

M320 Multiservice Edge Router Interface Module Reference



Modified: 2015-06-08

Juniper Networks, Inc.
1133 Innovation Way
Sunnyvale, California 94089
USA
408-745-2000
www.juniper.net

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M320 Multiservice Edge Router Interface Module Reference
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- Requesting Technical Support on page xvi

Documentation and 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/>.

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Supported Platforms

For the features described in this document, the following platforms are supported:

- M320

Documentation Conventions

Table 1 on page xiv defines notice icons used in this guide.

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xiv defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the configure command: user@host> configure
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active
<i>Italic text like this</i>	- Introduces or emphasizes important new terms. - Identifies guide names. - Identifies RFC and Internet draft titles.	- A policy <i>term</i> is a named structure that defines match conditions and actions. <i>Junos OS CLI User Guide</i> - RFC 1997, <i>BGP Communities Attribute</i>
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# set system domain-name <i>domain-name</i>

Table 2: Text and Syntax Conventions (*continued*)

Convention	Description	Examples
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	- To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level. - The console port is labeled CONSOLE.
< > (angle brackets)	Encloses optional keywords or variables.	stub <default-metric <i>metric</i>>;
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	broadcast multicast (<i>string1</i> <i>string2</i> <i>string3</i>)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[] (square brackets)	Encloses a variable for which you can substitute one or more values.	community name members [<i>community-ids</i>]
Indentation and braces ({ })	Identifies a level in the configuration hierarchy.	<pre>[edit] routing-options { static { route default { nexthop <i>address</i>; retain; } } }</pre>
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	- In the Logical Interfaces box, select All Interfaces. - To cancel the configuration, click Cancel.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select Protocols>Ospf .

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Requesting Technical Support

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- 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:

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- 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: <http://kb.juniper.net/InfoCenter/>
- 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>.

PART 1

Overview

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- [Network Interface Specifications on page 23](#)
- [Cable Pinouts on page 55](#)

CHAPTER 1

M320 Interface Modules Support

- [M320 PICs Supported on page 3](#)
- [M320 End-of-Life PICs Supported on page 12](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PIC/FPC Compatibility on page 15](#)

M320 PICs Supported

The following tables list the PICs supported by the M320 router. The PICs are listed alphabetically by PIC family.

- [Table 3 on page 4](#) lists the ATM IQ PICs.
- [Table 4 on page 4](#) lists the ATM2 IQ PICs.
- [Table 5 on page 5](#) lists the Channelized PICs.
- [Table 6 on page 5](#) lists the Channelized IQ PICs.
- [Table 7 on page 5](#) lists the Channelized IQE PICs.
- [Table 8 on page 6](#) lists the Circuit Emulation PICs.
- [Table 9 on page 6](#) lists the DS3, E1, E3, and T1 PICs.
- [Table 10 on page 7](#) lists the EIA-530 PIC.
- [Table 11 on page 7](#) lists the Fast Ethernet PICs.
- [Table 12 on page 8](#) lists the Gigabit Ethernet PICs.
- [Table 13 on page 10](#) lists the 10-Gigabit Ethernet PICs.
- [Table 14 on page 11](#) lists the Services PICs.
- [Table 15 on page 11](#) lists the SONET/SDH PICs.

Table 3: ATM IQ PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"ATM OC3 EOL PIC (M320 Router)" on page 198	2	PB-2OC3-ATM-MM PB-2OC3-ATM-SMIR	Duplex SC/PC connector (RX and TX)	6.3
"ATM OC12 EOL PIC (M320 Router)" on page 199	1	PB-1OC12-ATM-MM PB-1OC12-ATM-SMIR	Duplex SC/PC connector (RX and TX)	6.3

Table 4: ATM2 IQ PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"ATM2 DS3 IQ PIC (M320 Router)" on page 63	4	PB-4DS3-ATM2	Coaxial: 10 ft (3.05 m) posilock SMB to BNC (provided) - Four pairs of Rx and Tx coaxial cables	6.4
"ATM2 E3 IQ PIC (M320 Router)" on page 65	4	PB-4E3-ATM2	Coaxial: 10 ft (3.05 m) posilock SMB to BNC cable (provided) - Four pairs of Rx and Tx coaxial cables	6.3
"ATM2 OC3/STM1 IQ PIC (M320 Router)" on page 67	2	PB-2OC3-ATM2-MM PB-2OC3-ATM2-SMIR	Optical: SC/PC	6.2
"ATM2 OC12/STM4 IQ PICs (M320 Router)" on page 70				
ATM2 OC12/STM4 IQ PIC	1	PB-1OC12-ATM2-MM PB-1OC12-ATM2-SMIR	Optical: SC/PC	6.2
ATM2 OC12/STM4 IQ PIC	2	PB-2OC12-ATM2-MM PB-2OC12-ATM2-SMIR	Optical: SC/PC	6.2
"ATM2 OC48/STM16 IQ PIC with SFP (M320 Router)" on page 73	1	PB-1OC48-ATM2-SFP	Optical: LC/PC	7.3

Table 5: Channelized PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Channelized DS3 EOL PIC (M320 Router)" on page 201	4	PB-4CHDS3	Custom 10-ft (3.05-m) posilock to BNC male cable, separate RX and TX	6.3
"Channelized OC12 EOL PIC (M320 Router)" on page 202	1	PB-1CHOC12DS3-SMIR	Duplex SC/PC connector (RX and TX)	6.3
"Multichannel DS3 EOL PIC (M320 Router)" on page 204	2	PB-2MCDS3	Custom 10 ft/3.05 m posilock to BNC male cable, separate Rx and Tx	6.2

Table 6: Channelized IQ PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Channelized DS3 IQ PIC (M320 Router)" on page 77	4	PB-4CHDS3-QPP	Coaxial Standard DS3 BNC coaxial cable interfaces	6.2
"Channelized E1 IQ PIC (M320 Router)" on page 79	10	PB-10CHE1-RJ48-QPP-N	120-ohm RJ-48C	9.1R4 9.2R3 9.3R1
"Channelized OC3 IQ PIC (M320 Router)" on page 81	1	PB-1CHOC3-SMIR-QPP	Optical: SC/PC	7.1
"Channelized OC12 IQ EOL PIC (M320 Router)" on page 207	1	PB-1CHOC12SMIR-QPP	Duplex SC/PC connector (Rx and Tx); single-mode fiber	6.2
"Channelized STM1 IQ PIC (M320 Router)" on page 84	1	PB-1CHSTM1-SMIR-QPP	Optical: SC/PC	6.2
"Channelized T1 IQ PIC (M320 Router)" on page 86	10	PB-10CHT1-RJ48-QPP	120-ohm RJ-48C connector (female)	7.4

Table 7: Channelized IQE PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Channelized DS3/E3 Enhanced IQ (IQE) PIC (M320 Router)" on page 90	4	PB-4CHDS3-E3-IQE-BNC	Coaxial Standard DS3 BNC coaxial cable interfaces	9.3

Table 7: Channelized IQE PICs Supported by the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Channelized E1/T1 Enhanced IQ (IQE) PIC (M320 Router)" on page 93	10	PB-10CHE1-T1-IQE-RJ48	120-ohm RJ-48C connector (female)	9.5
"Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 96	2	PB-2CHOC3-STM1-IQE-SFP	Optical: LC/PC	9.3
"Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 100				
Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	1	PB-1CHOC12-STM4-IQE-SFP	Optical: LC/PC	9.3
Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	4	PB-4CHOC12-STM4-IQE-SFP	Optical: LC/PC	9.4
"Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 105	1	PB-1CHOC48-STM16-IQE-SFP	Optical: LC/PC	9.4

Table 8: Circuit Emulation PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Channelized OC3/STM1 Circuit Emulation PIC with SFP (M320 Router)" on page 111	4	PB-4CHOC3-CE-SFP	Optical: LC/PC	9.4
"E1/T1 Circuit Emulation PIC (M320 Router)" on page 114	12	PB-12T1E1-CE-TELCO	- RJ-21 connector - Cables are rated for intra-building connections only.	9.4

Table 9: DS3, E1, E3, and T1 PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"DS3/E3 Enhanced IQ (IQE) PIC (M320 Router)" on page 120	4	PB-4DS3-E3-IQE-BNC	Coaxial Standard DS3 BNC coaxial cable interfaces	9.3R2

Table 9: DS3, E1, E3, and T1 PICs Supported by the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"DS3 EOL PIC (M320 Router)" on page 210	4	PB-2DS3	Custom 10-ft (3.05-m) posilock SMB to BNC male cable, separate Rx and Tx (provided)	6.2
"E1 PICs (M320 Router)" on page 123	4	PB-4E1-COAX PB-4E1-RJ48	- Four RJ-48 connectors (one per port) - Four coaxial connectors Custom 10-ft (3.05-m) posilock to BNC male cable, separate Rx and Tx	6.4
"E3 PIC (M320 Router)" on page 125	4	PB-4E3-QPP	Custom 10 ft (3.05 m) posilock to BNC male cable, separate RX and TX	6.3
"E3 IQ PIC (M320 Router)" on page 126	4	PB-4E3-QPP	Coaxial Standard DS3 BNC coaxial cable interfaces	6.2
"T1 PIC (M320 Router)" on page 128	4	PB-4T1-RJ48	100-ohm RJ-48 connector	6.4

Table 10: EIA-530 PIC Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"EIA-530 PIC (M320 Router)" on page 131	2	PB-2EIA530	- Two DB-25 male connectors (one per port, included with PIC) - V.35 requires an EIA-530 to V.35 cable and connects to a V.35 DTE 34-pin Winchester type male cable (one per port) - X.21 requires an EIA-530 to X.21 cable and connects to a X.21 DTE DB-15 male cable	6.2

Table 11: Fast Ethernet PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
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"Fast Ethernet PICs (M320 Router)" on page 135

Table 11: Fast Ethernet PICs Supported by the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
• Fast Ethernet PIC	4	PB-4FE-TX	• RJ-45 • Two-pair, Category 5 unshielded twisted-pair • Pinout: MDI noncrossover	6.2
• Fast Ethernet PIC	8	PB-8FE-FX	• MT-RJ female	6.3
• Fast Ethernet PIC	12	PB-12FE-TX-MDI PB-12FE-TX-MDIX	• One very high density connector interface (VHDCI) to RJ-21 cable that connects to an RJ-45 patch panel	6.2
• Fast Ethernet PIC	48	PB-48FE-TX	• Four VHDCI connectors • VHDCI-to-RJ-21 cables that connect to an RJ-45 patch panel	6.4

Table 12: Gigabit Ethernet PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
Gigabit Ethernet				
"Gigabit Ethernet PICs with SFP (M320 Router)" on page 140				
• Gigabit Ethernet PIC with SFP	1	PB-1GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity • Pinout: MDI crossover	6.4
• Gigabit Ethernet PIC with SFP	2	PB-2GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	6.4
• Gigabit Ethernet PIC with SFP	4	PB-4GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	7.0

Table 12: Gigabit Ethernet PICs Supported by the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
Gigabit Ethernet PIC with SFP	10	PC-10GE-SFP	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity	6.2
Gigabit Ethernet IQ				
"Gigabit Ethernet IQ PICs with SFP (M320 Router)" on page 143				
Gigabit Ethernet IQ PIC with SFP	1	PB-1GE-SFP-QPP	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	6.2
Gigabit Ethernet IQ PIC with SFP	2	PB-2GE-SFP-QPP	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	6.2
Gigabit Ethernet IQ2				
"Gigabit Ethernet IQ2 PICs with SFP (M320 Router)" on page 145				
Gigabit Ethernet IQ2 PIC with SFP	4	PB-4GE-TYPE1-SFP-IQ2	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity	7.6R3
Gigabit Ethernet IQ2 PIC with SFP	8	PB-8GE-TYPE2-SFP-IQ2	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity	7.6R2

Table 12: Gigabit Ethernet PICs Supported by the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
Gigabit Ethernet IQ2 PIC with SFP	8	PC-8GE-TYPE3-SFP-IQ2	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity	8.2
Gigabit Ethernet IQ2E				
“Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (M320 Router)” on page 149				
Type 1 Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	4	PB-4GE-TYPE1-SFP-IQ2E	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity	9.4
Type 2 Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	8	PB-8GE-TYPE2-SFP-IQ2E	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity	9.4
Type 3 Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	8	PC-8GE-TYPE3-SFP-IQ2E	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity	9.4

Table 13: 10-Gigabit Ethernet PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
“10-Gigabit Ethernet PIC with XENPAK (M320 Router)” on page 153	1	PC-1XGE-XENPAK	XENPAK	6.2
“10-Gigabit Ethernet DWDM PIC (M320 Router)” on page 155	1	PC-1XGE-DWDM-CBAND	Optical: SC/PC	7.5
“10-Gigabit Ethernet IQ2 PIC with XFP (M320 Router)” on page 156	1	PC-1XGE-TYPE3-XFP-IQ2	Optical: LC/PC	8.0R3

Table 13: 10-Gigabit Ethernet PICs Supported by the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (M320 Router)" on page 158	1	PC-1XGE-TYPE3-XFP-IQ2E	• Optical: LC/PC	9.4

Table 14: Service PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Multiservices PICs (M320 Router)" on page 161				
• 100 Multiservices PIC	0	PB-MS-100-1	• None	8.1
• 400 Multiservices PIC	0	PB-MS-400-2	• None	8.1R2
• 500 Multiservices PIC	0	PB-MS-500-3	• None	8.3
"Tunnel Services PIC (M320 Router)" on page 165				
• Type 1 Tunnel Services PIC	0	PB-TUNNEL-1	• None	6.2
• Type 2 Tunnel Services PIC	0	PB-TUNNEL	• None	6.2
• Type 3 Tunnel Services PIC	0	PC-TUNNEL	• None	6.3

Table 15: SONET/SDH PICs Supported by the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
SONET/SDH				
"SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 168	4	PB-4OC3-STM1-IQE-SFP	• Optical: LC/PC	9.3R2
"SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (M320 Router)" on page 171				
• SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	4	PB-4OC3-1OC12-SON-SFP	• Optical: LC/PC	8.4
• SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	4	PB-4OC3-1OC12-SON2-SFP	• Optical: LC/PC	8.3
"SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 174	1	PB-1OC12-STM4-IQE-SFP	• Optical: LC/PC	9.3

Table 15: SONET/SDH PICs Supported by the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
“SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (M320 Router)” on page 177				
• SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	1	PB-1OC12-SON-SFP	• Optical: LC/PC	8.4
• SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	4	PB-4OC3-4OC12-SON-SFP	• Optical: LC/PC	8.3
“SONET/SDH OC48c/STM16 PICs with SFP (M320 Router)” on page 180	4	PC-4OC48-SON-SFP	• Optical: LC/PC	6.2
“SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (M320 Router)” on page 183	4	PC-4OC48-STM16-IQE-SFP	• Optical: LC/PC	10.4R2
“SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (M320 Router)” on page 187	1	PB-1OC48-SON-B-SFP	• Optical: LC/PC	8.3
“SONET/SDH OC192c/STM64 PIC (M320 Router)” on page 190	1	PC-1OC192-SON-VSR	• 12-ribbon multimode fiber with MTP connector	6.2
“SONET/SDH OC192/STM64 PIC with XFP (M320 Router)” on page 193	1	PC-1OC192-SON-XFP	• Optical: LC/PC	8.1

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 FPCs Supported](#)
 - [M320 PIC/FPC Compatibility on page 15](#)

M320 End-of-Life PICs Supported

[Table 16 on page 12](#) lists the end-of-life PICs supported by the M320 router. The PICs are listed alphabetically by PIC family.

Table 16: End-of-Life PICs Supported in the M320 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
ATM				
“ATM OC3 EOL PIC (M320 Router)” on page 198	2	PB-2OC3-ATM-MM PB-2OC3-ATM-SMIR		6.3

Table 16: End-of-Life PICs Supported in the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"ATM OC12 EOL PIC (M320 Router)" on page 199	1	PB-1OC12-ATM-MM PB-1OC12-ATM-SMIR		6.3
Channelized				
"Channelized DS3 EOL PIC (M320 Router)" on page 201	4	PB-4CHDS3		6.3
"Channelized OC12 EOL PIC (M320 Router)" on page 202	1	PB-1CHOC12DS3-SMIR		6.3
"Multichannel DS3 EOL PIC (M320 Router)" on page 204	2	PB-2MCDS3		6.2
Channelized IQ				
"Channelized E1 IQ EOL PIC (M320 Router)" on page 206	10	PB-10CHE1-RJ48-QPP		6.2
"Channelized OC12 IQ EOL PIC (M320 Router)" on page 207	1	PB-1CHOC12SMIR-QPP		6.2
DS3				
"DS3 EOL PIC (M320 Router)" on page 210	4	PB-2DS3		6.2
Ethernet				
"Gigabit Ethernet EOL PICs (M320 Router)" on page 211	1	PB-1GE-LH PB-1GE-LX PB-1GE-SX		6.2
"Gigabit Ethernet EOL PICs (M320 Router)" on page 211				
• Gigabit Ethernet PIC	2	PB-2GE-LX PB-2GE-SX		6.2
• Gigabit Ethernet PIC	4	PB-4GE-SX		6.2
"10-Gigabit Ethernet EOL PIC (M320 Router)" on page 213	1	PC-1XGE-LR		6.2
Services				
"Adaptive Services II EOL PIC (M320 Router)" on page 215	0	PB-AS2	• None	6.4
"Adaptive Services II Layer 2 Services EOL PIC (M320 Router)" on page 217	0	PB-AS2-LAYER2SERVICES	• None	7.5

Table 16: End-of-Life PICs Supported in the M320 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Adaptive Services II FIPS EOL PIC (M320 Router)" on page 220	0	PB-AS2-FIPS	• None	7.2
"ES EOL PIC (M320 Router)" on page 222	0	PB-ES-800	• None	6.2
"Link Services EOL PIC (M320 Router)" on page 223	0	PB-LS-4 PB-LS-32 PB-LS-128	• None	6.2
"Monitoring Services II EOL PIC (M320 Router)" on page 224	0	PB-PM2	• None	6.0
"Monitoring Services III EOL PIC (M320 Router)" on page 226	0	PB-PM3	• None	7.4
SONET/SDH				
"SONET/SDH OC3c/STM1 EOL PICs (M320 Router)" on page 227	4	PB-4OC3-SON-MM PB-4OC3-SON-SMIR		6.2
"SONET/SDH OC12c/STM4 EOL PICs (M320 Router)" on page 230				
• SONET/SDH OC12c/STM4 PIC	1	PB-1OC12-SON-MM		6.2
• SONET/SDH OC12c/STM4 PIC	4	PB-4OC12-SON-MM PB-4OC12-SON-SMIR		6.2
"SONET/SDH OC48c/STM16 EOL PICs (M320 Router)" on page 233				
• SONET/SDH OC48c/STM16 PIC	1	PB-1OC48-SON-SMLR PB-1OC48-SON-SMSR		6.2
• SONET/SDH OC48c/STM16 PIC	4	PC-4OC48-SON-SMSR		6.2
"SONET/SDH OC48c/STM16 EOL PIC with SFP (M320 Router)" on page 236	1	PB-1OC48-SON-SFP		6.2
"SONET/SDH OC192c/STM64 EOL PICs (M320 Router)" on page 238	1	PC-1OC192-SON-LR PC-1OC192-SON-SR2		5.4

Related Documentation • *M320 PIC Description*

M320 PIC Combination Limitations

In most cases, you can install PICs of different media types on the same FPC as long as the FPC and the router support those PICs. However, configuration rules might limit certain combinations of PICs on some platforms.

Newer Junos OS services for some PICs can require significant Internet Processor ASIC memory. Ethernet and SONET PICs typically do not use large amounts of memory. Gigabit Ethernet, ATM2, IQ serial PICs, and Multiservices PICs use more. To conserve memory, you can group PICs in the same family together on the same FPC.

If you have different PIC families on a single FPC, review the configuration rules to plan which PICs to install on the FPCs for your router. Consult technical bulletin [PSN-2007-01-023](#) for information about configuration rules for PIC combinations on the Juniper Networks Support site at <https://www.juniper.net/alerts/>.

When you upgrade to Junos OS Release 7.5 or later, a warning appears if any configuration rules affect your PIC combinations. If you continue the installation, one or more PICs might appear to be online (the LEDs are on), but the Junos OS cannot enable them and they cannot pass traffic. As a workaround, you can:

- Install a Junos OS release that supports the combination.
- Install PICs on a different FPC.
- Remove PICs from the affected FPC.

Related Documentation

- [M320 PIC Description](#)
- [M320 PICs Supported on page 3](#)
- [M320 FPCs Supported](#)
- [M320 PIC/FPC Compatibility on page 15](#)

M320 PIC/FPC Compatibility

The PIC/FPC compatibility matrixes list the first Junos OS Release in which an FPC supports each PIC currently supported for the M320 router. For example, Junos OS Release 7.5 is the first release in which the E-II-FPC1 supports the ATM2 OC3/STM1 IQ, 2-port PIC.



NOTE: A – indicates that the PIC is not supported by the FPC.

- [PIC/FPC Compatibility \(Type 1 FPCs and Type 1 PICs\) on page 16](#)
- [PIC/FPC Compatibility \(Type 2 FPCs and Type 2 PICs\) on page 19](#)
- [PIC/FPC Compatibility \(Type 3 FPCs and Type 3 PICs\) on page 21](#)

PIC/FPC Compatibility (Type 1 FPCs and Type 1 PICs)

Table 17 on page 16 provides a PIC/FPC compatibility matrix for the current Type 1 PICs for the M320 router and Type 1 FPCs. A link to the PIC description is included in the table.

Table 17: M320 PIC/FPC Compatibility Type 1

PIC	PIC Model Number	FPC1	E-II FPC1	E-III FPC1
ATM2 IQ PICs				
“ATM2 DS3 IQ PIC (M320 Router)” on page 63 4-port	PB-4DS3-ATM2	6.4	7.5	8.4
“ATM2 E3 IQ PIC (M320 Router)” on page 65 4-port	PB-4E3-ATM2	6.3	7.5	8.4
“ATM2 OC3/STM1 IQ PIC (M320 Router)” on page 67 2-port	PB-2OC3-ATM2-MM	6.2	7.5	8.4
	PB-2OC3-ATM2-SMIR	6.2	7.5	8.4
“ATM2 OC12/STM4 IQ PICs (M320 Router)” on page 70 1-port	PB-1OC12-ATM2-MM	6.2	7.5	8.4
	PB-1OC12-ATM2-SMIR	6.2	7.5	8.4
	PB-1OC12-ATM2-MM	6.2	7.5	8.4
Channelized Circuit Emulation PICs				
“Channelized OC3/STM1 Circuit Emulation PIC with SFP (M320 Router)” on page 111	PB-4CHOC3-CE-SFP	–	–	9.4
Channelized IQ PICs				
“Channelized DS3 IQ PIC (M320 Router)” on page 77 4-port	PB-4CHDS3-QPP	6.2	7.5	8.4
“Channelized E1 IQ PIC (M320 Router)” on page 79 10-port	PB-1OCHE1-RJ48-QPP-N	9.1R4	9.1R4	9.1R4
		9.2R3	9.2R3	9.2R3
		9.3R1	9.3R1	9.3R1
“Channelized OC3 IQ PIC (M320 Router)” on page 81 1-port	PB-1CHOC3-SMIR-QPP	7.1	7.5	8.4
“Channelized STM1 IQ PIC (M320 Router)” on page 84 1-port	PB-1CHSTM1-SMIR-QPP	6.2	7.5	8.4

Table 17: M320 PIC/FPC Compatibility Type 1 (*continued*)

PIC	PIC Model Number	FPC1	E-II FPC1	E-III FPC1
"Channelized T1 IQ PIC (M320 Router)" on page 86 10-port	PB-1OCHT1-RJ48-QPP	7.4	7.5	8.4
Channelized Enhanced IQ (IQE) PICs				
"Channelized DS3/E3 Enhanced IQ (IQE) PIC (M320 Router)" on page 90 4-port	PB-4CHDS3-E3-IQE-BNC	–	9.3	9.3
"Channelized E1/T1 Enhanced IQ (IQE) PIC (M320 Router)" on page 93 10-port	PB-1OCHE1-T1-IQE-RJ48	–	9.5	9.5
"Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 96 2-port	PB-2CHOC3-STM1-IQE-SFP	–	9.3	9.3
"Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 100 IQE, 1-port	PB-1CHOC12-STM4-IQE-SFP	–	9.3	9.3
T1, DS3, E1, E3 PICs				
"DS3 EOL PIC (M320 Router)" on page 210, 4-port	PB-4DS3	–	6.2	–
"DS3/E3 Enhanced IQ (IQE) PIC (M320 Router)" on page 120 4-port	PB-4DS3-E3-IQE-BNC	–	9.3R2	9.3R2
"E1 PICs (M320 Router)" on page 123, 4-port	PB-4E1-COAX	6.4	7.5	8.4
	PB-4E1-RJ48	6.4	7.5	8.4
"E1/T1 Circuit Emulation PIC (M320 Router)" on page 114, 12-port	PB-12T1E1-CE-TELCO	–	–	9.4
"E3 PIC (M320 Router)" on page 125, 4-port	PB-4E3	6.3	7.5	–
"T1 PIC (M320 Router)" on page 128, 4-port	PB-4T1-RJ48	6.4	7.5	8.4
E3 IQ PIC				
"E3 IQ PIC (M320 Router)" on page 126, 4-port	PB-4E3-QPP	6.2	7.5	8.4

Table 17: M320 PIC/FPC Compatibility Type 1 (*continued*)

PIC	PIC Model Number	FPC1	E-II FPC1	E-III FPC1
EIA-530 PIC				
"EIA-530 PIC (M320 Router)" on page 131, 2-port	PB-2EIA530	6.2	7.5	8.4
Ethernet PICs				
"Fast Ethernet PICs (M320 Router)" on page 135, 4-port	PB-4FE-TX	6.2	7.5	8.4
"Fast Ethernet PICs (M320 Router)" on page 135, 8-port	PB-8FE-FX	6.3	7.5	8.4
"Fast Ethernet PICs (M320 Router)" on page 135, 12-port	PB-12FE-TX	6.2	7.5	8.4
"Gigabit Ethernet PICs with SFP (M320 Router)" on page 140, 1-port SFP	PB-1GE-SFP	6.4	7.5	8.4
Ethernet IQ PICs				
"Gigabit Ethernet IQ PICs with SFP (M320 Router)" on page 143, 1-port SFP	PB-1GE-SFP-QPP	6.2	7.5	8.4
Ethernet IQ2 PICs				
"Gigabit Ethernet IQ2 PICs with SFP (M320 Router)" on page 145, 4-port SFP	PB-4GE-TYPE1-SFP-IQ2	7.6R3	7.6R3	8.4
Ethernet Enhanced IQ2 (IQ2E) PICs				
"Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (M320 Router)" on page 149, 4-port SFP	PB-4GE-TYPE1-SFP-IQ2E	9.4	9.4	9.4
Services PICs				
"Multiservices PICs (M320 Router)" on page 161 100	PB-MS-100-1	8.1	8.1	8.4
"Tunnel Services PIC (M320 Router)" on page 165	PB-TUNNEL-1	6.2	7.5	8.4

Table 17: M320 PIC/FPC Compatibility Type 1 (*continued*)

PIC	PIC Model Number	FPC1	E-II FPC1	E-III FPC1
SONET/SDH PICs				
"SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 168 4-port, SFP	PB-4OC3-STM1-IQE-SFP	–	9.3R2	9.3R2
"SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (M320 Router)" on page 171, 4-port, SFP (Type 1)	PB-4OC3-1OC12-SON-SFP	8.4	8.4	8.4
"SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 174, 1-port, SFP	PB-1OC12-STM4-IQE-SFP	–	9.3	9.3
"SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (M320 Router)" on page 177), 1-port, SFP	PB-1OC12-SON-SFP	8.4	8.4	8.4

PIC/FPC Compatibility (Type 2 FPCs and Type 2 PICs)

Table 18 on page 19 provides a PIC/FPC compatibility matrix for the current Type 2 PICs for the M320 router and Type 2 FPCs. A link to the PIC description is included in the table.

Table 18: M320 PIC/FPC Compatibility Type 2

PIC	Model Number	FPC2	E-II FPC2	E-III-FPC2
ATM2 IQ PICs				
"ATM2 OC12/STM4 IQ PICs (M320 Router)" on page 70 2-port	PB-2OC12-ATM2-MM	6.2	7.5	8.4
	PB-2OC12-ATM2-SMIR	6.2	7.5	8.4
	"ATM2 OC12/STM4 IQ PICs (M320 Router)" on page 70			
"ATM2 OC48/STM16 IQ PIC with SFP (M320 Router)" on page 73 1-port	PB-1OC48-ATM2-SFP	7.3	7.5	8.4
Channelized Enhanced IQ (IQE) PICs				
"Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 100 4-port	PB-4CHOC12-STM4-IQE-SFP	–	–	9.4

Table 18: M320 PIC/FPC Compatibility Type 2 (*continued*)

PIC	Model Number	FPC2	E-II FPC2	E-III-FPC2
"Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 105 1-port	PB-1CHOC48-STM16-IQE	—	—	9.4
Ethernet PICs				
"Fast Ethernet PICs (M320 Router)" on page 135 48-port	PB-48FE-TX	6.4	7.5	8.4
"Gigabit Ethernet PICs with SFP (M320 Router)" on page 140 2-port	PB-2GE-SFP	6.4	7.5	8.4
"Gigabit Ethernet PICs with SFP (M320 Router)" on page 140 4-port	PB-4GE-SFP	7.0	7.5	8.4
Ethernet IQ PICs				
"Gigabit Ethernet IQ PICs with SFP (M320 Router)" on page 143 2-port	PB-2GE-SFP-QPP	6.2	7.5	8.4
Ethernet IQ2 PICs				
"Gigabit Ethernet IQ2 PICs with SFP (M320 Router)" on page 145 8-port	PB-8GE-TYPE2-SFP-IQ2	7.6R2	7.6R2	8.4
Ethernet Enhanced IQ2 (IQ2E) PICs				
"Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (M320 Router)" on page 149 8-port	PB-8GE-TYPE2-SFP-IQ2E	9.4	9.4	9.4
Services PICs				
"Multiservices PICs (M320 Router)" on page 161 400	PB-MS-400-2	8.1R2	8.1R2	8.4
"Tunnel Services PIC (M320 Router)" on page 165	PB-TUNNEL	6.3	7.5	8.4
SONET/SDH PICs				
"SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (M320 Router)" on page 171 4-port	PB-4OC3-IOC12-SON2-SFP	8.3	8.3	8.4
"SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (M320 Router)" on page 177 4-port	PB-4OC3-4OC12-SON-SFP	8.3	8.3	8.4

Table 18: M320 PIC/FPC Compatibility Type 2 (*continued*)

PIC	Model Number	FPC2	E-II FPC2	E-III-FPC2
"SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (M320 Router)" on page 187 1-port	PB-1OC48-SON-B-SFP	8.3	8.3	8.4

PIC/FPC Compatibility (Type 3 FPCs and Type 3 PICs)

Table 19 on page 21 provides a PIC/FPC compatibility matrix for the current Type 3 PICs for the M320 router and Type 3 FPCs. A link to the PIC description is included in the table.

Table 19: M320 PIC/FPC Compatibility Type 3

PIC	Model Number	FPC3	E-II-FPC3	E-III-FPC3
Ethernet PICs				
"Gigabit Ethernet PICs with SFP (M320 Router)" on page 140 10-port	PC-10GE-SFP	6.2	7.5	8.4
10-Gigabit Ethernet PICs				
"10-Gigabit Ethernet PIC with XENPAK (M320 Router)" on page 153 1-port	PC-1XGE-XENPAK	6.2	7.5	8.4
"10-Gigabit Ethernet DWDM PIC (M320 Router)" on page 155 1-port	PC-1XGE-DWDM-CBAND	7.5	7.5	8.4
Ethernet IQ2 PICs				
"Gigabit Ethernet IQ2 PICs with SFP (M320 Router)" on page 145 8-port	PC-8GE-TYPE3-SFP-IQ2	8.2	8.2	8.4
"Gigabit Ethernet IQ2 PICs with SFP (M320 Router)" on page 145 1-port	PC-1GE-TYPE3-XFP-IQ2	8.0R3	8.0R3	8.4
Ethernet Enhanced IQ2 (IQ2E) PICs				
"Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (M320 Router)" on page 149 8-port	PC-8GE-TYPE3-SFP-IQ2E	9.4	9.4	9.4
"10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (M320 Router)" on page 158 1-port	PC-1XGE-TYPE3-XFP-IQ2E	9.4	9.4	9.4
Services PICs				
"Multiservices PICs (M320 Router)" on page 161 500	PC-MS-500-3	8.3	8.3	8.4

Table 19: M320 PIC/FPC Compatibility Type 3 (*continued*)

PIC	Model Number	FPC3	E-II-FPC3	E-III-FPC3
"Tunnel Services PIC (M320 Router)" on page 165	PC-TUNNEL	6.3	7.5	8.4
SONET/SDH PICs				
"SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (M320 Router)" on page 183 4-port	PC-4OC48-STM16-IQE-SFP	–	–	10.4R2
"SONET/SDH OC48c/STM16 PICs with SFP (M320 Router)" on page 180 4-port	PC-4OC48-SON-SFP	6.2	7.5	8.4
"SONET/SDH OC192c/STM64 PIC (M320 Router)" on page 190 1-port	PC-1OC192-SON-VSR	6.2	7.5	8.4
"SONET/SDH OC192/STM64 PIC with XFP (M320 Router)" on page 193 1-port	PC-1OC192-SON-SFP	8.1	8.1	8.4

- Related Documentation**
- *M320 PIC Description*
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)
 - *M320 FPCs Supported*

CHAPTER 2

Network Interface Specifications

- [Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers on page 23](#)
- [Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31](#)
- [Gigabit Ethernet 1000BASE Optical Interface Specifications on page 35](#)
- [10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38](#)
- [SONET/SDH OC3/STM1 Optical Interface Specifications on page 43](#)
- [SONET/SDH OC12/STM4 Optical Interface Specifications on page 46](#)
- [SONET/SDH OC48/STM16 Optical Interface Specifications on page 48](#)
- [SONET/SDH OC192/STM64 Optical Interface Specifications on page 50](#)

Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers

[Table 20 on page 24](#) and [Table 21 on page 30](#) list the transceivers supported by ACX, M, MX, and T Series devices. To determine which transceivers are supported in a particular device, see the “Cables and Connectors” section for each PIC, MIC, or line card in the *Interface Module Reference* for your router.

- [Table 20 on page 24](#) lists the supported Ethernet standards for each transceiver.
- [Table 21 on page 30](#) lists the supported SONET standards for each transceiver.

Some transceivers support monitoring by using the operational mode CLI command **show interfaces diagnostics optics**. To determine which transceivers support monitoring, refer to the “Monitoring Available” column in [Table 20 on page 24](#) and [Table 21 on page 30](#). For a description of the monitoring fields displayed by the transceiver, see *show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and 100-Gigabit Ethernet)* or *show interfaces diagnostics optics (SONET)*.



CAUTION: If you are having a problem running a Juniper Networks device that is using a third-party optic or cable, the Juniper Networks Technical Assistance Center (JTAC) can help you diagnose the source of the problem. Your JTAC engineer might recommend that you check the third-party optic

or cable and potentially replace it with an equivalent Juniper Networks optic or cable that is qualified for the device.



