX-55 | 100BASE-ZX SFP 1550nm 80km DOM LC SMF Transceiver Module                   |
| SFP-100FX-31 | 100BASE-FX SFP 1310nm 2km Industrial DOM LC MMF Transceiver Module         |
| SFP-100LX-31 | 100BASE-LX SFP 1310nm 10km Industrial DOM LC SMF Transceiver Module        |
| SFP-FE-BX    | 100BASE-BX BiDi SFP 1310nm-TX/1550nm-RX 10km DOM LC SMF Transceiver Module |
| SFP-FE-BX    | 100BASE-BX BiDi SFP 1550nm-TX/1310nm-RX 10km DOM LC SMF Transceiver Module |
| SFP-FE-BX    | 100BASE-BX BiDi SFP 1310nm-TX/1550nm-RX 20km DOM LC SMF Transceiver Module |
| SFP-FE-BX    | 100BASE-BX BiDi SFP 1550nm-TX/1310nm-RX 20km DOM LC SMF Transceiver Module |



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