

# SFP Transceivers

Small Form-Factor Pluggable Transceivers

Fiber optic/electrical  
transceivers and  
System-on-an-SFP  
miniature converters

**System™**  
on an **SFP**



- Fiber optic or electrical transceiver units, providing pluggable interfaces according to known standards and specifications
- MSA (Multi-Source Agreement) compliance
- System-on-an-SFP architecture, providing internal logical frame conversion
- Fast Ethernet or Gigabit Ethernet to E1/T1 or E3/T3 remote bridging
- TDM pseudowire connectivity and wire-speed packet forwarding

## Serving as Interface Transceivers

SFP (Small Form-factor Pluggable) transceivers (SFPs) are hot-swappable input/output optical and electrical transceiver units, each providing a different interface according to known compliance standards and pre-determined specifications. The units are plugged into other products to provide the required interface, thus enabling optimal combination of Capex reduction, ease of network planning and stock flexibility.

RAD's SFP transceivers are fully compliant with the Multisource Agreement (MSA) specifications, and are fully interoperable with third-party standards-based devices.

On account of their small size, SFPs allow higher port densities than with other transceivers, resulting in more efficient host device design.

The intuitive squeeze-and-pull mechanism makes it easy to install SFP transceivers and remove them. Rather than replacing an entire circuit board containing several soldered-in modules, individual SFPs are unplugged and replaced for repair or upgrade, with cost savings both in maintenance and in upgrading efforts.

# SFP Transceivers

## Small Form-Factor Pluggable Transceivers

Built-in digital diagnostic monitoring (DDM) functionality is available for designated SFP types, allowing users to monitor the unit's transmitter optical output power, receiver input optical power, internal temperature, supply voltage and transmitter bias current levels in real-time.

Some of RAD's SFP's are available in industrially hardened (H) versions, designed to withstand temperatures between -40° to 85° C (-40° to 185° F).

### Serving as Traffic Converters

The SFP-based converter units forward 100Base-FX Ethernet LAN packets to TDM-based WAN networks at wire-speed, fully utilizing the expensive, E1/T1 or E3/T3 rate TDM circuit bandwidth (see *Figure 1*).

The converters handle 64 to 2016-byte frames, including VLAN-tagged frames.

In event of E1/T1 or E3/T3 loss of signal, the device propagates the fault by sending an electrical LOS signal to the LAN port. In addition, the LOS LED provides a visual indication.

If the LAN traffic exceeds capacity, the flow control mechanism is activated, and Pause packets are transmitted towards the LAN port.

### Traffic Conversion with SFP-9F

SFP-9F converts 100BaseFX signals coming from the host to 100BaseTX electrical signals. It replaces optical SFP modules that are used with PHY operating in 100BaseFX mode.

**Note:** For more information, refer to the SFP-9F data sheet and to Table 3.

### TDM Pseudowire Connectivity with SFP-PWE1T1

The SFP-PWE1T1 unit (see *Table 3*) is a miniature TDM pseudowire gateway, which allows transmitting E1/T1 streams over packet-switched networks. The unit converts the incoming E1/T1 data streams into 100BaseFX packets for transmission over the network (see *Figure 2*).

## Specifications

### FIBER OPTIC INTERFACES

**Note:** The specified typical range may vary according to the specific product in which the SFP is used. For more information, refer to the data sheet of the specific product.

Table 1. Fiber Optic Fast Ethernet/STM-1/STM-4 SFPs

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [µm]	Standards	Transmitter Type	Input Power [dBm]		Output Power [dBm]		Typical Max. Range	
				[min]	[max]	[min]	[max]	[km]	[miles]
<b>SFP-1</b> Fast Ethernet/STM-1, LC	1310, 62.5/125 multimode	100BaseFX, IEEE 802.3 (FE) ANSI T1 646-1995 (STM-1)	LED	-30	-14	-20	-14	2	1.2
<b>SFP-1D</b> Fast Ethernet/ STM-1, LC, DDM, internal calibration	1310, 62.5/125 multimode	100BaseFX, IEEE 802.3 (FE) ANSI T1 646-1995 (STM-1)	LED	-30	-14	-20	-14	2	1.2
<b>SFP-2</b> Fast Ethernet/STM-1, LC	1310, 9/125 single mode	100BaseLX10, IEEE 802.3 (FE), G.957 S1.1 (STM-1)	Laser	-28	-8	-15	-8	15	9.3
<b>SFP-2H</b> Fast Ethernet/STM-1, LC, industrially hardened	1310, 9/125 single mode	100BaseLX10, IEEE 802.3 (FE), G.957 S1.1 (STM-1)	Laser	-28	-8	-15	-8	15	9.3
<b>SFP-2D</b> Fast Ethernet/ STM-1, LC, DDM, internal calibration	1310, 9/125 single mode	100BaseLX10, IEEE 802.3 (FE), G.957 S1.1 (STM-1)	Laser	-28	-8	-15	-8	15	9.3
<b>SFP-3</b> Fast Ethernet/STM-1, LC	1310, 9/125 single mode	G.957 L1.1 (STM-1)	Laser	-34	-10	-5	0	40	24.8