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 20 on page 24 is organized by transmission speed and then alphabetically by model number.

Table 20: Supported Ethernet Standards

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
Ethernet 10BASE, Fast Ethernet 100BASE, and Gigabit Ethernet 1000BASE Specifications					
SFP-1FE-FX	SFP	LC	No	100BASE-FX	Fast Ethernet 100BASE-FX Optical Interface Specifications
SFP-1GE-FE-E-T	SFP	RJ-45	No	10/100/1000 BASE-T	- Ethernet 10BASE-T Copper Interface Specifications - Fast Ethernet 100BASE-T Copper Interface Specifications - Gigabit Ethernet 1000BASE-T Copper Interface Specifications
SFP-1GE-LH	SFP	LC	Yes	1000BASE-LH	Gigabit Ethernet 1000BASE Optical Interface Specifications on page 35
SFP-1GE-LX	SFP	LC	Yes	1000BASE-LX 1000BASE-LX10	Gigabit Ethernet 1000BASE Optical Interface Specifications on page 35
SFP-1GE-SX	SFP	LC	Yes	1000BASE-SX	Gigabit Ethernet 1000BASE Optical Interface Specifications on page 35

Table 20: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SFP-1GE-T	SFP	RJ-45	No	1000BASE-T	Gigabit Ethernet 1000BASE-T Copper Interface Specifications
SFP-FE20KT13R15	SFP	LC	No	100BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31
SFP-FE20KT15R13	SFP	LC	No	100BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31
SFP-GE10KT13R14	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31
SFP-GE10KT13R15	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31
SFP-GE10KT14R13	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31
SFP-GE10KT15R13	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31
SFP-GE40KM	SFP	LC	Yes	1000BASE-EX	Gigabit Ethernet 1000BASE Optical Interface Specifications on page 35

Table 20: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SFP-GE40KT13R15	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31
SFP-GE40KT15R13	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 31
SFP-GE80KCWI470-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCWI490-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCWI510-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCWI530-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCWI550-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCWI570-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCWI590-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCWI610-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications

10-Gigabit Ethernet 10GBASE Specifications

Table 20: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
PC-1XGE-DWDM-CBAND	Fixed	SC	Yes	10-Gigabit Ethernet dense wavelength-division multiplexing (DWDM)	10-Gigabit Ethernet DWDM Optical Interface Specifications 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
PC-1XGE-DWDM-OTN	Fixed	SC	Yes	10-Gigabit Ethernet dense wavelength-division multiplexing (DWDM) OTN	10-Gigabit Ethernet DWDM OTN Optical Interface Specifications 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
SFPP-10G-CT50-ZR	SFP+	LC	Yes	10GBASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
SFPP-10G-DT-ZRC2	SFP+	LC	Yes	10BASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
SFPP-10G-ZR-OTN-XT	SFP+	LC	Yes	10GBASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
SFPP-10GE-ER	SFP+	LC	Yes	10GBASE-ER	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
SFPP-10GE-LR	SFP+	LC	Yes	10GBASE-LR	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
SFPP-10GE-LRM	SFP+	LC	Yes	10GBASE-LRM	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
SFPP-10GE-SR	SFP+	LC	Yes	10GBASE-SR	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38

Table 20: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SFP-10GE-ZR	SFP+	LC	Yes	10GBASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XENPAK-1XGE-ER	XENPAK	SC	Yes	10GBASE-ER	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XENPAK-1XGE-LR	XENPAK	SC	Yes	10GBASE-LR	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XENPAK-1XGE-SR	XENPAK	SC	Yes	10GBASE-SR	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XENPAK-1XGE-ZR EOL (see PSN-2010-02-649)	XENPAK	SC	Yes	10GBASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XFP-10G-CBAND-T50-ZR	XFP	LC	Yes	10GBASE-Z 10-Gigabit Ethernet dense wavelength-division multiplexing (DWDM)	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XFP-10G-E-OC192-IR2	XFP	LC	Yes	10GBASE-E	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XFP-10G-L-OC192-SR1	XFP	LC	Yes	10GBASE-L	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XFP-10G-S	XFP	LC	Yes	10GBASE-S	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38
XFP-10G-Z-OC192-LR2	XFP	LC	Yes	10GBASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 38

Table 20: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
40-Gigabit Ethernet 40GBASE Specifications					
CFP-40GBASE-LR4	CFP	SC	Yes	40GBASE-LR4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications
QSFP-40GBASE-LR4	QSFP+	LC	Yes	40GBASE-LR4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications
QSFP-40GBASE-SR4	QSFP+	12-fiber MPO	Yes	40GBASE-SR4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications
100-Gigabit Ethernet 100GBASE-R Specifications					
CFP-100GBASE-ER4	CFP	LC	Yes	100GBASE-ER4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CFP-GEN2-CGE-ER4	CFP	LC	Yes	100GBASE-ER4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CFP-100GBASE-LR4	CFP	SC	Yes	100GBASE-LR4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CFP-GEN2-100GBASE-LR4	CFP	LC	Yes	100GBASE-LR4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CFP-100GBASE-SR10	CFP	24-fiber MPO	Yes NOTE: Optical power monitoring is not supported.	100GBASE-SR10	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CXP-100GBASE-SR10	CXP	24-fiber MPO	Yes	100GBASE-SR10	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications

Table 21 on page 30 is organized by transmission speed and then alphabetically by model number.

Table 21: Supported SONET Standards

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SONET OC3/STM1 Specifications					
SFP-OC3-IR	SFP	LC	Yes	SONET/SDH OC3/STM1 Intermediate Reach	SONET/SDH OC3/STM1 Optical Interface Specifications on page 43
SFP-OC3-LR	SFP	LC	Yes	SONET/SDH OC3/STM1 Long Reach	SONET/SDH OC3/STM1 Optical Interface Specifications on page 43
SFP-OC3-SR	SFP	LC	Yes	SONET/SDH OC3/STM1 Multimode	SONET/SDH OC3/STM1 Optical Interface Specifications on page 43
SONET OC12/STM4 Specifications					
SFP-OC12-IR	SFP	LC	Yes	SONET/SDH OC12/STM4 Intermediate Reach (IR-1)	SONET/SDH OC12/STM4 Optical Interface Specifications on page 46
SFP-OC12-LR	SFP	LC	Yes	SONET/SDH OC12/STM4 Long Reach (LR-1)	SONET/SDH OC12/STM4 Optical Interface Specifications on page 46
SFP-OC12-LR2	SFP	LC	Yes	SONET/SDH OC12/STM4 Long Reach (LR-2)	SONET/SDH OC12/STM4 Optical Interface Specifications on page 46
SFP-OC12-SR	SFP	LC	Yes	SONET/SDH OC12/STM4 Short Reach (SR-1)	SONET/SDH OC12/STM4 Optical Interface Specifications on page 46
SONET OC48/STM16 Specifications					
SFP-1OC48-IR	SFP	LC	No	SONET/SDH OC48/STM16 Intermediate Reach (IR-1)	SONET/SDH OC48/STM16 Optical Interface Specifications on page 48
SFP-1OC48-LR	SFP	LC	Yes	SONET/SDH OC48/STM16 Long Reach (LR-2)	SONET/SDH OC48/STM16 Optical Interface Specifications on page 48
SFP-1OC48-SR	SFP	LC	No	SONET/SDH OC48/STM16 Short Reach (SR-1)	SONET/SDH OC48/STM16 Optical Interface Specifications on page 48
SONET OC192/STM64 Specifications					

Table 21: Supported SONET Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
XFP-10G-E-OC192-IR2	XFP	LC	Yes	SONET/SDH OC192/STM64 Intermediate Reach (IR-2)	SONET/SDH OC192/STM64 Optical Interface Specifications on page 50
XFP-10G-L-OC192-SR1	XFP	LC	Yes	SONET/SDH OC192/STM64 Short Reach (SR-1)	SONET/SDH OC192/STM64 Optical Interface Specifications on page 50
XFP-10G-Z-OC192-LR2	XFP	LC	Yes	SONET/SDH OC192/STM64 Long Reach (LR-2)	SONET/SDH OC192/STM64 Optical Interface Specifications on page 50
SONET OC768/STM256 Specifications					
PD-10C768-SON-SR	Fixed	SC	Yes	SONET/SDH OC768/STM256 Short Reach (SR)	SONET/SDH OC768/STM256 Optical Interface Specifications

Related Documentation

- Supported Network Interface Standards by Transceiver for PTX Series Routers

Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

The bidirectional SFP standards are supported on M Series, MX Series, and T Series routers.

To determine which transceivers support each bidirectional SFP standard, see “Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers” on page 23. The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The standards are organized by distance supported.

- Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications on page 32
- Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/14 and D 14/13) Optical Interface Specifications on page 32
- Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications on page 33
- Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U 13/15 and D 15/13) Optical Interface Specifications on page 34

Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications

Table 22 on page 32 shows the optical specifications for 100BASE-BX bidirectional SFPs. 100BASE-BX bidirectional interfaces are supported in Junos OS Release 9.6 and later and must be used in pairs.

Table 22: 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	SFP-FE20KT13R15	SFP-FE20KT15R13
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 23 on page 32 shows the optical specifications for 1000BASE-BX bidirectional SFPs. 1000BASE-BX bidirectional interfaces are supported in Junos OS Release 9.0 and later and must be used in pairs.

Table 23: 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

Table 23: 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
Rate	1000 Mbps	1000 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	IEEE 802.3-2005	IEEE 802.3-2005
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 25 on page 34 shows the optical specifications for 1000BASE-BX bidirectional SFPs. 1000BASE-BX bidirectional interfaces are supported in Junos OS Release 9.0 and later and must be used in pairs.

Table 24: 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)

Table 24: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications (*continued*)

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

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

Table 24 on page 33 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 25: 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**
- [Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers on page 23](#)

Gigabit Ethernet 1000BASE Optical Interface Specifications

The Gigabit Ethernet 1000BASE standards are supported on M Series, MX Series, PTX Series, and T Series routers.

To determine which transceivers support each Gigabit Ethernet 1000BASE standard, see [“Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers” on page 23](#) and [Supported Network Interface Standards by Transceiver for PTX Series Routers](#). The “Cables and connectors” section in the description for each DPC, MIC, or PIC lists which standards and transceivers are supported.

The standards are organized by distance supported.

- [Gigabit Ethernet 1000BASE-SX Optical Interface Specifications on page 35](#)
- [Gigabit Ethernet 1000BASE-LX Optical Interface Specifications on page 36](#)
- [Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications on page 36](#)
- [Gigabit Ethernet 1000BASE-EX Optical Interface Specifications on page 37](#)
- [Gigabit Ethernet 1000BASE-LH Optical Interface Specifications on page 37](#)

Gigabit Ethernet 1000BASE-SX Optical Interface Specifications

[Table 26 on page 35](#) shows the optical interface specifications for the 1000BASE-SX standard.

Table 26: 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 27 on page 36 shows the optical interface specifications for the 1000BASE-LX standard.

Table 27: Gigabit Ethernet 1000BASE-LX Optical Interface Specifications

Parameter	1000BASE-LX
Rate	1000 Mbps
Optical interface	Multimode and single-mode
Maximum distance	62.5/125 and 50/125 MMF cable: 1804.5 ft (550 m) 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-LX10 Optical Interface Specifications

Table 28 on page 36 shows the optical interface specifications for the 1000BASE-LX10 standard.

Table 28: 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 28 on page 36 shows the optical interface specifications for the 1000BASE-EX standard.

Table 29: 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 30: 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	1460 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

- [Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers on page 23](#)

- [Supported Network Interface Standards by Transceiver for PTX Series Routers](#)

10-Gigabit Ethernet 10GBASE Optical Interface Specifications

The 10-Gigabit Ethernet optical interface standards are supported on M120 routers, M320 routers, MX Series routers, T Series routers, and PTX Series routers.

To determine which transceivers support each 10GBASE standard, see [“Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers” on page 23](#) and [Supported Network Interface Standards by Transceiver for PTX Series Routers](#). The “Cables and Connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.



NOTE: Some XFP transceivers can support either the 10-Gigabit Ethernet or SONET/SDH OC192/STM64 specifications. Check the standard supported for the device in 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/SDH OC192/STM64 PIC supports the SONET/SDH OC192/STM64 IR2 standard.

The specifications are organized by distance supported.

- [10GBASE-LRM Specifications on page 38](#)
- [10GBASE-S Specifications on page 39](#)
- [10GBASE-L Specifications on page 40](#)
- [10GBASE-E Specifications on page 40](#)
- [10GBASE-Z Specifications on page 41](#)

10GBASE-LRM Specifications

[Table 31 on page 38](#) shows the optical interface specifications for the 10GBASE-LRM standard.

Table 31: 10GBASE-LRM Optical Interface Specifications

Parameter	10GBASE-LRM
Optical interface	Multimode
Standard	IEEE 802.3aq—2006
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

Table 31: 10GBASE-LRM Optical Interface Specifications (*continued*)

Parameter	10GBASE-LRM
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 32 on page 39 shows the optical interface specifications for the 10GBASE-SR and 10GBASE-SW standards.



NOTE: The XFP-10G-L-OC192-SR1 transceiver supports single-mode fiber and the 10GBASE-L optical interface specifications.

Table 32: 10GBASE-S (10GBASE-SR and 10GBASE-SW) Optical Interface Specifications

Parameter	10GBASE-S
Optical interface	Multimode
Standard	IEEE 802.3ae–2002
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 33 on page 40 shows the optical interface specifications for the 10GBASE-LR and 10GBASE-LW standards.

Table 33: 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 34 on page 40 shows the optical interface specifications for the 10GBASE-ER and 10GBASE-EW standards.

Table 34: 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 18.6 miles (30 km) are considered to be engineered links. NOTE: Any distance greater than 30 km requires engineered links that must be field-tested to verify the conformance of the 11 dB channel insertion loss specification. EANSI/TIA/EIA-526-7/Method A1 describes the insertion loss measurement of installed fiber-optic cables.
Transmitter wavelength	1530 through 1565 nm

Table 34: 10GBASE-E (10GBASE-ER and 10GBASE-EW) Optical Interface Specifications (*continued*)

Parameter	10GBASE-E
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 35 on page 41 shows the optical interface specifications for the 10GBASE-ZR and 10GBASE-ZW transceiver.

Table 35: 10GBASE-Z (10GBASE-ZR and 10GBASE-ZW) Optical Interface Specifications

Parameter	10GBASE-Z
Optical interface	Single-mode
Standard	Multivendor
Maximum distance	9/125 SMF cable: 49.6 miles (80 km)
Transmitter wavelength	1530 through 1565 nm 1528.38 through 1568.77 nm (tunable) for XFP-10G-CBAND-T50-ZR 1528.38 through 1568.77 nm (tunable) for SFPP-10G-CT50-ZR 1528.38 through 1568.77 nm (tunable) for SFPP-10G-DT-ZRC2
Average launch power	0 through 4.0 dBm for XENPAK-1XGE-ZR 0 through 4.0 dBm for XFP-10G-CBAND-T50-ZR 0 through 4.0 dBm for XFP-10G-Z-OC192-LR2 0 through 5.0 dBm for SFPP-10GE-ZR –1.0 through +3.0 dBm for SFPP-10G-CT50-ZR –1.0 through +3.0 dBm for SFPP-10G-DT-ZRC2 0 through 4 dBm for SFPP-10G-ZR-OTN-XT

Table 35: 10GBASE-Z (10GBASE-ZR and 10GBASE-ZW) Optical Interface Specifications (*continued*)

Parameter	10GBASE-Z
Average receive power	–25.0 through –7.0 dBm for XENPAK-1XGE-ZR –23.0 through –7.0 dBm for XFP-10G-CBAND-T50-ZR –24.0 through –7.0 dBm for XFP-10G-Z-OC192-LR2 –23.0 through –8.0 dBm for SFPP-10GE-ZR –24.0 through –8.0 dBm for SFPP-10G-CT50-ZR –24.0 through –7.0 dBm (9.95, 10.312, and 10.709 Gbps) for SFPP-10G-DT-ZRC2 –24.0 through –8.0 dBm for SFPP-10G-ZR-OTN-XT
Receiver saturation	–7.0 dBm for XENPAK-1XGE-ZR –7.0 dBm for XFP-10G-CBAND-T50-ZR –7.0 dBm for XFP-10G-Z-OC192-LR2 –8.0 dBm for SFPP-10GE-ZR –7.0 dBm for SFPP-10G-CT50-ZR –7.0 dBm for SFPP-10G-DT-ZRC2 –7.0 dBm for SFPP-10G-ZR-OTN-XT

Table 35: 10GBASE-Z (10GBASE-ZR and 10GBASE-ZW) Optical Interface Specifications (*continued*)

Parameter	10GBASE-Z
Receiver sensitivity	–25.0 dBm for XENPAK-1XGE-ZR –23.0 dBm for XFP-10G-CBAND-T50-ZR –24.0 dBm for XFP-10G-Z-OC192-LR2 –23.0 dBm for SFPP-10GE-ZR –23.0 dBm for SFPP-10G-CT50-ZR For SFPP-10G-DT-ZRC2: –24.0 dBm (9.95, 10.312, and 10.709 Gbps, BER $<1 \times 10^{-12}$, no FEC) –25.0 dBm (11.049 and 11.095 Gbps, BER $<1 \times 10^{-6}$, pre-FEC) NOTE: When you use SFPP-10G-DT-ZRC2 in OTU1e (11.049 Gbps) or OTU2e (11.095 Gbps) applications, you must enable forward error correction (FEC) to achieve target receiver sensitivity. To enable FEC mode, use the fec command at the [edit interfaces interface-name otn-options] hierarchy level (see <i>fec</i>). –23.0 dBm for SFPP-10G-ZR-OTN-XT

- Related Documentation**
- [Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers on page 23](#)
 - [Supported Network Interface Standards by Transceiver for PTX Series Routers](#)

SONET/SDH OC3/STM1 Optical Interface Specifications

The SONET/SDH OC3/STM1 standards are supported on M Series routers, MX Series routers, and T Series routers.

To determine which transceivers support each SONET/SDH OC3/STM1 standard, see “Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers” on page 23. The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [SONET/SDH OC3/STM1 Specifications on page 44](#)
- [SONET/SDH OC3/STM1 Intermediate Reach \(IR-1\) Specifications on page 44](#)
- [SONET/SDH OC3/STM1 Long Reach \(LR-1\) Specifications on page 45](#)
- [SONET/SDH OC3/STM1 Long Reach \(LR-2\) Specifications on page 45](#)

SONET/SDH OC3/STM1 Specifications

Table 36 on page 44 shows the multimode SONET/SDH OC3/STM1 optical interface specifications.

Table 36: 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

SONET/SDH OC3/STM1 Intermediate Reach (IR-1) Specifications

Table 37 on page 44 shows the SONET/SDH OC3/STM1 intermediate reach (IR-1) optical interface specifications.

Table 37: 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
Receiver sensitivity	–28 dBm

SONET/SDH OC3/STM1 Long Reach (LR-1) Specifications

Table 38 on page 45 shows the SONET/SDH OC3/STM1 long reach (LR-1) optical interface specifications.

Table 38: SONET/SDH OC3/STM1 Long Reach -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	1263 through 1360 nm
Average launch power	-5 through 0 dBm
Receiver saturation	-10 dBm
Receiver sensitivity	-34 dBm

SONET/SDH OC3/STM1 Long Reach (LR-2) Specifications

Table 39 on page 45 shows the SONET/SDH OC3/STM1 long reach (LR-2) optical interface specifications.

Table 39: SONET/SDH OC3/STM1 Long Reach -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	1480 to 1580 nm
Average launch power	-5 through 0 dBm
Receiver saturation	-10 dBm
Receiver sensitivity	-34 dBm

Related Documentation

- [Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers on page 23](#)

SONET/SDH OC12/STM4 Optical Interface Specifications

The SONET/SDH OC12/STM4 optical interface standards are supported on M Series routers, MX Series routers, and T Series routers.

To determine which transceivers support each SONET/SDH OC12/STM4 standard, see [“Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers” on page 23](#). The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [SONET/SDH OC12/STM4 Short Reach \(SR-1\) Specifications on page 46](#)
- [SONET/SDH OC12/STM4 Intermediate Reach \(IR-1\) Specifications on page 46](#)
- [SONET/SDH OC12/STM4 Long Reach \(LR-1\) Specifications on page 47](#)
- [SONET/SDH OC12/STM4 Long Reach \(LR-2\) Specifications on page 47](#)

SONET/SDH OC12/STM4 Short Reach (SR-1) Specifications

[Table 40 on page 46](#) shows the SONET/SDH OC12/STM4 short reach (SR-1) optical interface specifications.

Table 40: SONET/SDH OC12/STM4 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	1261 through 1360 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–23 dBm

SONET/SDH OC12/STM4 Intermediate Reach (IR-1) Specifications

[Table 41 on page 47](#) shows the SONET/SDH OC12/STM4 short reach (IR-1) optical interface specifications.

Table 41: 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

SONET/SDH OC12/STM4 Long Reach (LR-1) Specifications

Table 42 on page 47 shows the SONET/SDH OC12/STM4 short reach (LR-1) optical interface specifications.

Table 42: 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
Receiver saturation	-8 dBm
Receiver sensitivity	-28 dBm

SONET/SDH OC12/STM4 Long Reach (LR-2) Specifications

Table 43 on page 48 shows the SONET/SDH OC12/STM4 short reach (LR-2) optical interface specifications.

Table 43: SONET/SDH OC12/STM4 Long Reach (LR-2) Optical Interface Specifications

Parameter	Long Reach (LR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 49.70 miles (80 km)
Standard	Telcordia GR-253
Transmitter wavelength	1480 through 1580 nm
Average launch power	-3 through 2 dBm
Receiver saturation	-8 dBm
Receiver sensitivity	-28 through -8 dBm

Related Documentation

- [Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers on page 23](#)

SONET/SDH OC48/STM16 Optical Interface Specifications

The SONET/SDH OC48/STM16 standards are supported on M40e routers, M120 routers, M320 routers, MX Series routers, and T Series routers.

To determine which transceivers support each SONET/SDH OC48/STM16 standard, see “Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers” on page 23. The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [SONET/SDH OC48/STM16 Short Reach \(SR-1\) Specifications on page 48](#)
- [SONET/SDH OC48/STM16 Intermediate Reach \(IR-1\) Specifications on page 49](#)
- [SONET/SDH OC48/STM16 Long Reach \(LR-1\) Specifications on page 49](#)
- [SONET/SDH OC48/STM16 Long Reach \(LR-2\) Specifications on page 50](#)

SONET/SDH OC48/STM16 Short Reach (SR-1) Specifications

[Table 44 on page 48](#) shows the SONET/SDH OC48/STM16 short reach (SR-1) optical interface specifications.

Table 44: SONET/SDH OC48/STM16 Short Reach (SR-1) Optical Interface Specifications

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

Table 44: SONET/SDH OC48/STM16 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	1266 through 1360 nm
Average launch power	-10 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-18 dBm

SONET/SDH OC48/STM16 Intermediate Reach (IR-1) Specifications

Table 45 on page 49 shows the SONET/SDH OC48/STM16 intermediate reach (IR-1) optical interface specifications.

Table 45: 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

SONET/SDH OC48/STM16 Long Reach (LR-1) Specifications

Table 46 on page 49 shows the SONET/SDH OC48/STM16 long reach (LR-1) optical interface specifications.

Table 46: SONET/SDH OC48/STM16 Long Reach (LR-1) Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode

Table 46: SONET/SDH OC48/STM16 Long Reach (LR-1) Optical Interface Specifications (*continued*)

Parameter	Long Reach (LR-1)
Maximum distance	SMF cable: 28.85 miles (40 km)
Standard	Telcordia GR-253
Transmitter wavelength	1280 through 1335 nm
Average launch power	-2 through +3 dBm
Receiver saturation	-9 dBm
Receiver sensitivity	-28 dBm

SONET/SDH OC48/STM16 Long Reach (LR-2) Specifications

Table 47 on page 50 shows the SONET/SDH OC48/STM16 long reach (LR-2) optical interface specifications.

Table 47: 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

- [Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers on page 23](#)

SONET/SDH OC192/STM64 Optical Interface Specifications

The SONET/SDH OC192/STM64 standards are supported on M120 routers, M320 routers, MX Series routers, and T Series routers.

To determine which transceivers support the SONET/SDH OC192/STM64 standard, see [“Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers” on page 23](#). The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [SONET/SDH OC192/STM64 Very Short Reach \(VSR\) on page 51](#)
- [SONET/SDH OC192/STM64 Short Reach \(SR-1\) on page 51](#)
- [SONET/SDH OC192/STM64 Short Reach \(SR-2\) on page 52](#)
- [SONET/SDH OC192/STM64 Intermediate Reach \(IR-2\) on page 52](#)
- [SONET/SDH OC192/STM64 Long reach \(LR-1\) on page 53](#)
- [SONET/SDH OC192/STM64 Long reach \(LR-2\) on page 53](#)

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

[Table 48 on page 51](#) shows the SONET/SDH OC192/STM64 very short reach (VSR) optical interface specifications.

Table 48: 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 49 on page 51](#) shows the SONET/SDH OC192/STM64 short reach (SR-1) optical interface specifications.

Table 49: SONET/SDH OC192/STM64 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 6.21 miles (10 km)

Table 49: SONET/SDH OC192/STM64 Short Reach (SR-1) Optical Interface Specifications (*continued*)

Parameter	Short Reach (SR-1)
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 50 on page 52 shows the SONET/SDH OC192/STM64 short reach (SR-2) optical interface specifications.

Table 50: 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 51 on page 52 shows the SONET/SDH OC192/STM64 Intermediate reach (IR-2) optical interface specifications.

Table 51: SONET/SDH OC192/STM64 Intermediate Reach (IR-2) Optical Interface Specifications

Parameter	Intermediate Reach (IR-2)
Optical interface	Single-mode

Table 51: SONET/SDH OC192/STM64 Intermediate Reach (IR-2) Optical Interface Specifications (*continued*)

Parameter	Intermediate Reach (IR-2)
Maximum distance	SMF cable: 24.8 miles (40 km) <i>NOTE:</i> 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 52 on page 53 shows the SONET/SDH OC192/STM64 long reach (LR-1) optical interface specifications.

Table 52: 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 53 on page 54 shows the SONET/SDH OC192/STM64 long reach (LR-2) optical interface specifications.

Table 53: 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

- [Supported Network Interface Standards by Transceiver for ACX, M, MX, and T Series Routers on page 23](#)

CHAPTER 3

Cable Pinouts

- M320 Fast Ethernet 48-port Cable Pinouts on page 55
- M320 RJ-48 Cable Pinouts for E1 and T1 PICs on page 56

M320 Fast Ethernet 48-port Cable Pinouts

The Fast Ethernet 48-port PIC has four VHDCI connector ports on its faceplate (see [Figure 1 on page 55](#)), each of which accepts one of the four RJ-21 cables supplied with the PIC (see [Figure 2 on page 55](#)). Each VHDCI connector port supports 12 Ethernet ports.

Figure 1: Fast Ethernet 48-port PIC

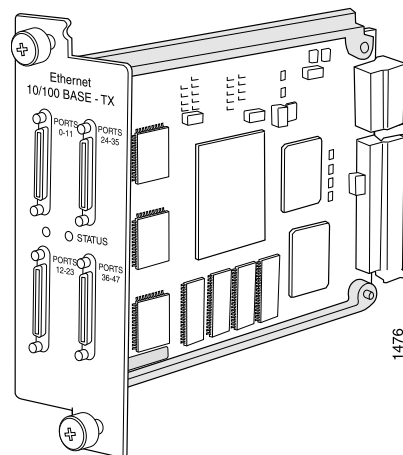
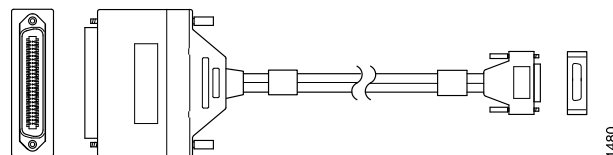


Figure 2: VHDCI to RJ-21 Cable



NOTE: RJ-21 pin numbers 25 and 50 do not appear in the table because they are ground connectors.

Table 54: RJ-21 Pin Assignments

Ethernet Port Numbers	RJ-21 Pin Assignment			
	TX -	TX +	RX -	RX +
0, 12, 24, 36	2	27	1	26
1, 13, 25, 37	4	29	3	28
2, 14, 26, 38	6	31	5	30
3, 15, 27, 39	8	33	7	32
4, 16, 28, 40	10	35	9	34
5, 17, 29, 41	12	37	11	36
6, 18, 30, 42	14	39	13	38
7, 19, 31, 43	16	41	15	40
8, 20, 32, 44	18	43	17	42
9, 21, 33, 45	20	45	19	44
10, 22, 34, 46	22	47	21	46
11, 23, 35, 47	24	49	23	48

- Related Documentation**
- *M320 Chassis Description*
 - *M320 Site Preparation Checklist Requirements*

M320 RJ-48 Cable Pinouts for E1 and T1 PICs

The E1 and T1 PICs use an RJ-48 cable, which is not supplied with the PIC.



CAUTION: To maintain agency approvals, use only a properly constructed, shielded cable.

Table 55 on page 57, Table 56 on page 57, Table 57 on page 58, and Table 58 on page 59 describe the RJ-48 connector pinouts.

Table 55: RJ-48 Connector to RJ-48 Connector (Straight) Pinouts

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	RJ-48 Pin (Data numbering form)	Signal
1	1	RX, Ring, –
2	2	RX, Tip, +
4	4	TX, Ring, –
5	5	TX, Tip, +
3	3	Shield/Return/Ground
6	6	Shield/Return/Ground
7	No connect	No connect
8	No connect	No connect
9	No connect	No connect
10	No connect	No connect
11	No connect	No connect
12	No connect	No connect
13	No connect	No connect
14	No connect	No connect
15	No connect	No connect

Table 56: RJ-48 Connector to RJ-48 Connector (Crossover) Pinouts

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	RJ-48 Pin (Data numbering form)	Signal
1	4	RX/Ring/– <--->TX/Ring/–
2	5	RX/Tip/+ <--->TX/Tip/+
4	1	TX/Ring/– <--->RX/Ring/–
5	2	TX/Tip/+ <--->RX/Tip/+

Table 56: RJ-48 Connector to RJ-48 Connector (Crossover) Pinouts (*continued*)

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	RJ-48 Pin (Data numbering form)	Signal
3	3	Shield/Return/Ground
6	6	Shield/Return/Ground
7	No connect	No connect
8	No connect	No connect
9	No connect	No connect
10	No connect	No connect
11	No connect	No connect
12	No connect	No connect
13	No connect	No connect
14	No connect	No connect
15	No connect	No connect

Table 57: RJ-48 Connector to DB-15 Connector (Straight) Pinouts

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	DB-15 Pin (Data numbering form)	Signal
1	11	RX/Ring/– <--->RX/Ring/–
2	3	RX/Tip/+ <--->RX/Tip/+
4	9	TX/Ring/– <--->TX/Ring/–
5	1	TX/Tip/+ <--->TX/Tip/+
3	4	Shield/Return/Ground
6	2	Shield/Return/Ground
7	No connect	No connect
8	No connect	No connect

Table 57: RJ-48 Connector to DB-15 Connector (Straight) Pinouts (*continued*)

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	DB-15 Pin (Data numbering form)	Signal
9	No connect	No connect
10	No connect	No connect
11	No connect	No connect
12	No connect	No connect
13	No connect	No connect
14	No connect	No connect
15	No connect	No connect

Table 58: RJ-48 Connector to DB-15 Connector (Crossover) Pinouts

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	DB-15 Pin (Data numbering form)	Signal
1	9	RX/Ring/– <--->TX/Ring/–
2	1	RX/Tip/+ <--->TX/Tip/+
4	11	TX/Ring/– <--->RX/Ring/–
5	3	TX/Tip/+ <--->RX/Tip/+
3	4	Shield/Return/Ground
6	2	Shield/Return/Ground
7	No connect	No connect
8	No connect	No connect
9	No connect	No connect
10	No connect	No connect
11	No connect	No connect
12	No connect	No connect

**Table 58: RJ-48 Connector to DB-15 Connector (Crossover)
Pinouts (*continued*)**

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	DB-15 Pin (Data numbering form)	Signal
13	No connect	No connect
14	No connect	No connect
15	No connect	No connect

- Related Documentation**
- *M320 Chassis Description*
 - *M320 Connector Interface Panel (CIP) Description*
 - *M320 Site Preparation Checklist Requirements*

PART 2

PIC Descriptions

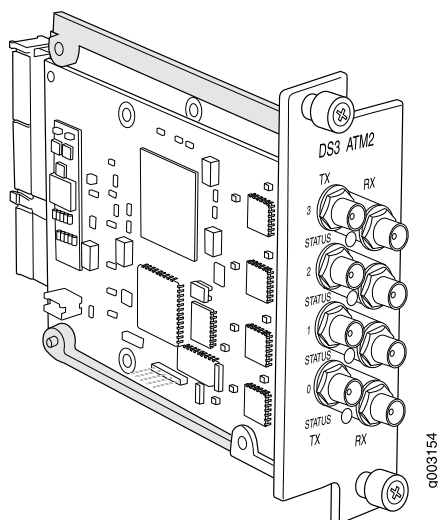
- [ATM2 IQ PIC Descriptions on page 63](#)
- [Channelized IQ PIC Descriptions on page 77](#)
- [Channelized Enhanced IQ \(IQE\) PIC Descriptions on page 89](#)
- [Circuit Emulation PIC Descriptions on page 111](#)
- [DS3, E1, E3, and T1 Pic Descriptions on page 119](#)
- [EIA-530 PIC Descriptions on page 131](#)
- [Fast Ethernet PIC Descriptions on page 135](#)
- [Gigabit Ethernet PIC Descriptions on page 139](#)
- [10-Gigabit Ethernet PIC Descriptions on page 153](#)
- [Services PIC Descriptions on page 161](#)
- [SONET/SDH PIC Descriptions on page 167](#)
- [End-of-Life PIC Descriptions on page 197](#)

CHAPTER 4

ATM2 IQ PIC Descriptions

- ATM2 DS3 IQ PIC (M320 Router) on page 63
- ATM2 E3 IQ PIC (M320 Router) on page 65
- ATM2 OC3/STM1 IQ PIC (M320 Router) on page 67
- ATM2 OC12/STM4 IQ PICs (M320 Router) on page 70
- ATM2 OC48/STM16 IQ PIC with SFP (M320 Router) on page 73

ATM2 DS3 IQ PIC (M320 Router)



Software release

- Junos OS Release 6.4 and later (Type 1)
For information on which FPCs support this PIC, see ["M320 PIC/FPC Compatibility"](#) on page 15.

