

## Cisco Small Form-Factor Pluggable Modules for Gigabit Ethernet Applications

The industry-standard Cisco® Small Form-Factor Pluggable (SFP) Gigabit Interface Converter is a hot-swappable input/output device that plugs into a Gigabit Ethernet port or slot, linking the port with the network (Figures 1 and 2). SFPs can be used and interchanged on a wide variety of Cisco products and can be intermixed in combinations of 1000BASE-T, 1000BASE-SX, 1000BASE-LX/LH, 1000BASE-EX, 1000BASE-ZX, or 1000BASE-BX10-D/U on a port-by-port basis.

**Figure 1.** Gigabit Ethernet SFP



**Figure 2.** Cisco 1000BASE-T Copper SFP



### 1000BASE-T SFP for Copper networks

The 1000BASE-T SFP operates on standard Category 5 unshielded twisted pair copper cabling of up to 100m (328 ft) link length. Cisco 1000BASE-T SFP modules support 10/100/1000 autonegotiation and Auto MDI/MDIX.

### 1000BASE-SX SFP for Multimode Fiber Only

The 1000BASE-SX SFP, compatible with the IEEE 802.3z 1000BASE-SX standard, operates on legacy 50 µm multimode fiber links up to 550 m and on 62.5 µm Fiber Distributed Data Interface (FDDI)-grade multimode fibers up to 220 m. It can support up to 1km over laser-optimized 50 µm multimode fiber cable.

### 1000BASE-LX/LH SFP for Both Multimode and Single-Mode Fibers

The 1000BASE-LX/LH SFP, compatible with the IEEE 802.3z 1000BASE-LX standard, operates on standard single-mode fiber-optic link spans of up to 10 km and up to 550 m on any multimode fibers. When used over legacy multimode fiber type, the transmitter should be coupled through a mode conditioning patch cable. For details on this implementation, refer to [http://www.cisco.com/en/US/prod/collateral/modules/ps5455/product\\_bulletin\\_c25-530836.html](http://www.cisco.com/en/US/prod/collateral/modules/ps5455/product_bulletin_c25-530836.html).

### 1000BASE-EX SFP for Long-Reach Single-Mode Fibers

The 1000BASE-EX SFP operates on standard single-mode fiber-optic link spans of up to 40 km in length. A 5-dB inline optical attenuator should be inserted between the fiber-optic cable and the receiving port on the SFP at each end of the link for back-to-back connectivity.

### 1000BASE-ZX SFP for Long-Reach Single-Mode Fibers

The 1000BASE-ZX SFP operates on standard single-mode fiber-optic link spans of up to approximately 70 km in length. The SFP provides an optical link budget of 23 dB, but the precise link span length depends on multiple factors such as fiber quality, number of splices, and connectors.

When shorter distances of single-mode fiber (SMF) are used, it might be necessary to insert an inline optical attenuator in the link to avoid overloading the receiver. A 10-dB inline optical attenuator should be inserted between the fiber-optic cable plant and the receiving port on the SFP at each end of the link whenever the fiber-optic cable span loss is less than 8 dB.

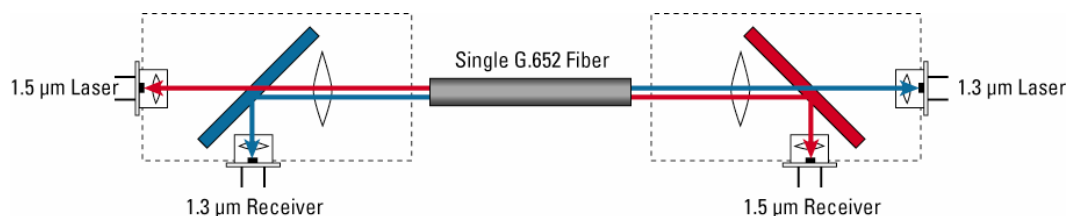
### 1000BASE-BX10-D and 1000BASE-BX10-U SFP for Single-Fiber Bidirectional Applications

The 1000BASE-BX-D and 1000BASE-BX-U SFPs, compatible with the IEEE 802.3ah 1000BASE-BX10-D and 1000BASE-BX10-U standards, operate on a single strand of standard SMF.

A 1000BASE-BX10-D device is always connected to a 1000BASE-BX10-U device with a single strand of standard SMF with an operating transmission range up to 10 km.

