

Transceiver Specifications for M Series, MX Series, and T Series Routers

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M Series, MX Series, and T Series Transceiver Overview

M Series, MX Series, and T Series routers support a variety of fixed and pluggable transceivers. To determine which transceivers are supported on a particular device, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*.

For transceiver specifications, see:

- Ethernet 10BASE-T Copper Interface Specifications on page 7
- Fast Ethernet 100BASE-T Copper Interface Specifications on page 7
- Gigabit Ethernet 1000BASE-T Copper Interface Specifications on page 8
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 8
- Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
- 100-Gigabit Ethernet 100GBASE Optical Interface Specifications on page 24
- SONET/SDH OC3/STM1 Optical Interface Specifications on page 26
- SONET/SDH OC12/STM4 Optical Interface Specifications on page 27
- SONET/SDH OC48/STM16 Optical Interface Specifications on page 29
- SONET/SDH OC192/STM64 Optical Interface Specifications on page 30
- SONET/SDH OC768/STM256 Optical Interface Specifications on page 34

Related Documentation

- Supported Network Interface Standards by Transceiver on page 3

Supported Network Interface Standards by Transceiver

The following transceivers are supported on M Series, MX Series, or T Series routers. To determine which transceivers are supported on a particular device and router, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*.

- Table 1 on page 4 lists the supported Ethernet standards for each transceiver.
- Table 2 on page 5 lists the supported SONET standards for each transceiver.



NOTE: For XFP transceivers that can support either the 10-Gigabit Ethernet or SONET OC192/STM64 specifications, check the standard supported for the device into which the transceiver is installed. For example, the XFP-10G-E-OC192-IR2 transceiver installed in a 10-Gigabit Ethernet PIC supports the 10GBASE-E standard. However, the XFP-10G-E-OC192-IR2 transceiver installed in a SONET OC192/STM64 PIC supports the SONET OC192/STM64 IR2 standard.

Table 1 on page 4 is organized by transmission speed and distance supported.

Table 1: Supported Ethernet Standards

Transceiver Model Number	Transceiver Type	Connector	Standard	Specifications
Ethernet 10BASE, Fast Ethernet 100BASE, and Gigabit Ethernet 1000BASE Specifications				
SFP-1FE-FX	SFP	LC/PC	100BASE-FX	<ul style="list-style-type: none"> Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
SFP-1-GE-T	SFP	RJ-45	1000BASE-T	<ul style="list-style-type: none"> Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
SFP-1GE-FE-E-T	SFP	RJ-45	10/100/1000BASE-T	<ul style="list-style-type: none"> Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
SFP-1GE-SX	SFP	LC/PC	1000BASE-SX	<ul style="list-style-type: none"> Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
SFP-1GE-LX	SFP	LC/PC	1000BASE-LX10	<ul style="list-style-type: none"> Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
SFP-GE40KM	SFP	LC/PC	1000BASE-EX	<ul style="list-style-type: none"> Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
SFP-1GE-LH	SFP	LC/PC	1000BASE-LH	<ul style="list-style-type: none"> Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
10-Gigabit Ethernet 10GBASE Specifications				
SFP-10GE-LRM	SFP+	LC/PC	10GBASE-LRM	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
SFP-10GE-SR	SFP+	LC/PC	10GBASE-SR	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
XENPAK-1XGE-SR	XENPAK	SC/PC	10GBASE-SR	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
XFP-10G-S	XFP	LC/PC	10GBASE-S	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
SFP-10GE-LR	SFP+	LC/PC	10GBASE-LR	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15

Table 1: Supported Ethernet Standards (*continued*)

Transceiver Model Number	Transceiver Type	Connector	Standard	Specifications
XENPAK-1XGE-LR	XENPAK	SC/PC	10GBASE-LR	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
XFP-10G-L-OC192-SR1	XFP	LC/PC	10GBASE-L	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
SFP+10GE-ER	SFP+	LC/PC	10GBASE-ER	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
XENPAK-1XGE-ER	XENPAK	SC/PC	10GBASE-ER	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
XFP-10G-E-OC192-IR2	XFP	LC/PC	10GBASE-E	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
XENPAK-1XGE-ZR	XENPAK	SC/PC	10GBASE-ZR	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
XFP-10G-Z-OC192-LR2	XFP	LC/PC	10GBASE-Z	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
XFP-10G-CBAND-T50-ZR	XFP	LC/PC	10GBASE-ZR 10-Gigabit Ethernet Dense wavelength division multiplexing (DWDM)	<ul style="list-style-type: none"> 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
None	Fixed	SC/PC	10-Gigabit Ethernet Dense wavelength division multiplexing (DWDM)	<ul style="list-style-type: none"> 10-Gigabit Ethernet DWDM Optical Interface Specifications on page 19
None	Fixed	SC/PC	10-Gigabit Ethernet Dense wavelength division multiplexing (DWDM) OTN	<ul style="list-style-type: none"> 10-Gigabit Ethernet DWDM OTN Optical Interface Specifications on page 20
100-Gigabit Ethernet 100GBASE Specifications				
CFP-100GBASE-LR4	CFP	SC/PC	100GBASE-LR4	<ul style="list-style-type: none"> 100-Gigabit Ethernet 100GBASE Optical Interface Specifications on page 24

Table 2 on page 5 is organized by transmission speed and distance supported.

Table 2: Supported SONET Standards

Transceiver Model Number	Transceiver Type	Connector	Standard	Specifications
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SONET OC3/STM1 Specifications

Table 2: Supported SONET Standards (continued)

