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Data Sheet

General Availability

Pluggable Transceivers

Small Form-Factor Pluggable Transceivers

SFP (Small Form-factor Pluggable) transceivers (SFPs) are hot-swappable optical and electrical transceiver units, each providing a different interface according to known compliance standards and pre-determined specifications. The units are plugged into host platforms to provide the required interface, thus enabling optimal combination of CAPEX and OPEX reduction, due to ease of network planning, management, maintenance, and stock flexibility.

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

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.

The XFP and SFP+ are transceivers designed for 10G network applications.

QSFP28 transceiver modules are designed for use in 100 Gigabit Ethernet links over multimode or single-mode fibers.

QSFP+ transceiver modules are designed for use in 40 Gigabit Ethernet links over multimode or single-mode fibers.

RAD

Your Network's Edge®

Pluggable Transceivers

Small Form-Factor Pluggable Transceivers

Specifications

FIBER OPTIC INTERFACES

Notes:

- *Commercial Pluggable Transceivers are designed to withstand temperatures between 0–70˚C (32–158˚F).*
- *Some of RAD's Pluggable Transceivers are available with* extended temperature range between -20–85˚C (-4–185˚F) or *in industrially hardened versions, designed to withstand temperatures between -40–85˚C (-40–185˚F).*
- *The specified typical range may vary according to the specific product in which the SFP/XFP/SFP+/QSFP28 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] [min]	[max]	Output Power [dBm] [min]	[max]	Typical Max. Range [km]	[miles]
SFP-1 Fast Ethernet/STM-1, LC	1310, 62.5/125 multimode	100BASE-FX, IEEE 802.3 (FE) ANSI T1 646-1995 (STM-1)	LED	-30	-14	-20	-14	2	1.2
SFP-2DH*, SFP-2H* Fast Ethernet/STM-1, LC	1310, 9/125 single mode	100BASE-LX10, IEEE 802.3 (FE), G.957 S1.1 (STM-1)	Laser	-28	-8	-15	-8	15	9.3
SFP-3D*, SFP-3H* Fast Ethernet/STM-1, LC	1310, 9/125 single mode	G.957 L1.1 (STM-1)	Laser	-34	-10	-5	0	40	24.8
SFP-10AD*, SFP-10ADH* Fast Ethernet/STM-1, LC	Tx –1310/Rx –1550, 9/125 single mode (single fiber)	100BASE-BX10, IEEE 802.3 (FE) G.957 (STM-1)	Laser (WDM)	-28	-8	-14	-8	20	12.4
SFP-10BD*, SFP-10BDH* Fast Ethernet/STM-1, LC	Tx –1550/Rx –1310, 9/125 single mode (single fiber)	100BASE-BX10, IEEE 802.3 (FE) G.957 (STM-1)	Laser (WDM)	-28	-8	-14	-8	20	12.4
SFP-14D* STM-4, LC	1310, 62.5/125 multimode	–	Laser	-28	-14	-20	-14	0.5	0.3
SFP-15DH* STM-4, LC	1310, 9/125 single mode	G.957 S4.1	Laser	-28	-8	-15	-8	15	9.3
SFP-16 STM-4, LC	1550, 9/125 single mode	G.957 L4.2	Laser	-28	-8	-3	+2	80	49.7
SFP-18A, SFP-18AED* Fast Ethernet/STM-1, LC	Tx –1310/Rx –1550, 9/125 single mode (single fiber)	–	Laser (WDM)	-28	-8	-5	0	40	24.8
SFP-18B, SFP-18BED* 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-24 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

** **Legend**: **D** – internal DDM calibration; **H** – industrially hardened SFP -40–85˚C (-40–185˚F); **ED** – external DDM calibration*

