

T4000 Core Router Interface Module Reference



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T4000 Core Router Interface Module Reference

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Documentation and Release Notes

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Documentation Conventions

Table 1 on page xviii 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 xviii 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>	<ul style="list-style-type: none"> Introduces or emphasizes important new terms. Identifies guide names. Identifies RFC and Internet draft titles. 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none">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.	<ul style="list-style-type: none">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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- E-mail—Send your comments to techpubs-comments@juniper.net. Include the document or topic name, URL or page number, and software version (if applicable).

Requesting Technical Support

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

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

Self-Help Online Tools and Resources

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

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

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

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 <https://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 <https://www.juniper.net/support/requesting-support.html>.

PART 1

Overview

- [T4000 Interface Modules Support on page 3](#)
- [Network Interface Specifications on page 17](#)

CHAPTER 1

T4000 Interface Modules Support

- [T4000 PICs Supported on page 3](#)
- [T4000 End-of-Life PICs Supported on page 7](#)
- [T4000 PIC/FPC Compatibility on page 8](#)

T4000 PICs Supported

[Table 3 on page 3](#) through [Table 10 on page 6](#) list the PICs supported by the T4000 router by PIC family. The First Junos OS Release Support column indicates the first release the PIC was supported on the T4000 router.

- [ATM IQ PICs on page 3](#)
- [Channelized PICs on page 3](#)
- [Gigabit Ethernet PICs on page 4](#)
- [10-Gigabit Ethernet PICs on page 4](#)
- [40-Gigabit Ethernet PICs on page 5](#)
- [100-Gigabit Ethernet PICs on page 5](#)
- [Services PICs on page 6](#)
- [SONET/SDH PICs on page 6](#)

ATM IQ PICs

[Table 3 on page 3](#) lists the ATM IQ PICs supported by the T4000 router.

Table 3: ATM IQ PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"ATM2 OC12/STM4 IQ PIC (T4000 Router)" on page 37	2	PB-2OC12-ATM2-SMIR	Optical: SC	12.2R2

Channelized PICs

[Table 4 on page 4](#) lists the Channelized PICs supported by the T4000 router.

Table 4: Channelized PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"Channelized DS3 IQ PIC (T4000 Router)" on page 43	4	PB-4CHDS3-QPP	Coaxial	12.1R2
"Channelized DS3/E3 Enhanced IQ (IQE) PIC (T4000 Router)" on page 52	4	PB-4CHDS3-E3-IQE-BNC	Coaxial	12.1R2
"Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T4000 Router)" on page 62	4	PB-4CHOC12-STM4-IQE-SFP	Optical: LC	12.2R1
	4	PC-4CHOC12-STM4-IQE-SFP	Optical: LC	13.2
"Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T4000 Router)" on page 69	1	PB-1CHOC48-STM16-IQE-SFP	Optical: LC	12.2R1

Gigabit Ethernet PICs

Table 5 on page 4 lists the Gigabit Ethernet PICs supported by the T4000 router.

Table 5: Gigabit Ethernet PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"Gigabit Ethernet PICs with SFP (T4000 Router)" on page 83	2	PB-2GE-SFP	Optical: LC	12.2R2
	4	PB-4GE-SFP	Optical: LC	12.2R2
	10	PC-10GE-SFP	Optical: LC	12.1R2
"Gigabit Ethernet IQ PIC with SFP (T4000 Router)" on page 86	2	PB-2GE-SFP-QPP	Optical: LC	12.2R2
"Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)" on page 89	8	PC-8GE-TYPE3-SFP-IQ2	Optical: LC	12.1R2
	8	PB-8GE-TYPE2-SFP-IQ2	Optical: LC	12.2R2
"Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP (T4000 Router)" on page 92	8	PC-8GE-TYPE3-SFP-IQ2E	Optical: LC	12.1R2

10-Gigabit Ethernet PICs

Table 6 on page 5 lists the 10-Gigabit Ethernet PICs supported by the T4000 router.

Table 6: 10-Gigabit Ethernet PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"10-Gigabit Ethernet PIC with XENPAK (T4000 Router)" on page 97	1	PC-1XGE-XENPAK	Optical: SC	12.2R2
"10-Gigabit Ethernet IQ2 PIC with XFP (T4000 Router)" on page 100	1	PC-1XGE-TYPE3-XFP-IQ2	Optical: LC	12.1R2
"10-Gigabit Ethernet IQ2E PIC with XFP (T4000 Router)" on page 103	1	PC-1XGE-TYPE3-XFP-IQ2E	Optical: LC	12.1R2
"10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T4000 Router)" on page 106	12	PF-12XGE-SFPP	Optical: LC	12.1
"10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (T4000 Router)" on page 110	10	PD-5-10XGE-SFPP	Optical: LC	12.1R2
	24	PF-24XGE-SFPP	Optical: LC	12.2
"10-Gigabit Ethernet LAN/WAN PIC with XFP (T4000 Router)" on page 117	4	PD-4XGE-XFP	Optical: LC	12.1R2

40-Gigabit Ethernet PICs

Table 7 on page 5 lists the 40-Gigabit Ethernet PICs supported by the T4000 router.