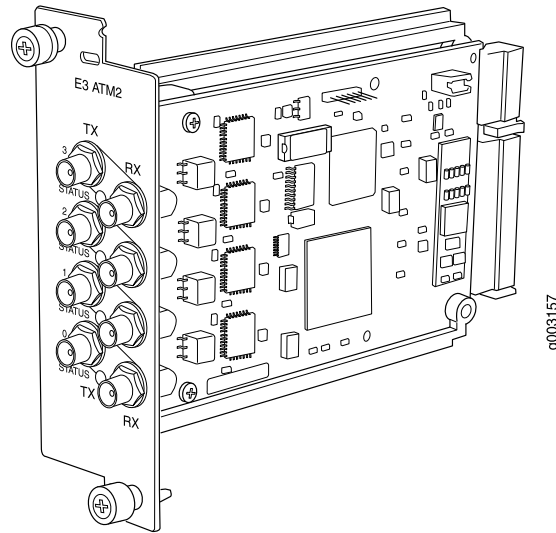
Description

- Four DS3 ports
 - Power requirement: 0.41 A @ 48 V (20.0 W)
 - Fine-grained queuing per logical interface
 - ATM standards compliant
 - Model number: PB-4DS3-ATM2
-

Hardware features	• 16-MB SDRAM memory for ATM segmentation and reassembly (SAR) • ATM switch ID • Configurable framing options: • C-bit with ATM direct mapping • C-bit with Physical Layer Convergence Protocol (PLCP) framing (default) • M23 ATM direct mapping • M23 with PLCP framing • Internal and loop timing
Software features	• Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping • Unspecified bit rate (UBR) traffic shaping • Fine-grained variable bit rate (VBR) traffic shaping • Circuit cross-connect (CCC) • ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC) • Simple Network Management Protocol (SNMP): • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB • AAL5 encapsulations: • ATM-VC-MUX • ATM-NLPID • ATM-Cisco-LLPID • ATM-SNAP • ATM-CCC-VC-MUX
Cables and connectors	• 10 ft (3.05 m) posilock SMB to BNC (provided) • Four pairs of Rx and Tx coaxial cables
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS) • Far-end block error (FEBE) • Frame error • Idle code • Idle received • Local and remote loopback • Loss of signal (LOS) • Out of frame (OOF) • Path parity error • Yellow alarm

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)

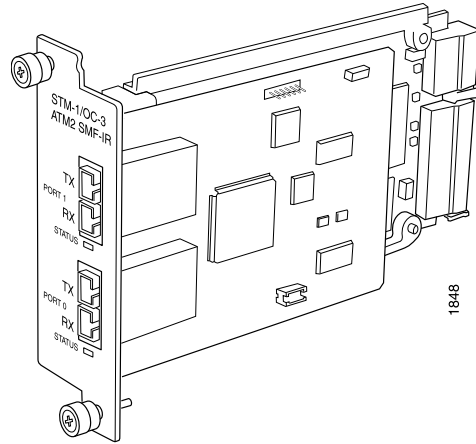
ATM2 E3 IQ PIC (M320 Router)



Software release	• Junos OS Release 6.3 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	• Four E3 ports • Power requirement: 0.41 A @ 48 V (20 W) • Fine-grained queuing per logical interface • ATM standards compliant • Model number: PB-2E3-ATM2
Hardware features	• 16-MB SDRAM memory for ATM segmentation and reassembly (SAR) • ATM switch ID • Configurable framing options: • G.751 direct mapping • G.751 with PLCP encapsulation (default) • G.832 ATM direct mapping • Internal and loop timing

Software features	• Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping • Unspecified bit rate (UBR) traffic shaping • Fine-grained variable bit rate (VBR) traffic shaping • Circuit cross-connect (CCC) • ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC) • Simple Network Management Protocol (SNMP): • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB • AAL5 encapsulations: • ATM-VC-MUX • ATM-NLPID • ATM-Cisco-LLPID • ATM-SNAP • ATM-CCC-VC-MUX
Cables and connectors	• 10 ft (3.05 m) posilock SMB to BNC (provided) • Four pairs of Rx and Tx coaxial cables
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS) • Frame error • Line code violation • Local and remote loopback • Loss of signal (LOS) • Out of frame (OOF) • Yellow alarm
Related Documentation	• <i>M320 PIC Description</i> • M320 PIC Combination Limitations on page 15 • M320 PICs Supported on page 3

ATM2 OC3/STM1 IQ PIC (M320 Router)



Software release	Junos OS Release 6.2 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Two OC3 ports - Power requirement: 0.41 A @ 48 V (20 W) - Fine-grained queuing per logical interface - Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 - ATM and SONET/SDH standards compliant - Alarm and event counting and detection - Compatible with well-known ATM switches - ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches - Model number: PB-2OC3-ATM2-MM PB-2OC3-ATM2-SMIR
Hardware features	- Single 3010 SAR for segmentation and reassembly into 53 byte ATM cells - High-performance parsing of SONET/SDH frames - ASIC-based packet segmentation and reassembly (SAR) management and output port queuing 64 MB SDRAM memory for ATM SAR - Packet buffering, Layer 2 parsing

Software features	• Circuit cross-connect (CCC) for leveraging ATM access networks • User-configurable virtual circuit (VC) and virtual path (VP) support • Support for idle cell or unassigned cell transmission • OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI) cells, and loop cells • Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP • Local and remote loopback • ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC) • Simple Network Management Protocol (SNMP): • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB • Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping • Per-VC or per-VP traffic shaping • Support for F4 OAM cells • Support for 16 bit VCI range
Cables and connectors	• Duplex SC/PC connector (RX and TX) • SONET/SDH OC3/STM1 fixed transceivers: • Multimode • Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- Alarm indication signal—line (AIS-L)
- Alarm indication signal—path (AIS-P)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate— signal fail (BERR-SF)
- Loss of cell delineation (LOC)
- Loss of frame (LOF)
- Loss of pointer (LOP-P)
- Loss of signal (LOS)
- Payload mismatch (PLM-P)
- Payload unequipped (unequipped STS at path level) (UNEQ-P)
- Remote defect indication—line (RDI-L)
- Remote defect indication—path (RDI-P)
- Error detection:
 - Bit interleaved parity errors B1, B2, B3
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end bit errors, remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored frames (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

ATM2 OC12/STM4 IQ PICs (M320 Router)

Figure 3: 1-Port ATM2 OC12/STM4 IQ PIC

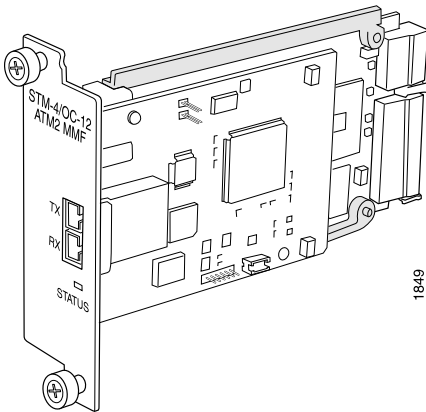
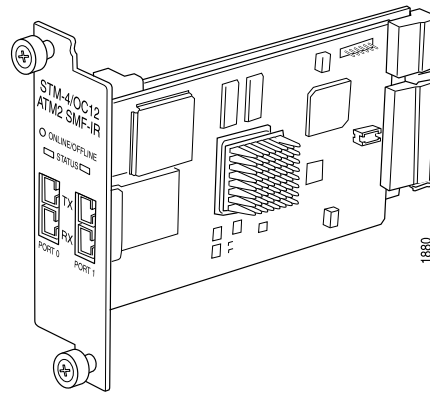


Figure 4: 2-Port ATM2 OC12/STM4 IQ PIC



Software release	Junos OS Release 6.2 and later (Type 1 and Type 2) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One or two OC12 ports - Power requirement: 1-port: 0.41 A @ 48 V (20 W) 2-port: 0.52 A @ 48 V (25 W) - Fine-grained queuing per logical interface - Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 - Complies with ATM and SONET/SDH standards - Alarm and event counting and detection - Compatible with well-known ATM switches - ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches - Model number for 1-Port ATM2 OC12/STM4 IQ PIC: PB-1OC12-ATM2-MM PB-1OC12-ATM2-SMIR - Model number for 2-Port ATM2 OC12/STM4 IQ PIC: PB-2OC12-ATM2-MM PB-2OC12-ATM2-SMIR
Hardware features	- ATM2 IQ 1-port OC12 PICs have one 3010 SAR for segmentation and reassembly into 53-byte ATM cells; ATM2 IQ 2-port OC12 PICs have dual 3010 SAR - High-performance parsing of SONET/SDH frames - ASIC-based packet segmentation and reassembly (SAR) management and output port queuing 64 MB SDRAM memory for ATM SAR - Packet buffering, Layer 2 parsing

Software features	• Circuit cross-connect for leveraging ATM access networks • User-configurable virtual circuit (VC) and virtual path (VP) support • Support for idle cell or unassigned cell transmission • OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI), and loop cells • Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP • Local and remote loopback • ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC • Simple Network Management Protocol (SNMP): • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB • Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping • Per-VC or per-VP traffic shaping • Support for F4 OAM cells • Support for 16-bit VCI range
Cables and connectors	• Duplex SC/PC connector (Rx and Tx) • SONET/SDH OC12/STM4 fixed transceivers: • Multimode • Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

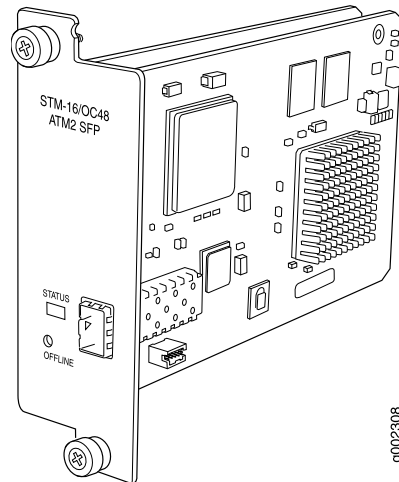
Alarms, errors, and events

- Alarm indication signal—line (AIS-L)
- Alarm indication signal—path (AIS-P)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate— signal fail (BERR-SF)
- Loss of cell delineation (LOC)
- Loss of frame (LOF)
- Loss of pointer (LOP-P)
- Loss of signal (LOS)
- Payload mismatch (PLM-P)
- Payload unequipped (unequipped STS at path level) (UNEQ-P)
- Remote defect indication—line (RDI-L)
- Remote defect indication—path (RDI-P)
- Error detection:
 - Bit interleaved parity errors B1, B2, B3
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end bit errors, remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored frames (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

ATM2 OC48/STM16 IQ PIC with SFP (M320 Router)



Software release	Junos OS Release 7.3 and later (Type 2) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One OC48 port - Power requirement: 0.41 A @ 48 V (20 W) - Fine-grained queuing per logical interface - Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 - Complies with ATM and SONET/SDH standards - Alarm and event counting and detection - Compatible with well-known ATM switches - ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches
Hardware features	- ATM2 IQ 1-port OC48 PICs have one 3010 SAR for segmentation and reassembly into 53-byte ATM cells. - High-performance parsing of SONET/SDH frames - ASIC-based packet segmentation and reassembly (SAR) management and output port queuing 64-MB SDRAM memory for ATM SAR - Packet buffering, Layer 2 parsing - Model number: PB-1OC48-ATM2-SFP

Software features	• Multiprotocol Label Switching (MPLS) circuit cross-connect for leveraging ATM access networks • User-configurable virtual circuit (VC) and virtual path (VP) support • Support for idle cell or unassigned cell transmission • OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI), and loop cells • Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP • Local and remote loopback • ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC • Simple Network Management Protocol (SNMP): • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB • Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping • Per-VC or per-VP traffic shaping • Support for F4 OAM cells • Support for 16-bit VCI range
Cables and connectors	• Duplex LC/PC connector (RX and TX) • SONET/SDH OC48/STM16 fiber-optic SFPs: • Intermediate reach (IR-1) (model number: SFP-1OC48-IR) Optical interface specifications—see “SONET/SDH OC48/STM16 Optical Interface Specifications” on page 48
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- Alarm indication signal—line (AIS-L)
- Alarm indication signal—path (AIS-P)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate— signal fail (BERR-SF)
- Loss of cell delineation (LOC)
- Loss of frame (LOF)
- Loss of pointer (LOP-P)
- Loss of signal (LOS)
- Payload mismatch (PLM-P)
- Payload unequipped (unequipped STS at path level) (UNEQ-P)
- Remote defect indication—line (RDI-L)
- Remote defect indication—path (RDI-P)
- Error detection:
 - Bit interleaved parity errors B1, B2, B3
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end bit errors, remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored frames (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

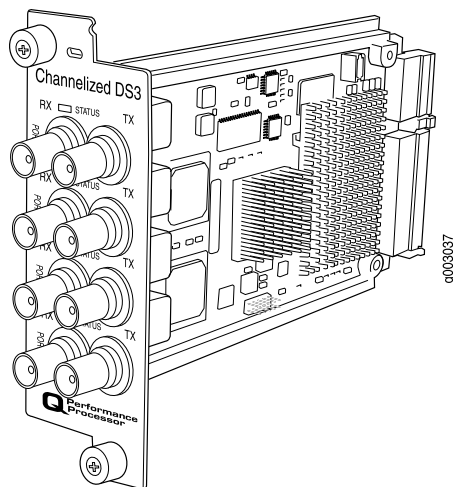
- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

CHAPTER 5

Channelized IQ PIC Descriptions

- Channelized DS3 IQ PIC (M320 Router) on page 77
- Channelized E1 IQ PIC (M320 Router) on page 79
- Channelized OC3 IQ PIC (M320 Router) on page 81
- Channelized STM1 IQ PIC (M320 Router) on page 84
- Channelized T1 IQ PIC (M320 Router) on page 86

Channelized DS3 IQ PIC (M320 Router)



Software release

- Junos OS Release 6.2 and later (Type 1)
For information on which FPCs support this PIC, see ["M320 PIC/FPC Compatibility"](#) on page 15.

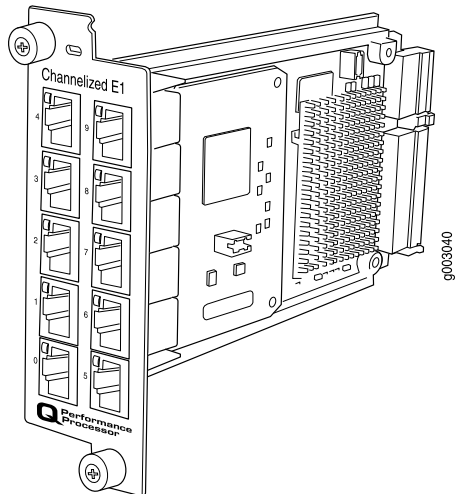
Description

- Four DS3 ports
- Power requirement: 0.32 A @ 48 V (15.6 W)
- Fine-grained queuing per logical interface
- Channelization: DS3, DS1, DS0
- Model number: PB-4CHDS3-QPP

Hardware features	• Data service unit (DSU) functionality • Subrate and scrambling: • Digital Link/Quick Eagle • Kentrox • Larscom • ADTRAN • Verilink • B3ZS line encoding • M13 or C-bit parity • Full bit error rate test (BERT) • Local and remote loopback testing
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Simple Network Management Protocol (SNMP): DS1 MIB, DS3 MIB • Dynamic, arbitrary channel configuration • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Standard DS3 BNC coaxial cable interfaces
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS) • Excessive zeros (EXZ) • Far-end block error (FEBE) • Frame error • Idle code, Idle received • Line code violation (LCV) • Loss of signal (LOS) • Out of frame (OOF) • Parity bit (P-bit) disagreements • Path parity error • Yellow alarm bit (X-bit) disagreements
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

- Related Documentation
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)

Channelized E1 IQ PIC (M320 Router)



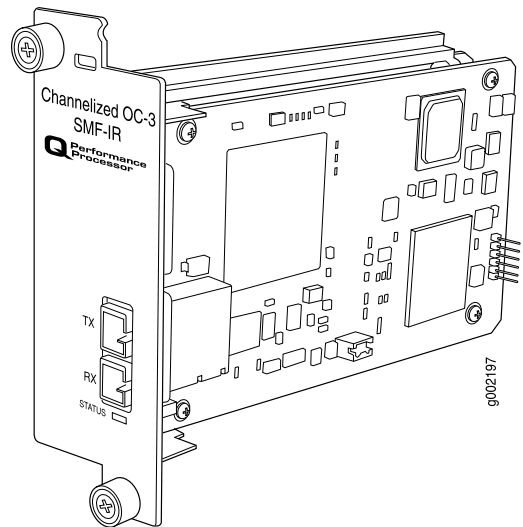
Software release	• PB-10CHE1-RJ48-QPP-N: Junos OS Release 9.1R4, 9.2R3, 9.3R1 and later For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15. • PB-10CHE1-RJ48-QPP: Junos OS Release 6.2 and later Type 1 End-of-life (see notificationPSN-2013-03-892)
Description	• Ten E1 ports • Power requirement: 0.15 A @ 48 V (7.2 W) • Fine-grained queuing per logical interface • Channelization: E1, DS0 • Model number: PB-10CHE1-RJ48-QPP-N • EOL Model number: PB-10CHE1-RJ48-QPP
Hardware features	• Data service unit (DSU) functionality • Ports configurable as clear channel E1 interfaces with 2.048-Mbps connectivity • Supports unframed E1 G.703 and G.704 framing modes • Supports HDB3 line coding • CRC4 configurable • Local and remote loopback testing

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Simple Network Management Protocol (SNMP): E1 MIB, DSO MIB • Dynamic, arbitrary channel configuration • Full bit error rate test (BERT) • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
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Cables and connectors	• 120-ohm RJ-48C
LEDs	One bicolor per E1 port: • Off—Port not enabled • Green—Physical E1 link is up; individual subchannels can be down • Red—Physical E1 link is down
Alarms, errors, and events	• Alarm indication signal (AIS) • Loss of frame (LOF) • Out of frame (OOF) • Failed signal rate (FSR)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

Related Documentation	• M320 PIC Description • M320 PIC Combination Limitations on page 15 • M320 PICs Supported on page 3
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Channelized OC3 IQ PIC (M320 Router)



Software release	Junos OS Release 7.1 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One OC3 port - Power requirement: 0.39 A @ 48 V (18.6 W) - Fine-grained queuing per logical interface - Channelization: DS3, DS1, DS0 - Model number: PB-1CHOC3-SMIR-QPP
Hardware features	- Subrate and scrambling: - Digital Link/Quick Eagle - Kentrox - Larscom - ADTRAN - Verilink - Packet buffering, Layer 2 parsing - M13/C-bit parity encoding - DS3 far-end alarm and control (FEAC) channel support - Local and remote loopback testing

- | | |
|-------------------|--|
| Software features | <ul style="list-style-type: none">• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)• Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB• Dynamic, arbitrary channel configuration• Full bit error rate test (BERT)• Encapsulations:<ul style="list-style-type: none">• Circuit cross-connect (CCC)• Translational cross-connect (TCC)• Frame Relay• High-Level Data Link Control (HDLC)• Point-to-Point Protocol (PPP) |
|-------------------|--|

- | | |
|-----------------------|--|
| Cables and connectors | <ul style="list-style-type: none">• Duplex SC/PC connector (Rx and Tx); single-mode fiber intermediate-reach fiber• SONET/SDH OC3/STM1 fiber-optic SFPs:<ul style="list-style-type: none">• Multimode (model number: SFP-OC3-SR)• Intermediate reach (IR-1) (model number: SFP-OC3-IR)• Long reach (IR-1) (model number: SFP-OC3-LR) <p>Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43</p> |
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| LEDs | <p>One tricolor per port:</p> <ul style="list-style-type: none">• Off—Not enabled• Green—Online with no alarms or failures• Yellow—Online with alarms for remote failures• Red—Active with a local alarm; router has detected a failure |
|------|--|
-

Alarms, errors, and events**Alarms:**

- Alarm indication signal—line (AIS-L)
- Alarm indication signal—path (AIS-P)
- Bit error rate signal degrade (BERR-SD)
- Bit error rate signal fail (BERR-SF)
- Idle code, idle received
- Loss of frame (LOF)
- Loss of pointer (LOP-P)
- Loss of signal (LOS)
- Out of frame (OOF)
- Payload mismatch (PLM-P)
- Payload unequipped (unequipped STS at path level) (UNEQ-P)
- Parity bit (P-bit) disagreements
- Path parity error
- Remote defect indication—line (RDI-L)
- Remote defect indication—path (RDI-P)
- Yellow alarm bit (X-bit) disagreements

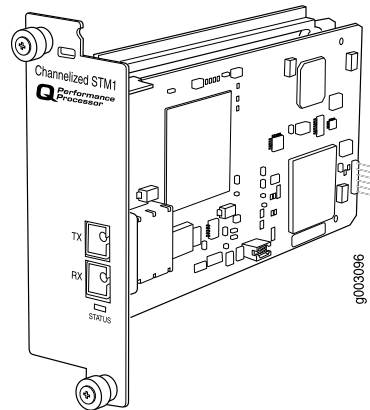
Error detection:

- Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P)
- Errored seconds (ES-S, ES-L, ES-P)
- Far-end bit errors, remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
- Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
- Far-end block error (FEBE)
- Far-end errored seconds (ES-LFE, ES-PFE)
- Far-end severely errored seconds (SES-LFE, SES-PFE)
- Far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Frame error
- Severely errored frames (SEF)
- Severely errored framing seconds (SEFS-S)
- Severely errored seconds (SES-S, SES-L, SES-P)
- Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

Channelized STM1 IQ PIC (M320 Router)



Software release	Junos OS Release 6.2 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One STM1 port - Power requirement: 0.39 A @ 48 V (18.6 W) - Fine-grained queuing per logical interface - Channelization: STM1c, fractional E1, framed and unframed DS0 - Model number: PB-1CHSTM1-SMIR-QPP
Hardware features	- Packet buffering, Layer 2 parsing - Local and remote loopback testing
Software features	- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) - SNMP: SONET/SDH MIB, T1/E1 MIB - Dynamic, arbitrary channel configuration - Full bit error rate test (BERT) patterns at E1 and DS0 levels - Encapsulations: - High-Level Data Link Control (HDLC) - Frame Relay - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Point-to-Point Protocol (PPP)
Cables and connectors	Duplex SC/PC connector (Rx and Tx); single-mode intermediate-reach fiber
LEDs	One tricolor per port: - Off—Not enabled - Green—Online with no alarms or failures - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- Alarm indication signal—line (AIS-L)
- Alarm indication signal—path (AIS-P)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate—signal fail (BERR-SF)
- Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P)
- Loss of frame (LOF)
- Loss of pointer (LOP-P)
- Loss of signal (LOS)
- Payload mismatch (PLM-P)
- Payload unequipped (unequipped STS at path level) (UNEQ-P)
- Remote defect indication—line (RDI-L)
- Remote defect indication—path (RDI-P)

Error detection:

- Errored seconds (ES-S, ES-L, ES-P)
- Far-end bit errors, remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
- Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
- Far-end errored seconds (ES-LFE, ES-PFE)
- Far-end severely errored seconds (SES-LFE, SES-PFE)
- Far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored frames (SEF)
- Severely errored framing seconds (SEFS-S)
- Severely errored seconds (SES-S, SES-L, SES-P)
- Unavailable seconds (UAS-L, UAS-P)

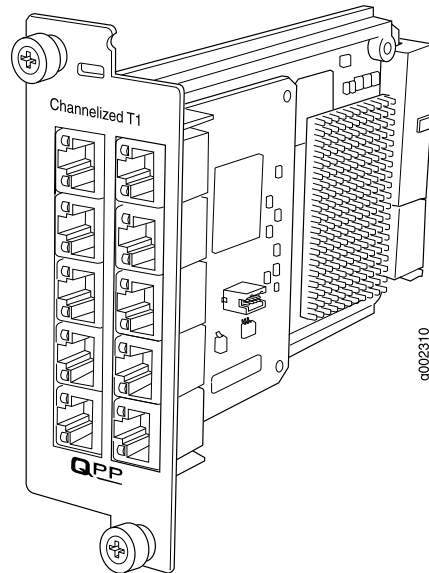
Instrumentation (counters)

- Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

Channelized T1 IQ PIC (M320 Router)



Software release	Junos OS Release 7.4 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Ten T1 ports - Power requirement: 0.15 A @ 48 V (7.2 W) - Fine-grained queuing per logical interface - Channelization: T1, FT1, NxDS0 - Model number: PB-10CHST1-RJ48-QPP

Hardware features	• Data service unit (DSU) and channel service unit (CSU) functionality • Ports configurable as clear channel T1 interfaces with 1.544-Mbps connectivity • Framing: Superframe (SF or D4) and Extended Superframe (ESF) • Supports B8ZS (bipolar 8-zero substitution) and AMI (alternate mark inversion) line coding • Local, remote, and payload loopback testing • ANSI T1.403 loopback support: • Responds to embedded loopback commands upon receipt of an FDL command from remote end with loopup and loopdown at both line and payload level • Insertion of loopback commands enables remote CSU/NIU/Smartjack to enter loopback and loopdown at both the line and payload level (ANSI and Telcordia) • Inband loopback support: • Responds to inband loopback commands at both the line and payload level (ANSI and Telcordia) • Insertion of inband loopback commands at both the line and payload level (ANSI and Telcordia) • Clocking support of external (line) and internal • Buildout support of the following ranges: • 0 through 132 (Line buildout is from 1 through 132 feet) • 133 through 265 (Line buildout is from 133 through 265 feet) • 266 through 398 (Line buildout is from 266 through 398 feet) • 399 through 531 (Line buildout is from 399 through 531 feet) • 532 through 655 (Line buildout is from 532 through 655 feet)
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • SNMP: T1 MIB and DS0 MIB • Dynamic, arbitrary channel configuration • Full bit error rate test (BERT) patterns at T1 and DS0 levels • Encapsulations: • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Point-to-Point Protocol (PPP)
Cables and connectors	• 120-ohm RJ-48C connector (female)
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events**Alarms:**

- Alarm indication signal (AIS)
- Bipolar violation (BPV)
- Excessive zero (EXZ)
- Line code violation (LCV)
- Loss of frame (LOF)
- Loss of signal (LOS)
- Remote defect indication (RDI)

Error detection:

- Error seconds (ES)
- Severely errored seconds (SES)
- Severely errored frames (SEF)
- Bit error event (BEE)

Instrumentation (counters)

- Layer 2 per-queue and per-channel packet and byte counters
- 24-hour history or error counter updated at 15-minute intervals

Related Documentation

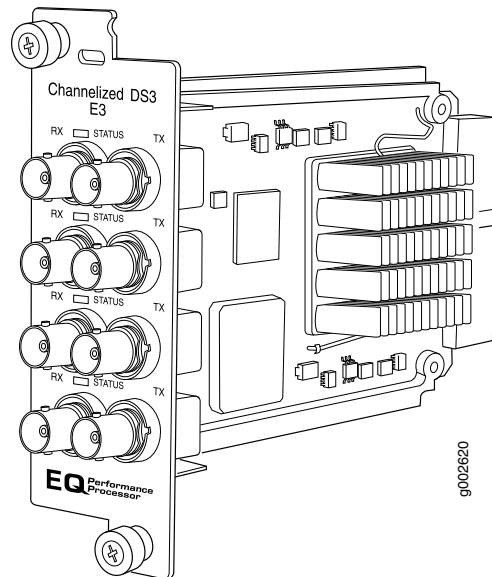
- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

CHAPTER 6

Channelized Enhanced IQ (IQE) PIC Descriptions

- [Channelized DS3/E3 Enhanced IQ \(IQE\) PIC \(M320 Router\) on page 90](#)
- [Channelized E1/T1 Enhanced IQ \(IQE\) PIC \(M320 Router\) on page 93](#)
- [Channelized OC3/STM1 Enhanced IQ \(IQE\) PIC with SFP \(M320 Router\) on page 96](#)
- [Channelized OC12/STM4 Enhanced IQ \(IQE\) PIC with SFP \(M320 Router\) on page 100](#)
- [Channelized OC48/STM16 Enhanced IQ \(IQE\) PIC with SFP \(M320 Router\) on page 105](#)

Channelized DS3/E3 Enhanced IQ (IQE) PIC (M320 Router)



Software release	Junos OS Release 9.3 and later (Type 1) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	- Four E3 or Channelized DS3 ports - E3 or Channelized DS3 is configurable on a per-port granularity - DS3 channelization: 4 DS3 channels 112 DS1 channels 1011 DS0 channels - Power requirement: 0.53 A @ 48 V (25.4 W) - Model number: PB-4CHDS3-E3-IQE-BNC
Hardware features	Ports are numbered 0 through 3 top to bottom
Software features	- Maximum transmission units (MTUs) of up to 9000 bytes - Dynamic, arbitrary channel configuration - Subrate and scrambling: NOTE: Only DS3 supports subrate and scrambling. - Digital Link/Quick Eagle - Kentrox - Larscom - ADTRAN - Verilink (subrate: only port A mode) NOTE: For DS3 interfaces, Verilink does not function if an IQE interface is paired with an IQ interface.

- Data service unit (DSU) functionality
- B3ZS line encoding
- Framing: M13, C-bit parity, framed clear channel
- Full bit error rate test (BERT) for DS0, DS1, and DS3
- ANSI T1.403 FDL
- Internal and loop clocking for DS3 and DS1
- DS3 far end alarm and control (FEAC) channel
- Local line, remote line, and remote playback loopback testing for each DS3 and DS1 channel
- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
- Enhanced fine-grained queuing per logical interface. See the *Class of Service Feature Guide for Routing Devices* for more information about class of service features.
- Simple Network Management Protocol (SNMP): DS1 MIB, DS3 MIB
- Encapsulations:
 - Circuit cross-connect (CCC)
 - Translational cross-connect (TCC)
 - Extended Frame Relay for CCC and TCC
 - Flexible Frame Relay
 - Frame Relay
 - Frame Relay for CCC
 - Frame Relay for TCC
 - Frame Relay port CCC
 - High-Level Data Link Control (HDLC)
 - HDLC framing for CCC
 - HDLC framing for TCC
 - MPLS CCC
 - MPLS TCC
 - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
 - Point-to-Point Protocol (PPP)
 - PPP for CCC
 - PPP for TCC

Cables and connectors	• Standard DS3 BNC coaxial cable interfaces
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LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
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Alarms, errors, and events

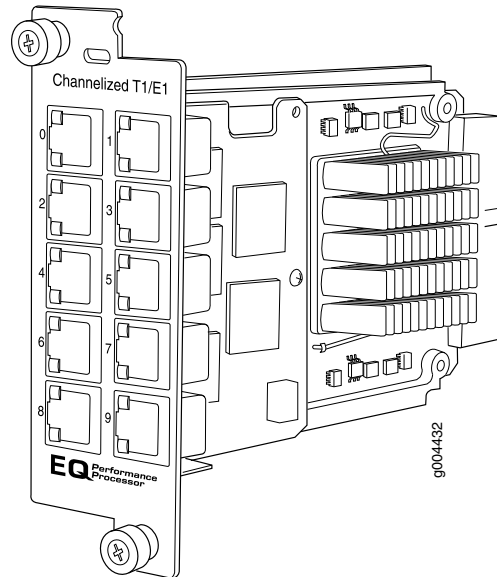
- Alarm reporting for error statistics and failure counts
- DS1 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Remote alarm indication signal (RAIS)
- DS1 error detection:
 - Bursty errored seconds (BES)
 - CRC errors
 - Errored seconds (ES)
 - Line errored seconds (LES)
 - Loss of framing seconds (LOFS)
 - Loss of signal seconds (LOS)
 - Severely errored seconds (SES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)
- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Phase lock loop (PLL)
 - Yellow alarm
- DS3 error detection:
 - When running bit error rate test (BERT) on 4-port CHDS3/E3 IQE PICs, where DS3/E3 is not SONET/SDH mapped, the LOF is reported and errors can be seen on the remote side. Both local and remote ends are C-bit framed and do not show errors when the bit error rate test is not running. When the bit error rate test is begun, framing mode on the local interface is set to unframed while the remote interface is still set to C-bit. This behavior is expected the 4-port CHDS3/E3 IQE PICs since Amur Framing does not support framed bit error rate testing.
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing seconds (CEFS)
 - CRC errors
 - Excessive zeros (EXZ)
 - Far-end block error (FEBE)
Upon initiation of the FEAC loop from the local port to the remote port, far-end block errors (FEBEs) are detected in the remote port statistics, this is expected behavior and these errors should be suppressed.
 - Far-end receive failure (FERF)
 - Line errored seconds (LES)
 - Parity bit (P-bit) code violations (PCV)
 - Parity bit (P-bit) errored seconds (PES)
 - Parity bit (P-bit) severely errored framing seconds (PSES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)

Instrumentation (counters)

- Layer 2 per-queue and per-channel packet and byte counters

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)

Channelized E1/T1 Enhanced IQ (IQE) PIC (M320 Router)



Software release	• Junos OS Release 9.5 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	• Ten E1 or T1 ports • DS1 and E1 interfaces are selectable on a per-port granularity • E1 channelization per PIC: • 10 E1 channels • 310 DS0 channels • T1 channelization per PIC: • 10 T1 channels • 240 DS0 channels • Power requirement: 0.52 A @ 48 V (24.73 W) • Model number: PB-10CHE1-T1-IQE-RJ48

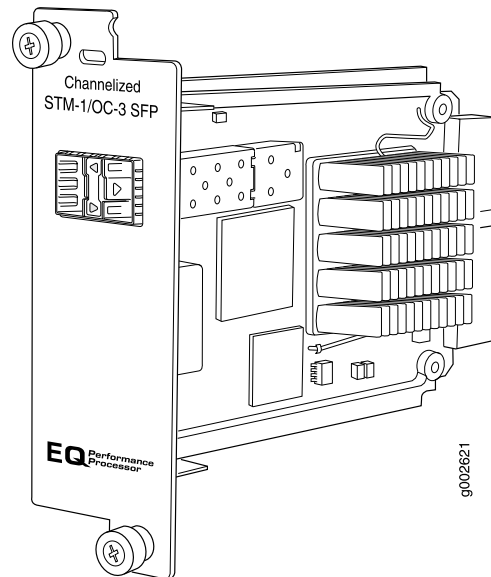
Hardware features	Ports are numbered: • Top row: 0 and 1 from left to right • Second row: 2 and 3 from left to right • Third row: 3 and 4 from left to right • Bottom row: 5 and 6 from left to right
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Enhanced fine-grained queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices</i> for more information about class of service features. • Support sending and receiving in-band loopback codes in both framed and unframed mode: • Framed in-band loopback at CSU • Framed in-band loopback at Smartjack (ANSI) • Unframed in-band loopback at CSU • Unframed in-band loopback at Smartjack (ANSI) • You can configure the following framing modes using the CLI: • T1—SF (D4/superframe), ESF (extended superframe) • E1—G704, G704—no-crc4, unframed • Packet buffering, Layer 2 parsing • Local line, remote line, and remote payload loopback testing; each channel can be looped individually and independently of other channels (DS1/E1 channels) • Simple Network Management Protocol (SNMP): T1 MIB (RFC 1406) • Dynamic, arbitrary channel configuration • Full bit error rate test (BERT) • Clocking: internal and loop (clock recovered from network and use for transmit). Internal timing is the default for channelized T1 ports. The external master clock can be a multiple of 2.048 MHz or 1.544 MHz for E1 or T1 operation. • Line coding: • T1—CLI configurable as AMI or B8ZS • E1—HDB3 • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Extended Frame Relay for CCC and TCC • Flexible Frame Relay • Frame Relay • Frame Relay for CCC • Frame Relay for TCC • Frame Relay port CCC • High-Level Data Link Control (HDLC) • HDLC framing for CCC • HDLC framing for TCC • MPLS CCC • MPLS TCC • Point-to-Point Protocol (PPP) • PPP for CCC • PPP for TCC

- Encapsulations available only for DS0 and DS1:
 - Multilink Frame Relay end-to-end (MLFR FRF.15)
 - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
 - Multilink PPP (MLPPP)
- Encapsulations available only for DS1:
 - PPP over Frame Relay

Cables and connectors	• 120-ohm RJ-48C connector (female)
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• DS1 alarms: • Alarm indication signal (AIS) • Loss of frame (LOF) • Remote alarm indication signal (RAIS) • 24-hour alarm reporting history maintained for error statistics and failure counts, 15-minute intervals on all errors • DS1 error detection: • Bursty errored seconds (BES) • CRC errors • Errored seconds (ES) • Line errored seconds (LES) • Loss of framing seconds (LOFS) • Loss of signal seconds (LOSS) • Severely errored seconds (SES) • Severely errored framing seconds (SEFS) • Unavailable seconds (UAS)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters • Layer 2 per-queue and per-channel packet and byte drop counters

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)

Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M320 Router)



Software release	Junos OS Release 9.3 and later (Type 1) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	- Two OC3 or STM1 ports - SONET or SDH is configurable on a per-port granularity - Channelization: OC3, DS3, DS1, DS0, E3, E1 - SONET channelization: 2 OC3 channels 6 DS3 channels 168 DS1 channels 1011 DS0 channels - SDH channelization: 2 STM1 channels (non-concatenated) 6 E3 channels 126 E1 channels 6 DS3 channels (Junos OS Release 10.1 and later) 168 DS1 channels (Junos OS Release 10.1 and later) 1011 DS0 channels - Power requirement: 0.56 A @ 48 V (27.1 W) - Model number: PB-2CHOC3-STM1-IQE-SFP
Hardware features	Ports are numbered 0 and 1 from left to right

Software features

- Dynamic, arbitrary channel configuration
- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
- Enhanced fine-grained queuing per logical interface. See the *Junos Class of Service Configuration Guide* for more information about class of service features.
- Subrate and scrambling:
 - Digital Link/Quick Eagle
 - Kentrox
 - Larscom
 - ADTRAN
 - Verilink
- Packet buffering, Layer 2 parsing
- M13/C-bit parity encoding
- DS3 far-end alarm and control (FEAC) channel support
- Local line, remote line, and remote payload loopback testing
- Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB
- Full bit error rate test (BERT)
- Encapsulations:
 - Circuit cross-connect (CCC)
 - Translational cross-connect (TCC)
 - Extended Frame Relay for CCC and TCC
 - Flexible Frame Relay
 - Frame Relay
 - Frame Relay for CCC
 - Frame Relay for TCC
 - Frame Relay port CCC
 - High-Level Data Link Control (HDLC)
 - HDLC framing for CCC
 - HDLC framing for TCC
 - MPLS CCC
 - MPLS TCC
 - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
 - Point-to-Point Protocol (PPP)
 - PPP for CCC
 - PPP for TCC
- Encapsulations available only for DS1:
 - Multilink Frame Relay end-to-end (MLFR FRF.15)
 - Multilink PPP (MLPPP)
 - PPP over Frame Relay

Cables and connectors

- Duplex LC/PC connector (Rx and Tx)
- SONET/SDH OC3/STM1 fiber-optic SFPs:
 - Multimode (model number: SFP-OC3-SR)
 - Intermediate reach (IR-1) (model number: SFP-OC3-IR)
 - Long reach (LR-1) (model number: SFP-OC3-LR)

Optical interface specifications—see [“SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43](#)

LEDs

One tricolor Status LED per port:

- Off—Not enabled.
- Green—Online with no alarms or failures.
- Yellow—Online with alarms for remote failures.
- Red—Active with a local alarm; router has detected a failure.