Table 1. Fiber Optic Fast Ethernet/STM-1/STM-4 SFPs (cont.)

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [μm]	Standards	Transmitter Type	Input Power [dBm]		Output Power [dBm]		Typical Max. Range	
				[min]	[max]	[min]	[max]	[km]	[miles]
<b>SFP-3D</b> Fast Ethernet/STM-1, LC, DDM, internal calibration	1310, 9/125 single mode	G.957 L1.1 (STM-1)	Laser	-34	-10	-5	0	40	24.8
<b>SFP-3H</b> Fast Ethernet/STM-1, LC, industrially hardened	1310, 9/125 single mode	G.957 L1.1 (STM-1)	Laser	-34	-10	-5	0	40	24.8
<b>SFP-4</b> Fast Ethernet/STM-1, LC	1550, 9/125 single mode	G.957 L1.2 (STM-1)	Laser	-34	-10	-5	0	80	49.7
<b>SFP-4D</b> Fast Ethernet/STM-1, LC, DDM, internal calibration	1550, 9/125 single mode	G.957 L1.2 (STM-1)	Laser	-34	-10	-5	0	80	49.7
<b>SFP-10A</b> Fast Ethernet/STM-1, LC	Tx – 1310 Rx – 1550 9/125 single mode (single fiber)	100BaseBX10, IEEE 802.3 (FE) G.957 (STM-1)	Laser (WDM)	-28	-8	-14	-8	20	12.4
<b>SFP-10B</b> Fast Ethernet/STM-1, LC	Tx – 1550 Rx – 1310 9/125 single mode (single fiber)	100BaseBX10, IEEE 802.3 (FE) G.957 (STM-1)	Laser (WDM)	-28	-8	-14	-8	20	12.4
<b>SFP-10AD</b> Fast Ethernet/STM-1, LC, DDM, internal calibration	Tx – 1310 Rx – 1550 9/125 single mode (single fiber)	100BaseBX10, IEEE 802.3 (FE) G.957 (STM-1)	Laser (WDM)	-28	-8	-14	-8	20	12.4
<b>SFP-10BD</b> Fast Ethernet/STM-1, LC, DDM, internal calibration	Tx – 1550 Rx – 1310 9/125 single mode (single fiber)	100BaseBX10, IEEE 802.3 (FE) G.957 (STM-1)	Laser (WDM)	-28	-8	-14	-8	20	12.4
<b>SFP-14D</b> , STM-4, LC, DDM, internal calibration	1310, 62.5/125 multimode	–	Laser	-28	-14	-20	-14	0.5	0.3
<b>SFP-15</b> STM-4, LC	1310, 9/125 single mode	G.957 S4.1	Laser	-28	-8	-15	-8	15	9.3
<b>SFP-16</b> STM-4, LC	1550, 9/125 single mode	G.957 L4.2	Laser	-28	-8	-3	+2	80	49.7
<b>SFP-18A</b> Fast Ethernet/STM-1, LC	Tx – 1310 Rx – 1550 9/125 single mode (single fiber)	–	Laser (WDM)	-28	-8	-5	0	40	24.8
<b>SFP-18B</b> Fast Ethernet/STM-1, LC	Tx – 1550 Rx – 1310 9/125 single mode (single fiber)	–	Laser (WDM)	-28	-8	-5	0	40	24.8

# SFP Transceivers

## Small Form-Factor Pluggable Transceivers

Table 1. Fiber Optic Fast Ethernet/STM-1/STM-4 SFPs (cont.)