Transceiver Model Number	Transceiver Type	Connector	Standard	Specifications
SFP-OC3-SR	SFP	LC/PC	SONET/SDH OC3/STM1 Multimode	<ul style="list-style-type: none"> SONET/SDH OC3/STM1 Optical Interface Specifications on page 26
SFP-OC3-IR	SFP	LC/PC	SONET/SDH OC3/STM1 Intermediate Reach	<ul style="list-style-type: none"> SONET/SDH OC3/STM1 Optical Interface Specifications on page 26
SFP-OC3-LR	SFP	LC/PC	SONET/SDH OC3/STM1 Long Reach	<ul style="list-style-type: none"> SONET/SDH OC3/STM1 Optical Interface Specifications on page 26
SONET OC12/STM4 Specifications				
SFP-OC12-SR	SFP	LC/PC	SONET/SDH OC12/STM4 Short Reach (SR-1)	<ul style="list-style-type: none"> SONET/SDH OC12/STM4 Optical Interface Specifications on page 27
SFP-OC12-IR	SFP	LC/PC	SONET/SDH OC12/STM4 Intermediate Reach (IR-1)	<ul style="list-style-type: none"> SONET/SDH OC12/STM4 Optical Interface Specifications on page 27
SFP-OC12-LR	SFP	LC/PC	SONET/SDH OC12/STM4 Long Reach (LR-1)	<ul style="list-style-type: none"> SONET/SDH OC12/STM4 Optical Interface Specifications on page 27
OC48/STM16 Specifications				
SFP-1OC48-SR	SFP	LC/PC	SONET/SDH OC48/STM16 Short Reach (SR-1)	<ul style="list-style-type: none"> SONET/SDH OC48/STM16 Optical Interface Specifications on page 29
SFP-1OC48-IR	SFP	LC/PC	SONET/SDH OC48/STM16 Intermediate Reach (IR-1)	<ul style="list-style-type: none"> SONET/SDH OC48/STM16 Optical Interface Specifications on page 29
SFP-1OC48-LR	SFP	LC/PC	SONET/SDH OC48/STM16 Long Reach (LR-2)	<ul style="list-style-type: none"> SONET/SDH OC48/STM16 Optical Interface Specifications on page 29
SONET OC192/STM64 Specifications				
XFP-10G-L-OC192-SR1	XFP	LC/PC	SONET/SDH OC192/STM64 Short Reach (SR-1)	<ul style="list-style-type: none"> SONET/SDH OC192/STM64 Optical Interface Specifications on page 30
XFP-10G-E-OC192-IR2	XFP	LC/PC	SONET/SDH OC192/STM64 Intermediate Reach (IR-2)	<ul style="list-style-type: none"> SONET/SDH OC192/STM64 Optical Interface Specifications on page 30

Table 2: Supported SONET Standards (continued)

Transceiver Model Number	Transceiver Type	Connector	Standard	Specifications
XFP-10G-Z-OC192-LR2	XFP	LC/PC	SONET/SDH OC192/STM64 Long Reach (LR-2)	<ul style="list-style-type: none"> SONET/SDH OC192/STM64 Optical Interface Specifications on page 30
SONET OC768/STM256 Specifications				
PD-10C768-SON-SR	Fixed	SC/PC	SONET/SDH OC768/STM256 Short Reach (SR)	<ul style="list-style-type: none"> SONET/SDH OC768/STM256 Optical Interface Specifications on page 34

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3

Ethernet Copper Interface Specifications

- Ethernet 10BASE-T Copper Interface Specifications on page 7
- Fast Ethernet 100BASE-T Copper Interface Specifications on page 7
- Gigabit Ethernet 1000BASE-T Copper Interface Specifications on page 8

Ethernet 10BASE-T Copper Interface Specifications

Table 3 on page 7 shows the copper interface specifications for the 10BASE-T standard.

Table 3: 10BASE-T Copper Interface Specifications

Parameter	10BASE-T
Rate	10 Mbps
Distance	328 ft (100 m)
Cable	Four-pair, Category 5 shielded twisted-pair

Fast Ethernet 100BASE-T Copper Interface Specifications

Table 4 on page 7 shows the copper interface specifications for the 100BASE-T standard.

Table 4: Ethernet 100BASE-T Copper Interface Specifications

Parameter	100BASE-T
Rate	10 Mbps
Distance	328 ft (100 m)
Cable	Four-pair, Category 5 shielded twisted-pair

Gigabit Ethernet 1000BASE-T Copper Interface Specifications

Table 5 on page 8 shows the copper interface specifications for the 1000BASE-T standard.

Table 5: 1000BASE-T Copper Interface Specifications

Parameter	1000BASE-T
Rate	1000 Mbps autosensing
Distance	328 ft (100 m)
Cable	Four-pair, Category 5 shielded twisted-pair

Fast Ethernet and Gigabit Ethernet Optical Interface Specifications

- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 8
- Fast Ethernet 100BASE Optical Interface Specifications on page 12
- Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12

Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

The following bidirectional SFPs are supported on M Series, MX Series, and T Series routers. To determine which SFPs are supported on a particular device, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*.

- Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications on page 8
- Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/14 and D 14/13) Optical Interface Specifications on page 9
- Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications on page 10
- Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U 13/15 and D 15/13) Optical Interface Specifications on page 11

Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications

Table 6 on page 8 shows the optical specifications for 100BASE-BX bidirectional SFPs. 100BASE-BX bidirectional interfaces are supported in JUNOS 9.6 and later and must be used in pairs.

Table 6: Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications

Parameter	100BASE-BX-U	100BASE-BX-D
Pairs with	100BASE-BX-D	100BASE-BX-U
Transceiver model number	EX-SFP-FE20KT13R15	EX-SFP-FE20KT15R13

Table 6: Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications (continued)

Parameter	100BASE-BX-U	100BASE-BX-D
Rate	100 Mbps	100 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	100BASE-BX IEEE 802.3-2005	100BASE-BX IEEE 802.3-2005
Maximum distance	9/125 SMF cable: 12.4 miles/20 km	9/125 SMF cable: 12.4 miles/20 km
Transmitter wavelength	1260 through 1360 nm	1480 through 1580 nm
Average launch power	-14 through -8 dBm	-14 through -8 dBm
Average receive power	-45 through -8 dBm	-45 through -8 dBm
Receiver saturation	-8 dBm	-8 dBm
Receiver sensitivity	-45 dBm	-45 dBm

Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/14 and D 14/13) Optical Interface Specifications

Table 7 on page 9 shows the optical specifications for 1000BASE-BX bidirectional SFPs. 1000BASE-BX bidirectional interfaces are supported in JUNOS 9.0 and later and must be used in pairs.

Table 7: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/14 and D 14/13) Optical Interface Specifications

Parameter	1000BASE-BX10-U 13/14	1000BASE-BX10-D 14/13
Pairs with	1000BASE-BX10-D 14/13	1000BASE-BX10-U 13/14
Transceiver model number	SFP-GE10KT13R14	SFP-GE10KT14R13
Rate	1000 Mbps	1000 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	IEEE 802.3-2005	IEEE 802.3-2005

Table 7: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/14 and D 14/13) Optical Interface Specifications (continued)

Parameter	1000BASE-BX10-U 13/14	1000BASE-BX10-D 14/13
Maximum distance	9/125 SMF cable: 6.2 miles/10 km	9/125 SMF cable: 6.2 miles/10 km
Transmitter wavelength	1260 through 1360 nm	1480 through 1500 nm
Average launch power	-9 through -3 dBm	-9 through -3 dBm
Average receive power	-19.5 through -3 dBm	-19.5 through -3 dBm
Receiver saturation	-3 dBm	-3 dBm
Receiver sensitivity	-19.5 dBm	-19.5 dBm

Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications

Table 9 on page 11 shows the optical specifications for 1000BASE-BX bidirectional SFPs. 1000BASE-BX bidirectional interfaces are supported in JUNOS 9.0 and later and must be used in pairs.