The communication over a single strand of fiber is achieved by separating the transmission wavelength of the two devices as depicted in Figure 3: 1000BASE-BX10-D transmits a 1490-nm channel and receives a 1310-nm signal, whereas 1000BASE-BX10-U transmits at a 1310-nm wavelength and receives a 1490-nm signal. Note in Figure 3 the presence of a wavelength-division multiplexing (WDM) splitter integrated into the SFP to split the 1310-nm and 1490-nm light paths.

**Figure 3.** Bidirectional Transmission of a Single Strand of SMF



The GLC-BX-D and GLC-BX-U SFPs also support digital optical monitoring (DOM) functions according to the industry-standard SFF-8724 multisource agreement (MSA). This feature gives the end user the ability to monitor real-time parameters of the SFP, such as optical output power, optical input power, temperature, laser bias current, and transceiver supply voltage.

## Technical Specifications

### Platform Support

The Cisco SFPs are supported across a variety of Cisco switches, routers, and optical transport devices. For more details, refer to the document SFP Compatibility Matrix at [http://www.cisco.com/en/US/docs/interfaces\\_modules/transceiver\\_modules/compatibility/matrix/OL\\_6981.pdf](http://www.cisco.com/en/US/docs/interfaces_modules/transceiver_modules/compatibility/matrix/OL_6981.pdf).

### Connectors and Cabling

Connectors include the following:

- Dual LC/PC connector (1000BASE-SX, 1000BASE-LX/LH, and 1000BASE-ZX)
- Single LC/PC connector (1000BASE-BX-D and 1000BASE-BX-U)
- RJ-45 connector (1000BASE-T)

**Note:** Only connections with patch cords with PC or UPC connectors are supported. Patch cords with APC connectors are not supported. All cables and cable assemblies used must be compliant with the standards specified in the standards section.

Table 1 provides cabling specifications for the SFPs that you install in the Gigabit Ethernet port. Note that all SFP ports have LC-type connectors, and the minimum cable distance for all SFPs listed (multimode and single-mode fiber) is 6.5 feet (2 m).

**Table 1.** SFP Port Cabling Specifications

| Product        | Wavelength (nm) | Fiber Type | Core Size (µm) | Modal Bandwidth (MHz* Km) | Operating Distance (m)                     |
|----------------|-----------------|------------|----------------|---------------------------|--|
| 1000BASE-SX    | 850             | MMF        | 62.5           | 160                       | 220 (722 ft)                               |
|                |                 |            | 62.5           | 200                       | 275 (902 ft)                               |
|                |                 |            | 50             | 400                       | 500 (1,640 ft)                             |
|                |                 |            | 50             | 500                       | 550 (1,804 ft)                             |
|                |                 |            | 50             | 2000                      | 1000 (3281 ft)                             |
| 1000BASE-LX/LH | 1310            | MMF*       | 62.5           | 500                       | 550 (1,804 ft)                             |
|                |                 |            | 50             | 400                       | 550 (1,804 ft)                             |
|                |                 |            | 50             | 500                       | 550 (1,804 ft)                             |
|                |                 | SMF        | --**           | –                         | 10,000 (32,821 ft)                         |
| 1000BASE-EX    | 1310            | SMF        | --**           | –                         | 40,000 (131,234 ft)                        |
| 1000BASE-ZX    | 1550            | SMF        | –              | –                         | Approximately 70 km depending on link loss |
| 1000BASE-BX-U  | 1310            | SMF        | --**           | –                         | 10,000 (32,821 ft)                         |
| 1000BASE-BS-D  | 1490            | SMF        | --**           | –                         | 10,000 (32,821 ft)                         |

\*A mode-conditioning patch cord, as specified by the IEEE standard, is required regardless of the span length. Note how the mode conditioning patch cord for 62.5-µm fibers has a different specification from the mode-conditioning patch cord for 50-µm fibers.

\*\*ITU-T G.652 SMF as specified by the IEEE 802.3z standard.

### Optical Specifications

Table 2 gives optical parameters for the SFPs.