Pluggable Transceivers

Small Form-Factor Pluggable Transceivers

Table 2. Fiber Optic Gigabit Ethernet SFPs

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [μm]	Standards	Transmitter Type	Input Power [dBm] [min]	[max]	Output Power [dBm] [min]	[max]	Typical Max. Range [km]	[miles]
SFP-5D*, SFP-5DH*, SFP-5H* Gigabit Ethernet, LC	850, 50/125 multimode	1000BASE-SX, IEEE 802.3 (GbE)	VCSEL	-17	0	-9.5	0	0.55	0.3
SFP-6DH* Gigabit Ethernet, LC	1310, 9/125 single mode	1000BASE-LX10, IEEE 802.3 (GbE)	Laser	-20	-3	-9.5	-3	10	6.2
SFP-7, SFP-7D*, SFP-7DH* Gigabit Ethernet, LC	1550, 9/125 single mode	1000BASE-ZX (GbE)	Laser	-22	-3	0	+5	80	49.7
SFP-8D*, SFP-8DH* Gigabit Ethernet, LC	1310, 9/125 single mode	1000BASE-EX (GbE)	Laser	-21	-3	-4	+4	40	24.8
SFP-17AD*, SFP-17AH* Gigabit Ethernet, LC	Tx –1310/Rx –1490, 9/125 single mode (single fiber)	1000BASE-BX10, IEEE 802.3 (GbE)	Laser (WDM)	-20	-3	-9	-3	10	6.2
SFP-17BD*, SFP-17BH* Gigabit Ethernet, LC	Tx –1490/Rx –1310, 9/125 single mode (single fiber)	1000BASE-BX10, IEEE 802.3 (GbE)	Laser (WDM)	-20	-3	-9	-3	10	6.2
SFP-20, SFP-20EDH* Gigabit Ethernet, LC	1550, 9/125 single mode	1000BASE-EZX (GbE)	Laser	-32	-8	+1	+5	120	74.5
SFP-21A, SFP-21AED*, SFP-21AH* Gigabit Ethernet, LC	Tx –1310/Rx –1490, 9/125 single mode (single fiber)	1000BASE-BX, IEEE 802.3 (GbE)	Laser (WDM)	-24	-3	-5	0	40	24.8
SFP-21B, SFP-21BED*, SFP-21BH* Gigabit Ethernet, LC	Tx –1490/Rx –1310, 9/125 single mode (single fiber)	1000BASE-BX, IEEE 802.3 (GbE)	Laser (WDM)	-24	-3	-5	0	40	24.8
SFP-22A, SFP-22AH* Gigabit Ethernet, LC	Tx –1490/Rx –1570, 9/125 single mode (single fiber)	1000BASE-BX, IEEE 802.3 (GbE)	Laser (WDM)	-24	-3	0	+5	80	49.7
SFP-22B, SFP-22BH* Gigabit Ethernet, LC	Tx –1570/Rx –1490, 9/125 single mode (single fiber)	1000BASE-BX, IEEE 802.3 (GbE)	Laser (WDM)	-24	-3	0	+5	80	49.7
SFP-23A, SFP-23AED* Gigabit Ethernet, LC	Tx –1310/Rx –1550, 9/125 single mode (single fiber)	1000BASE-BX, IEEE 802.3 (GbE)	Laser (WDM)	-24	-3	-5	0	40	24.8
SFP-23B, SFP-23BED* Gigabit Ethernet, LC	Tx –1550/Rx –1310, 9/125 single mode (single fiber)	1000BASE-BX, IEEE 802.3 (GbE)	Laser (WDM)	-24	-3	-5	0	40	24.8
SFP-28A, SFP-28AD* Gigabit Ethernet, LC	Tx – 1310/Rx – 1550 9/125 single mode (single fiber)	1000BASE-BX10, IEEE 802.3 (GbE)	Laser (WDM)	-20	-3	-9	-3	10	6.2
SFP-28B, SFP-28BD* Gigabit Ethernet, LC	Tx – 1550/Rx –1310, 9/125 single mode (single fiber)	1000BASE-BX10, IEEE 802.3 (GbE)	Laser (WDM)	-20	-3	-9	-3	10	6.2
SFP-76DH* Gigabit Ethernet, LC	1550, 9/125 single mode	1000BASE-EZX (GbE)	Laser	-34	-8	+2	+7	140	87.0
SFP-77ADH* Gigabit Ethernet, LC	Tx – 1310/Rx – 1490 9/125 single mode (single fiber)	1000BASE-BX, IEEE 802.3 (GbE)	Laser (WDM)	-26	-3	0	+5	60	37.3
SFP-77BDH* Gigabit Ethernet, LC	Tx – 1490/Rx – 1310 9/125 single mode (single fiber)	1000BASE-BX, IEEE 802.3 (GbE)	Laser (WDM)	-26	-3	0	+5	60	37.3

** **Legend**: **D** – internal DDM calibration; **H** – industrially hardened SFP -40–85˚C (-40–185˚F); **ED** – external DDM calibration*