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [μm]	Standards	Transmitter Type	Input Power [dBm]		Output Power [dBm]		Typical Max. Range	
				[min]	[max]	[min]	[max]	[km]	[miles]
<b>SFP-19A</b> Fast Ethernet/STM-1, LC	Tx - 1490 Rx - 1570 9/125 single mode (single fiber)	-	Laser (WDM)	-30	-8	0	+5	80	49.7
<b>SFP-19B</b> Fast Ethernet/STM-1, LC	Tx - 1570 Rx - 1490 9/125 single mode (single fiber)	-	Laser (WDM)	-30	-8	0	+5	80	49.7
<b>SFP-24</b> Fast Ethernet/STM-1, LC	850, 50/125 multimode	-	VCSEL	-25	-2	-10	-4	2	1.2
	850, 62.5/125 multimode	-	VCSEL	-25	-2	-10	-4	1	0.6

Table 2. Fiber Optic Gigabit Ethernet SFPs

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [μm]	Standards	Transmitter Type	Input Power [dBm]		Output Power [dBm]		Typical Max. Range	
				[min]	[max]	[min]	[max]	[km]	[miles]
<b>SFP-5</b> Gigabit Ethernet, LC	850, 50/125 multimode	1000BaseSX, IEEE 802.3 (GbE)	VCSEL	-17	0	-9.5	0	0.55	0.3
<b>SFP-5H</b> Gigabit Ethernet, LC, industrially hardened	850, 50/125 multimode	1000BaseSX, IEEE 802.3 (GbE)	VCSEL	-17	0	-9.5	0	0.55	0.3
<b>SFP-5D</b> Gigabit Ethernet, LC, DDM, internal calibration	850, 50/125 multimode	1000BaseSX, IEEE 802.3 (GbE)	VCSEL	-17	0	-9.5	0	0.55	0.3
<b>SFP-5DH</b> Gigabit Ethernet, LC, DDM, internal calibration, industrially hardened	850, 50/125 multimode	1000BaseSX, IEEE 802.3 (GbE)	VCSEL	-17	0	-9.5	0	0.55	0.3
<b>SFP-6</b> Gigabit Ethernet, LC	1310, 9/125 single mode	1000BaseLX10, IEEE 802.3 (GbE)	Laser	-20	-3	-9.5	-3	10	6.2
<b>SFP-6H</b> Gigabit Ethernet, LC, industrially hardened	1310, 9/125 single mode	1000BaseLX10, IEEE 802.3 (GbE)	Laser	-20	-3	-9.5	-3	10	6.2
<b>SFP-6D</b> Gigabit Ethernet, LC, DDM, internal calibration	1310, 9/125 single mode	1000BaseLX10, IEEE 802.3 (GbE)	Laser	-20	-3	-9.5	-3	10	6.2
<b>SFP-7</b> Gigabit Ethernet, LC	1550, 9/125 single mode	-	Laser	-22	-3	0	+5	80	49.7
<b>SFP-7D</b> Gigabit Ethernet, LC, DDM, internal calibration	1550, 9/125 single mode	-	Laser	-22	-3	0	+5	80	49.7

Table 2. Fiber Optic Gigabit Ethernet SFPs (cont.)

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [μm]	Standards	Transmitter Type	Input Power [dBm]		Output Power [dBm]		Typical Max. Range	
				[min]	[max]	[min]	[max]	[km]	[miles]
<b>SFP-8</b> Gigabit Ethernet, LC	1310, 9/125 single mode	-	Laser	-21	-3	-4	+4	40	24.8
<b>SFP-8H</b> Gigabit Ethernet, LC, industrially hardened	1310, 9/125 single mode	-	Laser	-21	-3	-4	+4	40	24.8
<b>SFP-8D</b> Gigabit Ethernet, LC, DDM, internal calibration	1310, 9/125 single mode	-	Laser	-21	-3	-4	+4	40	24.8
<b>SFP-8DH</b> Gigabit Ethernet, LC, DDM, internal calibration, industrially hardened	1310, 9/125 single mode	-	Laser	-21	-3	-4	+4	40	24.8
<b>SFP-17a</b> Gigabit Ethernet, LC	Tx - 1310 Rx - 1490 9/125 single mode (single fiber)	1000BaseBX10, IEEE 802.3 (GbE)	Laser (WDM)	-20	-3	-9	-3	10	6.2
<b>SFP-17b</b> Gigabit Ethernet, LC	Tx - 1490 Rx - 1310 9/125 single mode (single fiber)	1000BaseBX10, IEEE 802.3 (GbE)	Laser (WDM)	-20	-3	-9	-3	10	6.2
<b>SFP-20</b> Gigabit Ethernet, LC	1550, 9/125 single mode	-	Laser	-32	-3	0	+5	120	74.5
<b>SFP-21A</b> Gigabit Ethernet, LC	9/125 single mode (single fiber) Tx - 1310 Rx - 1490	-	Laser (WDM)	-24	-3	-5	0	40	24.8
<b>SFP-21A</b> Gigabit Ethernet, LC	9/125 single mode (single fiber) Tx - 1490 Rx - 1310	-	Laser (WDM)	-24	-3	-5	0	40	24.8
<b>SFP-22A</b> Gigabit Ethernet, LC	Tx - 1490 Rx - 1570 9/125 single mode (single fiber)	-	Laser (WDM)	-24	-3	0	+5	80	49.7
<b>SFP-22B</b> Gigabit Ethernet, LC	Tx - 1570 Rx - 1490 9/125 single mode (single fiber)	-	Laser (WDM)	-24	-3	0	+5	80	49.7
<b>SFP-23A</b> Gigabit Ethernet, LC	9/125 single mode (single fiber) Tx - 1310 Rx - 1550	-	Laser (WDM)	-24	-3	-5	0	40	24.8
<b>SFP-23B</b> Gigabit Ethernet, LC	9/125 single mode (single fiber) Tx - 1550 Rx - 1310	-	Laser (WDM)	-24	-3	-5	0	40	24.8