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of pointer (LOP)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
 - Remote error indication (REI)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Virtual container—alarm indication signal (VAIS)
 - Virtual container—loss of pointer (VLOP)
 - Virtual container—mismatch (VMIS)
 - Virtual container—remote defect indication (VRDI)
 - Virtual container—unequipped (VUNEQ)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receive failure (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive failure (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
 - Phase lock loop (PLL)
 - Remote error indication (REI)
 - Severely errored frames (SEF)

- Tributary unit—alarm indication signal (TU-AIS)
- Tributary unit—loss of clock (TU-LOC)
- Tributary unit—loss of pointer (TU-LOP)
- Tributary unit—mismatch (TU-MIS)
- Tributary unit—remote defect indication (TU-RD1)
- Tributary unit—unequipped (TU-UNEQ)
- DS1 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Remote alarm indication signal (RAIS)
- DS1 error detection:
 - Bursty errored seconds (BES)
 - CRC errors
 - Errored seconds (ES)
 - Line errored seconds (LES)
 - Loss of framing seconds (LOFS)
 - Loss of signal seconds (LOS)
 - Severely errored seconds (SES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)
- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Yellow alarm
- DS3 error detection:
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing seconds (CEFS)
 - CRC errors
 - Excessive zeros (EXZ)
 - Far-end block error (FEBE)
 - Far-end receive failure (FERF)
 - Line errored seconds (LES)
 - Parity bit (P-bit) code violations (PCV)
 - Parity bit (P-bit) errored seconds (PES)
 - Parity bit (P-bit) severely errored framing seconds (PSES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)

**Related
Documentation**

- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M320 Router)

Figure 5: 1-Port IQE PIC

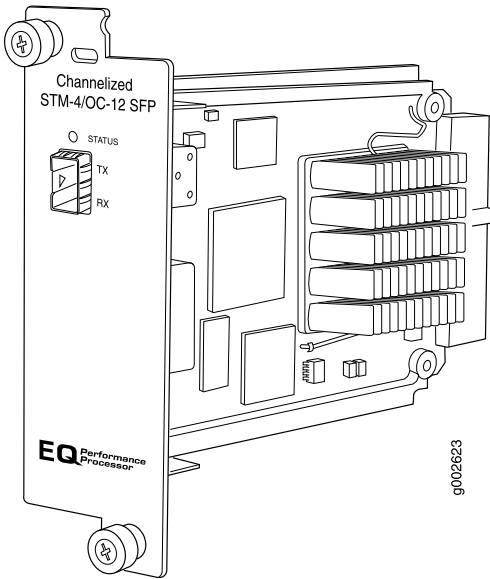
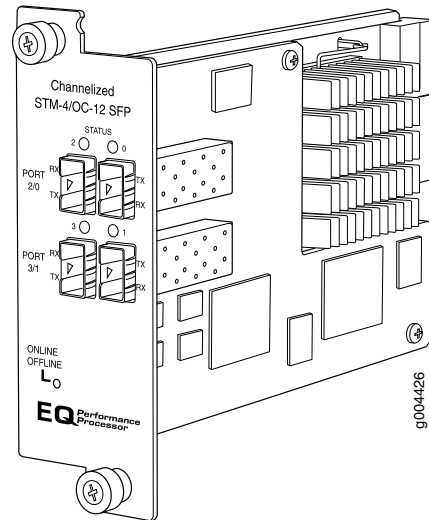


Figure 6: 4-Port IQE PIC



Software release

- 1-port: Junos OS Release 9.3 and later (Type 1)
- 4-port: Junos OS Release 9.4 and later (Type 2)

For information on which FPCs support these PICs, see [“M320 PIC/FPC Compatibility” on page 15](#).

Description

- One or four OC12/STM4 ports
- SONET or SDH is configurable on a per-port granularity
- SONET channelization (1-port PIC):
 - 1 OC12 channel
 - 4 OC3 channels
 - 12 DS3 channels
 - 336 DS1 channels
 - 1011 DS0 channels
- SDH channelization (1-port PIC):
 - 1 STM4 channel
 - 4 STM1 channels
 - 12 E3 channels
 - 252 E1 channels
 - 12 DS3 channels (Junos OS Release 10.1 and later)
 - 336 DS1 channels (Junos OS Release 10.1 and later)
 - 1011 DS0 channels
- SONET channelization (4-port PIC):
 - 4 OC12 channel
 - 16 OC3 channels

- 48 DS3 channels
- 672 DS1 channels
- 974 DS0 channels
- SDH channelization (4-port PIC):
 - 4 STM4 channel
 - 16 STM1 channels
 - 48 E3 channels
 - 504 E1 channels
 - 48 DS3 channels (Junos OS Release 10.1 and later)
 - 672 DS1 channels (Junos OS Release 10.1 and later)
 - 974 DS0 channels
- Power requirement:
 - 1-port: 0.64 A @ -48 V (30.7 W)
 - 4-port: 1.08 A @ -48V (52 W)
- Model number for 1-Port IQE PIC: PB-1CHOC12-STM4-IQE-SFP
Model number for 4-Port IQE PIC: PB-4CHOC12-STM4-IQE-SFP

Hardware features	• 1-port: Port is numbered 0. • 4-port: Ports are numbered: • Top row: 2 and 0 from left to right • Bottom row: 3 and 1 from left to right
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Enhanced fine-grained queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices</i> for more information about class of service features. • Subrate and scrambling: • Digital Link/Quick Eagle • Kentrox • Larscom • ADTRAN • Verilink • Packet buffering, Layer 2 parsing • M13/C-bit parity encoding • DS3 far-end alarm and control (FEAC) channel support • Local line, remote line, and remote payload loopback testing • Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB • Dynamic, arbitrary channel configuration • Full bit error rate test (BERT) • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Extended Frame Relay for CCC and TCC • Flexible Frame Relay • Frame Relay • Frame Relay for CCC • Frame Relay for TCC

- Frame Relay port CCC
- High-Level Data Link Control (HDLC)
- HDLC framing for CCC
- HDLC framing for TCC
- MPLS CCC
- MPLS TCC
- Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
- Point-to-Point Protocol (PPP)
- PPP for CCC
- PPP for TCC
- Encapsulations available only for DS1:
 - Multilink Frame Relay end-to-end (MLFR FRF.15)
 - Multilink PPP (MLPPP)
 - PPP over Frame Relay

Cables and connectors

- Duplex LC/PC connector (Rx and Tx); single-mode fiber
- SONET/SDH OC12/STM4 fiber-optic SFP transceivers:
 - Short reach (model number: SFP-OC12-SR)
 - Intermediate reach (IR-1) (model number: SFP-OC12-IR)
 - Long reach (LR-1) (model number: SFP-OC12-LR)

Optical interface specifications—see [“SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46](#)

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of pointer (LOP)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
 - Remote error indication (REI)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Virtual container—alarm indication signal (VAIS)
 - Virtual container—loss of pointer (VLOP)
 - Virtual container—mismatch (VMIS)

- Virtual container—remote defect indication (VRDI)
- Virtual container—unequipped (VUNEQ)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receive failure (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive failure (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
 - Phase lock loop (PLL)
 - Remote error indication (REI)
 - Severely errored frame (SEF)
 - Tributary unit—alarm indication signal (TU-AIS)
 - Tributary unit—loss of pointer (TU-LOP)
 - Tributary unit—mismatch (TU-MIS)
 - Tributary unit—remote defect indication (TU-RDI)
 - Tributary unit—unequipped (TU-UNEQ)
- DS1 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Remote alarm indication signal (RAIS)
- DS1 error detection:
 - Bursty errored seconds (BES)
 - CRC errors
 - Errored seconds (ES)
 - Line errored seconds (LES)
 - Loss of framing seconds (LOFS)
 - Severely errored seconds (SES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)
- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Yellow alarm

- DS3 error detection:
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing seconds (CEFS)
 - CRC errors
 - Excessive zeros (EXZ)
 - Far-end block error (FEBE)
 - Far-end receive failure (FERF)
 - Line errored seconds (LES)
 - Parity bit (P-bit) code violations (PCV)
 - Parity bit (P-bit) errored seconds (PES)
 - Parity bit (P-bit) severely errored framing seconds (PSES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)

Instrumentation
(counters)

- Layer 2 per-queue and per-channel packet and byte counters

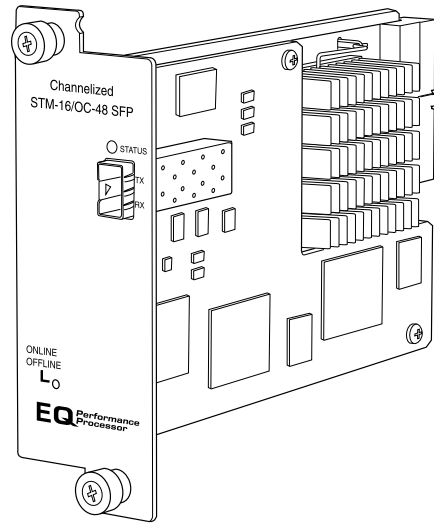
Table 59: PICs Supported in Fourth Slot of M320-FPC2-E2 and M320-FPC2-E3 with Type 2 IQE PICs on M320 Routers

PIC Name	PIC Model Number
Gigabit Ethernet, 2-port SFP	PB-2GE-SFP
Gigabit Ethernet, 4-port SFP	PB-4GE-SFP
Gigabit Ethernet IQ, 2-port SFP	PB-2GE-SFP-QPP
SONET/SDH OC12c/STM4, 4-port with multimode transceivers installed	PB-4OC12-SON-MM
SONET/SDH OC12c/STM4, 4-port with single-mode intermediate reach transceivers installed	PB-4OC12-SON-SMIR
SONET/SDH OC48/STM16, 1-port SFP	PB-1OC48-SON-SFP
Tunnel Services	PB-TUNNEL

**Related
Documentation**

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (M320 Router)



Software release	Junos OS Release 9.4 and later (Type 2) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One OC48/STM16 port - SONET or SDH is configurable on a per-port granularity - SONET channelization: 4 OC12 channels 16 OC3 channels 48 DS3 channels 672 DS1 channels 975 DS0 channels - SDH channelization: 4 STM4 channels 16 STM1 channels 48 E3 channels 504 E1 channels 48 DS3 channels 672 DS1 channels 975 DS0 channels - Power requirement: 1.10 A @ 48V (53 W) - Model number: PB-1CHOC48-STM16-IQE-SFP
Hardware features	Port is numbered 0.

Software features

- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
- Enhanced fine-grained queuing per logical interface. See the *Class of Service Feature Guide for Routing Devices* for more information about class of service features.
- Subrate and scrambling:
 - Digital Link/Quick Eagle
 - Kentrox
 - Larscom
 - ADTRAN
 - Verilink
- Packet buffering, Layer 2 parsing
- M13/C-bit parity encoding
- DS3 far-end alarm and control (FEAC) channel support
- Local line, remote line, and remote payload loopback testing
- Simple Network Management Protocol (SNMP): OC12, OC3 MIB, DS3 MIB, T1 MIB
- Dynamic, arbitrary channel configuration
- Full bit error rate test (BERT)
- Encapsulations:
 - Circuit cross-connect (CCC)
 - Translational cross-connect (TCC)
 - Extended Frame Relay for CCC and TCC
 - Flexible Frame Relay
 - Frame Relay
 - Frame Relay for CCC
 - Frame Relay for TCC
 - Frame Relay port CCC
 - High-Level Data Link Control (HDLC)
 - HDLC framing for CCC
 - HDLC framing for TCC
 - MPLS CCC
 - MPLS TCC
 - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
 - Point-to-Point Protocol (PPP)
 - PPP for CCC
 - PPP for TCC
- Encapsulations available only for DS1:
 - Multilink Frame Relay end-to-end (MLFR FRF.15)
 - Multilink PPP (MLPPP)
 - PPP over Frame Relay

Cables and connectors

- Duplex LC connector (Rx and Tx); single-mode fiber
- SONET/SDH OC48/STM16 fiber-optic SFP transceivers:
 - Short reach (SR-1) (model number: SFP-1OC48-SR)
 - Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
 - Long reach (LR-1) (model number: SFP-1OC48-LR)

Optical interface specifications—see [“SONET/SDH OC48/STM16 Optical Interface Specifications” on page 48](#)

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of pointer (LOP)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
 - Remote error indication (REI)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Virtual container—alarm indication signal (VAIS)
 - Virtual container—loss of pointer (VLOP)
 - Virtual container—mismatch (VMIS)
 - Virtual container—remote defect indication (VRDI)
 - Virtual container—unequipped (VUNEQ)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receive failure (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive failure (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
 - Phase lock loop (PLL)
 - Remote error indication (REI)
 - Severely errored frame (SEF)
 - Tributary unit—alarm indication signal (TU-AIS)

- Tributary unit—loss of pointer (TU-LOP)
- Tributary unit—mismatch (TU-MIS)
- Tributary unit—remote defect indication (TU-RD1)
- Tributary unit—unequipped (TU-UNEQ)
- DS1 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Remote alarm indication signal (RAIS)
- DS1 error detection:
 - Bursty errored seconds (BES)
 - CRC errors
 - Errored seconds (ES)
 - Line errored seconds (LES)
 - Loss of framing seconds (LOFS)
 - Severely errored seconds (SES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)
- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Yellow alarm
- DS3 error detection:
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing seconds (CEFS)
 - CRC errors
 - Excessive zeros (EXZ)
 - Far-end block error (FEBE)
 - Far-end receive failure (FERF)
 - Line errored seconds (LES)
 - Parity bit (P-bit) code violations (PCV)
 - Parity bit (P-bit) errored seconds (PES)
 - Parity bit (P-bit) severely errored framing seconds (PSES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)

Instrumentation
(counters)

- Layer 2 per-queue and per-channel packet and byte counters

Table 60: PICs Supported in Fourth Slot of M320-FPC2-E2 and M320-FPC2-E3 with Type 2 IQE PICs on M320 Routers

PIC Name	PIC Model Number
Gigabit Ethernet, 2-port SFP	PB-2GE-SFP
Gigabit Ethernet, 4-port SFP	PB-4GE-SFP

Table 60: PICs Supported in Fourth Slot of M320-FPC2-E2 and M320-FPC2-E3 with Type 2 IQE PICs on M320 Routers (*continued*)

PIC Name	PIC Model Number
Gigabit Ethernet IQ, 2-port SFP	PB-2GE-SFP-QPP
SONET/SDH OC12c/STM4, 4-port with multimode transceivers installed	PB-4OC12-SON-MM
SONET/SDH OC12c/STM4, 4-port with single-mode intermediate reach transceivers installed	PB-4OC12-SON-SMIR
SONET/SDH OC48/STM16, 1-port SFP	PB-1OC48-SON-SFP
Tunnel Services	PB-TUNNEL

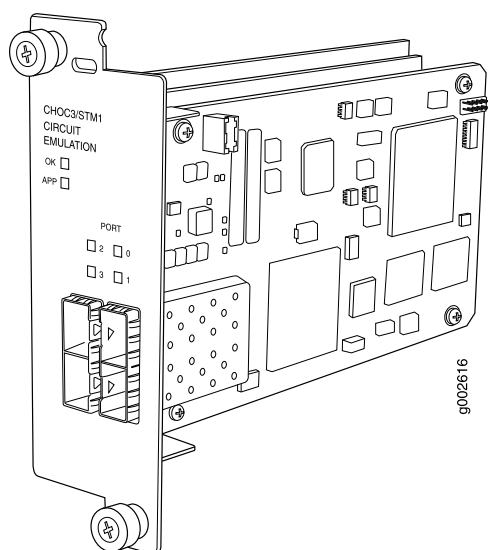
- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)

CHAPTER 7

Circuit Emulation PIC Descriptions

- Channelized OC3/STM1 Circuit Emulation PIC with SFP (M320 Router) on page 111
- E1/T1 Circuit Emulation PIC (M320 Router) on page 114

Channelized OC3/STM1 Circuit Emulation PIC with SFP (M320 Router)



Software release	• Junos OS Release 9.4 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	• Four OC3/STM1 ports • Power requirement: 0.52 A @ 48 V (25 W) • Channelization: DS1 Channelization down to E1/T1 Each port can be channelized as 84 T1 ports for a total of 336 T1 pseudowires or 63 E1 ports for a total of 252 pseudowires. • Model number: PB-4CHOC3-CE-SFP

Hardware features	• Subrate and scrambling: • Digital Link/Quick Eagle • Kentrox • Larscom • ADTRAN • Verilink • M13/C-bit parity encoding • Local and remote loopback testing
Software features	• Loop timing and external timing • Optical diagnostics • AM1 or B8ZS line encoding • APS/SDH MSP • Fractional mode and framed clear channel mode • Superframe (D4/SF) and extended superframe (ESP) framing • Simple Network Management Protocol (SNMP): • OC3 MIB • T1 MIB • ATM MIB (Junos OS Release 10.2 and later) • Automatic protection switching (APS) • Dynamic, arbitrary channel configuration • Full bit error rate test (BERT) • Encapsulations: Structure-agnostic time-division multiplexing (TDM) over packet (SAToP) (RFC 4553) • Pseudowire emulation edge-to-edge (PWE3) for ATM (RFC 4717) (Junos OS Release 9.6 and later) • ATM Pseudowire emulation edge-to-edge via dynamic labels (LDP, RSVP-TE) (Junos OS Release 9.6 and later) • Inverse multiplexing (IMA) for ATM (Junos OS Release 10.0 and later) • ATM QoS for the Junos OS Release 10.2 and later: • Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping • Unspecified bit rate (UBR) traffic shaping • Fine-grained real-time variable bit rate (rtVBR) and real-time variable bit rate (nrtVBR) traffic shaping • Port-level egress shaping • Constant bit rate (CBR) • Policing on a per virtual circuit basis • Independent peak cell rate (PCR) and sustained cell rate (SCR) policing • Counting, tagging, or discard policing actions
Cables and connectors	• Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 fiber-optic SFPs: • Multimode (model number: SFP-OC3-SR) • Intermediate reach (IR-1) (model number: SFP-OC3-IR) • Long reach (IR-1) (model number: SFP-OC3-LR) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43

LEDs

OK LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the router.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure.

APP LED, one bicolor:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

Structure-agnostic alarms for T1 interface:

- Alarm indication signal (AIS-L, AIS-P)
- Loss of signal (LOS)
- Errored seconds (ES)
- Line-errored seconds (LES)
- Severely errored seconds (SES)
- Unavailable errored seconds (UAS)
- Bipolar violation (BPV)
- Controlled slip (CS)
- Line code violation (LCV)

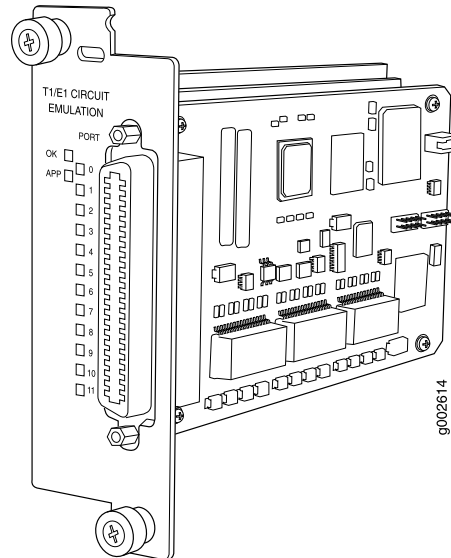
Structure-agnostic alarms for E1 interface:

- Alarm indication signal (AIS-L, AIS-P)
- Loss of signal (LOS)
- Errored seconds (ES)
- Line-errored seconds (LES)
- Severely errored seconds (SES)
- Unavailable errored seconds (UAS)
- Bipolar violation (BPV)
- Controlled slip (CS)
- Line code violation (LCV)

**Related
Documentation**

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

E1/T1 Circuit Emulation PIC (M320 Router)



Software release	Junos OS Release 9.4 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Configurable as either twelve E1 ports or twelve T1 ports NOTE: Mixing E1 and T1 ports on the same PIC is not supported. - Power requirement: 0.52 A @ 48 V (25 W) - Onboard DSU functionality for E1 connectivity - Model number: PB-12T1E1-CE-TELCO
Hardware features	- Maximum transmission units (MTUs) of up to 1024 bytes - Per-interface diagnostics and loopback control - Per-interface alarm and event counting and detection - Framing 4-bit CRC for G.704 framed mode - G.704 without CRC4 - Unframed - Balanced and unbalanced modes - Full bit error rate test (BERT)

Software features	• PIC can be configured as twelve T1 ports or twelve E1 ports • Local and remote loopback diagnostics • E1 ports • High-performance throughput on each port at speeds up to 2048 Mbps, full duplex • HDB3 line encoding • Integrated support for G.704 framed mode with CRC; this feature is user-configurable NOTE: The G.704 implementation supports speeds slower than 2.048 Mbps; multiple channels within a single E1 interface are not supported. • G.704 framed without CRC4 • Unframed • Framed clear channel mode • Unframed clear channel mode • Framed fractional mode • T1 ports • High-performance throughput on each port at speeds up to 1544 Mbps, full duplex • AMI and B8ZS line encoding • Framed clear channel mode • Fractional mode • Superframe (D4/SF) and extended superframe (ESF) framing • ESF CSU counters, WRT impairments, and CRC checking • Local DS1 line loopback, remote line loopback • Loop timing, PIC line timing, and external timing • Encapsulations: Structure-agnostic time-division multiplexing (TDM) over packet (SAToP) (RFC 4553) • Pseudowire emulation edge-to-edge (PWE3) for ATM (RFC 4717) (Junos OS Release 9.6 and later) • ATM Pseudowire emulation edge-to-edge via dynamic labels (LDP, RSVP-TE) (Junos OS Release 9.6 and later) • Inverse multiplexing (IMA) for ATM (Junos OS Release 10.0 and later) • Simple Network Management Protocol (SNMP): ATM MIB for the Junos OS Release 10.2 and later • ATM QoS for the Junos OS Release 10.2 and later: • Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping • Unspecified bit rate (UBR) traffic shaping • Fine-grained real-time variable bit rate (rtVBR) and real-time variable bit rate (nrtVBR) traffic shaping • Port-level egress shaping • Constant bit rate (CBR) • Policing on a per virtual circuit basis • Independent peak cell rate (PCR) and sustained cell rate (SCR) policing • Counting, tagging, or discard policing actions
Cables and connectors	• RJ-21 connector • Cables are rated for intra-building connections only.

LEDs

OK or Status LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the router.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure.

APP LED, one bicolor:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.

One tricolor per port:

- Off—Not enabled
 - Green—Online with no alarms or failures
 - Yellow—Online with alarms for remote failures
 - Red—Active with a local alarm; router has detected a failure
-

Alarms, errors, and events**Structure-agnostic alarms for T1:**

- Alarm indication signal (AIS)
- Loss of signal (LOS)
- Errored seconds (ES)
- Line code violation (LCV)
- Line errored seconds (LES)
- Severely errored seconds (SES)
- Unavailable seconds (UAS)

Structure-agnostic alarms for E1:

- Alarm indication signal (AIS)
- Errored seconds (ES)
- Line code violation (LCV)
- Line errored seconds (LES)
- Severely errored seconds (SES)
- Unavailable seconds (UAS)

Structure aware alarms for E1:

- Alarm indication signal (AIS)
- Loss of frame (LOF)
- Loss of signal (LOS)
- Yellow alarm (remote alarm indication (RAI) (YLW)
- Far-end block error (FEBE)
- Cyclical Redundancy Check (CRC)
- CRC major
- CRC minor
- Line code violation (LCV)
- Path code violation (LCV)
- Errored seconds (ES)
- Bursty errored seconds (BES)
- Line errored seconds (LES)
- Severely errored seconds (SES)
- Severely errored frame seconds (SEFS)
- Unavailable seconds (UAS)

Related Documentation

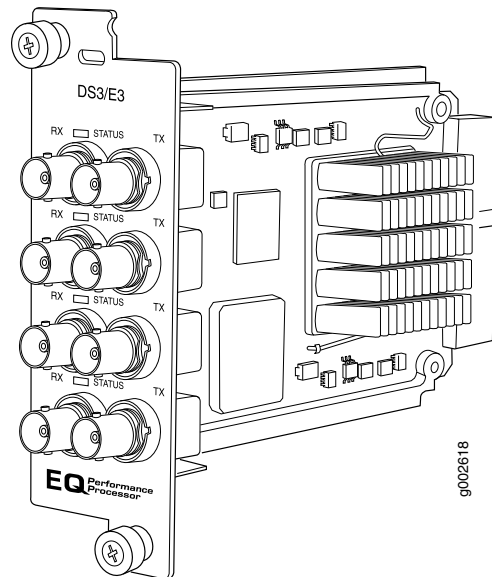
- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

CHAPTER 8

DS3, E1, E3, and T1 Pic Descriptions

- [DS3/E3 Enhanced IQ \(IQE\) PIC \(M320 Router\) on page 120](#)
- [E1 PICs \(M320 Router\) on page 123](#)
- [E3 PIC \(M320 Router\) on page 125](#)
- [E3 IQ PIC \(M320 Router\) on page 126](#)
- [T1 PIC \(M320 Router\) on page 128](#)

DS3/E3 Enhanced IQ (IQE) PIC (M320 Router)



Software release	Junos OS Release 9.3R2 and later For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	- Four DS3 or E3 ports - DS3 or E3 is configurable on a per-port granularity - Power requirement: 0.51 A @ 48 V (24.7 W) - Model number: PB-4DS3-E3-IQE-BNC
Hardware features	Ports are numbered 0 through 3 top to bottom
Software features	- Maximum transmission units (MTUs) of up to 9192 bytes - Subrate and scrambling: NOTE: Only DS3 interfaces support subrate and scrambling. - Digital Link/Quick Eagle - Kentrox - Larscom - ADTRAN - Verilink (subrate: only port A mode) NOTE: For DS3 interfaces, Verilink does not function if an IQE interface is paired with an IQ interface. - Data service unit (DSU) functionality - B3ZS line encoding - Framing: M13, C-bit parity, framed clear channel - Full bit error rate test (BERT) - ANSI T1.403 FDL

- Internal and loop clocking
- DS3 far end alarm and control (FEAC) channel
- Local line, remote line, and remote playback loopback testing
- Simple Network Management Protocol (SNMP): DS3 MIB
- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
- Enhanced fine-grained queuing per logical interface. See the *Class of Service Feature Guide for Routing Devices* for more information about class of service features.
- Encapsulations:
 - Circuit cross-connect (CCC)
 - Translational cross-connect (TCC)
 - Extended Frame Relay for CCC and TCC
 - Flexible Frame Relay
 - Frame Relay
 - Frame Relay for CCC
 - Frame Relay for TCC
 - Frame Relay port CCC
 - High-Level Data Link Control (HDLC)
 - HDLC framing for CCC
 - HDLC framing for TCC
 - MPLS CCC
 - MPLS TCC
 - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
 - Point-to-Point Protocol (PPP)
 - PPP for CCC
 - PPP for TCC

Cables and connectors	• Standard DS3 BNC coaxial cable interfaces
-----------------------	---

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
------	---

Alarms, errors, and events

- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Phase lock loop (PLL)
 - Yellow alarm
- DS3 error detection:
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing seconds (CEFS)
 - CRC errors
 - Excessive zeros (EXZ)
 - Far-end block error (FEBE)
 - Far-end receive failure (FERF)
 - Line errored seconds (LES)
 - Parity bit (P-bit) code violations (PCV)
 - Parity bit (P-bit) errored seconds (PES)
 - Parity bit (P-bit) severely errored framing seconds (PSES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)

Instrumentation (counters)

- Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

E1 PICs (M320 Router)

Figure 7: E1 RJ-48 PIC

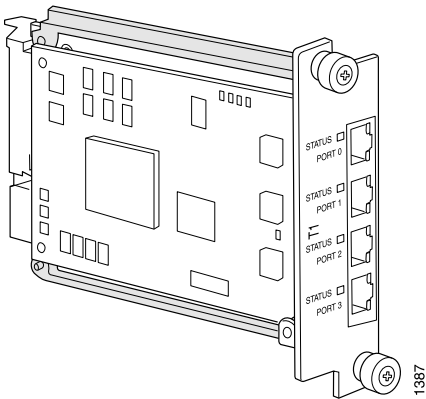
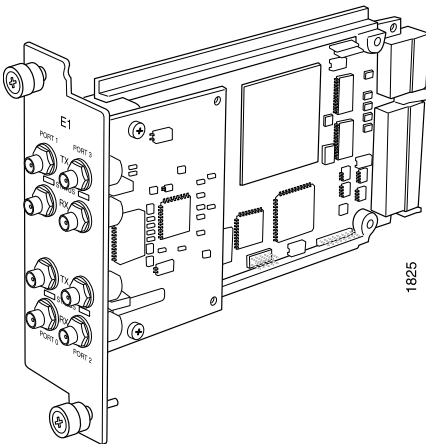


Figure 8: E1 Coaxial PIC



Software release	Junos OS Release 6.4 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Four E1 or coaxial ports - Power requirement: 0.08 A @ 48 V (3.74 W) - Two versions: 4-port, 120-ohm, RJ-48 4-port, 75-ohm, coaxial - Onboard DSU functionality for E1 connectivity - Model number: PB-4E1-COAX PB-4E1-RJ48
Hardware features	- High-performance throughput on each port at speeds up to 2.048 Mbps, full duplex - Maximum transmission units (MTUs) of up to 4500 bytes - Per-interface diagnostics and loopback control - Per-interface shaping on output - Per-interface alarm and event counting and detection - HDB3 line coding 4-bit CRC for G.704 framed mode - Per-port loop timing - Balanced and unbalanced modes - Packet buffering, Layer 2 parsing - Full bit error rate test (BERT)

- | | |
|-------------------|---|
| Software features | <ul style="list-style-type: none">• Integrated support for G.703 unframed mode and G.704 framed mode with CRC; this feature is user-configurableNOTE: The G.704 implementation supports speeds slower than 2.048 Mbps; multiple channels within a single E1 interface are not supported.• Configurable clock source: Internal or loop• Encapsulations:<ul style="list-style-type: none">• High-Level Data Link Control (HDLC)• Frame Relay• Circuit cross-connect (CCC)• Point-to-Point Protocol (PPP) |
|-------------------|---|

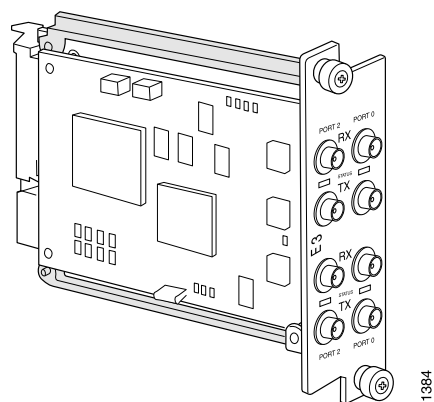
- | | |
|-----------------------|--|
| Cables and connectors | <ul style="list-style-type: none">• Two versions:<ul style="list-style-type: none">• Four RJ-48 connectors (one per port)• Four coaxial connectors• Custom 10-ft (3.05-m) posilock to BNC male cable, separate Rx and Tx |
|-----------------------|--|

- | | |
|------|--|
| LEDs | <p>One tricolor per port:</p> <ul style="list-style-type: none">• Off—Not enabled• Green—Online with no alarms or failures• Yellow—Online with alarms for remote failures• Red—Active with a local alarm; router has detected a failure |
|------|--|

- | | |
|----------------------------|---|
| Alarms, errors, and events | <ul style="list-style-type: none">• Alarm indication signal (AIS)• Bipolar violations• Excessive zeros• Far-end block errors (FEBE, E-bit errors)• Loss of frame (LOF), Loss of signal (LOS)• Local and remote loopback diagnostics• Yellow alarm bit (X-bit) disagreements |
|----------------------------|---|

- | | |
|------------------------------|--|
| Related Documentation | <ul style="list-style-type: none">• M320 PIC Description• M320 PIC Combination Limitations on page 15• M320 PICs Supported on page 3 |
|------------------------------|--|

E3 PIC (M320 Router)