Table 7: 40-Gigabit Ethernet PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"40-Gigabit Ethernet PIC with CFP (T4000 Router)" on page 121	4	PD-1XLE-CFP	Optical: SC	13.2

100-Gigabit Ethernet PICs

Table 8 on page 6 lists the 100-Gigabit Ethernet PICs supported by the T4000 router.

Table 8: 100-Gigabit Ethernet PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"100-Gigabit Ethernet PIC with CFP (T4000 Router)" on page 125	1	PF-1CGE-CFP	Optical: SC, LC, or 24-fiber MPO depending on the transceiver. See the PIC description for more information.	12.1
	1	PD-1CE-CFP-FPC4 (PIC and FPC) NOTE: This PIC is available only packaged in an assembly with the T1600-FPC4-ES FPC.	Optical: SC, LC, or 24-fiber MPO depending on the transceiver. See the PIC description for more information.	12.1R2

Services PICs

Table 9 on page 6 lists the services PICs supported by the T4000 router.

Table 9: Services PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"MultiServices PICs (T4000 Router)" on page 133	0	PB-MS-400-2	None	12.2
	0	PB-MS-500-3	None	12.1R2
"Tunnel Services PICs (T4000 Router)" on page 137	0	PC-TUNNEL	None	12.1R2
	0	PB-TUNNEL	None	12.2R2

SONET/SDH PICs

Table 10 on page 6 lists the SONET/SDH PICs supported by the T4000 router.

Table 10: SONET/SDH PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T4000 Router)" on page 139	4	PB-4OC3-1OC12-SON2-SFP	Optical: LC	12.2R2
"SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T4000 Router)" on page 144	4	PB-4OC3-4OC12-SON-SFP	Optical: LC	12.2R2

Table 10: SONET/SDH PICs Supported in the T4000 Router (continued)

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"SONET/SDH OC48c/STM16 PIC with SFP (T4000 Router)" on page 148	4	PC-4OC48-SON-SFP	Optical: LC	12.1R2
	1	PB-1OC48-SON-SMSR	Optical: SC	12.2R2
"SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T4000 Router)" on page 152	4	PC-4OC48-STM16-IQE-SFP	Optical: LC	13.2
"SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T4000 Router)" on page 156	1	PB-1OC48-SON-B-SFP	Optical: LC	12.2R2
"SONET/SDH OC192/STM64 PICs with XFP (T4000 Router)" on page 160	1	PC-1OC192-SON-XFP	Optical: LC	12.1R2
	4	PD-4OC192-SON-XFP	Optical: LC	12.1
"SONET/SDH OC768c/STM256 PIC (T4000 Router)" on page 165	1	PD-1OC768-SON-SR	Optical: SC	12.1

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 End-of-Life PICs Supported on page 7](#)
 - [T4000 PIC/FPC Compatibility on page 8](#)

T4000 End-of-Life PICs Supported

Table 11 on page 8 lists the end-of-life PICs supported by the T4000 router. The PICs are listed alphabetically by PIC family.



NOTE: End-of-life (EOL) indicates that the product has been removed from the price list and is no longer available for purchase. End-of-support (EOS) indicates that no new support contracts are available on these products and the last contract will expire on the EOS date associated with each product.

Table 11: End-of-Life PICs Supported in the T4000 Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"10-Gigabit Ethernet DWDM OTN EOL PIC (T4000 Router)" on page 169	1	PC-1XGE-DWDM-OTN	Optical: SC	12.1R2
"SONET/SDH OC12c/STM4 EOL PIC (T4000 Router)" on page 171	4	PB-4OC12-SON-MM	Optical: SC	12.2R2
		PB-4OC12-SON-SMIR		
"SONET/SDH OC48c/STM16 EOL PICs (T4000 Router)" on page 175	4	PC-4OC48-SON-SMSR	Optical: SC	12.1R2
	1	PB-1OC48-SON-SMSR	Optical: SC	12.2R2
"SONET/SDH OC48c/STM16 EOL PIC with SFP (T4000 Router)" on page 179	1	PB-1OC48-SON-SFP	Optical: LC	12.2R2
"SONET/SDH OC192/STM64 EOL PIC (T4000 Router)" on page 182	1	PC-1OC192-SON-SR2	Optical: SC	12.1R2

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)
 - [T4000 PIC/FPC Compatibility on page 8](#)

T4000 PIC/FPC Compatibility

The PIC/FPC compatibility matrixes list the current PICs for the T4000 router. For example, Junos OS Release 12.1 is the first release in which the T1600-FPC4-ES supports the OC192/STM64, 4-port PIC in the T4000 router.