Table 8: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications

Parameter	1000BASE-BX10-U 13/15	1000BASE-BX10-D 15/13
Pairs with	1000BASE-BX10-D 15/13	1000BASE-BX10-U 13/15
Transceiver model number	SFP-GE10KT13R15	SFP-GE10KT15R13
Rate	1000 Mbps	1000 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	Multivendor agreement	Multivendor agreement
Maximum distance	9/125 SMF cable: 6.2 miles/10 km	9/125 SMF cable: 6.2 miles/10 km
Transmitter wavelength	1270 through 1360 nm	1530 through 1570 nm
Average launch power	-9 through -3 dBm	-9 through -3 dBm
Average receive power	-20 through -3 dBm	-20 through -3 dBm
Receiver saturation	-3 dBm	-3 dBm

Table 8: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D15/13) Optical Interface Specifications (continued)

Parameter	1000BASE-BX10-U 13/15	1000BASE-BX10-D 15/13
Receiver sensitivity	-20 dBm	-20 dBm

Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U13/15 and D15/13) Optical Interface Specifications

Table 8 on page 10, shows the optical specifications for 1000BASE-BX bidirectional SFPs. 1000BASE-BX bidirectional interfaces are supported in JUNOS 9.0 and later and must be used in pairs.

Table 9: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U 13/15 and D 15/13) Optical Interface Specifications

Parameter	1000BASE-BX40-U 13/15	1000BASE-BX40-D 15/13
Pairs with	1000BASE-BX40-D 15/13	1000BASE-BX40-U 13/15
Transceiver model number	SFP-GE40KT13R15	SFP-GE40KT15R13
Rate	1000 Mbps	1000 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	Multivendor agreement	Multivendor agreement
Maximum distance	9/125 SMF cable: 24.9 miles/40 km	9/125 SMF cable: 24.9 miles/40 km
Transmitter wavelength	1260 through 1360 nm	1530 through 1570 nm
Average launch power	-3 through 2 dBm	-7 through 2 dBm
Average receive power	-23 through -3 dBm	-23 through -3 dBm
Receiver saturation	-3 dBm	-3 dBm
Receiver sensitivity	-23 dBm	-23 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3
- Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12
- Supported Network Interface Standards by Transceiver on page 3

Fast Ethernet 100BASE Optical Interface Specifications

Table 10 on page 12 shows the optical interface specifications for the 100BASE-FX standard.

Table 10: Fast Ethernet 100BASE-FX Optical Interface Specifications

Parameter	100BASE-FX
Rate	100 Mbps
Optical interface	Multimode
Maximum distance	50/125 MMF cable: 1640 ft (500 m) 62.5/125 MMF cable: 6562 ft (2 km)
Transmitter wavelength	1270 through 1380 nm
Average launch power	-19 through -14 dBm
Average receive power	-31 through -14 dBm
Receiver saturation	-14 dBm
Receiver sensitivity	-31 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3

Gigabit Ethernet 1000BASE Optical Interface Specifications

The following Gigabit Ethernet standards are supported on M Series, MX Series, or T Series routers. The standards are organized by distance supported. To determine which standards are supported by a transceiver in a particular device and router, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*.

- Gigabit Ethernet 1000BASE-SX Optical Interface Specifications on page 12
- Gigabit Ethernet 1000BASE-LX Optical Interface Specifications on page 13
- Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications on page 14
- Gigabit Ethernet 1000BASE-EX Optical Interface Specifications on page 14
- Gigabit Ethernet 1000BASE-LH Optical Interface Specifications on page 15

Gigabit Ethernet 1000BASE-SX Optical Interface Specifications

Table 11 on page 13 shows the optical interface specifications for the 1000BASE-SX standard.

Table 11: Gigabit Ethernet 1000BASE-SX Optical Interface Specifications

Parameter	1000BASE-SX
Rate	1000 Mbps
Optical interface	Multimode
Maximum distance	62.5/125 MMF cable: 656 ft (200 m) 50/125 MMF cable: 1640 ft (500 m)
Transmitter wavelength	770 through 860 nm
Average launch power	-9.5 through 0 dBm
Average receive power	-17 through 0 dBm
Receiver saturation	0 dBm
Receiver sensitivity	-17 dBm

Gigabit Ethernet 1000BASE-LX Optical Interface Specifications

Table 12 on page 13 shows the optical interface specifications for the 1000BASE-LX standard.

Table 12: Gigabit Ethernet 1000BASE-LX Optical Interface Specifications

Parameter	1000BASE-LX
Rate	1000 Mbps
Optical interface	Multimode
Maximum distance	62.5/125 and 50/125 MMF cable: 1804.5 ft (550 m)
Transmitter wavelength	1270 through 1355 nm
Average launch power	-11.5 through -3 dBm
Average receive power	-19 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-19 dBm

Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications

Table 13 on page 14 shows the optical interface specifications for the 1000BASE-LX10 standard.

Table 13: Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications

Parameter	1000BASE-LX10
Rate	1000 Mbps
Optical interface	Single-mode
Maximum distance	9/125 SMF cable: 6.2 miles (10 km)
Transmitter wavelength	1270 through 1355 nm
Average launch power	-11.5 through -3 dBm
Average receive power	-19 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-19 dBm

Gigabit Ethernet 1000BASE-EX Optical Interface Specifications

Table 13 on page 14 shows the optical interface specifications for the 1000BASE-EX standard.

Table 14: Gigabit Ethernet 1000BASE-EX Optical Interface Specifications

Parameter	1000BASE-EX
Rate	1000 Mbps
Optical interface	Single-mode
Maximum distance	9/125 SMF cable: 24.85 miles (40 km)
Transmitter wavelength	1260 through 1360 nm
Average launch power	-4.5 through 0 dBm
Average receive power	-22.5 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-22.5 dBm

Gigabit Ethernet 1000BASE-LH Optical Interface Specifications

Table 15: Gigabit Ethernet 1000BASE-LH Optical Interface Specifications

Parameter	1000BASE-LH
Rate	1000 Mbps
Optical interface	Single-mode
Maximum distance	9/125 SMF cable: 43.5 miles (70 km)
Transmitter wavelength	1500 through 1580 nm
Average launch power	-3 through +3 dBm
Average receive power	-20 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-20 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3
- Supported Network Interface Standards by Transceiver on page 3

10-Gigabit Ethernet Optical Interface Specifications

- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15
- 10-Gigabit Ethernet DWDM Optical Interface Specifications on page 19
- 10-Gigabit Ethernet DWDM OTN Optical Interface Specifications on page 20

10-Gigabit Ethernet 10GBASE Optical Interface Specifications

The following 10-Gigabit Ethernet optical interface standards are supported on M Series, MX Series, or T Series routers. To determine which standards are supported for a transceiver on a particular device and router, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*.