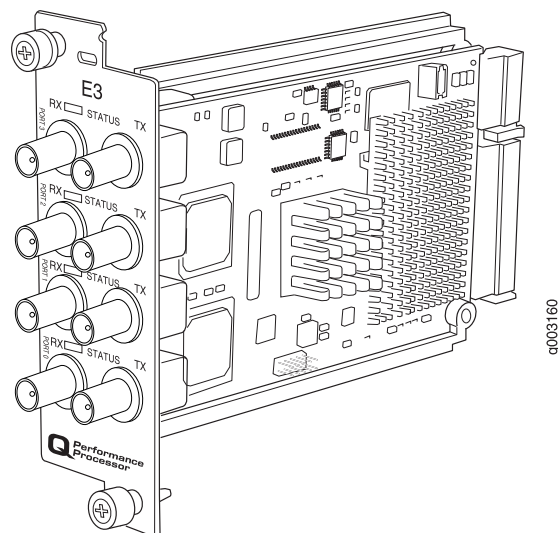
Software release	Junos OS Release 6.3 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Four E3 ports - Power requirement: 0.47 A @ 48 V (22.5 W) - Integrated DSU interoperability - Model number: PB-4E3-QPP
Hardware features	- High-density E3 (34.368-Mbps) connectivity - High-performance throughput on each port at speeds up to 34.368 Mbps, full duplex - Scrambling support - Subrate clocking support - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing - Large MTUs, up to 9192 bytes - Local and remote loopback
Software features	- Supports G-751 framing - E3 diagnostics and loopback control - E3 alarm and event counting and detection - DS3 diagnostics and loopback control - Bit error rate test (BERT); you can configure one port in BERT mode and configure the remaining channels to transmit and receive normal traffic - Encapsulations: - High-level Data Link Control (HDLC) - Frame Relay - Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) - Point-to-Point Protocol (PPP)
Cables and connectors	Custom 10 ft (3.05 m) posilock to BNC male cable, separate RX and TX

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
------	---

Alarms, errors, and events	• Alarm indication signal (AIS) • Equipment failure (does not affect service) • Frame error • Line code violation • Loss of signal (LOS) • Out of frame (OOF) • Yellow alarm bit (A-bit) disagreements
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Related Documentation	• M320 PIC Description • M320 PIC Combination Limitations on page 15 • M320 PICs Supported on page 3
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E3 IQ PIC (M320 Router)

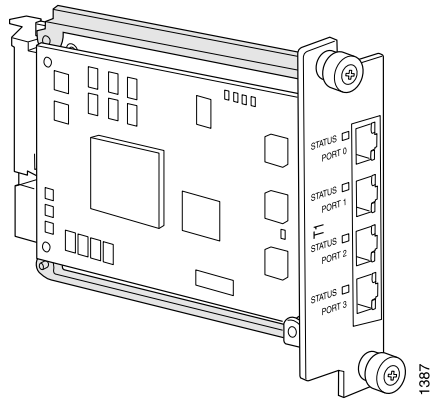


Software release	• Junos OS Release 6.2 and later (Type 1) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	• Four E3 ports • Power requirement: 0.38 A @ 48 V (18 W) • Fine-grained queuing per logical interface • Model number: PB-4E3-QPP

Hardware features	• Clear-channel (34.368-Mbps) and subrate E3 • Unframed or ITU G.751 framing • Data service unit (DSU) functionality • Subrate and scrambling: • Digital Link/Quick Eagle • Kentrox • HDB3 line encoding • Full bit error rate test (BERT) • Local and remote loopback testing
Software features	• Quality of service (QoS) per port: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Simple Network Management Protocol (SNMP): E3 MIB, QoS MIB • Input policing and output shaping • Provider-side rate limiting • Full data link connection identifier (DLCI) range with sparse channel numbering • Per-DLCI queues with weighted deficit round-robin and strict priority • Encapsulations: • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Point-to-Point Protocol (PPP) • Junos OS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES).
Cables and connectors	• Standard E3 BNC coaxial cable interfaces
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS) • Equipment failure (does not affect service) • Frame error • Line code violation • Loss of signal (LOS) • Out of frame (OOF) • Yellow alarm bit (A-bit) disagreements
Instrumentation (counters)	• Layer 2 per-queue packet and byte counters
Related Documentation	• <i>M320 PIC Description</i> • M320 PIC Combination Limitations on page 15

- [M320 PICs Supported on page 3](#)

T1 PIC (M320 Router)



Software release	• Junos OS Release 6.4 and later For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	• Four T1 ports • Power requirement: 0.08 A @ 48 V (3.7 W) • Supports clear channel T1 per port (1.544 Mbps per channel) • Supports attenuation up to -12 dBm • Model number: PB-4T1-RJ48
Hardware features	• Per-port loop timing • Onboard DSU functionality for T1 connectivity
Software features	• ESF and SF framing • B8ZS and AMI coding • ESF CSU counters, WRT impairments, and CRC checking • Local DS1 line loopback, remote line loopback • Configurable clock source—internal or loop • Encapsulations: • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Point-to-Point Protocol (PPP)
Cables and connectors	• 100-ohm RJ-48 connector
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- Alarm indication signal (AIS)
- Bipolar violations
- Excessive zeros
- Far-end block errors (FEBE, E-bit errors)
- Loss of frame (LOF)
- Loss of signal (LOS)
- Yellow alarm bit (X-bit) disagreements

Related Documentation

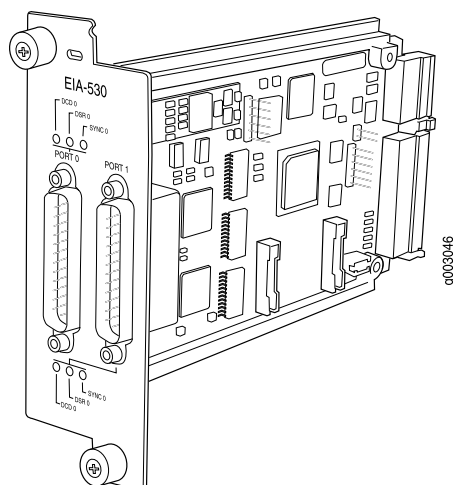
- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

CHAPTER 9

EIA-530 PIC Descriptions

- EIA-530 PIC (M320 Router) on page 131

EIA-530 PIC (M320 Router)



Software release	• Junos OS Release 6.2 and later (Type 1) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	• Two EIA-530, X.21, or V.35 serial ports • Power requirement: 0.07 A @ 48 V (3.4 W) • Model number: PB-2EIA530
Hardware features	• Configured as data terminal equipment (DTE) ports • Resynchronization signal • Receives clock rates up to 16 Mbps • Local, data communications equipment (DCE) local, and DTE remote loopbacks

Software features	• Supports four queues per port • Random early detection (RED) • Transmitter Signal Element Timing is looped from the timing received on the Transmitted Signal Element DCE. EIA-530 ports support the ability to invert the Transmit Data Element. The EIA-530 ports support the following rates: • 2.048 Mbps • 2.341 Mbps • 2.731 Mbps • 3.277 Mbps • 4.09 Mbps • 5.461 Mbps • 8.192 Mbps • 16.384 Mbps • V.35 ports support up to 2.048 Mbps • X.21 ports support up to 10 Mbps • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Two DB-25 male connectors (one per port, included with PIC) • V.35 requires an EIA-530 to V.35 cable and connects to a V.35 DTE 34-pin Winchester type male cable (one per port) • X.21 requires an EIA-530 to X.21 cable and connects to a X.21 DTE DB-15 male cable
LEDs	Three bicolor per port: • Data set ready (DSR): • Green—DSR is detected or ignored • Red—DSR expected but not present • Data carrier detect (DCD): • Green—DCD is detected or ignored • Red—DCD expected but not present • Resynchronization: • Green—Keepalives are being received • Red—Data terminal ready (DTR) toggled from low to high (resynchronization pulses are being sent)
Instrumentation (counters)	• Per-port packet and byte counters • Resynchronization counters: • Number of resynchronizations initiated • Time of last resynchronization

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)

- [M320 PICs Supported on page 3](#)

CHAPTER 10

Fast Ethernet PIC Descriptions

- Fast Ethernet PICs (M320 Router) on page 135

Fast Ethernet PICs (M320 Router)

Figure 9: 4-Port Fast Ethernet PIC

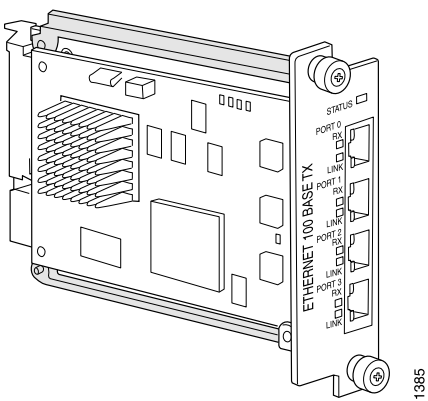


Figure 10: 8-Port Fast Ethernet PIC

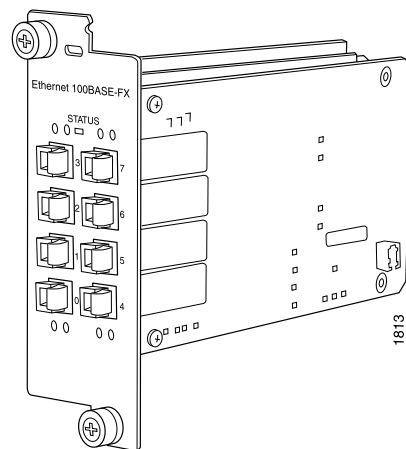


Figure 11: 12-Port Fast Ethernet PIC

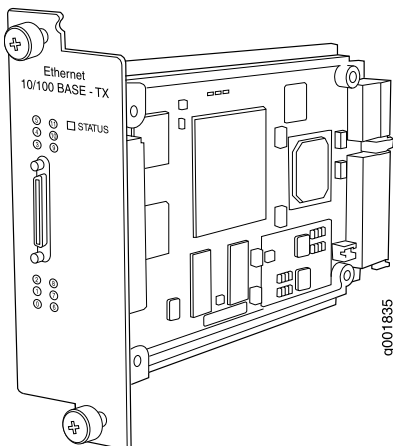


Figure 12: 48-Port Fast Ethernet PIC

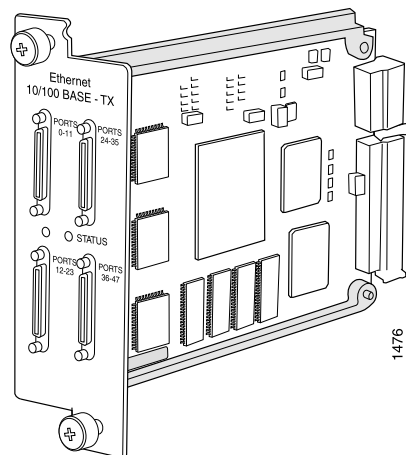
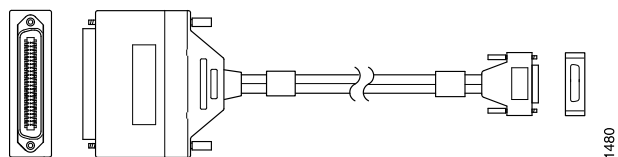


Figure 13: VHDCI to RJ-21 Cable



Software release	• 4-port: Junos OS Release 6.2 and later (Type 1) • 8-port: Junos OS Release 6.3 and later (Type 1) • 12-port: Junos OS Release 6.2 and later (Type 1) • 48-port: Junos OS Release 6.4 and later (Type 2) For information on which FPCs support these PICs, see “M320 PIC/FPC Compatibility” on page 15.
Description	• 4 100Base-TX ports • 8 100Base-FX ports • 12 100Base-TX ports • 48 100Base-TX ports • Power requirement: • 4-port: 0.14 A @ 48 V (6.8 W) • 8-port: 0.26 A @ 48 V (12.5 W) • 12-port: 0.23 A @ 48 V (11 W) • 48-port: 0.69 A @ 48 V (33.3 W) • Model number for 4-Port Fast Ethernet PIC: PB-4FE-TX Model number for 8-Port Fast Ethernet PIC: PB-8FE-FX Model number for 12-Port Fast Ethernet PIC: PB12FE-TX-MDI PB-12FE-TX-MDIX Model number for 48-Port Fast Ethernet PIC: PB-48FE-TX
Hardware features	• High-performance throughput on each port at speeds up to 100 Mbps • Source and destination Media Access Control (MAC) address filtering • RMON EtherStats packet buffering • 802.3 Ethernet standard compliant • 4-port PICs support MTUs of up to 9,192 bytes; 8-port, 12-port, and 48-port PICs support MTUs of up to 1,532 bytes • 4-port PICs support 1,024 802.1Q VLANs per port; 8-port, 12-port, and 48-port PICs support 16 802.1Q VLANs per port
Software features	• Autosensing full-duplex and half-duplex modes • Virtual Router Redundancy Protocol (VRRP) • 802.1q virtual LANs (VLANs) • Circuit cross-connect (CCC) VLAN
Cables and connectors	4-port PIC: • Connector: Two-pair, Category 5 unshielded twisted-pair connectivity through an RJ-45 connector • Pinout: MDI noncrossover 8-port PIC: • Connector: MT-RJ female FX optical interface—see <i>Fast Ethernet 100BASE-FX Optical Interface Specifications</i> 12-port PIC: • Connector: One very high density connector interface (VHDCI) to RJ-21 cable that connects to an RJ-45 patch panel

48-port PIC:

- VHDCI to RJ-21 cables that connect to an RJ-45 patch panel
- Four VHDCI connectors that each service 12 10/100 ports

NOTE: Each of the four connectors on a Fast Ethernet 48-port PIC can support a maximum of approximately 800 Mbps. However, this constitutes oversubscription. Use this PIC only in environments that can support this level of oversubscription.

LEDs

Status LED, one bicolor:

- Off—PIC ports not enabled.
- Green—PIC is operating normally.
- Red—PIC has an error or failure.

4-port PIC—One pair of port LEDs:

- Link LED—If green, the port is online; if there is no light, the port is down.
- RX LED—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data.

8-port PIC—one pair of port LEDs per port:

- Port link LED—If green, the port is online; if there is no light, the port is down.

NOTE: The Link LED remains lit on the 8-port PIC when the port is down.

- Port RX LED—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data.

12-port PIC—one port LED per port:

- Green—100-Mbps link established.
- Flashing green—100-Mbps activity.
- Yellow—10-Mbps link established.
- Flashing yellow—10-Mbps activity.
- Off—No link present.

NOTE: The port LEDs remain lit on the 12-port PIC when the ports are down.

NOTE: The 48-port PIC does not have port LEDs. To check port status on a 48-port PIC, use the **show interfaces fe-fpc/pic/port** command. For more information about this command, see the *Junos OS Network Interfaces Library for Routing Devices*.

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

CHAPTER 11

Gigabit Ethernet PIC Descriptions

- [Gigabit Ethernet PICs with SFP \(M320 Router\) on page 140](#)
- [Gigabit Ethernet IQ PICs with SFP \(M320 Router\) on page 143](#)
- [Gigabit Ethernet IQ2 PICs with SFP \(M320 Router\) on page 145](#)
- [Gigabit Ethernet Enhanced IQ2 \(IQ2E\) PICs with SFP \(M320 Router\) on page 149](#)

Gigabit Ethernet PICs with SFP (M320 Router)

Figure 14: 1-Port Gigabit Ethernet PIC

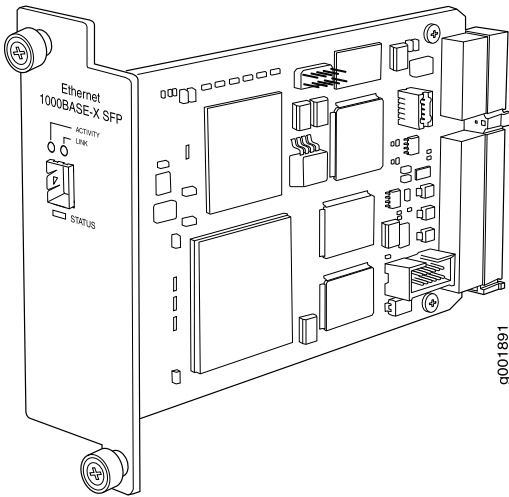


Figure 15: 2-Port Gigabit Ethernet PIC

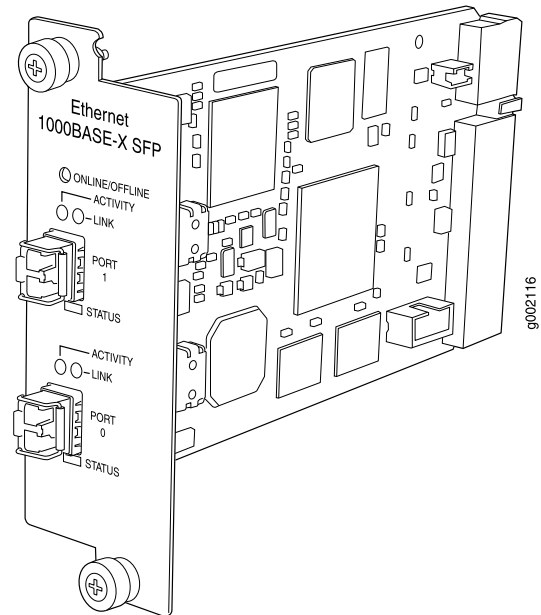


Figure 16: 4-Port Gigabit Ethernet PIC

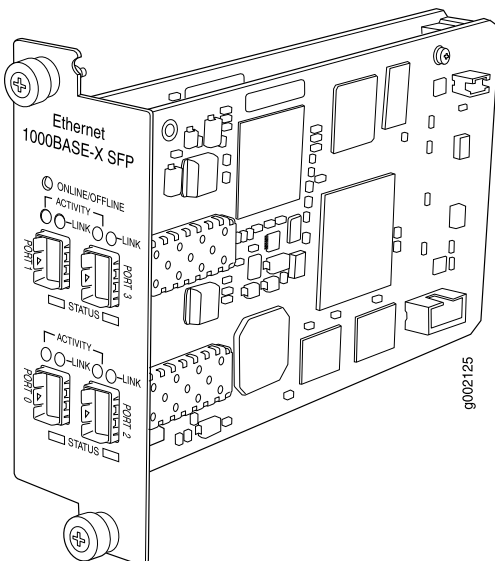
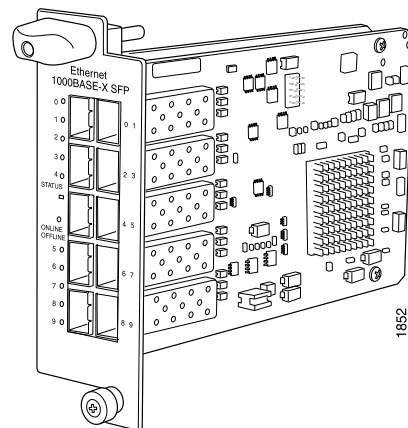


Figure 17: 10-Port Gigabit Ethernet PIC



Software release	• 1-port: Junos OS Release 6.4 and later (Type 1) • 2-port: Junos OS Release 6.4 and later (Type 2) • 4-port: Junos OS Release 7.0 and later (Type 2) • 10-port: Junos OS Release 6.2 and later (Type 3) For information on which FPCs support these PICs, see “M320 PIC/FPC Compatibility” on page 15.
Description	• One, two, four, or ten Gigabit Ethernet ports • Power requirement: • 1-port: 0.15 A @ 48 V (7.3 W) • 2-port: 0.25 A @ 48 V (11.9 W) • 4-port: 0.50 A @ 48 V (23.8 W) • 10-port: 0.62 A @ 48 V (29.9 W) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number for 1-Port Gigabit Ethernet PIC: PB-1GE-SFP Model number for 2-Port Gigabit Ethernet PIC: PB-2GE-SFP Model number for 4-Port Gigabit Ethernet PIC: PB-4GE-SFP Model number for 10-Port Gigabit Ethernet PIC: PC-10GE-SFP
Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Autonegotiation between Gigabit Ethernet circuit partners • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Virtual Router Redundancy Protocol (VRRP) support • 802.1q virtual LANs (VLANs) support • 960 destination MAC filters per port • Optical diagnostics and related alarms on the 2-port, 4-port, and 10-port PICs (Junos OS Release 8.2 and later) • Flexible Ethernet encapsulation on the 1-port, 2-port, and 4-port PICs • Multiple tag protocol identifiers (TPID) support on the 1-port, 2-port, and 4-port PICs • Source MAC learning on the 1-port, 2-port, and 4-port PICs • MAC accounting and policing—Dynamic local address learning of source MAC addresses on the 1-port, 2-port, and 4-port PICs • Passive monitoring for IPv4 packets on the 10-port PIC (Junos OS Release 11.1 and later) NOTE: The 10-port Gigabit Ethernet PIC with SFP does not support MAC accounting and policing, MAC learning, TPID, or flexible Ethernet encapsulation.

- Cables and connectors**
- You can install any transceiver supported by the PIC.
 - Fiber-optic SFP transceivers:
 - Duplex LC/PC connector (Rx and Tx)
 - 1000Base-LH (model number: SFP-1GE-LH)
 - 1000Base-LX (model number: SFP-1GE-LX)
 - 1000Base-SX (model number: SFP-1GE-SX)
 - Optical interface specifications—see [“Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 35](#)
 - 1000Base-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—See [“Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications” on page 31](#)
 - Copper SFP transceivers:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000Base-T (model number: SFP-1GE-T)
 - Copper interface specifications—see [Gigabit Ethernet 1000BASE-T Copper Interface Specifications](#)

NOTE: Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP.

LEDs

Status LED on the 1-port, 2-port, and 4-port PICs, one bicolor:

- Off—PIC is not enabled.
- Green—PIC is operating normally.
- Red—PIC has an error or failure.

NOTE: The **Status LED** on the 10-port PIC indicates the status of the links and not the status of the PIC.

Status LED on the 10-port PIC, one bicolor:

- Off—PIC is not enabled.
- Green—At least one cable is connected to a port and the link status is green.
- Red—No cables are connected to the ports, or the link status of the connected ports are red.

Port LEDs, one pair per port:

- **Link**—If green, the port is online; if there is no light, the port is down.
- **Activity**—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data.

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

Gigabit Ethernet IQ PICs with SFP (M320 Router)

Figure 18: 1-Port Gigabit Ethernet IQ PIC

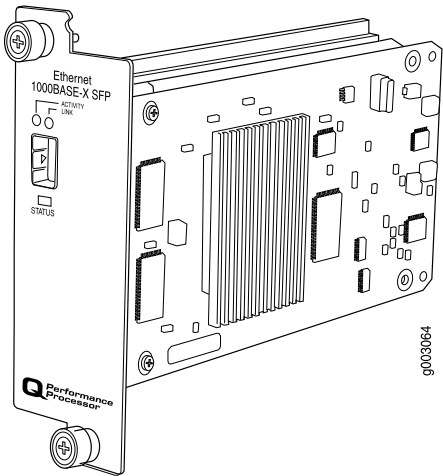
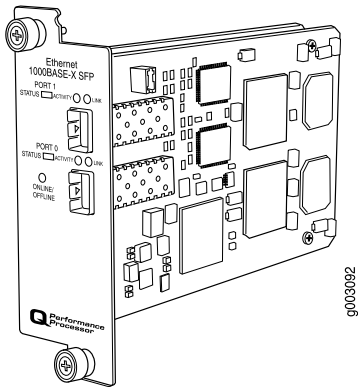


Figure 19: 2-Port Gigabit Ethernet IQ PIC



Software release	1-port: Junos OS Release 6.2 and later (Type 1) 2-port: Junos OS Release 6.2 and later (Type 2) For information on which FPCs support these PICs, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One or two Gigabit Ethernet ports - Power requirement: 0.46 A @ 48 V (22 W) - Fine-grained queuing per logical interface - Model number for 1-Port Gigabit IQ PIC: PB-1GE-SFP-QPP - Model number for 2-Port Gigabit IQ PIC: PB-2GE-SFP-QPP
Hardware features	- High-performance throughput on each port at speeds up to 1 Gbps - Full-duplex mode - Large MTUs of up to 9192 bytes
Software features	- Optical diagnostics and related alarms - Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) - Virtual Router Redundancy Protocol (VRRP) support 802.1q virtual LANs (VLANs) - VLAN stacking and rewriting - Flexible Ethernet encapsulation - MAC policing, accounts, and filters - Junos OS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES).

Cables and connectors

- You can install any transceiver supported by the PIC.
- Fiber-optic SFP transceivers:
 - Duplex LC/PC connector (Rx and Tx)
 - 1000Base-LH (model number: SFP-1GE-LH)
 - 1000Base-LX (model number: SFP-1GE-LX)
 - 1000Base-SX (model number: SFP-1GE-SX)
 - Optical interface specifications—see [“Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 35](#)
 - 1000Base-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—See [“Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications” on page 31](#)
- Copper transceivers:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000Base-T (model number: SFP-1GE-T)
 - Copper interface specifications—see [Gigabit Ethernet 1000BASE-T Copper Interface Specifications](#)

NOTE: Do not install SONET/SDH OC48c/STM16 SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.

LEDs

Status LED, one tricolor:

- Off—Not enabled.
- Green—Online with no alarms or failures.
- Yellow—Online with alarms for remote failures.
- Red—Active with a local alarm; router has detected a failure.

NOTE: The green status LED is lit on the 2-port Gigabit Ethernet IQ PIC when at least one port is online.

Port LEDs, one per port:

- Off—Port is down.
- Green—Link is established.

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

Gigabit Ethernet IQ2 PICs with SFP (M320 Router)

Figure 20: 4-Port Gigabit Ethernet IQ2 PIC (Type 1)

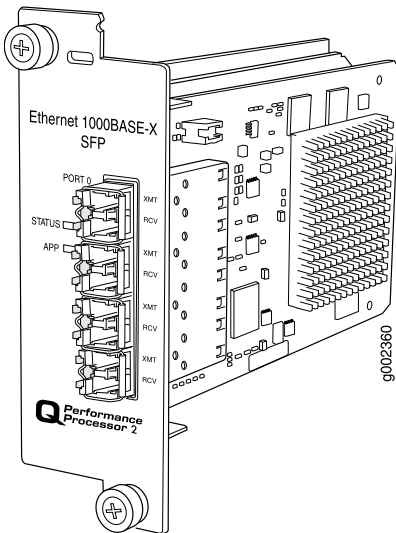


Figure 21: 8-Port Gigabit Ethernet IQ2 PIC (Type 2)

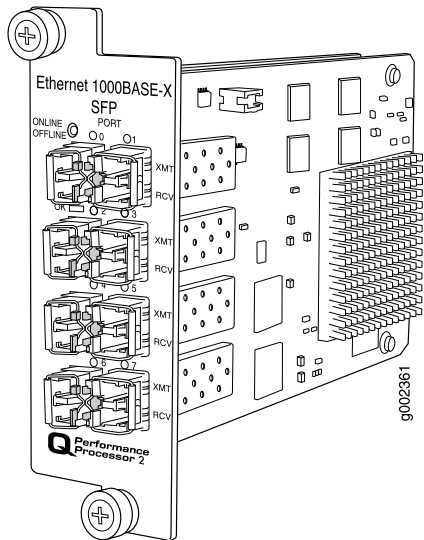
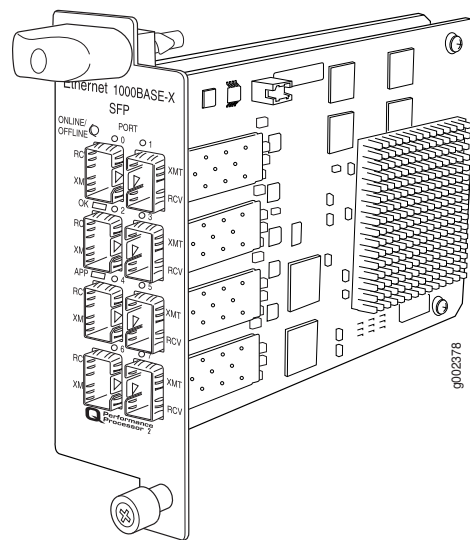


Figure 22: 8-Port Gigabit Ethernet IQ2 PIC (Type 3)



Software release

- 4-port: Junos OS Release 7.6R3 and later (Type 1)
- 8-port: Junos OS Release 7.6R2 and later (Type 2)

NOTE: M320 routers support no more than three 8-port Ethernet IQ2 PICs in an FPC2. [Table 61 on page 148](#) describes which PICs can be installed in the fourth slot of the FPC2.

- 8-port: Junos OS Release 8.2 and later (Type 3)

For information on which FPCs support these PICs, see [“M320 PIC/FPC Compatibility” on page 15](#).

Description

- Four or eight Gigabit Ethernet ports
- Power requirement:
 - 4-port: 0.65 A @ 48 V (31 W)
 - 8-port (Type 2): 0.89 A @ 48 V (42.5 W)
 - 8-port (Type 3): 1.25 A @ 48 V (60 W)
- Model number for 4-Port Gigabit Ethernet IQ2 PIC (Type 1): PB-4GE-TYPE1-SFP-IQ2
- Model number for 8-Port Gigabit Ethernet IQ2 PIC (Type 2): PB-8GE-TYPE2-SFP-IQ2
- Model number for 8-Port Gigabit Ethernet IQ2 PIC (Type 3): PB-8GE-TYPE3-SFP-IQ2

Hardware features

- High-performance throughput on each port:
 - 4-port with SFP: speeds up to 1 Gbps
 - 8-port with SFP: speeds up to 4 Gbps
- Full-duplex mode
- Large maximum transmission units (MTUs) of up to 9192 bytes

- Software features
- Intelligent handling of oversubscribed traffic for the Type 1 and Type 2 PICs
 - Optical diagnostics and related alarms
 - Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
 - Virtual Router Redundancy Protocol (VRRP) support
 - Hierarchical shaping
 - Fine-grained queuing and shaping per logical interface at both ingress and egress
 - 802.1q virtual LANs (VLANs)
 - VLAN stacking and rewriting
 - Channels defined by two stacked VLAN tags
 - Multiple tag protocol identifiers (TPID) support
 - IP service for nonstandard TPID and stacked VLAN tags
 - 802.1p rewrite per channel
 - Flexible mapping of channels and scheduler resources at both ingress and egress
 - Flexible Ethernet encapsulation
 - MAC learning, policing, accounting, and filtering

- Cables and connectors
- You can install any transceiver supported by the PIC.
 NOTE: Do not install SONET/SDH SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.
 - Fiber-optic small form-factor pluggable transceivers (SFPs):
 - Duplex LC/PC connector (Rx and Tx)
 - 1000Base-LH (model number: SFP-1GE-LH)
 - 1000Base-LX (model number: SFP-1GE-LX)
 - 1000Base-SX (model number: SFP-1GE-SX)
 - Optical interface specifications—see [“Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 35](#)
 - 1000Base-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—See [“Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications” on page 31](#)
 - Copper transceivers:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000Base-T (model number: SFP-1GE-T)
 - Copper interface specifications—see [Gigabit Ethernet 1000BASE-T Copper Interface Specifications](#)

LEDs

OK or Status LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the router.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure.

APP LED, one bicolor:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.

Port LEDs, one per port:

- Off—Port is not enabled.
- Green—Port is online with no alarms or failures.

Table 61: PICs Supported in Fourth Slot of FPC2 with Three 8-Port Ethernet IQ2 PICs on M320 Routers

PIC Name	PIC Model Number
Gigabit Ethernet, 2-port SFP	PB-2GE-SFP
Gigabit Ethernet, 4-port SFP	PB-4GE-SFP
Gigabit Ethernet IQ, 2-port SFP	PB-2GE-SFP-QPP
SONET/SDH OC12c/STM4, 4-port with multimode transceivers installed	PB-4OC12-SON-MM
SONET/SDH OC12c/STM4, 4-port with single-mode intermediate reach transceivers installed	PB-4OC12-SON-SMIR
SONET/SDH OC48/STM16, 1-port SFP	PB-1OC48-SON-SFP
Tunnel Services	PB-TUNNEL

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)

Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (M320 Router)

Figure 23: 4-Port Gigabit Ethernet IQ2E PIC (Type 1)

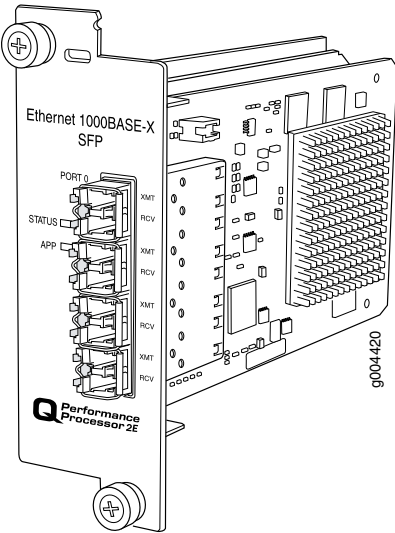


Figure 24: 8-Port Gigabit Ethernet IQ2E PIC (Type 2)

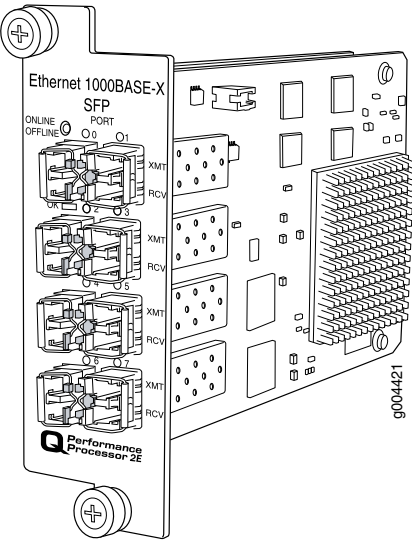
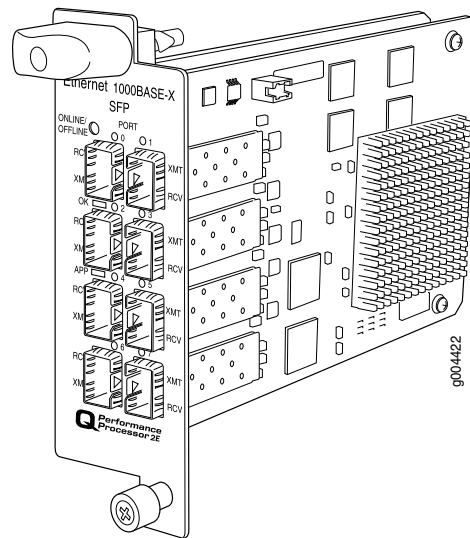


Figure 25: 8-Port Gigabit Ethernet IQ2E PIC (Type 3)



Software release

- 4-port: Junos OS Release 9.4 and later (Type 1)
- 8-port: Junos OS Release 9.4 and later (Type 2)

NOTE: M320 routers support no more than three 8-port Ethernet IQ2E PICs in an FPC2. [Table 62 on page 152](#) describes which PICs you can install in the fourth slot of the FPC2.

- 8-port: Junos OS Release 9.4 and later (Type 3)

For information on which FPCs support these PICs, see ["M320 PIC/FPC Compatibility" on page 15](#).