**Table 2.** Main Optical Parameters

| Product        | Transmit Power (dBm) | Receive Power Range (dBm) |
|----------------|----------------------|---------------------------|
| 1000BASE-SX    | –3 to –9.5           | 0 to –17                  |
| 1000BASE-LX/LH | –3 to –9.5           | –3 to –20                 |
| 1000BASE-EX    | +3 to –1             | +1 to –22                 |

|                                    |          |             |
|------------------------------------|----------|-------------|
| 1000BASE-ZX                        | +5 to 0  | -3 to -23   |
| 1000BASE-BX10-D<br>1000BASE-BX10-U | -3 to -9 | -3 to -19.5 |

### Dimensions

Dimensions (H x W x D): 8.5 x 13.4 x 56.5 mm. Cisco SFPs typically weigh 75 grams or less.

### Environmental Conditions and Power Requirements

Operating temperature range:

- Commercial temperature range (COM): 0 to 70°C (32 to 158°F)
- Extended temperature range (EXT): -5°C to 85°C (23 to 185°F)
- Industrial temperature range (IND): -40 to 85°C (-40 to 185°F)
- Storage temperature range: -40 to 85°C (-40 to 185°F)

Table 3 gives electrical parameters and Table 4 gives temperature range and DOM support information for the SFPs.

**Table 3.** Electrical Parameters

| Parameter      | Symbol             | Minimum | Typical | Maximum | Units |
|----------------|--------------------|---------|---------|---------|-------|
| Supply Current | I <sub>s</sub>     | -       | 200     | 300     | mA    |
| Surge Current  | I <sub>Surge</sub> | -       | -       | 30      | mA    |
| Input Voltage  | V <sub>cc</sub>    | 3.1     | 3.3     | 3.5     | V     |

**Table 4.** Temperature Range and DOM Support

| Product Number | Temperature Range | DOM |
|----------------|-------------------|-----|
| GLC-SX-MM      | COM               | No  |
| GLC-LH-SM      | COM               | No  |
| GLC-ZX-SM      | COM               | Yes |
| GLC-BX-U       | COM               | Yes |
| GLC-BX-D       | COM               | Yes |
| GLC-T          | COM               | n/a |
| SFP-GE-T       | EXT               | n/a |
| SFP-GE-S       | EXT               | Yes |
| SFP-GE-L       | EXT               | Yes |
| GLC-EX-SMD     | EXT               | Yes |
| SFP-GE-Z       | EXT               | Yes |
| GLC-SX-MM-RGD  | IND               | No  |
| GLC-LX-SM-RGD  | IND               | No  |
| GLC-ZX-SM-RGD  | IND               | No  |

### Warranty

- Standard warranty: 90 days.
- Extended warranty (option): Available under a Cisco SMARTnet<sup>®</sup> Service support contract for the Cisco switch or router chassis.

## Regulatory and Standards Compliance

### Safety:

- Laser Class I 21CFR1040 LN#50 7/2001
- Laser Class I IEC 60825-1

### Standards:

- IEEE 802.3z
- IEEE 802.3ah

GR-20-CORE: Generic Requirements for Optical Fiber and Optical Fiber Cable

GR-326-CORE: Generic Requirements for Single-Mode Optical Connectors and Jumper Assemblies

GR-1435-CORE: Generic Requirements for Multifiber Optical Connectors

## Ordering Information

To place an order, visit the Cisco Ordering homepage or refer to Table 5.

**Table 5.** Ordering Information

| Product Description   | Product Number |
|---|----------------|
| 1000BASE-T standard   | GLC-T          |
| 1000BASE-SX short wavelength; without DOM                       | GLC-SX-MM      |
| 1000BASE-LX/LH long-wavelength/long haul; without DOM           | GLC-LH-SM      |
| 1000BASE-ZX extended distance;                                  | GLC-ZX-SM      |
| 1000BASE-BX10-D downstream bidirectional single fiber; with DOM | GLC-BX-D       |
| 1000BASE-BX10-U upstream bidirectional single fiber; with DOM   | GLC-BX-U       |
| 1000BASE-T NEBS 3 ESD   | SFP-GE-T       |
| 1000BASE-SX short wavelength; with DOM                          | SFP-GE-S       |
| 1000BASE-LX/LH long-wavelength; with DOM                        | SFP-GE-L       |
| 1000BASE-EX long-wavelength; with DOM                           | GLC-EX-SMD     |
| 1000BASE-ZX extended distance; with DOM                         | SFP-GE-Z       |
| 1000BASE-SX short wavelength; rugged                            | GLC-SX-MM-RGD  |
| 1000BASE-LX/LH long wavelength; rugged                          | GLC-LX-SM-RGD  |
| 1000BASE-ZX extended distance; rugged                           | GLC-ZX-SM-RGD  |



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