Table 3. Copper STM-1/Fast Ethernet/Gigabit Ethernet/10 Gigabit Ethernet SFP+

Ordering Name, Interface, Connector	Standards	Cable Type	Impedance [Ω]	Typical Max. Range (Attenuation) [m] [ft]
SFP-9G, SFP-9-GH* Gigabit Ethernet, RJ-45, SerDes interface	1000BASE-T, IEEE 802.3	UTP, CAT.5	100	100
SFP-11 STM-1E, mini BNC**, DIN 1.0/2.3	G.703, supports CMI encoder/decoder	Coaxial	75	135 (12.7 dB)***
SFP-11PP STM-1E, Push-Pull mini BNC**, DIN 1.0/2.3	G.703, supports CMI encoder/decoder	Coaxial	75	135 (12.7 dB)***
SFP-30H* Gigabit Ethernet, RJ-45, SGMII Interface	10/100/1000BASE-T, IEEE 802.3	UTP, cat. 5	100	100
SFP-P-13 10 Gigabit Ethernet, RJ-45, SGMII Interface	100/1000BASE-T, IEEE 802.3	UTP, cat. 5e	100	100
	2.5GBASE-T, IEEE 802.3	UTP, cat. 5e		100
	5GBASE-T, IEEE 802.3	UTP, cat. 6		50
	10G BASE-T IEEE 802.3	UTP, cat. 6a		30

** **Legend**: **D** – internal DDM calibration; **H** – industrially hardened SFP -40–85˚C (-40–185˚F)*

*** For the cable specifications, refer to Supplied Accessories.*

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

Table 4. Fiber Optic 10 Gigabit Ethernet XFPs

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [µm]	Standards	Transmitter Type	Input Power [dBm] [min]	[max]	Output Power [dBm] [min]	[max]	Typical Max. Range [km]	[miles]
XFP-1D*, XFP-1DH* 10 Gigabit Ethernet, LC	1310, 9/125 single mode	10GBASE-LR/LW IEEE 802.3	Laser	-14.4	+0.5	-8.2	+0.5	10	6.2
XFP-2D*, XFP-2DH* 10 Gigabit Ethernet, LC	1550, 9/125 single mode	10GBASE-ZR/ZW IEEE 802.3	Laser	-24	-7	0	+4	80	49.7
XFP-3D*, XFP-3DH* 10 Gigabit Ethernet, LC	1550, 9/125 single mode	10GBASE-ER/EW IEEE 802.3	Laser	-15.8	-1	-4.7	+4	40	24.8
XFP-4D* 10 Gigabit Ethernet, LC	850, 50/125 multimode	10GBASE-SR/SW IEEE 802.3	VCSEL	-9.9	-1	-7.3	-1	0.3	0.186
XFP-5D-17 to XFP-5D-61* 10 Gigabit Ethernet, LC	C-Band, Channels 17 to 61, 9/125 single mode	10GBASE-ER/EW IEEE 802.3 ITU grid, 100 Ghz spacing, C-Band channels	Laser [DWDM]	-15.8	-1	-4.7	+4	40	24.8
XFP-7D-17 to XFP-7D-61* 10 Gigabit Ethernet, LC	C-Band, Channels 17 to 61, 9/125 single mode	10GBASE-ZR/ZW ITU grid, 100 Ghz spacing, C-Band channels	Laser [DWDM]	-24	-7	-1	+4	80	49.7

** **Legend**: **D** – internal DDM calibration; **H** – industrially hardened SFP -40–85˚C (-40–85˚F); **ED** – external DDM calibration*

Table 5. Fiber Optic 10 Gigabit Ethernet SFP+

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [µm]	Standards	Transmitter Type	Input Power [dBm] [min]	[max]	Output Power [dBm] [min]	[max]	Typical Max. Range [km]	[miles]
SFP-P-1DH* 10 Gigabit Ethernet, LC	1310nm, 9/125 single mode	10GBASE-LR/LW IEEE 802.3	Laser	-14.4	+0.5	-8.2	+0.5	10	6.2
SFP-P-2DH* 10 Gigabit Ethernet, LC	1550nm, 9/125 single mode	10GBASE-ZR/ZW	Laser	-24	-7	0	+4	80	49.7
SFP-P-3DH* 10 Gigabit Ethernet, LC	1550nm, 9/125 single mode	10GBASE-ER/EW IEEE 802.3	Laser	-15.8	-1	-4.7	+4	40	24.8
SFP-P-4DH* 10 Gigabit Ethernet, LC	850nm, 50/125 multimode	10GBASE-SR/SW IEEE 802.3	VCSEL	-9.9	-1	-7.3	-1	0.3	0.186
SFP-P-5ADH* 10 Gigabit Ethernet, LC	Tx – 1330 Rx – 1270 9/125 single mode (single fiber)	10GBASE-LR/LW IEEE 802.3	Laser (WDM)	-14	+0.5	-8.2	+0.5	10	6.2
SFP-P-5BDH* 10 Gigabit Ethernet, LC	Tx – 1270 Rx – 1330 9/125 single mode (single fiber)	10GBASE-LR/LW IEEE 802.3	Laser (WDM)	-14	+0.5	-8.2	+0.5	10	6.2
SFP-P-6DH* multirate, 10 Gigabit Ethernet, Gigabit Ethernet, LC	1310nm, 9/125 single mode	10GBASE-LR/LW 1000BASE-LX10 IEEE 802.3	Laser	-14.4 -20	+0.5 -3	-8.2 -9.5	+0.5 -3	10 10	6.2 6.2
SFP-P-6ADH* 10 Gigabit Ethernet, LC	Tx - 1330nm, Rx – 1270nm 9/125 single mode (single fiber)	10GBASE-BX (10GbE)	Laser (WDM)	-15	+0.5	0	+6	40 (max. 15db link budget)	24.8 (max. 15db link budget)
SFP-P-6BDH* 10 Gigabit Ethernet, LC	Tx – 1270 nm, Rx - 1330nm, 9/125 single mode (single fiber)	10GBASE-BX (10GbE)	Laser (WDM)	-15	+0.5	0	+6	40 (max. 15db link budget)	24.8 (max. 15db link budget)
SFP-P-12AD 10 Gigabit Ethernet, LC	Tx – 1490 nm Rx – 1550 nm single mode (single fiber) DDMI	10GBASE-BX (10GbE)	Laser (EML)	-23	-6	-1	+4	80 (max. 22db link budget)	49.7 (max. 22db link budget)
SFP-P-12BD 10 Gigabit Ethernet, LC	Tx – 1550 nm Rx – 1490 nm single mode (single fiber) DDMI	10GBASE-BX (10GbE)	Laser (EML)	-23	-6	-1	+4	80 (max. 22db link budget)	49.7 (max. 22db link budget)