NOTE: Some XFP transceivers can support either the 10-Gigabit Ethernet or SONET/SDH OC192/STM64 specifications. Check the standard supported for the device into which the transceiver is installed. For example, the XFP-10G-E-OC192-IR2 transceiver installed in a 10-Gigabit Ethernet PIC supports the 10GBASE-E standard. However, the XFP-10G-E-OC192-IR2 transceiver installed in a SONETSDH OC192/STM64 PIC supports the SONETSDH OC192/STM64 IR2 standard.

The specifications are organized by distance supported.

- 10GBASE-LRM Specifications on page 16
- 10GBASE-S Specifications on page 16
- 10GBASE-L Specifications on page 17
- 10GBASE-E Specifications on page 18
- 10GBASE-Z Specifications on page 18

10GBASE-LRM Specifications

Table 16 on page 16 shows the optical interface specifications for the 10GBASE-LRM standard.

Table 16: 10GBASE-LRM Optical Interface Specifications

Parameter	10GBASE-LRM
Optical interface	Multimode
Standard	IEEE 802.3aq–2002
Maximum distance	62.5/125 MMF cable, 500 MHz-km: 722 ft (220 m) 50/125 MMF cable, 500 MHz-km: 722 ft (220 m)
Transmitter wavelength	1260 through 1355 nm
Average launch power	–6.5 through +0.5 dBm
Average receive power	–6.5 through +1.5 dBm
Receiver saturation	+1.5 dBm
Receiver sensitivity	–6.5 dBm

10GBASE-S Specifications

Table 17 on page 16 shows the optical interface specifications for the 10GBASE-SR and 10GBASE-SW standards.

Table 17: 10GBASE-S (10GBASE-SR and 10GBASE-SW) Optical Interface Specifications

Parameter	10GBASE-S
Optical interface	Multimode
Standard	IEEE 802.3ae–2002

Table 17: 10GBASE-S (10GBASE-SR and 10GBASE-SW) Optical Interface Specifications (continued)

Parameter	10GBASE-S
Maximum distance	50/125 MMF cable, 2000 MHz-km: 948 ft (300 m)
	50/125 MMF cable, 500 MHz-km: 269 ft (82 m)
	50/125 MMF cable, 400 MHz-km: 217 ft (66 m)
	62.5/125 MMF cable, 200 MHz-km: 108 ft (33 m)
	62.5/125 MMF cable, 160 MHz-km: 85 ft (26 m)
Transmitter wavelength	840 through 860 nm
Average launch power	-4.5 through -1.0 dBm
Average receive power	-9.9 through -1.0 dBm
Receiver saturation	-1.0 dBm
Receiver sensitivity	-9.9 dBm

10GBASE-L Specifications

Table 18 on page 17 shows the optical interface specifications for the 10GBASE-LR and 10GBASE-LW standards.

Table 18: 10GBASE-L (10GBASE-LR and 10GBASE-LW) Optical Interface Specifications

Parameter	10GBASE-L
Optical interface	Single-mode
Standard	IEEE 802.3ae-2002
Maximum distance	9/125 SMF cable: 6.2 miles (10 km)
Transmitter wavelength	1260 through 1355 nm
Average launch power	-8.2 through 0.5 dBm
Average receive power	-14.4 through 0.5 dBm
Receiver saturation	0.5 dBm
Receiver sensitivity	-14.4 dBm

10GBASE-E Specifications

Table 19 on page 18 shows the optical interface specifications for the 10GBASE-ER and 10GBASE-EW standards.

Table 19: 10GBASE-E (10GBASE-ER and 10GBASE-EW) Optical Interface Specifications

Parameter	10GBASE-E
Optical interface	Single-mode
Standard	IEEE 802.3ae–2002
Maximum distance	9/125 SMF cable: 24.8 miles (40 km); distances greater than 30 km are considered to be engineered links.
Transmitter wavelength	1530 through 1565 nm
Average launch power	–4.7 through 4.0 dBm
Average receive power	–15.8 through –1.0 dBm
Receiver saturation	–1.0 dBm
Receiver sensitivity	–15.8 dBm

10GBASE-Z Specifications

Table 20 on page 18 shows the optical interface specifications for the 10GBASE-ZR and 10GBASE-ZW transceiver.

Table 20: 10GBASE-Z (10GBASE-ZR and 10GBASE-ZW) Optical Interface Specifications

Parameter	10GBASE-Z
Optical interface	Single-mode
Standard	Multivendor agreement
Maximum distance	9/125 SMF cable: 49.6 miles (80 km)
Transmitter wavelength	1530 through 1565 nm
Average launch power	0 through 4.0 dBm
Average receive power	–24.0 through –7.0 dBm
Receiver saturation	–7.0 dBm

Table 20: 10GBASE-Z (10GBASE-ZR and 10GBASE-ZW) Optical Interface Specifications (continued)

Parameter	10GBASE-Z
Receiver sensitivity	-24.0 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3
- Supported Network Interface Standards by Transceiver on page 3
- Gigabit Ethernet 1000BASE Optical Interface Specifications on page 12

10-Gigabit Ethernet DWDM Optical Interface Specifications

M320 and T Series routers support the following 10-Gigabit Ethernet DWDM PIC transceiver.

- Table 21 on page 19 shows the optical interface specifications for the 10-Gigabit Ethernet DWDM PIC transceiver.

Table 21: 10-Gigabit Ethernet DWDM LAN Rate Optical Interface Specifications

Parameter	Extra-Long Wavelength Serial DWDM, LAN Rate
Optical interface	Single-mode
Transceiver type	Dense wavelength division multiplexing (DWDM)
Standard	ITU-T G.694.1
Maximum distance	9/125 SMF cable: 49.6 miles (80 km)
Transmitter wavelength	1528.77 through 1563.86 nm, 100-GHz ITU grid
Average launch power	0 through 4.0 dBm
Transmit extinction ratio	9.0 dBm
Average receive power	-24.0 through -7.0 dBm
Receiver saturation	-7.0 dBm
Receiver sensitivity	-24.0 dBm

Related Documentation

- 10-Gigabit Ethernet DWDM OTN Optical Interface Specifications

10-Gigabit Ethernet DWDM OTN Optical Interface Specifications

The following 10-Gigabit DWDM OTN transceiver is supported on T640 and T1600 routers.

- Table 22 on page 20 describes the 10-Gigabit Ethernet DWDM OTN transceiver optical interface specifications.
- Table 23 on page 23 provides the supported wavelengths for the 100-GHz grid and the 50-GHz offset in both THz and nm.
- The OSNR performance listed in Table 24 on page 24 is for an appropriate level of optical filtering of the amplified spontaneous emission (ASE) reaching the receiver and is derived using a 0.22-nm 3-dB full-width Gaussian filter. When no FEC is used, there is no OTN framing.