Description

- Four or eight Gigabit Ethernet ports
- Power requirement:
 - 4-port: 0.67 A @ 48 V (32 W)
 - 8-port (Type 2): 0.92 A @ 48 V (44 W)
 - 8-port (Type 3): 1.25 A @ 48 V (60 W)
- Model number for 4-Port Gigabit Ethernet IQ2E PIC (Type 1): PB-4GE-TYPE1-SFP-IQ2E
- Model number for 8-Port Gigabit Ethernet IQ2E PIC (Type 2): PB-8GE-TYPE2-SFP-IQ2E
- Model number for 8-Port Gigabit Ethernet IQ2E PIC (Type 3): PC-8GE-TYPE3-SFP-IQ2E

Hardware features

- High-performance throughput: speeds up to 1 Gbps on each port
- Full-duplex mode
- Large maximum transmission units (MTUs) of up to 9192 bytes

- Software features
- Intelligent handling of oversubscribed traffic for the Type 1 and Type 2 PICs
 - Optical diagnostics and related alarms
 - Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
 - Drop statistics reported per queue for each of four priority-based drop profiles
 - Four levels of strict priorities with priority propagation among scheduling levels
 - Hierarchical shaping and hierarchical scheduler
 - Virtual Router Redundancy Protocol (VRRP) support
 - Fine-grained queuing and shaping per logical interface at both ingress and egress
 - 802.1q virtual LANs (VLANs)
 - VLAN stacking and rewriting
 - Channels defined by two stacked VLAN tags
 - Multiple tag protocol identifiers (TPID) support
 - IP service for nonstandard TPID and stacked VLAN tags
 - 802.1p rewrite per channel
 - Flexible mapping of channels and scheduler resources at both ingress and egress
 - 16,000 schedulers (2,000 schedulers with 8 queues each or 4,000 schedulers with 4 queues each)
 - Scheduler resources dynamically allocated across ports
 - Flexible Ethernet encapsulation
 - MAC learning, policing, accounting, and filtering

- Cables and connectors
- You can install any transceiver supported by the PIC.
 NOTE: Do not install SONET/SDH SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.
 - Small form-factor pluggable transceivers (SFPs):
 - Duplex LC/PC connector (Rx and Tx)
 - Fiber-optic transceivers
 - 1000Base-LH (model number: SFP-IGE-LH)
 - 1000Base-LX (model number: SFP-IGE-LX)
 - 1000Base-SX (model number: SFP-IGE-SX)
 - Optical interface specifications—see [“Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 35](#)
 - 1000Base-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—See [“Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications” on page 31](#)
 - Copper transceivers:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000Base-T (model number: SFP-IGE-T)
 - Copper interface specifications—see [Gigabit Ethernet 1000BASE-T Copper Interface Specifications](#)

LEDs

OK or Status LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the router.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure.

APP LED, one bicolor:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.

Port LEDs, one per port:

- Off—Port is not enabled.
- Green—Port is online with no alarms or failures.

Table 62: PICs Supported in Fourth Slot of FPC2 with Three 8-Port Ethernet IQ2E PICs on M320 Routers

PIC Name	PIC Model Number
Gigabit Ethernet, 2-port SFP	PB-2GE-SFP
Gigabit Ethernet, 4-port SFP	PB-4GE-SFP
Gigabit Ethernet IQ, 2-port SFP	PB-2GE-SFP-QPP
SONET/SDH OC12c/STM4, 4-port with multimode transceivers installed	PB-4OC12-SON-MM
SONET/SDH OC12c/STM4, 4-port with single-mode intermediate reach transceivers installed	PB-4OC12-SON-SMIR
SONET/SDH OC48/STM16, 1-port SFP	PB-1OC48-SON-SFP
Tunnel Services	PB-TUNNEL

**Related
Documentation**

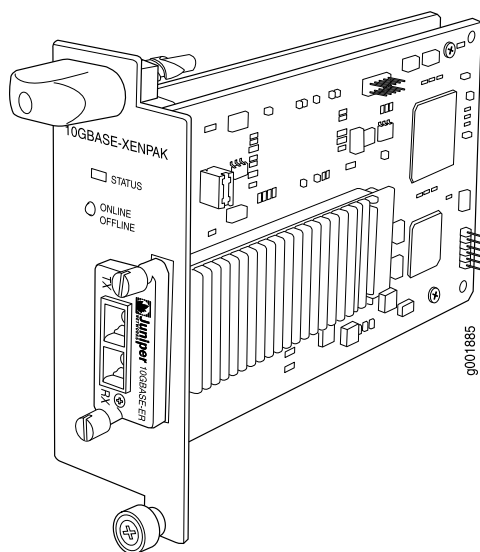
- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

CHAPTER 12

10-Gigabit Ethernet PIC Descriptions

- 10-Gigabit Ethernet PIC with XENPAK (M320 Router) on page 153
- 10-Gigabit Ethernet DWDM PIC (M320 Router) on page 155
- 10-Gigabit Ethernet IQ2 PIC with XFP (M320 Router) on page 156
- 10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (M320 Router) on page 158

10-Gigabit Ethernet PIC with XENPAK (M320 Router)



Software release

- 10GBASE-LR and 10GBASE-ER transceivers: Junos OS Release 6.2 and later (Type 3)
- 10GBASE-SR and 10GBASE-ZR transceivers: Junos OS Release 7.1 and later (Type 3)

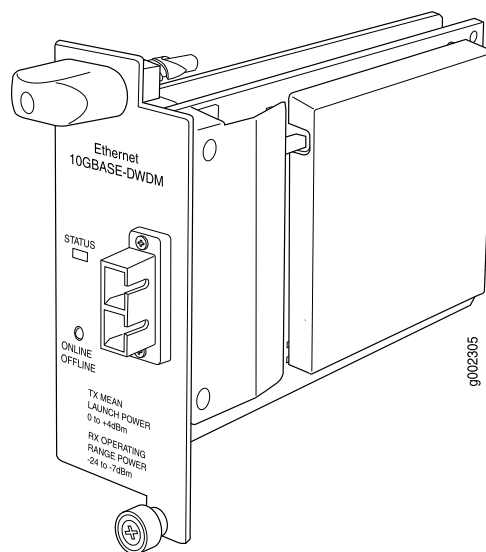
For information on which FPCs support this PIC, see [“M320 PIC/FPC Compatibility” on page 15](#).

Description

- One 10-Gigabit Ethernet port
 - Power requirement: 0.55 A @ 48 V (26.6 W)
 - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
 - Model number: PC-1XGE-XENPAK
-

Hardware features	• High-performance throughput at speeds up to 10 Gbps • Full-duplex mode • Maximum transmission units (MTUs) up to 9192 bytes • 64 source MAC address filters • 960 destination MAC filters
Software features	• Virtual Router Redundancy Protocol (VRRP) support • 802.1q virtual LANs (VLANs) support • 802.3ad link aggregation support • RMON EtherStats • Optical diagnostics and related alarms : • Transceiver temperature • Laser bias current • Laser output power • Receive optical power
Cables and connectors	• Duplex SC/PC connector (RX and TX) • 10-Gigabit Ethernet XENPAK transceivers: • Short Wavelength Serial (10GBase-SR), LAN Rate (model number: XENPAK-1XGE-SR) • Long Wavelength Serial (10GBase-LR), LAN Rate (model number: XENPAK-1XGE-LR) • Extra-Long Wavelength Serial (10GBase-ER), LAN Rate (model number: XENPAK-1XGE-ER) • Extra-Long Wavelength Serial (10GBase-ZR), LAN Rate (model number: XENPAK-1XGE-ZR) EOL (see notification PSN-2010-02-649) Optical interface specifications—see “10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 38
LEDs	Status LED, one bicolor: • Off—PIC not enabled. • Green—PIC is operating normally. • Red—PIC has an error or failure. Port LEDs, one pair: • Link—If green, the port is online; if there is no light, the port is down. • RX—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data.
Related Documentation	• <i>M320 PIC Description</i> • M320 PIC Combination Limitations on page 15 • M320 PICs Supported on page 3

10-Gigabit Ethernet DWDM PIC (M320 Router)



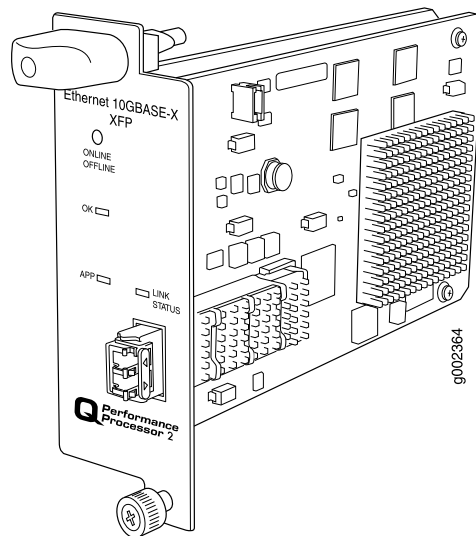
Software release	Junos OS Release 7.5 and later (Type 3) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One 10-Gigabit Ethernet port - Power requirement: 0.55 A @ 48 V (26.6 W) - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network - Model number: PC-1XGE-DWDM-CBAND
Hardware features	- C-band ITU-Grid with 100 GHz spacing - High-performance throughput at speeds up to 10 Gbps - Full-duplex mode - Maximum transmission units (MTUs) up to 9192 bytes 64 source MAC address filters 960 destination MAC filters 45 individual wavelengths: 1528.77 nm, 1529.55 nm, 1530.33 nm, 1531.12 nm, 1531.90 nm, 1532.68 nm, 1533.47 nm, 1534.25 nm, 1535.04 nm, 1535.82 nm, 1536.61 nm, 1537.40 nm, 1538.19 nm, 1538.98 nm, 1539.77 nm, 1540.56 nm, 1541.35 nm, 1542.14 nm, 1542.94 nm, 1543.73 nm, 1544.53 nm, 1545.32 nm, 1546.12 nm, 1546.92 nm, 1547.72 nm, 1548.52 nm, 1549.32 nm, 1550.12 nm, 1550.92 nm, 1551.72 nm, 1552.52 nm, 1553.33 nm, 1554.13 nm, 1554.94 nm, 1555.75 nm, 1556.56 nm, 1557.36 nm, 1558.17 nm, 1558.98 nm, 1559.79 nm, 1560.61 nm, 1561.42 nm, 1562.23 nm, 1563.05 nm, 1563.86 nm
Software features	- Enhanced optical monitoring capabilities - CLI configurable wavelength support - Virtual Router Redundancy Protocol (VRRP) support 802.1q virtual LANs (VLANs) support 802.3ad link aggregation support - RMON EtherStats

Cables and connectors	- Duplex SC/PC connector (RX and TX) - Fiber-optic 10-Gigabit DWDM transceivers: - Extra-Long Wavelength Serial DWDM, LAN Rate Optical interface specifications—see <i>10-Gigabit Ethernet DWDM Optical Interface Specifications</i>
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LEDs	Status LED, one bicolor: - Off—PIC is not enabled. - Green—PIC is operating normally. - Red—PIC has an error or failure. Port LEDs, one pair: - Link—If green, the port is online; if there is no light, the port is down. - RX—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data.
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Related Documentation	M320 PIC Description M320 PIC Combination Limitations on page 15 M320 PICs Supported on page 3
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10-Gigabit Ethernet IQ2 PIC with XFP (M320 Router)



Software release	Junos OS Release 8.0R3 and later (Type 3) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One 10-Gigabit Ethernet port - Power requirements: 1.2 A @48 V (56 W) - Model number: PC-1XGE-TYPE3-XF-IQ2

Hardware features	• High-performance throughput • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Large maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Configurable WAN-PHY mode options: • loopback • mpls • path-trace • trigger • Virtual Router Redundancy Protocol (VRRP) support • Hierarchical shaping • Fine-grained queueing and shaping per logical interface at both ingress and egress • 802.1q virtual LANs (VLANs) • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Multiple tag protocol identifiers (TPID) support • IP service for nonstandard TPID and stacked VLAN tags • 802.1p rewrite per channel • Flexible mapping of channels and scheduler resources at both ingress and egress • Flexible Ethernet encapsulation • MAC learning, policing, accounting, and filtering
Cables and connectors	• You can install any transceiver supported by the PIC. • Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers: • Duplex LC/PC connector (Rx and Tx) • 10-Gigabit Ethernet XFP transceivers: • 10GBase-S (model number: XFP-10G-S) • 10GBase-L (model number: XFP-10G-L-OC192-SR1) • 10GBase-E (model number: XFP-10G-E-OC192-IR2) • 10GBase-Z (model number: XFP-10G-Z-OC192-LR2) Optical interface specifications—see “10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 38

LEDs

OK LED, one tricolor:

- Off—PIC is offline and safe to remove from the router.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure.

APP LED, one:

- Off—Monitoring application is not running.
- Green—Monitoring application is running. under acceptable load
- Yellow—Monitoring application is overloaded.

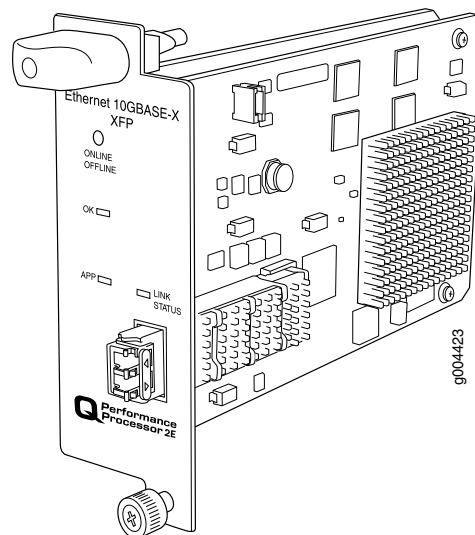
Link Status LED, one:

- Off—Port is down.
- Green—Port is online. Link is established.

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (M320 Router)



Software release

- Junos OS Release 9.4 and later (Type 3)
For information on which FPCs support this PIC, see "[M320 PIC/FPC Compatibility](#)" on page 15.

Description

- One 10-Gigabit Ethernet port
- Power requirements: 1.2 A @48 V (56 W)
- Model number: PC-1XGE-TYPE3-XFP-IQ2E

Hardware features	• High-performance throughput • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Large maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Drop statistics reported per queue for each of four priority-based drop profiles • Four levels of strict priorities with priority propagation among scheduling levels • Hierarchical shaping and hierarchical scheduler • Configurable WAN-PHY mode options: • loopback • mpls • path-trace • trigger • Virtual Router Redundancy Protocol (VRRP) support • Fine-grained queueing and shaping per logical interface at both ingress and egress • 802.1q virtual LANs (VLANs) • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Multiple tag protocol identifiers (TPID) support • IP service for nonstandard TPID and stacked VLAN tags • 802.1p rewrite per channel • Flexible mapping of channels and scheduler resources at both ingress and egress • 16,000 schedulers (2,000 schedulers with 8 queues each or 4,000 schedulers with 4 queues each) • Scheduler resources dynamically allocated across ports • Flexible Ethernet encapsulation • MAC learning, policing, accounting, and filtering
Cables and connectors	• You can install any transceiver supported by the PIC. • Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers: • Duplex LC/PC connector (Rx and Tx) • 10-Gigabit Ethernet XFP transceivers: • 10GBase-S (model number: XFP-10G-S) • 10GBase-L (model number: XFP-10G-L-OC192-SR1) • 10GBase-E (model number: XFP-10G-E-OC192-IR2) • 10GBase-Z (model number: XFP-10G-Z-OC192-LR2) Optical interface specifications—see “10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 38

LEDs

OK LED, one tricolor:

- Off—PIC is offline and safe to remove from the router.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure.

APP LED, one:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.
- Yellow—Monitoring application is overloaded.

Link Status LED, one:

- Off—Port is down.
- Green—Port is online. Link is established.

**Related
Documentation**

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

Services PIC Descriptions

- Multiservices PICs (M320 Router) on page 161
- Tunnel Services PIC (M320 Router) on page 165

Multiservices PICs (M320 Router)

Figure 26: Multiservices 100 PIC

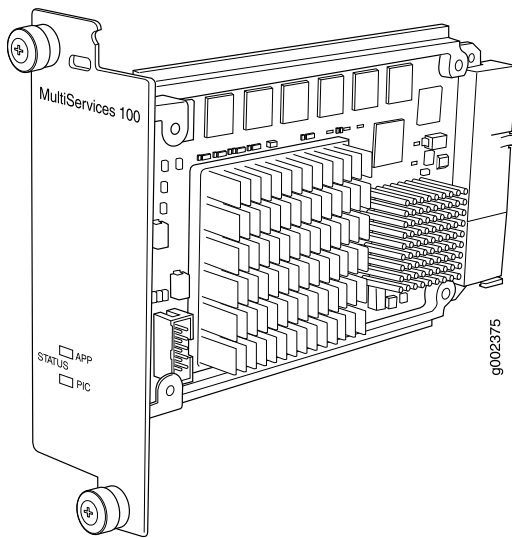


Figure 27: Multiservices 400 PIC

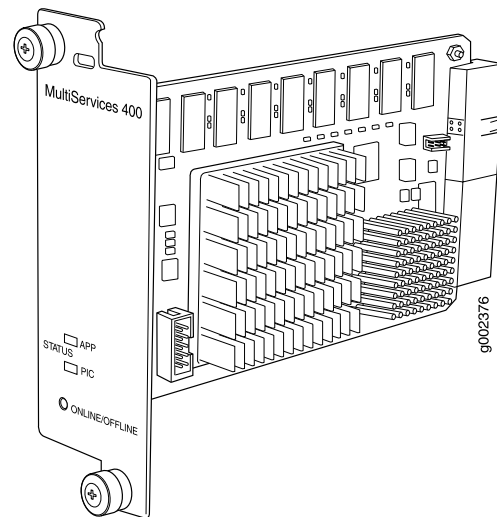
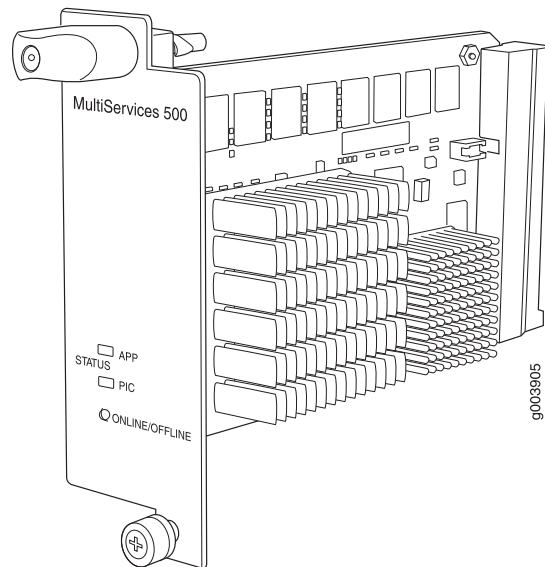


Figure 28: Multiservices 500 PIC**Software release**

- Multiservices 100: Junos OS Release 8.1 and later (Type 1)
- Multiservices 400: Junos OS Release 8.1R2 and later (Type 2)
- Multiservices 500: Junos OS Release 8.3 and later (Type 3)

For information on which FPCs support these PICs, see [“M320 PIC/FPC Compatibility” on page 15](#).

Description	• Supports tunnel services. This feature is included with the PIC and does not require an individual license. • Individual licenses must be purchased for additional services. • Power requirement: • Type 1: 0.52 A @ 48 V (25 W) • Type 2: 0.69 A @ 48 V (33 W) • Type 3: 0.83 A @ 48 V (40 W) • Model number for Multiservices 100 PIC: PB-MS100-1 • Model number for Multiservices 400 PIC: PB-MS-400-2 • Model number for Multiservices 500 PIC: PB-MS-500-3
Hardware features	• Active monitoring on: • Type 1: up to 1.6 million flows • Type 2: up to 3.2 million flows • Type 3: up to 3.2 million flows
Software features	• Support for up to 2000 service sets • Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces Depending on your Junos OS Release and individual licenses, software features for this PIC can include the features listed in Table 63 on page 163. For more information about the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>.
LEDs	Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the chassis. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one bicolor: • Off—Service is not running. • Green—Service is running under acceptable load. • Yellow—Service is overloaded.

Table 63: Multiservices PICs Software Features Supported on the M320 Router

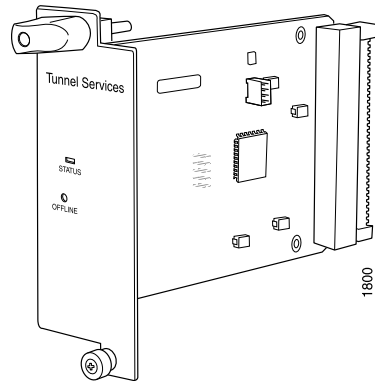
Software Feature	Multiservices 100	Multiservices 400	Multiservices 500
GRE Key	—	—	—
GRE dont-fragment	—	—	—
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	8.1	8.1R2	8.3
Network Address Translation (NAT) for IP addresses	8.1	8.1R2	8.3
Port Address Translation (PAT) for port numbers	8.1	8.1R2	8.3
IP Security (IPSec) encryption	8.1	8.1R2	8.5

Table 63: Multiservices PICs Software Features Supported on the M320 Router (*continued*)

Software Feature	Multiservices 100	Multiservices 400	Multiservices 500
Flow monitoring exports cflowd version 5 and version 8 records	8.1	8.1R2	8.3
Flow monitoring exports flow monitoring version 9 records, based on RFC 3954	8.3	8.3	8.5
Passive flow monitoring	–	8.4	–
Passive flow collection	–	8.5	–
Flow-tap	8.2	8.2	8.5
Dynamic flow capture	–	8.4	–
RPM	8.2	8.2	8.5
Link Services	8.1	8.1R2	8.5
Tunnel services: • IP-IP unicast tunneling • GRE unicast tunneling—Supports GRE fragmentation • Protocol Independent Multicast (PIM) sparse mode unicast tunneling	8.1	8.1R2	8.5
Virtual tunnel interface for Layer 3 VPNs	8.1	8.1R2	8.5
Layer 2 Tunneling Protocol (L2TP)	–	–	–
Voice services: • Compressed Real-Time Transport Protocol (CRTP)	8.1	8.1R2	8.5
Encapsulations: • Multilink Frame Relay (MLFR) • Multilink Point-to-Point Protocol (MLPP)	8.1	8.1R2	8.5

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)

Tunnel Services PIC (M320 Router)



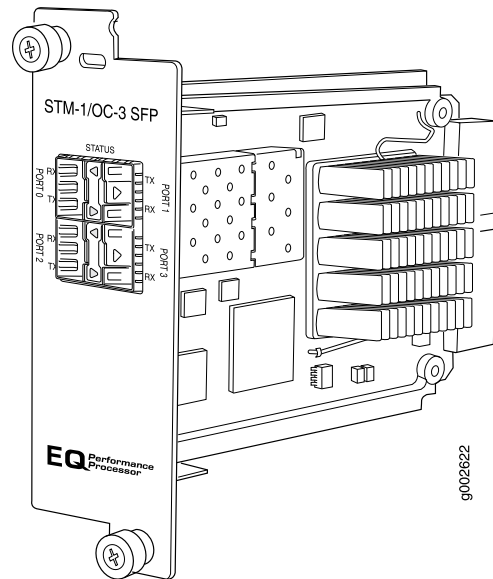
Software release	- Junos OS Release 6.2 and later (Type 1 and Type 2) - Junos OS Release 6.3 and later (Type 3) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	- Power requirement: 0.07 A @ 48 V (3.4 W) - Model number for Type 1 Tunnel Services PIC: PB-TUNNEL-1 - Model number for Type 2 Tunnel Services PIC: PB-TUNNEL - Model number for Type 3 tunnel Services PIC: PC-TUNNEL
Hardware features	- Loopback function that encapsulates and de-encapsulates packets - OC12/STM4 tunneling bandwidth on FPC1; OC48/STM16 tunneling bandwidth on FPC2; OC192/STM64 tunneling bandwidth on FPC3
Software features	For a list of the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>. - IP-IP unicast tunneling - GRE unicast tunneling - PIM sparse mode unicast tunneling
LEDs	One tricolor: - Off—Not enabled - Green—Online with no alarms or failures - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure
Related Documentation	M320 PIC Description M320 PIC Combination Limitations on page 15 M320 PICs Supported on page 3

CHAPTER 14

SONET/SDH PIC Descriptions

- [SONET/SDH OC3/STM1 Enhanced IQ \(IQE\) PIC with SFP \(M320 Router\) on page 168](#)
- [SONET/SDH OC3/STM1 \(Multi-Rate\) PICs with SFP \(M320 Router\) on page 171](#)
- [SONET/SDH OC12/STM4 Enhanced IQ \(IQE\) PIC with SFP \(M320 Router\) on page 174](#)
- [SONET/SDH OC12/STM4 \(Multi-Rate\) PICs with SFP \(M320 Router\) on page 177](#)
- [SONET/SDH OC48c/STM16 PICs with SFP \(M320 Router\) on page 180](#)
- [SONET/SDH OC48/STM16 Enhanced IQ \(IQE\) PIC with SFP \(M320 Router\) on page 183](#)
- [SONET/SDH OC48/STM16 \(Multi-Rate\) PIC with SFP \(M320 Router\) on page 187](#)
- [SONET/SDH OC192c/STM64 PIC \(M320 Router\) on page 190](#)
- [SONET/SDH OC192/STM64 PIC with XFP \(M320 Router\) on page 193](#)

SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M320 Router)



Software release	Junos OS Release 9.3R2 and later (Type 1) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	- Four OC3 or STM1 ports - SONET or SDH is configurable on a per-port granularity - Power requirement: 0.6 A @ 48 V (28.8 W) - Model number: PB-4OC3-STM1-IQE-SFP
Hardware features	- Top row: Ports are numbered 0 and 1 from left to right - Bottom row: Ports are numbered 2 and 3 from left to right

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Enhanced fine-grained queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices</i> for more information about class of service features. • Packet buffering, Layer 2 parsing • Local line and remote payload loopback testing • Simple Network Management Protocol (SNMP): OC3 MIB • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Extended Frame Relay for CCC and TCC • Flexible Frame Relay • Frame Relay • Frame Relay for CCC • Frame Relay for TCC • Frame Relay port CCC • High-Level Data Link Control (HDLC) • HDLC framing for CCC • HDLC framing for TCC • MPLS CCC • MPLS TCC • Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16) • Point-to-Point Protocol (PPP) • PPP for CCC • PPP for TCC
Cables and connectors	• Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 fiber-optic SFP transceivers: • Multimode (model number: SFP-OC3-SR) • Intermediate reach (IR-1) (model number: SFP-OC3-IR) • Long reach (LR-1) (model number: SFP-OC3-LR) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43
LEDs	One tricolor Status LED per port: • Off—Not enabled. • Green—Online with no alarms or failures. • Yellow—Online with alarms for remote failures. • Red—Active with a local alarm; router has detected a failure.
Alarms, errors, and events	• SONET alarms: • Alarm indication signal—line (AIS-L) • Alarm indication signal—path (AIS-P) • Bit error rate—signal degrade (BERR-SD) • Bit error rate—signal fail (BERR-SF) • Loss of frame (LOF) • Loss of light (LOL)

- Loss of pointer (LOP)
- Loss of signal (LOS)
- Payload label mismatch (PLM-P)
- Phase lock loop (PLL)
- Remote defect indication—line (RDI-L)
- Remote defect indication—path (RDI-P)
- Remote error indication (REI)
- Payload unequipped (unequipped STS at path level) (UNEQ-P)
- Severely errored frames (SEF)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receive failure (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive failure (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
 - Phase lock loop (PLL)
 - Remote error indication (REI)
 - Severely errored frames (SEF)
- Error detection:
 - Errored seconds (ES-S, ES-L, ES-P)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

**Related
Documentation**

- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (M320 Router)

Figure 29: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 1)

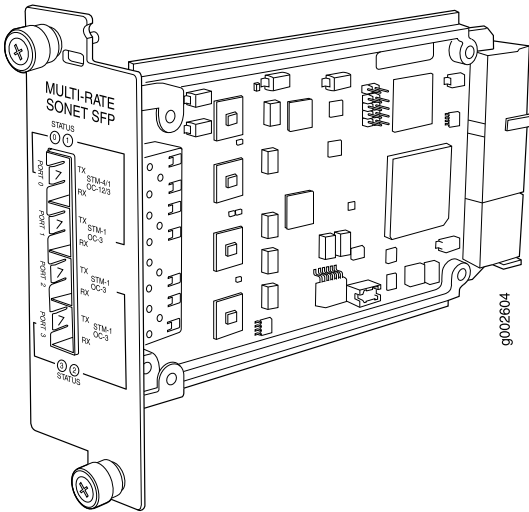
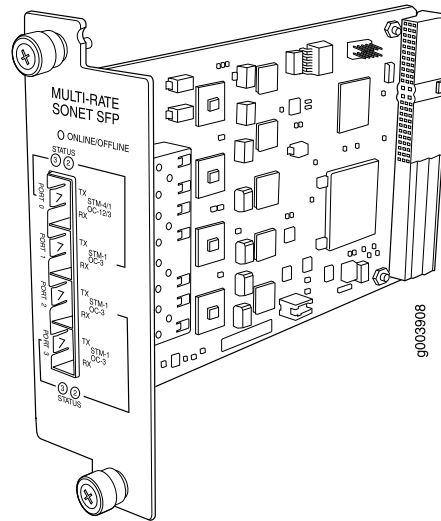


Figure 30: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 2)



Software release

- 4-port: Junos OS Release 8.4 and later (Type 1)
- 4-port: Junos OS Release 8.3 and later (Type 2)

For information on which FPCs support these PICs, see ["M320 PIC/FPC Compatibility"](#) on page 15.

Description

- Rate-selectable using one of the following rates:
 - 1-port OC12
 - 1-port OC12c
 - 4-port OC3c
- Power requirement: 0.40 A @ 48 V (19 W)
- Model number for SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 1): PB-4OC3-1OC12-SON-SFP
Model number for SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 2): PB-4OC3-1OC12-SON2-SFP

Hardware features

- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

- | | |
|-------------------|---|
| Software features | <ul style="list-style-type: none"> • Optical diagnostics and related alarms • Per-port SONET/SDH framing • Link aggregation • Alarm and event counting and detection • Dual-router automatic protection switching (APS) • Multiprotocol Label Switching (MPLS) fast reroute • Encapsulations: <ul style="list-style-type: none"> • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP) |
|-------------------|---|

- | | |
|-----------------------|---|
| Cables and connectors | <p>You can install any transceiver supported by the PIC.</p> <ul style="list-style-type: none"> • Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers: <ul style="list-style-type: none"> • Multimode (model number: SFP-OC3-SR) • Intermediate reach (IR-1) (model number: SFP-OC3-IR) • Long reach (LR-1) (model number: SFP-OC3-LR) <p>Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43</p> • SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers: <ul style="list-style-type: none"> • Short reach (model number: SFP-OC12-SR) • Intermediate reach (IR-1) (model number: SFP-OC312-IR) • Long reach (LR-1) (model number: SFP-OC12-LR) <p>Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46</p> <p>NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the <i>Junos System Basics and Services Command Reference</i>.</p> |
|-----------------------|---|

- | | |
|------|---|
| LEDs | <p>One tricolor per port:</p> <ul style="list-style-type: none"> • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure |
|------|---|

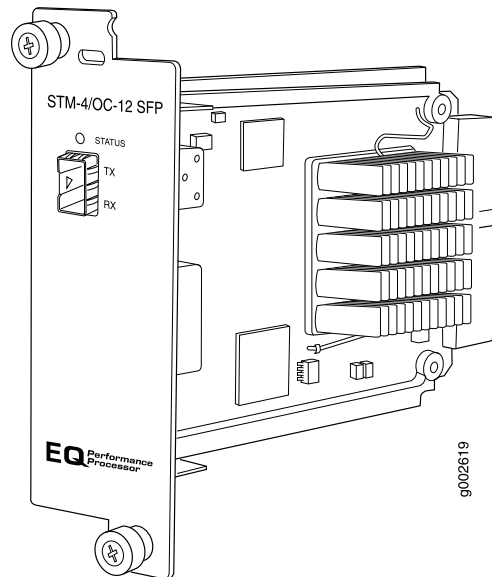
Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
- Error detection:
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored frames (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M320 Router)



Software release	Junos OS Release 9.3 and later (Type 1) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	- One OC12/STM4 port - SONET or SDH is configurable on a per-port granularity - Power requirement: 0.58 A @ 48 V (27.8 W) - Model number: PB-1OC12-STM4-IQE-SFP
Hardware features	Port is numbered 0.
Software features	- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) - Enhanced fine-grained queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices</i> for more information about class of service features. - Packet buffering, Layer 2 parsing - Local line and remote payload loopback testing - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Extended Frame Relay for CCC and TCC - Flexible Frame Relay - Frame Relay - Frame Relay for CCC - Frame Relay for TCC - Frame Relay port CCC - High-Level Data Link Control (HDLC) - HDLC framing for CCC

- HDLC framing for TCC
- MPLS CCC
- MPLS TCC
- Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
- Point-to-Point Protocol (PPP)
- PPP for CCC
- PPP for TCC
- Encapsulations available only for DS1:
 - Multilink Frame Relay end-to-end (MLFR FRF.15)
 - Multilink PPP (MLPPP)
 - PPP over Frame Relay

Cables and connectors

- Duplex LC/PC connector (Rx and Tx)
- SONET/SDH OC12/STM4 fiber-optic SFP transceivers:
 - Short reach (model number: SFP-OC12-SR)
 - Intermediate reach (IR-1) (model number: SFP-OC12-IR)
 - Long reach (LR-1) (model number: SFP-OC12-LR)

Optical interface specifications—see [“SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46](#)

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of pointer (LOP)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
 - Remote error indication (REI)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receive failure (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive failure (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
 - Phase lock loop (PLL)
 - Remote error indication (REI)
 - Severely errored frame (SEF)

Instrumentation (counters)

- Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (M320 Router)

Figure 31: 1-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC

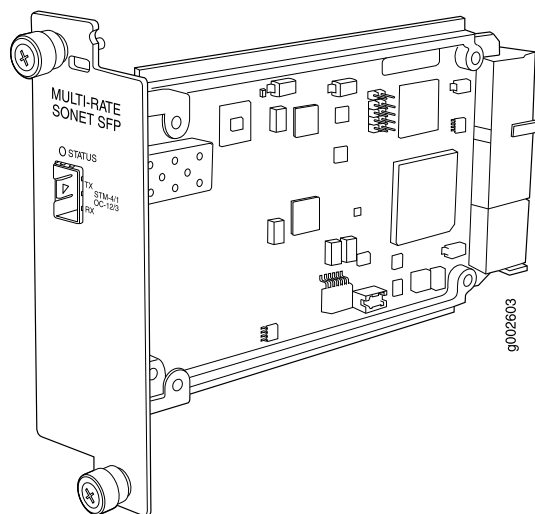
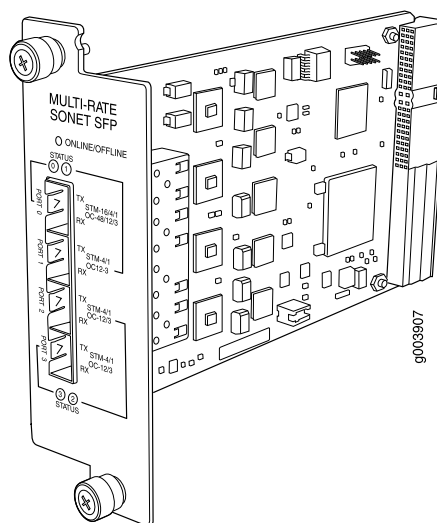


Figure 32: 4-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC



Software release

- 1-port: Junos OS Release 8.4 and later (Type 1)
- 4-port: Junos OS Release 8.3 and later (Type 2)

For information on which FPCs support these PICs, see ["M320 PIC/FPC Compatibility"](#) on page 15.