# SFP Transceivers

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Table 3. Electrical Interface SFPs

Ordering Name, Interface, Connector	Standards	Cable Type	Impedance	Typical Max. Range (Attenuation)	
			[Ω]	[m]	[ft]
<b>SFP-9F*</b> Fast Ethernet, RJ-45	100BaseT, IEEE 802.3	UTP, cat. 5	100	100	328
<b>SFP-9G</b> Gigabit Ethernet, RJ-45	1000BaseT, IEEE 802.3	UTP, cat. 5	100	100	328
<b>SFP-11</b> STM-1E, mini BNC, DIN 1.0/2.3	G.703, supports CMI encoder/decoder	Coaxial	75	135 (12.7 dB)**	442
<b>SFP-12</b> E3, SMB	G.703	Coaxial	75	135 (12.7 dB)**	442

Table 4. System on an SFP

Ordering Name, Interface, Connector	Standards	Cable Type	Impedance	Typical Max. Range (Attenuation)	
			[Ω]	[m]	[ft]
<b>SFP-E1T1/FE***</b> Fast Ethernet, E1/T1, remote bridge, RJ-45	100BaseFX, IEEE 802.3 (FE), G.703 (E1/T1)	UTP, cat. 5 (AWG-22)	120 (E1) 100 (T1)	2550 (E1) 1829 (T1)	8202 (E1) 6000 (T1)
<b>SFP-E1T1/GbE***</b> Gigabit Ethernet, E1/T1, remote bridge, RJ-45	1000Base-x, IEEE 802.3 (GbE), G.703 (E1/T1)	UTP, cat. 5 (AWG-22)	120 (E1) 100 (T1)	2550 (E1) 1829 (T1)	8202 (E1) 6000 (T1)
<b>SFP-E3T3/FE***</b> Fast Ethernet, E3/T3, remote bridge, mini BNC, DIN 1.0/2.3	100BaseFX, IEEE 802.3 (FE), G.703 (E3/T3)	Coaxial	75	275	900
<b>SFP-E3T3/GbE***</b> Gigabit Ethernet, E3/T3, remote bridge, mini BNC, DIN 1.0/2.3	1000Base-x, IEEE 802.3, (GbE), G.703 (E3/T3)	Coaxial	75	275	900
<b>SFP-PWE1T1***</b> TDM to Ethernet pseudowire gateway	100BaseFX, IEEE 802.3 (FE), G.703 (E1/T1)	UTP, cat. 5	120 (E1) 100 (T1)	-	-

**Notes:**

\* SFP-9F includes a LED indicator, along with an underside DIP switch which controls the autonegotiation mode. For more information, refer to the SFP-9F data sheet and installation and operation manual.

\*\* With SFP-11 and SFP-12, a 135m range is attainable when using RG59 B/U (at 78 MHz, in accordance with the square root of frequency law).

\*\*\* Designed to work with RAD products only. An internal mechanism in these SFP units checks whether the hosting device is a RAD product.