Table 22: Optical Interface Support for the 10-Gigabit Ethernet DWDM OTN Transceiver

PIC Model number	<ul style="list-style-type: none"> • PC-1XGE-DWDM-OTN
Features	<ul style="list-style-type: none"> • 10-Gigabit digital wrapper with over-clocked G.709 framing • Generic Reed-Solomon forward error correction (GFEC) and enhanced forward error correction (EFEC) to transport 10GBASE-R (10-Gigabit Ethernet LAN PHY) • Reduced cost of deploying and maintaining the network due to: <ul style="list-style-type: none"> • Fewer optical-electrical-optical (OEO) conversions • Fewer optical amplifiers and regenerators • 89 tunable wavelengths (channels) supported per DWDM-OTN module • Link fault switchover
Transceiver type	<ul style="list-style-type: none"> • Dense wavelength division multiplexing (DWDM) module
Standards	<ul style="list-style-type: none"> • ITU-T G.709—Interfaces for the Optical Transport Network (OTN). The PC-1XGE-DWDM-OTN PIC supports two OTN extended mappings: <ul style="list-style-type: none"> • Supplement 43, section 7.1, optical channel payload unit 2e (OPU2e). This mapping inserts the original 10GE LAN PHY signal into a “digital wrapper” with overclocked G.709 framing that results in a line rate of 11.1 Gbps instead of the standard 10.7 Gbps. • Supplement 43, section 7.2, optical channel payload unit 1e (OPU1e). This mapping inserts the original 10GE LAN PHY signal into a “digital wrapper” with overclocked G.709 framing, but without the use of fixed stuff bytes, that results in a line rate of 11.05 Gbps instead of the standard 10.7 Gbps. <p>See <i>ITU-T Series G Supplement 43, ver 02/2008</i> for more information about OPU2e and OPU1e extended mappings.</p> • ITU-T G.975—GFEC • ITU-T G.975.1—Enhanced FEC • ITU-T G.694.1—Spectral grids for WDM applications: DWDM frequency grid Series G: Transmission Systems and Media, Digital Systems and Networks Transmission media characteristics-Characteristics of optical components and subsystems • IEEE 802.3ae—2005 • RFC 3591—Definitions of Managed Objects for the Optical Interface Type
Optical interface	<ul style="list-style-type: none"> • Single-mode optical fiber (SMF)

Table 22: Optical Interface Support for the 10-Gigabit Ethernet DWDM OTN Transceiver (continued)

Line interface	<ul style="list-style-type: none"> • Line rate: <ul style="list-style-type: none"> • 10GE LAN PHY: 10.3125 Gbps (pass-through) • G.709 LAN PHY without fixed stuff bytes: 11.049 Gbps • G.709 LAN PHY with fixed stuff bytes: 11.0957 Gbps • Transmit line rate deviation: G.709 LAN PHY modes: ffl20 ppm • Dispersion window: ffl1200 ps/nm or ffl1600 ps/nm (maximum) • FEC type (software selectable): Generic Reed-Solomon RS (255, 239) code computed as specified in Annex A/G. 709 (GFEC) or enhanced (EFEC)
Optical transmitter	<ul style="list-style-type: none"> • Transmitter type: LiNbO₃ MZI (Lithium Niobate Mach-Zehnder Interferometer) • Modulation format: Nonreturn-to-zero (NRZ) • Channel-plan wavelength range: 1528.77 through 1563.86 nm • Channel-plan frequency range: 191.7 through 196.1 THz • Channel spacing: 50 GHz • Channel tunability: 89 channels—see Table 23 on page 23 • Output power (on): +3 to +7 dBm • Output power (off): ≤ -40 dBm • Output power stability: -1.5 to +1.0 dB • Wavelength accuracy: ffl25 pm, ffl3.125 GHz • Tuning time: Warm tune – 10 seconds; cold start – 40 seconds • Extinction ratio: ≥ 11 dB • Crossing ratio: 45 to 55 percent • Side-mode suppression ratio: ≥ 30 dB • Optical spectral width: ≤ 25 GHz (informational, not a specification) • Average relative intensity noise (RIN): <ul style="list-style-type: none"> • 10 MHz to 1 GHz: -110 dB/Hz • 1 GHz to 10 GHz: -145 dB/Hz • Output OSNR: <ul style="list-style-type: none"> • Minimum: 50 dB (0.1 nm resolution bandwidth) • Typical: 55 dB (0.1 nm resolution bandwidth) • Polarization extinction ratio: 20 dB • Eye mask compliance: 802.3–2005 • Jitter generation compliance: GR-253/G.8251
Optical receiver	<ul style="list-style-type: none"> • Receiver type: Avalanche photodiode (APD) • Average receive power (input power range): see Input Power Range in Table 24 on page 24 • Jitter tolerance compliance: GR-253/G.8251/802.3ae (LAN PHY) • Rx DTV setting: <ul style="list-style-type: none"> • No FEC (pass-through): Static (factory optimized value) • GFEC: Managed by electronic dispersion compensation (EDC) • EFEC: Managed by EDC • Rx wavelength range: 1527 to 1567 nm • Overload (receiver saturation): -5 dBm (high OSNR), -8 dBm (low OSNR) • Damage input power: +5 dBm • Optical return loss: ≥ 27 dB

Table 22: Optical Interface Support for the 10-Gigabit Ethernet DWDM OTN Transceiver (continued)