Description

- 1-port: Rate-selectable using one of the following rates:
 - 1-port OC3/STM1
 - 1-port OC12/STM4
 - 1-port OC12c/STM4c
- 4-port: Rate-selectable using one of the following rates:
 - 1-port OC12/STM4
 - 1-port OC48/STM16
 - 1-port OC48c/STM4c
 - 4-port OC3c/STM1c
 - 4-port OC12c/STM4c
- Power requirement:
 - 1-port: 0.20 A @ 48 V (9.5 W)
 - 4-port: 0.40 A @ 48 V (19 W)
- Model number for 1-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC: PB-1OC12-SON-SFP
- Model number for 4-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC: PB-4OC3-4OC12-SON-SFP

Hardware features	• Multiplexing and demultiplexing • Rate policing on input • Rate shaping on output • Packet buffering, Layer 2 parsing
Software features	• Optical diagnostics and related alarms • Per-port SONET/SDH framing • Link aggregation • Alarm and event counting and detection • Dual-router automatic protection switching (APS) • Multiprotocol Label Switching (MPLS) fast reroute • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
Cables and connectors	You can install any transceiver supported by the PIC. • Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers: • Multimode (model number: SFP-OC3-SR) • Intermediate reach (IR-1) (model number: SFP-OC3-IR) • Long reach (LR-1) (model number: SFP-OC3-LR) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43 • SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers: • Short reach (model number: SFP-OC12-SR) • Intermediate reach (IR-1) (model number: SFP-OC312-IR) • Long reach (LR-1) (model number: SFP-OC12-LR) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46 NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

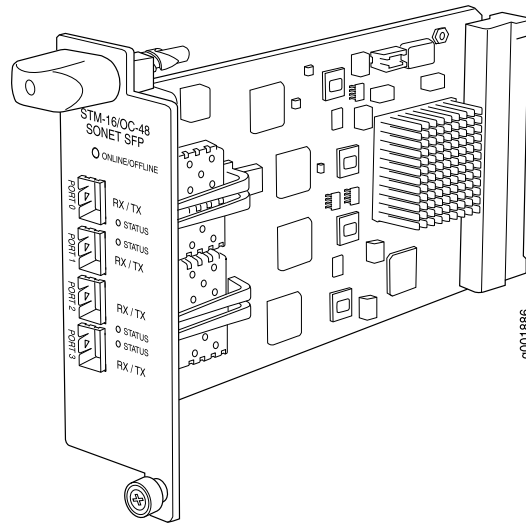
Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
- Error detection:
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored frames (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

SONET/SDH OC48c/STM16 PICs with SFP (M320 Router)



Software release	Junos OS Release 6.2 and later (Type 3) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Four OC48 ports - Power requirement: 0.86 A @ 48 V (41.4 W) - Model number: PC-4OC48-SON-SFP
Hardware features	- Multiplexing and demultiplexing on the 1-port PIC - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- Optical diagnostics and related alarms - Configuration of SONET or SDH framing on a per-port basis (Junos OS Release 8.1 and later) - SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Frame Relay - High-Level Data Link Control (HDLC) - Point-to-Point Protocol (PPP)

Cables and connectors	You can install any transceiver supported by the PIC. For information about installing and removing transceivers. • Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC48/STM16 small form-factor pluggable (SFP) transceivers: • Short reach (SR-1) (model number: SFP-1OC48-SR) • Intermediate reach (IR-1) (model number: SFP-1OC48-IR) • Long reach (LR-1) (model number: SFP-1OC48-LR) Optical interface specifications—see “SONET/SDH OC48/STM16 Optical Interface Specifications” on page 48 NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

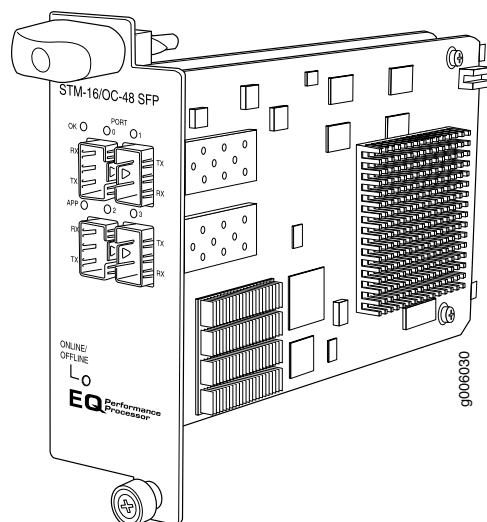
Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
- Error detection:
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored frames (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (M320 Router)



Software release	Junos OS Release 10.4R2 and later (Type 3) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Four OC48/STM16 ports - Clear channel functionality - SONET and SDH is configured on a per-port granularity - Power requirement: 1.06 A @ 48 V (51 W) - Weight: 1.6 lb (0.725 kg) - Model number: PC-4OC48-STM16-IQE-SFP
Hardware features	- Ports are numbered: - Top row: 0 and 1 from left to right - Bottom row: 2 and 3 from left to right - Maximum transmission units (MTUs) of up to 9192 bytes

Software features

- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
- Fine-grained egress queuing per logical interface. See the *Class of Service Feature Guide for Routing Devices* for more information about class-of-service features
- Packet buffering
- Local line and remote payload loopback testing
- Optical diagnostics and monitoring
- Clocking options: internal or external/loop mode. Each OC48 transmitter port is configured either in internal or external mode. The default clocking option is internal mode.
- Encapsulations:
 - Extended Frame Relay for circuit cross-connect (CCC) and translational cross-connect (TCC)
 - Flexible Frame Relay
 - Frame Relay
 - Frame Relay for CCC
 - Frame Relay for TCC
 - Frame Relay port CCC
 - High-Level Data Link Control (HDLC)
 - HDLC framing for CCC
 - HDLC framing for TCC
 - MPLS CCC
 - MPLS TCC
 - Point-to-Point Protocol (PPP)
 - PPP for CCC
 - PPP for TCC

Cables and connectors

You can install any transceiver supported by the PIC.

- Duplex LC/PC connector (Rx and Tx)
- SONET/SDH OC48/STM16 small form-factor pluggable (SFP) transceivers:
 - Short reach (SR-1) (model number: SFP-IOC48-SR)
 - Intermediate reach (IR-1) (model number: SFP-IOC48-IR)
 - Long reach (LR-1) (model number: SFP-IOC48-LR)

Optical interface specifications—see “[SONET/SDH OC48/STM16 Optical Interface Specifications](#)” on page 48

NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the *JUNOS System Basics and Services Command Reference*.

LEDs

OK LED, one tricolor:

- Off—PIC is offline and safe to remove from the router
- Green—PIC is operating normally
- Yellow—PIC is initializing
- Red—PIC has an error or failure

APP LED, one green per port:

- Off—Service is not running
- Green—Service is running under acceptable load

Port LEDs, one tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events**SONET alarms:**

- Loss of light (LOL)
- Phase lock loop (PLL)
- Loss of frame (LOF)
- Loss of signal (LOS)
- Severely errored frame (SEF)
- Alarm indicator signal—line (AIS-L)
- Alarm indicator signal—path (AIS-P)
- Loss of pointer (LOP)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate—signal fail (BERR-SF)
- Remote defect indicator—line (RDI-L)
- Remote defect indicator—path (RDI-P)
- Remote error indicator (REI)
- Unequipped (UNEQ)
- Payload label mismatch—path (PLM-P)

SDH alarms:

- Loss of light (LOL)
- Phase lock loop (PLL)
- Loss of frame (LOF)
- Loss of signal (LOS)
- Severely errored frame (SEF)
- Multiplex-section alarm indicator signal (MS-AIS)
- H Path alarm indicator signal (HP-AIS)
- Loss of pointer (LOP)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate—signal fail (BERR-SF)
- Multiplex section—far end receive failure (MS-FERF)
- High order path—far end receive failure (HP-FERF)
- Remote error indicator (REI)
- Unequipped (UNEQ)
- High order path—payload label mismatch - Path (HP-PLM)

Optical diagnostics related alarms:

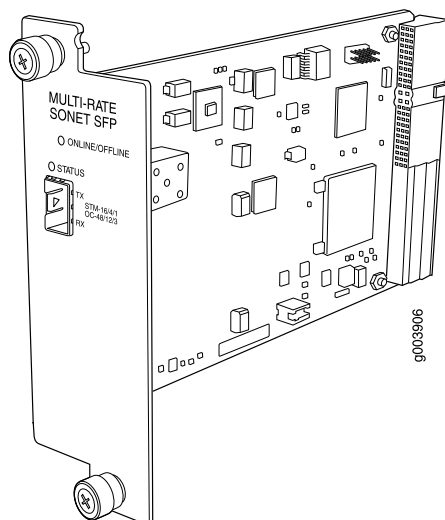
NOTE: Transceivers from some vendors do not support these fields.

- Temperature high/low alarms and warnings
- Supply voltage high/low alarms and warnings
- Tx bias current high/low alarms and warnings
- Tx output power high/low alarms and warnings
- Rx received power high/low alarms and warnings

Related Documentation

- *M320 PIC Description*
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (M320 Router)



Software release	Junos OS Release 8.3 and later (Type 2) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Rate-selectable using one of the following rates: 1-port OC3c 1-port OC12 1-port OC12c 1-port OC48 1-port OC48c - Power requirement: 0.20 A @ 48 V (9.5 W) - Model number: PB-1OC48-SON-B-SFP
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing

- | | |
|-------------------|---|
| Software features | <ul style="list-style-type: none"> • Optical diagnostics and related alarms • Per-port SONET/SDH framing • Link aggregation • Alarm and event counting and detection • Dual-router automatic protection switching (APS) • Multiprotocol Label Switching (MPLS) fast reroute • Encapsulations: <ul style="list-style-type: none"> • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP) |
|-------------------|---|

- | | |
|-----------------------|--|
| Cables and connectors | <p>You can install any transceiver supported by the PIC.</p> <ul style="list-style-type: none"> • Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers: <ul style="list-style-type: none"> • Multimode (model number: SFP-OC3-SR) • Intermediate reach (IR-1) (model number: SFP-OC3-IR) • Long reach (LR-1) (model number: SFP-OC3-LR) <p>Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43</p> • SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers: <ul style="list-style-type: none"> • Short reach (model number: SFP-OC12-SR) • Intermediate reach (IR-1) (model number: SFP-OC312-IR) • Long reach (LR-1) (model number: SFP-OC12-LR) <p>Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46</p> • SONET/SDH OC48/STM16 small form-factor pluggable (SFP) transceivers: <ul style="list-style-type: none"> • Short reach (SR-1) (model number: SFP-1OC48-SR) • Intermediate reach (IR-1) (model number: SFP-1OC48-IR) • Long reach (LR-1) (model number: SFP-1OC48-LR) <p>Optical interface specifications—see “SONET/SDH OC48/STM16 Optical Interface Specifications” on page 48</p> <p>NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the CLI Explorer.</p> |
|-----------------------|--|

- | | |
|------|---|
| LEDs | <p>One tricolor per port:</p> <ul style="list-style-type: none"> • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure |
|------|---|

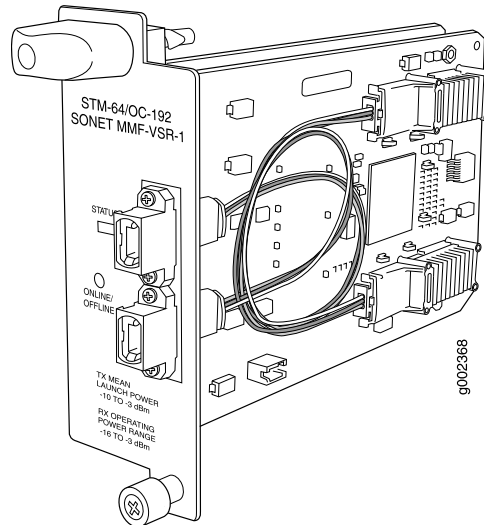
Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
- Error detection:
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored frames (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

SONET/SDH OC192c/STM64 PIC (M320 Router)



Software release	Junos OS Release 6.2 and later (Type 3) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- One OC192 port - Power requirement: 0.45 A @ 48 V (21.6 W) - Model number: PB-1OC192-SON-VSR
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Frame Relay - High-Level Data Link Control (HDLC) - Point-to-Point Protocol (PPP)

Cables and connectors	• 12-ribbon multimode fiber with MTP connector (Rx and Tx) • SONET/SDH OC192/STM64 fixed very short reach (VSR 1): transceiver Optical interface specifications—see “SONET/SDH OC192/STM64 Optical Interface Specifications” on page 50 NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

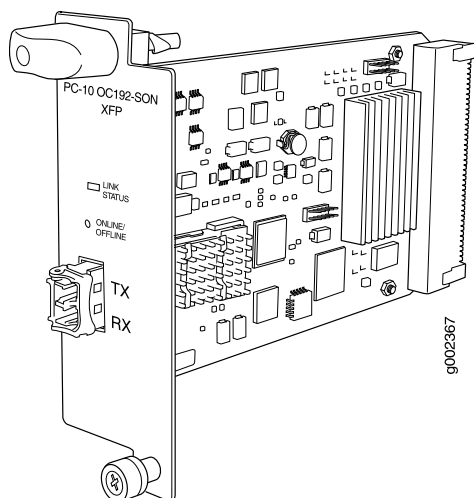
Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
- Error detection:
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored frames (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

SONET/SDH OC192/STM64 PIC with XFP (M320 Router)



Software release	1-port: Junos OS Release 8.1 and later (Type 3) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	- One OC192 port - Power requirement: 0.52A @ 48 V (25 W) - Model number: PB-1OC192-SON-XFP
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Frame Relay - High-Level Data Link Control (HDLC) - Point-to-Point Protocol (PPP)

Cables and connectors	- Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers: - Connector: Duplex LC/PC (Rx and Tx) - Short reach (SR-1) (model number: XFP-10G-L-OC192-SR1) - Intermediate reach (IR-2) (model number: XFP-10G-E-OC192-IR2) - Long reach (LR-2) (model number: XFP-10G-Z-OC192-LR2) Optical interface specifications—see “SONET/SDH OC192/STM64 Optical Interface Specifications” on page 50 NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the CLI Explorer.
LEDs	One tricolor LED per port: - Off—Not enabled - Green—Online with no alarms or failures - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
- Error detection:
 - Errored seconds (ES-S, ES-L, ES-P)
 - Far-end errored seconds (ES-LFE, ES-PFE)
 - Far-end severely errored seconds (SES-LFE, SES-PFE)
 - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
 - Severely errored framing (SEF)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

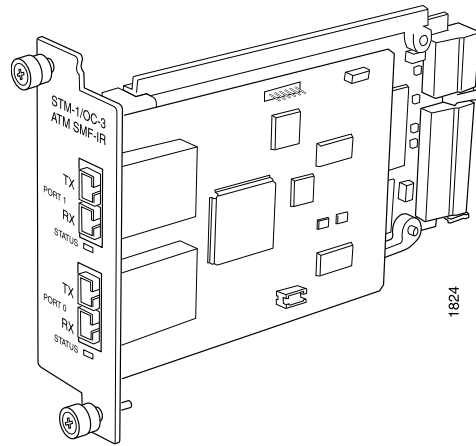
- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

CHAPTER 15

End-of-Life PIC Descriptions

- [ATM OC3 EOL PIC \(M320 Router\) on page 198](#)
- [ATM OC12 EOL PIC \(M320 Router\) on page 199](#)
- [Channelized DS3 EOL PIC \(M320 Router\) on page 201](#)
- [Channelized OC12 EOL PIC \(M320 Router\) on page 202](#)
- [Multichannel DS3 EOL PIC \(M320 Router\) on page 204](#)
- [Channelized E1 IQ EOL PIC \(M320 Router\) on page 206](#)
- [Channelized OC12 IQ EOL PIC \(M320 Router\) on page 207](#)
- [DS3 EOL PIC \(M320 Router\) on page 210](#)
- [Gigabit Ethernet EOL PICs \(M320 Router\) on page 211](#)
- [10-Gigabit Ethernet EOL PIC \(M320 Router\) on page 213](#)
- [Adaptive Services II EOL PIC \(M320 Router\) on page 215](#)
- [Adaptive Services II Layer 2 Services EOL PIC \(M320 Router\) on page 217](#)
- [Adaptive Services II FIPS EOL PIC \(M320 Router\) on page 220](#)
- [ES EOL PIC \(M320 Router\) on page 222](#)
- [Link Services EOL PIC \(M320 Router\) on page 223](#)
- [Monitoring Services II EOL PIC \(M320 Router\) on page 224](#)
- [Monitoring Services III EOL PIC \(M320 Router\) on page 226](#)
- [SONET/SDH OC3c/STM1 EOL PICs \(M320 Router\) on page 227](#)
- [SONET/SDH OC12c/STM4 EOL PICs \(M320 Router\) on page 230](#)
- [SONET/SDH OC48c/STM16 EOL PICs \(M320 Router\) on page 233](#)
- [SONET/SDH OC48c/STM16 EOL PIC with SFP \(M320 Router\) on page 236](#)
- [SONET/SDH OC192c/STM64 EOL PICs \(M320 Router\) on page 238](#)

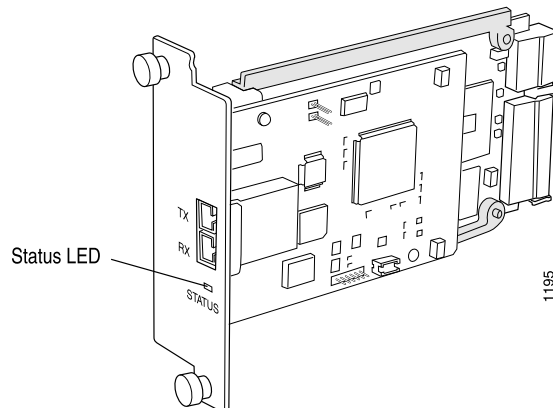
ATM OC3 EOL PIC (M320 Router)



Software release	Junos OS Release 6.3 and later
Description	- Two OC3 ports - Power requirement: 0.49 A @ 48 V (23.7 W) - Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 - ATM and SONET/SDH standards compliant - Alarm and event counting and detection - Compatible with well-known ATM switches - ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches
Hardware features	- Dual 3010 SAR for segmentation and reassembly into 53-byte ATM cells - High-performance parsing of SONET/SDH frames - OAM fault management processes alarm indication signal (AIS) and remote defect indicator (RDI) cells - ASIC-based packet segmentation and reassembly (SAR) management and output port queuing 16-MB SDRAM memory for ATM SAR - Packet buffering, Layer 2 parsing
Software features	- Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) for leveraging ATM access networks - Support for user-configurable virtual circuits (VC) and virtual paths (VP) - ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC) - Unspecified bit rate (UBR) traffic shaping - Fine-grained variable bit rate (VBR) traffic shaping - Outbound PIC queues cells on a per-VC basis - Encapsulations—AAL5 subnetwork attachment point (SNAP)

Cables and connectors	- Duplex SC/PC connector (RX and TX) - SONET/SDH OC3/STM1 fixed transceivers: - Multimode - Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43
LEDs	One tricolor per port: - Off—Not enabled - Green—Online with no alarms or failures - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	- Alarm indication signal (AIS-L, AIS-P) - Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF) - Bit interleaved parity errors B1, B2, B3 - Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE) - Loss of cell delineation (LOC), loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS) - Payload mismatch (PLM-P), payload unequipped (UNEQ-P) - Remote defect indication (RDI-L, RDI-P) - Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)
Related Documentation	M320 PIC Description M320 End-of-Life PICs Supported on page 12

ATM OC12 EOL PIC (M320 Router)

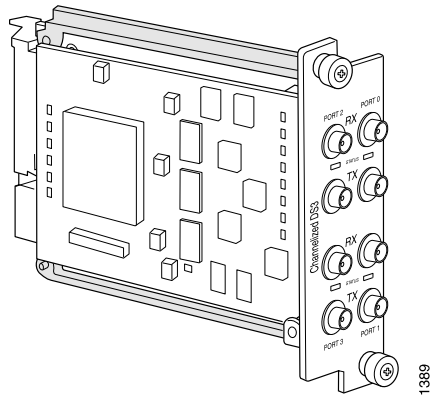


Software release	Junos OS Release 6.3 and later
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Description	• One OC12 port • Power requirement: 0.43 A @ 48 V (20.8 W) • Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 • ATM and SONET/SDH standards compliant • Alarm and event counting and detection • Compatible with well-known ATM switches • ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches
Hardware features	• High-performance parsing of SONET/SDH frames • OAM fault management processes Alarm indication signal (AIS) and remote defect indicator (RDI) cells • ASIC-based packet segmentation and reassembly (SAR) management and output port queuing • 16-MB SDRAM memory for ATM SAR • Packet buffering, Layer 2 parsing
Software features	• Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) for leveraging ATM access networks • Support for user-configurable virtual circuits (VC) and virtual paths (VP) • ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC) • Unspecified bit rate (UBR) traffic shaping • Fine-grained variable bit rate (VBR) traffic shaping • Outbound PIC queues cells on a per-VC basis • Encapsulations—AAL5 subnetwork attachment point (SNAP)
Cables and connectors	• Duplex SC/PC connector (RX and TX) • SONET/SDH OC12/STM4 fixed transceivers: • Multimode • Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS-L, AIS-P) • Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF) • Bit interleaved parity errors B1, B2, B3 • Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE) • Loss of cell delineation (LOC), loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS) • Payload mismatch (PLM-P), payload unequipped (UNEQ-P) • Remote defect indication (RDI-L, RDI-P) • Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 End-of-Life PICs Supported on page 12](#)

Channelized DS3 EOL PIC (M320 Router)

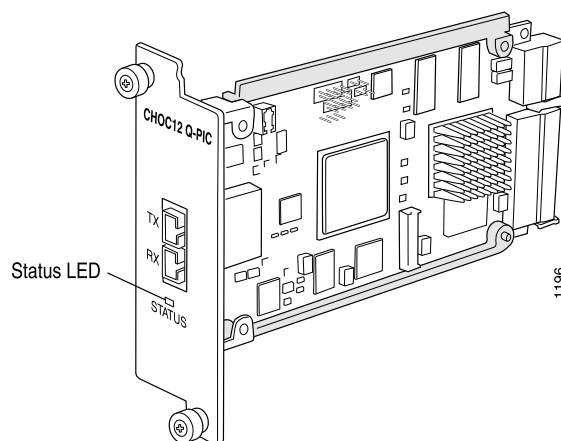


Software release	• Junos OS Release 6.3 and later
Description	• Four DS3 ports • Power requirement: 0.32 A @ 48 V (15.6 W) • Supports up to 28 T1 channels per port • Data Service Unit (DSU) functionality
Hardware features	• Each T1 channel supports a single High-level Data Link Control (HDLC) framer that can be configured for speeds ranging from DS0 (64 Kbps) through full T1 (1.54 Mbps) • Predictable throughput on all ports at 1.54 Mbps, full duplex • Rate limiting on input and output • Packet buffering, Layer 2 parsing
Software features	• DS3 alarm and event counting • DS3 alarm and event detection • DS3 diagnostics and loopback control • B3ZS line encoding • M13 or C-bit parity • DS3 Simple Network Management Protocol (SNMP) support (DS3 MIB) • Per-packet counts and byte counts • Local and remote loopback testing • Encapsulations: • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Custom 10-ft (3.05-m) posilock to BNC male cable, separate RX and TX

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS) • Bit error rate (BER) • Equipment failure (Does not affect service) • Excessive zeros (EXZ) • Far-end block error (FEBE) • Frame error • Idle code, Idle received • Line code violation (LCV) • Local and remote loopback • Loss of signal (LOS) • Out of frame (OOF) • Parity bit (P-bit) disagreements • Path parity error • Yellow alarm bit (X-bit) disagreements

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 End-of-Life PICs Supported on page 12](#)

Channelized OC12 EOL PIC (M320 Router)



- Software release**
- Junos OS Release 6.3 and later

Description	• One OC12 port • Power requirement: 0.23 A @ 48 V (10.8 W) • 12 DS3 channels • Supports IP version 4 (IPv4) unicast and multicast as well as MPLS, Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), and Border Gateway Protocol (BGP)
Hardware features	• ASIC-based, high-performance throughput on all ports • Integrated DSU functionality with subrate and scrambling support for each DS3 channel • Class-of-service support for each DS3 channel • Dual-router SONET automatic protection switching (APS) • Rate policing on input for each DS3 channel • Rate shaping output for each DS3 channel • Packet buffering, Layer 2 parsing
Software features	• M13/C-bit parity encoding • Full instrumentation per DS3 channel • DS3 diagnostics and loopback control • DS3 alarm and event counting and detection • DS3 Far-end Alarm and Control (FEAC) channel support • Encapsulations: • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Duplex SC/PC connector (RX and TX) • SONET/SDH OC12/STM4 fixed transceivers: • Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46
LEDs	One tricolor per port: One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

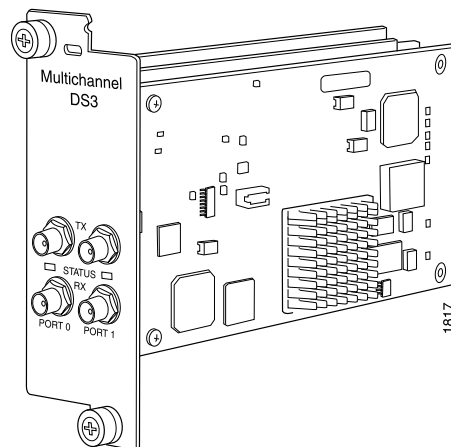
Alarms, errors, and events

- Alarm indication signal (AIS-L, AIS-P)
- BERT functionality (you can configure one DS3 channel in BERT mode and configure the remaining channels to transmit and receive normal traffic)
- Bit error rate signal degrade (BERR-SD), Bit error rate signal fail (BERR-SF)
- Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P)
- Equipment failure (Does not affect service)
- Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end block error (FEBE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Frame error
- Idle code, Idle received
- Loss of frame (LOF), Loss of pointer (LOP-P), Loss of signal (LOS)
- Out of frame (OOF)
- Payload Mismatch (PLM-P), payload unequipped (UNEQ-P)
- Parity bit (P-bit) disagreements
- Path parity error
- Remote defect indication (RDI-L, RDI-P)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)
- Yellow alarm bit (X-bit) disagreements

Related Documentation

- *M320 PIC Description*
- [M320 End-of-Life PICs Supported on page 12](#)

Multichannel DS3 EOL PIC (M320 Router)



Software release

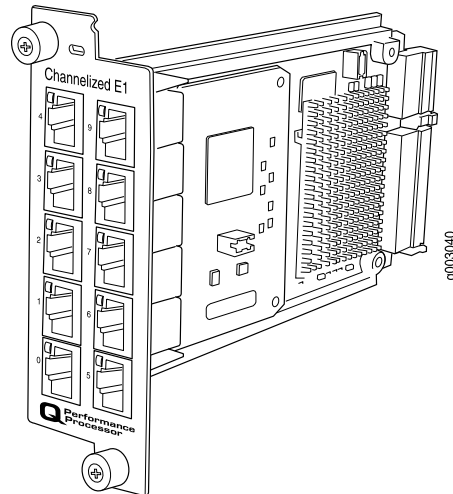
- Junos OS Release 6.2 and later

Description

- Two DS3 ports
- Power requirement: 0.31 A @ 48 V (14.9 W)
- Supports up to 128 logical customer channels per DS3 port

Hardware features	• Support for NxT1 by interoperating with the Link Services and Multilink Services PICs, using MLPPP and MLFR protocols • Onboard DSU functionality
Software features	• Support for four data-link connection identifiers (DLCIs) per logical customer channel • DS3 alarm and event counting • DS3 alarm and event detection • DS3 diagnostics and loopback control • DS3 framing: M13, C-bit • T1 framing: super frame (SF) and extended super frame (ESF) • Encapsulations: • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Custom 10 ft/3.05 m posilock to BNC male cable, separate Rx and Tx
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Far-end block error (FEBE) • Parity bit (P-bit) disagreements • Path priority error • Alarm indication signal (AIS) • Loss of signal (LOS) • Out of frame (OOF) • Yellow alarm • AIS received • Simultaneous BERT functionality • Idle received • Local and remote loopback
Related Documentation	• M320 PIC Description • M320 End-of-Life PICs Supported on page 12

Channelized E1 IQ EOL PIC (M320 Router)



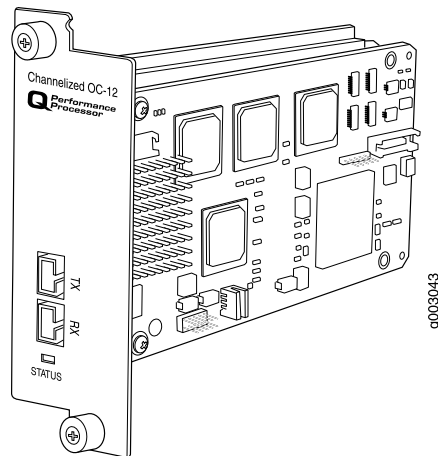
Software release	Junos OS Release 6.2 and later
Description	- Ten E1 ports - Power requirement: 0.15 A @ 48 V (7.2 W) - Fine-grained queuing per logical interface - Channelization: E1, DS0
Hardware features	- Data service unit (DSU) functionality - Ports configurable as clear channel E1 interfaces with 2.048-Mbps connectivity - Supports unframed E1 G.703 and G.704 framing modes - Supports HDB3 line coding - CRC4 configurable - Local and remote loopback testing
Software features	- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) - Simple Network Management Protocol (SNMP): E1 MIB, DS0 MIB - Dynamic, arbitrary channel configuration - Full bit error rate test (BERT) - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Frame Relay - High-Level Data Link Control (HDLC) - Point-to-Point Protocol (PPP)
Cables and connectors	120-ohm RJ-48C

LEDs	One bicolor per E1 port: • Off—Port not enabled • Green—Physical E1 link is up; individual subchannels can be down • Red—Physical E1 link is down
Alarms, errors, and events	• Alarm indication signal (AIS) • Loss of frame (LOF) • Out of frame (OOF) • Failed signal rate (FSR)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- [M320 PIC Description](#)
- [M320 End-of-Life PICs Supported on page 12](#)

Channelized OC12 IQ EOL PIC (M320 Router)

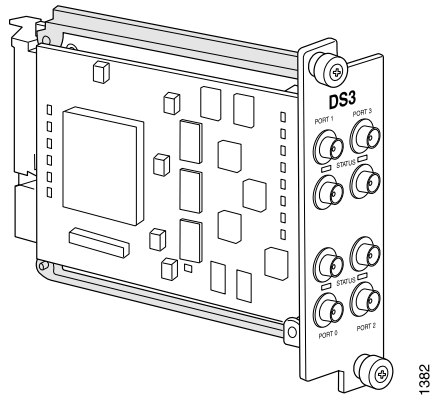


Software release	• Junos OS Release 6.2 and later (Type 1)
Description	• One OC12 port • Power requirement: 0.23 A @ 48 V (10.8 W) • Fine-grained queuing per logical interface • Channelization: OC3, DS3, DS1, DS0

Hardware features	• Subrate and scrambling: • Digital Link/Quick Eagle • Kentrox • Larscom • ADTRAN • Verilink • Packet buffering, Layer 2 parsing • M13/C-bit parity encoding • DS3 far-end alarm and control (FEAC) channel support • Local and remote loopback testing
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB • Dynamic, arbitrary channel configuration • Full bit error rate test (BERT) • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Duplex SC/PC connector (Rx and Tx); single-mode fiber • SONET/SDH OC12/STM4 fixed transceivers: • Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	Alarms: • Alarm indication signal—line (AIS-L) • Alarm indication signal—path (AIS-P) • Bit error rate—signal degrade (BERR-SD) • Bit error rate—signal fail (BERR-SF) • Frame error • Idle code, Idle received • Loss of frame (LOF) • Loss of pointer (LOP-P) • Loss of signal (LOS) • Out of frame (OOF) • Payload mismatch (PLM-P) • Payload unequipped (unequipped STS at path level) (UNEQ-P) • Parity bit (P-bit) disagreements • Path parity error • Remote defect indication—line (RDI-L) • Remote defect indication—path (RDI-P) • Yellow alarm bit (X-bit) disagreements Error detection: • Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P) • Errored seconds (ES-S, ES-L, ES-P) • Far-end bit errors, remote error indication—line (REI-L), far-end line coding violations (CV-LFE) • Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE) • Far-end errored seconds (ES-LFE, ES-PFE) • Far-end severely errored seconds (SES-LFE, SES-PFE) • Far-end unavailable seconds (UAS-LFE, UAS-PFE) • Severely errored frames (SEF) • Severely errored framing seconds (SEFS-S) • Severely errored seconds (SES-S, SES-L, SES-P) • Unavailable seconds (UAS-L, UAS-P)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters
Related Documentation	• <i>M320 PIC Description</i> • M320 End-of-Life PICs Supported on page 12

DS3 EOL PIC (M320 Router)



Software release	Junos OS Release 6.2 and later (Type 1)
Description	- Four DS3 ports - Power requirement: 0.47 A @ 48 V (22.5 W) - Integrated DSU interoperability with leading DSU vendors
Hardware features	- High-performance throughput on each port at speeds up to 44.736 Mbps, full duplex - C-bit framing - B3ZS line encoding - Subrate and scrambling: - Digital Link - Kentrox - Larscom - Per-port rate policing on input - Per-port rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- DS3 functionality: - C-bit framing - B3ZS line encoding - DS3 diagnostics and loopback control - DS3 alarm and event counting and detection - Per-packet counts and byte counts - Local and remote loopback testing, as well as BERT testing per DS3 - DS3 far-end alarm and control (FEAC) channel support - Encapsulations: - High-Level Data Link Control (HDLC) - Frame Relay - Circuit cross-connect (CCC) - Point-to-Point Protocol (PPP)
Cables and connectors	Custom 10-ft (3.05-m) posilock SMB to BNC male cable, separate Rx and Tx (provided)

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- Alarm indication signal (AIS)
- Bit error rate test (BERT) functionality on PIC (you can configure one DS3 channel in BERT mode and configure the remaining channels to transmit and receive normal traffic)
- Equipment failure (does not affect service)
- Far-end block error (FEBE)
- Frame error
- Idle code, Idle received
- Local and remote loopback
- Loss of signal (LOS)
- Out of frame (OOF)
- Parity bit (P-bit) disagreements
- Path parity error
- Yellow alarm bit (X-bit) disagreements

**Related
Documentation**

- [M320 PIC Description](#)
- [M320 End-of-Life PICs Supported on page 12](#)

Gigabit Ethernet EOL PICs (M320 Router)