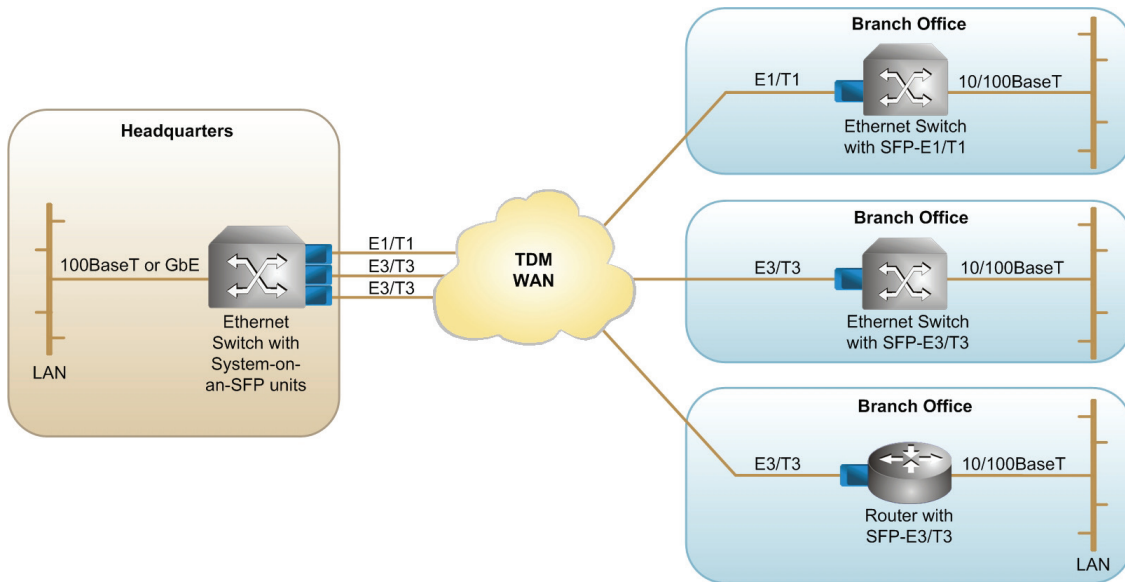


Figure 1. Providing Transparent LAN Services over Leased Lines

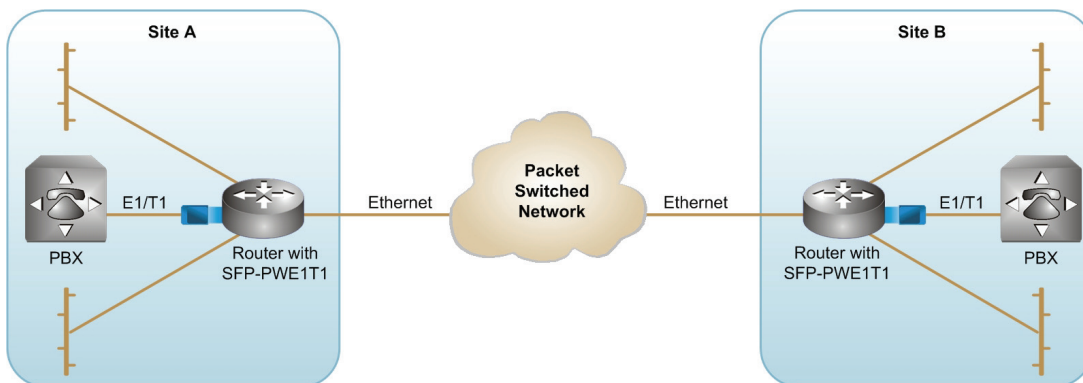


Figure 2. Delivering E1/T1 Services over a PSN

## SFP Transceivers

### Small Form-Factor Pluggable Transceivers

## Ordering

To order an SFP unit, use its ordering name as listed in *Tables 1-3*.

**Note:** *It is strongly recommended to order RAD products with original RAD SFPs installed. This will ensure that prior to shipping, RAD has performed comprehensive functional quality tests on the entire assembled unit, including the SFP devices. RAD cannot guarantee full compliance to product specifications for products using non-RAD SFPs.*

### SUPPLIED ACCESSORIES

#### **CBL-MINIBNC-BNC**

Two adapter cables for converting mini BNC connectors to regular BNC coaxial connectors (for SFP-11)

#### **CBL-SMB-BNC/M**

Two adapter cable for converting SMB connectors to regular BNC coaxial connectors (for SFP-12)

#### **CLB-1023-BNC**

Two adapter cable for converting mini BNC connectors to regular BNC coaxial connectors (for SFP-E3T3/FE and SFP-E3T3/GbE)