Optical performance	<p>Optical Applications—Power-Limited Receiver (High OSNR):</p> <ul style="list-style-type: none"> • Sensitivity: <ul style="list-style-type: none"> • No FEC: -5 to -24 dBm (>33 dB/0.1 nm OSNR, 0 ps/nm CD) at 10^{-12} BER (10.3 Gbps) • GFEC: -5 to -28 dBm at 8×10^{-5} pre-FEC BER (>33 dB/0.1 nm OSNR, 0 ps/nm CD) (10^{-15} post-FEC BER) (11.05 and 11.1 Gbps) • EFEC: -5 to -28 dBm at 1×10^{-3} pre-FEC BER (>33 dB/0.1 nm OSNR, 0 ps/nm CD) (10^{-15} post-FEC BER) (11.05 and 11.1 Gbps) • Chromatic dispersion (CD) power penalty: <ul style="list-style-type: none"> • No FEC: 3 dB (typical penalty at ffl1200 ps/nm without EDC) • GFEC or EFEC: 3 dB (typical penalty at ffl1600 ps/nm with EDC) <p>Optical Applications—Noise-Limited Receiver (Low OSNR):</p> <ul style="list-style-type: none"> • Required OSNR: <ul style="list-style-type: none"> • No FEC (10.3 Gbps): <ul style="list-style-type: none"> • 26 dB/0.1 nm (-8 to -20 dBm Rx input power range, 0 ps/nm CD, at 10^{-12} BER) • 26 dB/0.1 nm (-8 to -20 dBm Rx input power range, ffl1000 ps/nm without EDC, at 10^{-12} BER) • 30 dB/0.1 nm (-8 to -20 dBm Rx input power range, ffl1200 ps/nm without EDC, at 10^{-12} BER) • GFEC (11.05 and 11.1 Gbps): <ul style="list-style-type: none"> • 15.5 dB/0.1 nm (-8 to -20 dBm Rx input power range, 0 ps/nm, at $\leq 10^{-5}$ pre-FEC BER, $\leq 10^{-15}$ post-FEC BER) • 17 dB/0.1 nm (-8 to -20 dBm Rx input power range, ffl1200 ps/nm with EDC, at $\leq 10^{-5}$ pre-FEC BER, $\leq 10^{-15}$ post-FEC BER) • EFEC (11.05 and 11.1 Gbps): <ul style="list-style-type: none"> • 12 dB/0.1 nm (-8 to -20 dBm Rx input power range, 0 ps/nm, at $\leq 10^{-4}$ pre-FEC BER, $\leq 10^{-15}$ post-FEC BER) • 14 dB/0.1 nm (-8 to -20 dBm Rx input power range, ffl1200 ps/nm with EDC, at $\leq 10^{-4}$ pre-FEC BER, $\leq 10^{-15}$ post-FEC BER) • 16 dB/0.1 nm (-8 to -20 dBm Rx input power range, 0 ps/nm CD, 10^{-15} post-FEC BER) • CD OSNR penalty: <ul style="list-style-type: none"> • GFEC: 1.5 dB (typical penalty at ffl1200 ps/nm with Rx input power range from -8 to -20 dBm). • EFEC: 2 dB (typical penalty at ffl1200 ps/nm with Rx input power range from -8 to -20 dBm). <p>For more detailed information, see Table 24 on page 24.</p>
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Table 23: Supported Wavelengths for the 10-Gigabit Ethernet DWDM OTN Transceiver

100-GHz Grid		50-GHz Offset		100-GHz Grid		50-GHz Offset	
THz	nm	THz	nm	THz	nm	THz	nm
191.70	1563.86	191.75	1563.45	194.00	1545.32	194.05	1544.92
191.80	1563.04	191.85	1562.63	194.10	1544.52	194.15	1544.12
191.90	1562.23	191.95	1561.82	194.20	1543.73	194.25	1543.33
192.00	1561.41	192.05	1561.01	194.30	1542.93	194.35	1542.53
192.10	1560.60	192.15	1560.20	194.40	1542.14	194.45	1541.74
192.20	1559.79	192.25	1559.38	194.50	1541.34	194.55	1540.95
192.30	1558.98	192.35	1558.57	194.60	1540.55	194.65	1540.16
192.40	1558.17	192.45	1557.76	194.70	1539.76	194.75	1539.37
192.50	1557.36	192.55	1556.95	194.80	1538.97	194.85	1538.58
192.60	1556.55	192.65	1556.15	194.90	1538.18	194.95	1537.79
192.70	1555.74	192.75	1555.34	195.00	1537.39	195.05	1537.00
192.80	1554.94	192.85	1554.53	195.10	1536.60	195.15	1536.21
192.90	1554.13	192.95	1553.73	195.20	1535.82	195.25	1535.42
193.00	1553.32	193.05	1552.92	195.30	1535.03	195.35	1534.64
193.10	1552.52	193.15	1552.12	195.40	1534.25	195.45	1533.85
193.20	1551.72	193.25	1551.31	195.50	1533.46	195.55	1533.07
193.30	1550.91	193.35	1550.51	195.60	1532.68	195.65	1532.28
193.40	1550.11	193.45	1549.71	195.70	1531.89	195.75	1531.50
193.50	1549.31	193.55	1548.91	195.80	1531.11	195.85	1530.72
193.60	1548.51	193.65	1548.11	195.90	1530.33	195.95	1529.94
193.70	1547.71	193.75	1547.31	196.00	1529.55	196.05	1529.16
193.80	1546.91	193.85	1546.51	196.10	1528.77		
193.90	1546.11	193.95	1545.72				

Table 24: Optical Signal-to-Noise Ratio (OSNR) Performance for the 10-Gigabit Ethernet DWDM OTN Transceiver

OSNR (dB/0.1 nm)	OSNR (dB/0.5 nm)	FEC Type	Pre-FEC BER	Post-FEC BER	Input-Power Range (ROP) (dBm)	CD Tolerance (ps/nm)
33	26	None	10^{-12}	NA	-5 to -24	0
33	26	None	10^{-12}	NA	-5 to -21	ffl1200 (no EDC)
26	19	None	10^{-12}	NA	-8 to -22	0
26	19	None	10^{-12}	NA	-8 to -20	ffl1000 (no EDC)
30	23	None	10^{-12}	NA	-8 to -20	ffl1200 (no EDC)
33	26	GFEC	8×10^{-5}	10^{-15}	-5 to -28	0
33	26	GFEC	8×10^{-5}	10^{-15}	-5 to -25	ffl1600 (with EDC)
15.5	8.5	GFEC	10^{-5}	10^{-15}	-8 to -20	0
17	10	GFEC	10^{-5}	10^{-15}	-8 to -20	ffl1200 (with EDC)
33	26	EFEC	10^{-3}	10^{-15}	-5 to -28	0
33	26	EFEC	10^{-3}	10^{-15}	-5 to -25	ffl1600 (with EDC)
12	5	EFEC	7×10^{-4}	10^{-15}	-8 to -20	0
14	7	EFEC	7×10^{-4}	10^{-15}	-8 to -20	ffl1200 (with EDC)

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3
- Supported Network Interface Standards by Transceiver on page 3
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 15

100-Gigabit Ethernet Optical Interface Specifications

- 100-Gigabit Ethernet 100GBASE Optical Interface Specifications on page 24

100-Gigabit Ethernet 100GBASE Optical Interface Specifications

The following 100-Gigabit Ethernet optical interface standard is supported on T1600 routers.

- 100GBASE-LR4 Specifications on page 25

100GBASE-LR4 Specifications

Table 25 on page 25 shows the optical interface specifications for the 100GBASE-LR4 standard.