Figure 33: 1-Port Gigabit Ethernet PIC

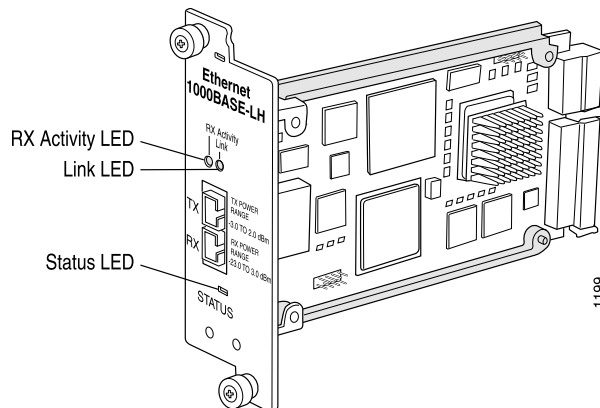


Figure 34: 2-Port Gigabit Ethernet PIC

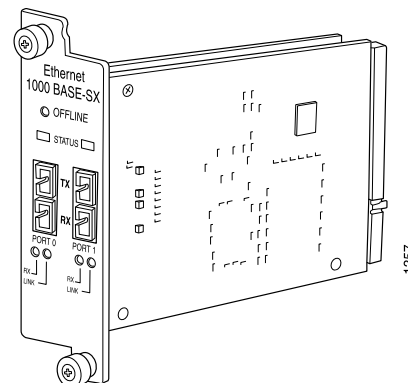
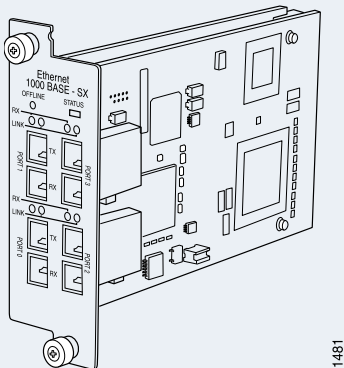


Figure 35: 4-Port Gigabit Ethernet PIC

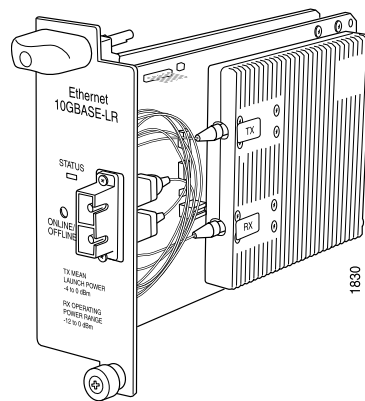


Software release	- Junos OS Release 6.2 and later - Junos OS Release 8.4 and later supports the 2-port PIC and 4-port PIC on the Enhanced III FPC2.
Description	- One, two, or four Gigabit Ethernet ports - Power requirement: 1-port: 0.27 A @ 48 V (13.2 W) 2-port: 0.35 A @ 48 V (17 W) 4-port: 0.40 A @ 48 V (19.2 W) - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
Hardware features	- High-performance throughput on all ports at speeds up to 1 Gbps - Autonegotiation between Gigabit Ethernet circuit partners - Full-duplex mode - Maximum transmission units (MTUs) of up to 9192 bytes
Software features	- Virtual Router Redundancy Protocol (VRRP) support 802.1Q virtual LANs (VLANs) support 64 source MAC address filters per port 960 destination MAC filters per port
Cables and connectors	- Duplex SC connector (TX and RX) - Fiber-optic fixed transceivers: 1000Base-LH 1000Base-LX 1000Base-SX 1000Base-T Optical interface specifications—see “Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 35

LEDs	Status LEDs, one bicolor: • Off—PIC not enabled • Green—PIC is operating normally • Red—PIC has an error or failure Port LEDs, one pair per port: • Link—If green, the port is online; if there is no light, the port is down • Activity—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data
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Related Documentation	• M320 PIC Description • M320 End-of-Life PICs Supported on page 12
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10-Gigabit Ethernet EOL PIC (M320 Router)



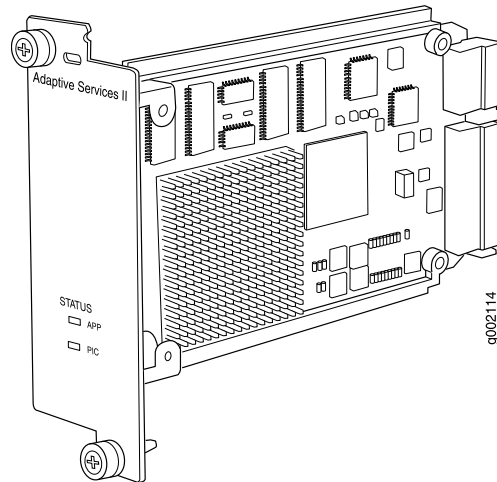
Software release	• Junos OS Release 6.2 and later • Junos OS Release 8.4 and later supports this PIC on the Enhanced III FPC
Description	• One 10-Gigabit Ethernet port • Power requirement: 0.74 A @ 48 V (35.5 W) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
Hardware features	• High-performance throughput at speeds up to 10 Gbps • Full-duplex mode • Maximum transmission units (MTUs) up to 9192 bytes • 64 source MAC address filters • 960 destination MAC filters
Software features	• Virtual Router Redundancy Protocol (VRRP) support • 802.1Q virtual LANs (VLANs) support • 802.3ae link aggregation support • RMON EtherStats

- Cables and connectors
- Duplex SC connector (RX and TX)
 - Long Wavelength Serial transceivers:
 - Duplex LC/PC connector (Rx and Tx)
 - 10-Gigabit Ethernet XFP transceivers:
 - 10GBASE-LR
- Optical interface specifications—see [“10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 38](#)

LEDs	Status LEDs, one bicolor: • Off—PIC not enabled • Green—PIC is operating normally • Red—PIC has an error or failure Port LEDs, one pair: • Link—If green, the port is online; if there is no light, the port is down • RX—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data
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- Related Documentation**
- [M320 PIC Description](#)
 - [M320 End-of-Life PICs Supported on page 12](#)

Adaptive Services II EOL PIC (M320 Router)



Software release	• Junos OS Release 6.4 and later
Description	• Supports tunnel services. This feature is included with the PIC and does not require an individual license. • Individual licenses must be purchased for additional services. • Power requirement: 0.4 A @ 48 V (19 W)
Hardware features	• Support for up to 2000 service sets • Active monitoring on up to 1 million flows • Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces
Software features	Depending on your Junos OS Release and individual licenses, software features for this PIC can include the features listed in Table 64 on page 216 . For more information about the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i> .
LEDs	Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the chassis. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one bicolor: • Off—Service is not running. • Green—Service is running under acceptable load. • Yellow—Service is overloaded.

Table 64: Adaptive Services PICs Software Features

Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
GRE Key	—	—
GRE dont-fragment	—	—
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	6.4	—
Network Address Translation (NAT) for IP addresses	6.4	—
Port Address Translation (PAT) for port numbers	6.4	—
IP Security (IPSec) encryption	6.4	—
Flow monitoring exports cflowd version 5 and version 8 records	7.0	—
Flow monitoring exports flow monitoring version 9 records, based on RFC 3954 (IP v4 templates only)	8.3	—
Passive flow monitoring	—	—
Passive flow collection	—	—
Flow-tap	8.1	—
Dynamic flow capture	—	—
Real-time performance monitoring	8.3	—
Link Services	7.3	7.5
Tunnel services: • IP-IP unicast tunneling • GRE unicast tunneling—Supports GRE fragmentation • Protocol Independent Multicast (PIM) sparse mode unicast tunneling	6.4	7.5
Virtual tunnel interface for Layer 3 VPNs	6.4	—
Layer 2 Tunneling Protocol (L2TP)	—	—

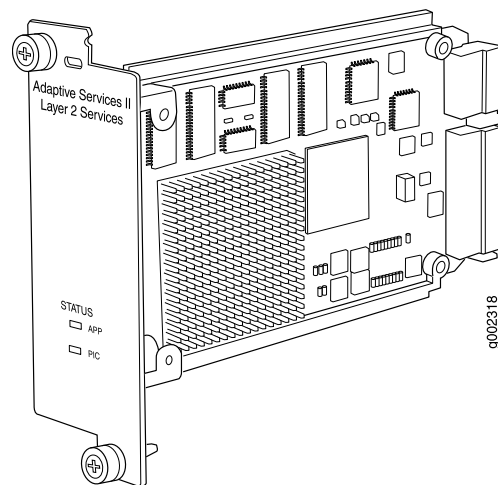
Table 64: Adaptive Services PICs Software Features (*continued*)

Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
Voice services:	7.3	7.5
Compressed Real-Time Transport Protocol (CRTP)		
Encapsulations:	7.1	—
- Multilink Frame Relay (MLFR) - Multilink Point-to-Point Protocol (MLPP)		

Related Documentation

- [M320 PIC Description](#)
- [M320 End-of-Life PICs Supported on page 12](#)

Adaptive Services II Layer 2 Services EOL PIC (M320 Router)



Software release	• Junos OS Release 7.5 and later (Type 1)
Description	• Supports Layer 2 Service package only. Tunnel services are included with the PIC. Other services require an individual license. • Power requirement: 0.4 A @ 48 V (19 W)
Hardware features	• Support for up to 2000 service sets • Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces
Software features	Depending on your Junos OS Release and individual licenses, software features for this PIC can include the features listed in Table 65 on page 218 . For more information about the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i> .

LEDs	Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the chassis. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one bicolor: • Off—Service is not running. • Green—Service is running under acceptable load. • Yellow—Service is overloaded.
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Table 65: Adaptive Services PICs Software Features

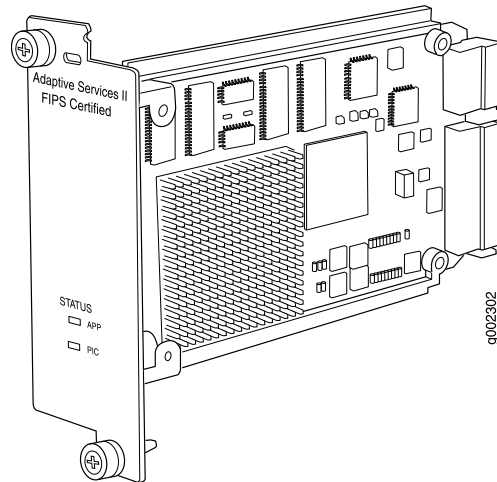
Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
GRE Key	—	—
GRE dont-fragment	—	—
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	6.4	—
Network Address Translation (NAT) for IP addresses	6.4	—
Port Address Translation (PAT) for port numbers	6.4	—
IP Security (IPSec) encryption	6.4	—
Flow monitoring exports cflowd version 5 and version 8 records	7.0	—
Flow monitoring exports flow monitoring version 9 records, based on RFC 3954 (IP v4 templates only)	8.3	—
Passive flow monitoring	—	—
Passive flow collection	—	—
Flow-tap	8.1	—
Dynamic flow capture	—	—
Real-time performance monitoring	8.3	—
Link Services	7.3	7.5

Table 65: Adaptive Services PICs Software Features (*continued*)

Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
Tunnel services:	6.4	7.5
• IP-IP unicast tunneling • GRE unicast tunneling—Supports GRE fragmentation • Protocol Independent Multicast (PIM) sparse mode unicast tunneling		
Virtual tunnel interface for Layer 3 VPNs	6.4	—
Layer 2 Tunneling Protocol (L2TP)	—	—
Voice services:	7.3	7.5
• Compressed Real-Time Transport Protocol (CRTP)		
Encapsulations:	7.1	—
• Multilink Frame Relay (MLFR) • Multilink Point-to-Point Protocol (MLPP)		

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 End-of-Life PICs Supported on page 12](#)

Adaptive Services II FIPS EOL PIC (M320 Router)



Software release	Junos OS Release 7.2 and later (Type 1) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15.
Description	- Junos-FIPS requires an Adaptive Services II FIPS PIC for external IPSec connections. See the <i>Secure Configuration Guide for Common Criteria and Junos-FIPS</i> for more information. - Supports tunnel services. This feature is included with the PIC and does not require an individual license. - Individual licenses must be purchased for additional services such as Network Address Translation (NAT), stateful firewall, intrusion detection services (IDS), IPSec, J-Flow accounting, and voice services. For information about which services are supported by PIC and platform type, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>. - Power requirement: 0.4 A @ 48 V (19 W)
Hardware features	- Support for up to 2000 service sets - Active monitoring on up to 1 million flows - Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces

Software features For a list of the software features available for services PICs, see the *Junos OS Services Interfaces Library for Routing Devices*.

Depending on your Junos OS Release and individual licenses, software features for this PIC can include:

- Stateful firewall with packet inspection:
 - Detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks
- NAT for IP addresses
- Port Address Translation (PAT) for port numbers
- J-Flow accounting exports cflowd version 5 and version 8 records
- Tunnel services:
 - IP-IP unicast tunneling
 - GRE unicast tunneling—Supports GRE fragmentation
 - PIM sparse mode unicast tunneling
 - Virtual tunnel interface for Layer 3 VPNs
- IPSec encryption
- Voice services:
 - Compressed Real-Time Protocol (CRTP)
- Encapsulations:
 - Multilink Frame Relay (MLFR)
 - Multilink Point-to-Point Protocol (MLPP)

LEDs

Status LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the chassis.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure and no further harm can be done by removing it from the chassis.

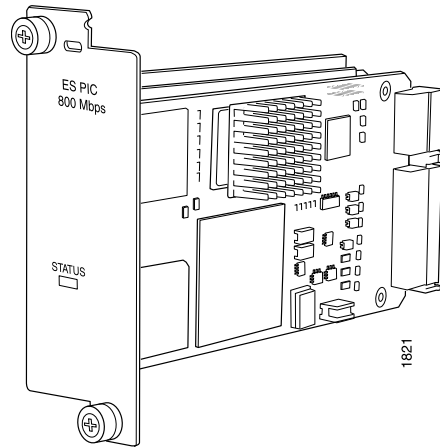
Application LED, one tricolor:

- Off—Service is not running.
- Green—Service is running under acceptable load.
- Yellow—Service is overloaded.

Related Documentation

- [M320 PIC Description](#)
- [M320 End-of-Life PICs Supported on page 12](#)

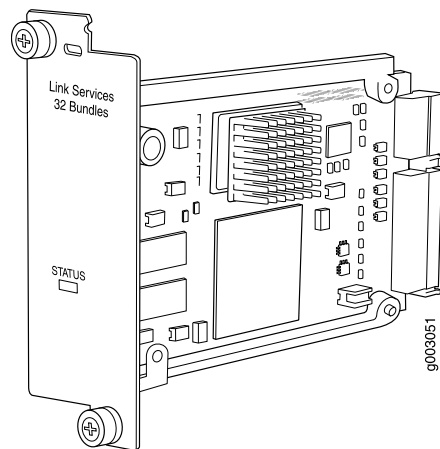
ES EOL PIC (M320 Router)



Software release	- Junos OS Release 6.2 and later (Type 1) For information on which FPCs support this PIC, see “M320 PIC/FPC Compatibility” on page 15. - EOL notification: PSN-2010-04-734
Description	- High-bandwidth encryption (in accordance with IPSec standards) - Power requirement: 0.21 A @ 48 V (10 W) - Support for IPSec encryption, decryption, and key calculation acceleration NOTE: The ES PIC does not support reassembly and decryption of encrypted packets that were fragmented in an IPSec tunnel.
Hardware features	- Extends the existing security functionality to Internet traffic at high-performance rates - Throughput at 800 Mbps, half duplex 1000 IPSec tunnels or 2000 IPSec security association (SA) pairs - Supports MTUs of up to 3900 bytes
Software features	For a list of the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>. - Support for IPv4 - Authentication hash algorithms: MD-5 and SHA-1 - Encryption algorithms: DES, 3-DES, and Null - Automated key management using Diffie-Hellman key establishment - Support for preshared key management - Authentication Header and Encapsulating Security Payload (ESP) independently or in bundle mode - Tunnel mode IPSec encryption and decryption for data traffic - Transport mode IPSec encryption and decryption for control traffic - Static and dynamic security associations (SA) supported - SA lifetime configurable in seconds and kilobytes - Junos OS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES).

LEDs	One tricolor: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Instrumentation (counters)	• Input and output bytes per tunnel • Total authentication failures • Total antireply failures • Total encryption ASIC errors per PIC
Related Documentation	• M320 PIC Description • M320 PIC Combination Limitations on page 15 • M320 PICs Supported on page 3

Link Services EOL PIC (M320 Router)



Software release	• Junos OS Release 6.2 and later (Type 1)
Description	• Power requirement: 0.17 A @ 48 V (8 W) • Three versions: • 4 multilink bundles, 256 LFI links • 32 multilink bundles, 256 LFI links • 128 multilink bundles, 256 LFI links • Multilink bonding, link fragmentation and interleaving (LFI), and tunneling
Hardware features	• Rate limiting/policing per multilink bundle • Byte-wise load balancing across multilink bundles • Bonding T1 links enable service ranging from 1.5 Mbps through 12 Mbps • Bonding E1 links enable service ranging from 2 Mbps through 16 Mbps • Loopback function that encapsulates and de-encapsulates packets

Software features For a list of the software features available for services PICs, see the *Junos OS Services Interfaces Library for Routing Devices*.

- Protocol support:
 - Multilink PPP (MLPPP)
 - Multilink Frame Relay (MLFR)—FRF.15 and FRF.16
 - Link fragmentation and interleaving (LFI)—FRF.12
 - LFI over MLPPP
- IP-IP unicast tunneling
- GRE unicast tunneling
- PIM sparse mode unicast tunneling

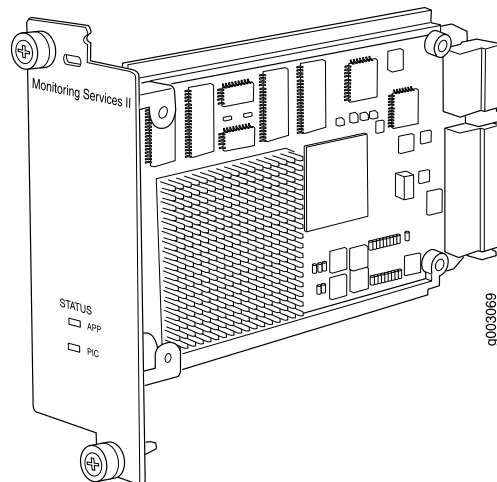
LEDs One bicolor:

- Off—PIC is offline
- Green—PIC is online and at least one configured bundle is operating
- Yellow—PIC is online, but no configured bundles are operating

Related Documentation

- [M320 PIC Description](#)
- [M320 End-of-Life PICs Supported on page 12](#)

Monitoring Services II EOL PIC (M320 Router)



Software release

- Junos OS Release 6.0 and later (Type 1)

Description

- Passive traffic monitoring or flow collection services
- Power requirement: 0.4 A @ 48 V (19 W)
- Monitors IPv4 packets
- Support for collecting and exporting cflowd records

Hardware features

- Monitors up to 400,000 packets per second
- Support for MTUs up to 4474 bytes for SONET interfaces

Software features For more information about the software features for services PICs, see the *Junos OS Services Interfaces Library for Routing Devices*.

- Load distribution across multiple PICs
- Active monitoring cflowd version 5 support
- Provides start and end times of each export
- Encapsulations:
 - Multilink Frame Relay (MLFR)
 - Multilink Point-to-Point Protocol (MLPP)
- Supports firewall filtering and filter-based forwarding (FBF)

NOTE: Flow collection services are supported.

NOTE: This PIC does not support graceful Routing Engine switchover.

Cables and connectors • None

LEDs

Status LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the chassis.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure and no further harm can be done by removing it from the chassis.

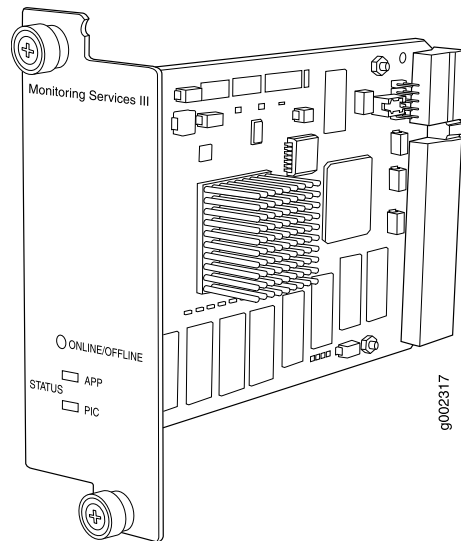
Application LED, one bicolor:

- Off—Flow collector is not running.
- Green—Flow collector is running under acceptable load.
- Yellow—Flow collector is overloaded.

Related Documentation

- [M320 PIC Description](#)
- [M320 PIC Combination Limitations on page 15](#)
- [M320 PICs Supported on page 3](#)

Monitoring Services III EOL PIC (M320 Router)



Software release	Junos OS Release 7.4 and later (Type 2) For information on which FPCs support this PIC, see "M320 PIC/FPC Compatibility" on page 15.
Description	- Power requirement: 0.4 A @ 48 V (19 W) - Supports dynamic flow capture 2 Gbps of sustained packet bandwidth
Hardware features	Supports MTUs up to 4474 bytes for SONET interfaces
Software features	For more information about the software features for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>. Dynamic flow capture
Cables and connectors	None
LEDs	Two Status LEDs: PIC and APP PIC LED, one tricolor: - Off—PIC is offline and it is safe to remove it from the chassis. - Green—PIC is operating normally. - Yellow—PIC is initializing. - Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one tricolor: - Off—Monitoring application is not running. - Green—Monitoring application is running under acceptable load. - Yellow—Monitoring application is overloaded. - Red—Not used.

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 PIC Combination Limitations on page 15](#)
 - [M320 PICs Supported on page 3](#)

SONET/SDH OC3c/STM1 EOL PICs (M320 Router)

Figure 36: 4-Port SONET/SDH OC3c/STM1 PIC (MMF)

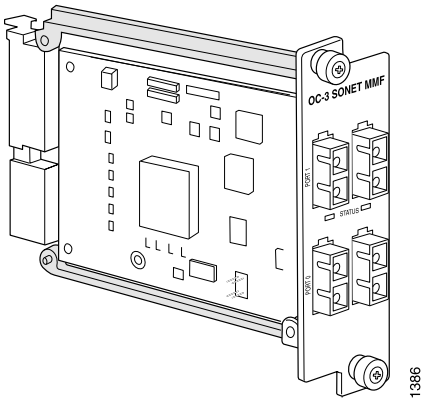
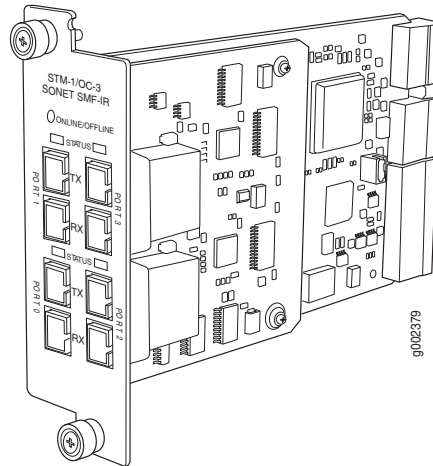


Figure 37: 4-Port SONET/SDH OC3c/STM1 PIC (SMF-IR)



Software release	• Junos OS Release 6.2 and later (Type 1 and Type 2) multimode and single-mode intermediate reach • Junos OS Release 8.4 and later supports the SONET/SDH OC3c/STM1 PIC (PC-4OC3-SON-SMIR) on the Enhanced III FPC1.
Description	• Four OC3 ports • Power requirement: 0.49 A @ 48 V (23.7 W)
Hardware features	• Multiplexing and demultiplexing • Rate policing on input • Rate shaping on output • Packet buffering, Layer 2 parsing

Software features	• SONET/SDH framing • Link aggregation • Alarm and event counting and detection • Dual-router automatic protection switching (APS) • Multiprotocol Label Switching (MPLS) fast reroute • Encapsulations: • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Duplex SC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 fixed transceivers: • Multimode • Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 43 NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - Bit interleaved parity (BIP) error B2
 - Bit interleaved parity (BIP) error B3
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
 - Payload mismatch (path label mismatch) (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Multiplex section alarm indication signal (MS-AIS)
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - Bit interleaved parity (BIP) error B2
 - Bit interleaved parity (BIP) error B3
 - Loss of frame (LOF)
 - Loss of pointer (HP-LOP)
 - Loss of signal (LOS)
 - Multiplex section remote error indication (MS-REI)
 - Higher path label mismatch (HP-PLM)
 - Higher path unequipped (HP-UNEQ)
 - Multiplex section remote defect indication (MS-RDI)
 - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

Related Documentation

- [M320 PIC Description](#)
- [M320 End-of-Life PICs Supported on page 12](#)

SONET/SDH OC12c/STM4 EOL PICs (M320 Router)

Figure 38: 1-Port SONET/SDH OC12c/STM4 PIC

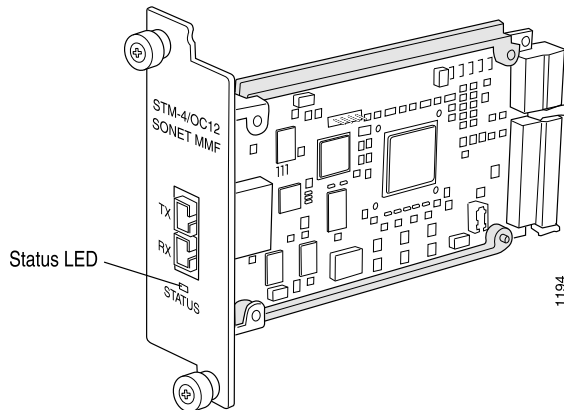
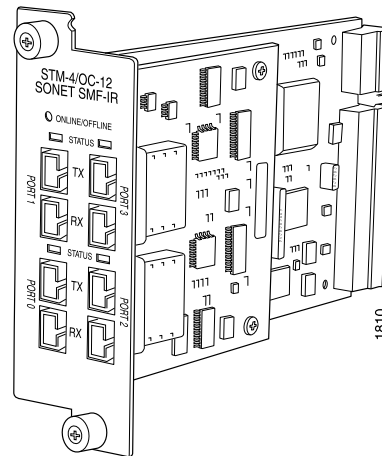


Figure 39: 4-Port SONET/SDH OC12c/STM4 PIC



Software release	- Junos OS Release 6.2 and later - Junos OS Release 8.4 and later supports the SONET/SDH OC12c/STM4 PICs (PB-4OC12-SON-MM) and (PB-4OC12-SON-SMIR) on the Enhanced III FPC2.
Description	- One or four ports - Power requirement: 0.23 A @ 48 V (10.8 W)
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - High-Level Data Link Control (HDLC) - Frame Relay - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Point-to-Point Protocol (PPP)

- Cables and connectors
- Duplex SC/PC connector (Rx and Tx)
 - SONET/SDH OC12/STM4 fixed transceivers:
 - Multimode
 - Intermediate reach (IR-1)
- Optical interface specifications—see [“SONET/SDH OC12/STM4 Optical Interface Specifications” on page 46](#)

NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the [CLI Explorer](#).

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
------	---

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - Bit interleaved parity (BIP) error B2
 - Bit interleaved parity (BIP) error B3
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
 - Payload mismatch (path label mismatch) (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Multiplex section alarm indication signal (MS-AIS)
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - Bit interleaved parity (BIP) error B2
 - Bit interleaved parity (BIP) error B3
 - Loss of frame (LOF)
 - Loss of pointer (HP-LOP)
 - Loss of signal (LOS)
 - Multiplex section remote error indication (MS-REI)
 - Higher path label mismatch (HP-PLM)
 - Higher path unequipped (HP-UNEQ)
 - Multiplex section remote defect indication (MS-RDI)
 - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

Related Documentation

- *M320 PIC Description*
- [M320 End-of-Life PICs Supported on page 12](#)

SONET/SDH OC48c/STM16 EOL PICs (M320 Router)

Figure 40: 1-Port SONET/SDH OC48c/STM16 PIC

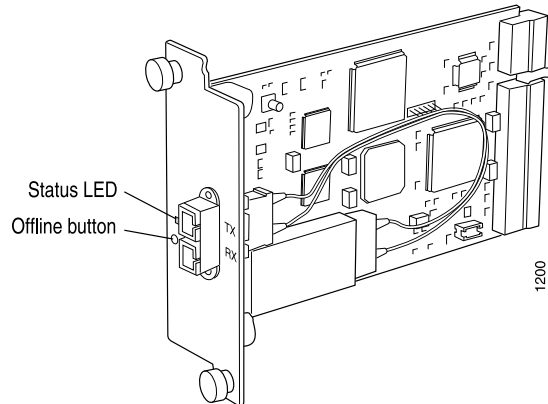
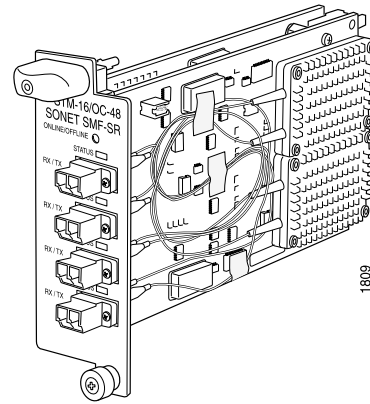


Figure 41: 4-Port SONET/SDH OC48c/STM16 PIC



Software release	- Junos OS Release 6.2 and later - Junos OS Release 9.0 and later supports the 1-port (Type 2) SONET/SDH OC48c/STM16 EOL PICs (PB-IOC48-SON-SMSR) and (PB-IOC48-SON-SMLR) on the Enhanced III FPC2.
Description	- One or four OC48 ports - Power requirement: 1-port: 0.38 A @ 48 V (18 W) 4-port: 0.86 A @ 48 V (41.4 W)
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - High-Level Data Link Control (HDLC) - Frame Relay - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Point-to-Point Protocol (PPP)

- Cables and connectors
- Duplex LC/PC Connector (Rx and Tx)
 - SONET/SDH OC48/STM16 fixed transceivers:
 - Short reach (SR-1)
 - Long reach (LR-1)
- Optical interface specifications—see [“SONET/SDH OC48/STM16 Optical Interface Specifications” on page 48](#)

NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the [CLI Explorer](#).

- | | |
|------|--|
| LEDs | <p>One tricolor per port:</p> <ul style="list-style-type: none">• Off—Not enabled• Green—Online with no alarms or failures• Yellow—Online with alarms for remote failures• Red—Active with a local alarm; router has detected a failure |
|------|--|

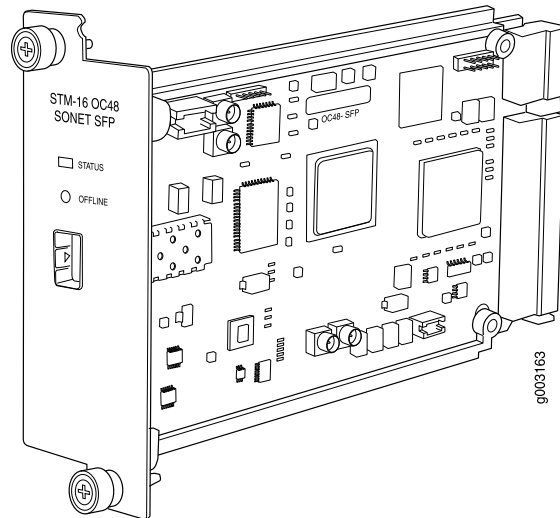
Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - Bit interleaved parity (BIP) error B2
 - Bit interleaved parity (BIP) error B3
 - Loss of frame (LOF)
 - Loss of pointer (LOP-P)
 - Loss of signal (LOS)
 - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
 - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
 - Payload mismatch (path label mismatch) (PLM-P)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
- SDH alarms:
 - Multiplex section alarm indication signal (MS-AIS)
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - Bit interleaved parity (BIP) error B2
 - Bit interleaved parity (BIP) error B3
 - Loss of frame (LOF)
 - Loss of pointer (HP-LOP)
 - Loss of signal (LOS)
 - Multiplex section remote error indication (MS-REI)
 - Higher path label mismatch (HP-PLM)
 - Higher path unequipped (HP-UNEQ)
 - Multiplex section remote defect indication (MS-RDI)
 - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

Related Documentation

- *M320 PIC Description*
- [M320 End-of-Life PICs Supported on page 12](#)

SONET/SDH OC48c/STM16 EOL PIC with SFP (M320 Router)



Software release	- Junos OS Release 6.2 and later - Junos OS Release 8.4 and later supports the 1-port (Type 2) SONET/SDH OC48c/STM16 EOL PIC with SFP (PB-1OC48-SON-SFP) on the Enhanced III FPC2.
Description	- One OC48 port - Power requirement: 0.33 A @ 48 V (16 W)
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - High-Level Data Link Control (HDLC) - Frame Relay - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Point-to-Point Protocol (PPP)

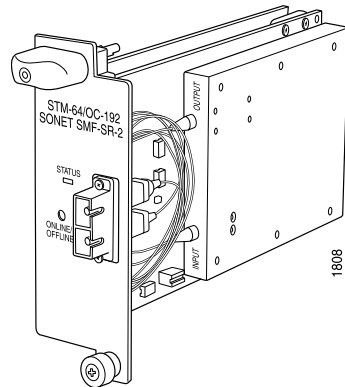
- Cables and connectors
- Duplex LC/PC Connector (Rx and Tx)
 - SONET/SDH OC48/STM16 fiber-optic SFP transceivers:
 - Short reach (SR-1) (model number: SFP-1OC48-SR)
 - Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
 - Long reach (LR-1) (model number: SFP-1OC48-LR)
- Optical interface specifications—see [“SONET/SDH OC48/STM16 Optical Interface Specifications” on page 48](#)

NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the [CLI Explorer](#).

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• SDH alarms: • Multiplex section alarm indication signal (MS-AIS) • Administrative unit alarm indication signal (AU-AIS) • Bit error rate signal degrade (BERR-SD) • Bit error rate signal fail (BERR-SF) • Bit interleaved parity (BIP) error B1 • Bit interleaved parity (BIP) error B2 • Bit interleaved parity (BIP) error B3 • Loss of frame (LOF) • Loss of pointer (HP-LOP) • Loss of signal (LOS) • Multiplex section remote error indication (MS-REI) • Higher path label mismatch (HP-PLM) • Higher path unequipped (HP-UNEQ) • Multiplex section remote defect indication (MS-RDI) • Higher path remote defect indication (HP-RDI) • Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE) • Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

- Related Documentation**
- [M320 PIC Description](#)
 - [M320 End-of-Life PICs Supported on page 12](#)

SONET/SDH OC192c/STM64 EOL PICs (M320 Router)



Software release	- Junos OS Release 5.4 and later (Type 3) - Junos OS Release 8.4 and later supports the 1-port (Type 3) SONET/SDH OC192c/STM64 EOL PICs (PC-IOC192-SON-SR2) and (PC-IOC192-SON-LR) on the Enhanced III FPC.
Description	- One OC192 port - Power requirement: 0.45 A @ 48 V (21.6 W)
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - High-Level Data Link Control (HDLC) - Frame Relay - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Point-to-Point Protocol (PPP)
Cables and connectors	- Duplex SC/PC connector (Rx and Tx) - SONET/SDH OC192/STM64 transceivers: - Short reach (SR-2) - Long reach (LR-1) Optical interface specifications—see “SONET/SDH OC192/STM64 Optical Interface Specifications” on page 50

NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the [CLI Explorer](#).

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• SDH alarms: • Multiplex section alarm indication signal (MS-AIS) • Administrative unit alarm indication signal (AU-AIS) • Bit error rate signal degrade (BERR-SD) • Bit error rate signal fail (BERR-SF) • Bit interleaved parity (BIP) error B1 • Bit interleaved parity (BIP) error B2 • Bit interleaved parity (BIP) error B3 • Loss of frame (LOF) • Loss of pointer (HP-LOP) • Loss of signal (LOS) • Multiplex section remote error indication (MS-REI) • Higher path label mismatch (HP-PLM) • Higher path unequipped (HP-UNEQ) • Multiplex section remote defect indication (MS-RDI) • Higher path remote defect indication (HP-RDI) • Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE) • Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)
Related Documentation	• M320 PIC Description • M320 End-of-Life PICs Supported on page 12

PART 3

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