* ***Legend**: **D** – internal DDM calibration; **H** – industrially hardened SFP -40–85˚C (-40–185˚F)*

Table 6. Fiber Optic 40 Gigabit Ethernet QSFP+

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [µm]	Standards	Transmitter Type	Input Power [dBm] [min]	[max]	Output Power [dBm] [min]	[max]	Typical Max. Range [km]	[miles]
QSFPP-1D 40 Gigabit Ethernet, LC	1310	40GBASE-LR4 IEEE 802.3	Laser (CWDM)	-13.7*	+2.3	-7.6	+2.3	10	6.2
** - Average input power, each lane (min) is informative and not the principal indicator of signal strength.*									

Table 7. Fiber Optic 100 Gigabit Ethernet QSFP28

Ordering Name, Interface, Connector	Wavelength, Fiber Type [nm], [μm]	Standards	Transmitter Type	Input Power [dBm] [min]	Input Power [dBm] [max]	Output Power [dBm] [min]	Output Power [dBm] [max]	Typical Max. Range [km]	Typical Max. Range [miles]
QSFP28-1D* 100 Gigabit Ethernet, LC, Internal Calibration	LAN-WDM wavelengths 1295.56nm, 1300.05nm, 1304.58nm, 1309.14nm, 9/125 Single mode	100GBASE-LR4 IEEE 802.3	Laser EML	-10.6 **	+4.5	-4.3	+4.5	10	6.2
QSFP28-1D-DML 100 Gigabit Ethernet, DML	LAN-WDM wavelengths 1295.56nm, 1300.05nm, 1304.58nm, 1309.14nm, 9/125 Single mode	100GBASE-LR4 IEEE 802.3	Laser DML	-10.6 **	+4.5	-4.3	+4.5	10	6.2
QSFP28 -2D* 100 Gigabit Ethernet, MPO12	850nm, 50/125 Multimode	100GBASE-SR4 IEEE 802.3	VCSEL	-10.3 **	+2.4	-8.4	+2.4	0.1 Over OM4 fiber 0.07 Over OM3 fiber	0.06 0.04

** **Legend**: **D** – internal DDM calibration; **H** – industrially hardened SFP -40–85˚C (-40–185˚F)*

*** Average input power, each lane (min) is informative and not the principal indicator of signal strength.*

Pluggable Transceivers

Small Form-Factor Pluggable Transceivers

Ordering

To order an SFP/XFP/SFP+/QSFP+/QSFP28 unit, use its ordering name as listed in *Tables 1–7*.

Note: *It is strongly recommended to order RAD products with original RAD SFP/XFP/SFP+/QSFP+/QSFP28 installed. This will ensure that prior to shipping, RAD has performed comprehensive functional quality tests on the entire assembled unit, including the SFP/XFP/SFP+/QSFP28 devices.*

RAD cannot guarantee full compliance to product specifications for products using non-RAD SFPs/XFPs/SFP+s/QSFP28.

SUPPLIED ACCESSORIES

CBL-MINIBNC-BNC

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

CBL-MINIBNC/PP-BNC

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

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