Table 25: 100GBASE-LR4 Optical Interface Specifications

Parameter	100GBASE-LR4
Optical interface	Singlemode
Standard	IEEE 802.3ba-2010
Maximum distance	9/125 SMF cable: 6.2 miles (10 km)
Transmitter wavelength per lane	1294.53 through 1296.59 nm 1299.02 through 1301.09 nm 1303.54 through 1305.63 nm 1308.09 through 1310.19 nm
Average launch power per lane	-4.3 through 4.5 dBm per lane Total maximum launch is 10.5 dBm
Average receive power per lane	-10.6 through 4.5 dBm
Receiver saturation per lane	4.5 dBm
Receiver sensitivity per lane	-10.6 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3

SONET/SDH Optical Interface Specifications

- SONET/SDH OC3/STM1 Optical Interface Specifications on page 26
- SONET/SDH OC12/STM4 Optical Interface Specifications on page 27
- SONET/SDH OC48/STM16 Optical Interface Specifications on page 29
- SONET/SDH OC192/STM64 Optical Interface Specifications on page 30
- SONET/SDH OC768/STM256 Optical Interface Specifications on page 34

SONET/SDH OC3/STM1 Optical Interface Specifications

The following SONET/SDH OC3/STM1 standards are supported on M Series, MX Series, and T Series routers. To determine which standards are supported for a transceiver on a particular device and router, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*.

- Table 26 on page 26 shows the multimode SONET/SDH OC3/STM1 optical interface specifications.
- Table 27 on page 26 shows the SONET/SDH OC3/STM1 intermediate reach (IR-1) optical interface specifications.
- Table 28 on page 27 shows the SONET/SDH OC3/STM1 long reach (LR-1) optical interface specifications.

Table 26: SONET/SDH OC3/STM1 Multimode Optical Interface Specifications

Parameter	Multimode
Optical interface	Multimode
Maximum distance	MMF cable: 1.2 miles/2 km
Standard	Multivendor agreement
Transmitter wavelength	1270 through 1380 nm
Average launch power	–20 through –14 dBm
Receiver saturation	–14 dBm
Receiver sensitivity	–30 dBm

Table 27: SONET/SDH OC3/STM1 Intermediate Reach Optical Interface Specifications

Parameter	Intermediate Reach (IR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 9.3 miles/15 km
Standard	Telcordia GR-253
Transmitter wavelength	1261 through 1360 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm

Table 27: SONET/SDH OC3/STM1 Intermediate Reach Optical Interface Specifications (continued)

Parameter	Intermediate Reach (IR-1)
Receiver sensitivity	-28 dBm

Table 28: SONET/SDH OC3/STM1 Long Reach Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 24.85 miles/40 km
Standard	Telcordia GR-253
Transmitter wavelength	1263 through 1360 nm
Average launch power	-5 through 0 dBm
Receiver saturation	-10 dBm
Receiver sensitivity	-34 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3
- Supported Network Interface Standards by Transceiver on page 3

SONET/SDH OC12/STM4 Optical Interface Specifications

The following SONET/SDH OC12/STM4 standards are supported on M Series, MX Series, and T Series routers. To determine which standards are supported for a transceiver on a particular device and router, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*.

- Table 29 on page 27 shows the SONET/SDH OC12/STM4 short reach (SR-1) optical interface specifications.
- Table 30 on page 28 shows the SONET/SDH OC12/STM4 intermediate reach (IR-1) optical interface specifications.
- Table 31 on page 28 shows the SONET/SDH OC12/STM4 long reach (LR-1) optical interface specifications.

Table 29: SONET/SDH OC12/STM4 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode

Table 29: SONET/SDH OC12/STM4 Short Reach (SR-1) Optical Interface Specifications (continued)

Parameter	Short Reach (SR-1)
Maximum distance	SMF cable: 1.24 miles/2 km
Standard	Telcordia GR-253
Transmitter wavelength	1261 through 1360 nm
Average launch power	-15 through -8 dBm
Receiver saturation	-8 dBm
Receiver sensitivity	-23 dBm

Table 30: SONET/SDH OC12/STM4 Intermediate Reach (IR-1) Optical Interface Specifications

Parameter	Intermediate Reach (IR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 9.3 miles/15 km
Standard	Telcordia GR-253
Transmitter wavelength	1274 through 1356 nm
Average launch power	-15 through -8 dBm
Receiver saturation	-8 dBm
Receiver sensitivity	-28 dBm

Table 31: SONET/SDH OC12/STM4 Long Reach (LR-1) Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 24.85 miles/40 km
Standard	Telcordia GR-253
Transmitter wavelength	1280 through 1335 nm
Average launch power	-3 through +2 dBm

Table 31: SONET/SDH OC12/STM4 Long Reach (LR-1) Optical Interface Specifications (continued)

Parameter	Long Reach (LR-1)
Receiver saturation	-8 dBm
Receiver sensitivity	-28 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3
- Supported Network Interface Standards by Transceiver on page 3

SONET/SDH OC48/STM16 Optical Interface Specifications

The following SONET/SDH OC48/STM16 standards are supported on M40e, M120, M320, MX Series, and T Series routers. The transceivers supported for each device might vary depending on the router. To determine which standards are supported for a transceiver on a particular device and router, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*.

- Table 32 on page 29 shows the SONET/SDH OC48/STM16 short reach (SR-1) optical interface specifications.
- Table 33 on page 30 shows the SONET/SDH OC48/STM16 intermediate reach (IR-1) optical interface specifications.
- Table 34 on page 30 shows the SONET/SDH OC48/STM16 long reach (LR-1) optical interface specifications.

Table 32: SONET/SDH OC48/STM16 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 1.24 miles/2 km
Standard	Telcordia GR-253
Transmitter wavelength	1266 through 1360 nm
Average launch power	-10 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-18 dBm

Table 33: SONET/SDH OC48/STM16 Intermediate Reach (IR-1) Optical Interface Specifications

Parameter	Intermediate Reach (IR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 9.3 miles/15 km
Standard	Telcordia GR-253
Transmitter wavelength	1260 through 1360 nm
Average launch power	-5 through 0 dBm
Receiver saturation	0 dBm
Receiver sensitivity	-18 dBm

Table 34: SONET/SDH OC48/STM16 Long Reach (LR-2) Optical Interface Specifications

Parameter	Long Reach (LR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 49.71 miles/80 km
Standard	Telcordia GR-253
Transmitter wavelength	1500 through 1580 nm
Average launch power	-2 through +3 dBm
Receiver saturation	-9 dBm
Receiver sensitivity	-28 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3
- Supported Network Interface Standards by Transceiver on page 3

SONET/SDH OC192/STM64 Optical Interface Specifications

The following SONET/SDH OC192/STM64 standards are supported on MX Series, M120, M320, and T Series routers. To determine which transceivers and standards are supported

on a particular device and router, see the “Cables and connectors” section for each device in the PIC guide for your router or the *MX Series 3D Universal Edge Routers Line Card Guide*..

- SONET/SDH OC192/STM64 Very Short Reach (VSR) on page 31
- SONET/SDH OC192/STM64 Short Reach (SR-1) on page 31
- SONET/SDH OC192/STM64 Short Reach (SR-2) on page 32
- SONET/SDH OC192/STM64 Intermediate Reach (IR-2) on page 32
- SONET/SDH OC192/STM64 Long reach (LR-1) on page 33
- SONET/SDH OC192/STM64 Long reach (LR-2) on page 33

SONET/SDH OC192/STM64 Very Short Reach (VSR)

Table 35 on page 31 shows the SONET/SDH OC192/STM64 very short reach (VSR) optical interface specifications.

Table 35: SONET/SDH OC192/STM64 Very Short Reach (VSR 1) Optical Interface Specifications

Parameter	Very Short Reach (VSR)
Optical interface	Multimode
Maximum distance	MMF cable: 984.25 feet (300 m)
Standard	OIF VSR4-1
Transmitter wavelength	830 through 860 nm
Average launch power	-10 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-16 dBm

SONET/SDH OC192/STM64 Short Reach (SR-1)

Table 36 on page 31 shows the SONET/SDH OC192/STM64 short reach (SR-1) optical interface specifications.



NOTE: The SR-2 interface is optically compatible with SR-1 (1310 nm) inputs. Optical characteristics and transmission distance are limited to worst-case specifications for SR-1.

Table 36: SONET/SDH OC192/STM64 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode

Table 36: SONET/SDH OC192/STM64 Short Reach (SR-1) Optical Interface Specifications (continued)

Parameter	Short Reach (SR-1)
Maximum distance	SMF cable: 6.21 miles (10 km)
Standard	Telcordia GR-253 OC192 SR1
Transmitter wavelength	1290 nm through 1330 nm
Average launch power	-6 through -1 dBm
Receiver saturation	-1.0 dBm
Receiver sensitivity	-11 dBm

SONET/SDH OC192/STM64 Short Reach (SR-2)

Table 37 on page 32 shows the SONET/SDH OC192/STM64 short reach (SR-2) optical interface specifications.



NOTE: The SR-2 interface is optically compatible with SR-1 (1310 nm) inputs. Optical characteristics and transmission distance are limited to worst-case specifications for SR-1.

Table 37: SONET/SDH OC192/STM64 Short Reach (SR-2) Optical Interface Specifications

Parameter	Short Reach (SR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 15.5 miles (25 km)
Standard	Telcordia GR-253 OC192 SR2
Transmitter wavelength	1530 through 1565 nm
Average launch power	-4 through 0 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-14 dBm

SONET/SDH OC192/STM64 Intermediate Reach (IR-2)

Table 38 on page 33 shows the SONET/SDH OC192/STM64 Intermediate reach (IR-2) optical interface specifications.

Table 38: SONET/SDH OC192/STM64 Intermediate Reach (IR-2) Optical Interface Specifications

Parameter	Intermediate Reach (IR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 24.8 miles (40 km) NOTE: Distances greater than 30 km are considered to be engineered links.
Standard	Telcordia GR-253 OC192 IR2
Transmitter wavelength	1530 nm through 1565 nm
Average launch power	-1.0. through 2 dBm
Receiver saturation	-1.0 dBm
Receiver sensitivity	-14 dBm

SONET/SDH OC192/STM64 Long reach (LR-1)

Table 39 on page 33 shows the SONET/SDH OC192/STM64 long reach (LR-1) optical interface specifications.

Table 39: SONET/SDH OC192/STM64 Long Reach (LR-1) Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 49.71 miles (80 km)
Standard	Telcordia GR-253 OC192 LR2
Transmitter wavelength	1530 nm through 1565 nm
Average launch power	6 through 8 dBm
Receiver saturation	-10 dBm
Receiver sensitivity	-22 dBm

SONET/SDH OC192/STM64 Long reach (LR-2)

Table 40 on page 34 shows the SONET/SDH OC192/STM64 long reach (LR-2) optical interface specifications.

Table 40: SONET/SDH OC192/STM64 Long Reach (LR-2) Optical Interface Specifications

Parameter	Long Reach (LR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 49.71 miles (80 km)
Standard	Telcordia GR-253 OC192 LR2
Transmitter wavelength	1530 nm through 1565 nm
Average launch power	0 through 4 dBm
Receiver saturation	-7 dBm
Receiver sensitivity	-24 dBm

Related Documentation

- M Series, MX Series, and T Series Transceiver Overview on page 3
- Supported Network Interface Standards by Transceiver on page 3

SONET/SDH OC768/STM256 Optical Interface Specifications

The SONET/SDH OC768/STM256 PIC is supported on T640 and T1600 routers. This PIC has a fixed SONET/SDH OC768/STM256 short reach (SR-1) optical interface.

Table 41 on page 34 shows the SONET/SDH OC768/STM256 short reach (SR-1) optical interface specifications.

Table 41: SONET/SDH OC768/STM256 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode
Maximum distance	1.24 miles/2 km
Standard	300-pin multi-source agreement (MSA) ITU G.693 VSR2000-3R2
Transmitter wavelength	1530 through 1565 nm
Average launch power	0 through +3 dBm
Receiver saturation	+3 dBm
Receiver sensitivity	-6 dBm

- Related Documentation**
- M Series, MX Series, and T Series Transceiver Overview on page 3
 - Supported Network Interface Standards by Transceiver on page 3

JUNOS Documentation and Release Notes

For a list of related JUNOS documentation, see <http://www.juniper.net/techpubs/software/junos/> .

If the information in the latest release notes differs from the information in the documentation, follow the *JUNOS Release Notes*.

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at <http://www.juniper.net/techpubs/>.

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the JTAC User Guide located at <http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf> .
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/> .
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: <http://www.juniper.net/customers/support/>
- Search for known bugs: <http://www2.juniper.net/kb/>
- Find product documentation: <http://www.juniper.net/techpubs/>
- Find solutions and answer questions using our Knowledge Base: <http://kb.juniper.net/>
- Download the latest versions of software and review release notes: <http://www.juniper.net/customers/csc/software/>
- Search technical bulletins for relevant hardware and software notifications: <https://www.juniper.net/alerts/>
- Join and participate in the Juniper Networks Community Forum: <http://www.juniper.net/company/communities/>
- Open a case online in the CSC Case Management tool: <http://www.juniper.net/cm/>

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: <https://tools.juniper.net/SerialNumberEntitlementSearch/>

Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Management tool in the CSC at <http://www.juniper.net/cm/> .
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see <http://www.juniper.net/support/requesting-support.html> .

Revision History

October 2010—New guide for optical and copper interface specifications.

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