- [PIC/FPC Compatibility \(Type 1\) on page 8](#)
- [PIC/FPC Compatibility \(Type 2\) on page 10](#)
- [PIC/FPC Compatibility \(Type 3\) on page 11](#)
- [PIC/FPC Compatibility \(Type 4\) on page 14](#)
- [PIC/FPC Compatibility \(Type 5\) on page 14](#)

PIC/FPC Compatibility (Type 1)

[Table 12 on page 9](#) provides a PIC/FPC compatibility matrix for the current Type 2 PICs for the T4000 router and Type 2 FPCs.

Table 12: T4000 PIC/FPC Compatibility Type 1

Type 1 PIC	PIC Model Number	T640-FPC1-ES
Channelized IQ PICs		
"Channelized DS3 IQ PIC (T4000 Router)" on page 43	PB-4CHDS3-QPP	12.1.R2
"Channelized OC3 IQ PIC (T4000 Router)" on page 48	PB-1CHOC3-SMIR-QPP	12.1.R2
"Channelized STM1 IQ PIC (T4000 Router)" on page 46	PB-1CHSTM1-SMIR-QPP	12.1.R2
Channelized IQE PICs		
"Channelized DS3/E3 Enhanced IQ (IQE) PIC (T4000 Router)" on page 52	PB-4CHDS3-E3-IQE-BNC	12.1.R2
"Channelized E1/T1 Enhanced IQ (IQE) PIC (T4000 Router)" on page 55	PB-1OCHE1-T1-IQE-RJ48	12.1.R2
"Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T4000 Router)" on page 58	PB-2CHOC3-STM1-IQE-SFP	12.1.R2
"Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T4000 Router)" on page 62	PB-1CHOC12-STM4-IQE-SFP	12.1.R2
DS3 and E3 PICs		
"DS3/E3 Enhanced IQ (IQE) PIC (T4000 Router)" on page 77	PB-4DS3-E3-IQE-BNC	12.1.R2
Fast Ethernet and Gigabit Ethernet PICs		
"Fast Ethernet PIC (T4000 Router)" on page 81	PB-4FE-TX	12.1.R2
<i>Gigabit Ethernet PICs with SFP (T4000 Router)</i>	PB-1GE-SFP	12.1.R2
Gigabit Ethernet IQ2 PICs		
"Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)" on page 89	PB-4GE-TYPE1-SFP-IQ2	12.1.R2
Gigabit Ethernet IQ2E PICs		
"Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP (T4000 Router)" on page 92	PB-4GE-TYPE1-SFP-IQ2E	12.1.R2
Services PICs		

Table 12: T4000 PIC/FPC Compatibility Type 1 (continued)

Type 1 PIC	PIC Model Number	T640-FPC1-ES
"Tunnel Services PICs (T4000 Router)" on page 137	PB-TUNNEL1	12.1.R2
SONET/SDH PICs		
"SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T4000 Router)" on page 139	PB-4OC3-1OC12-SON-SFP	12.1.R2
"SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T4000 Router)" on page 144	PB-1OC12-SON-SFP	12.1.R2

PIC/FPC Compatibility (Type 2)

Table 13 on page 10 provides a PIC/FPC compatibility matrix for the current Type 2 PICs for the T4000 router and Type 2 FPCs.

Table 13: T4000 PIC/FPC Compatibility Type 2

Type 2 PIC	PIC Model Number	T640-FPC2-ES
ATM PICs		
"ATM2 OC12/STM4 IQ PIC (T4000 Router)" on page 37	PB-2OC12-ATM2-SMIR	12.2.R1
Channelized IQ PICs		
"Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T4000 Router)" on page 62	PB-4CHOC12-STM4-IQE-SFP	12.2.R2
"Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T4000 Router)" on page 69	PB-1CHOC48-STM16-IQE-SFP	12.2.R2
Gigabit Ethernet PICs		
"Gigabit Ethernet PICs with SFP (T4000 Router)" on page 83	PB-2GE-SFP	12.2.R2
	PB-4GE-SFP	12.2.R2

Table 13: T4000 PIC/FPC Compatibility Type 2 (continued)

Type 2 PIC	PIC Model Number	T640-FPC2-ES
"Gigabit Ethernet IQ PIC with SFP (T4000 Router)" on page 86	PB-2GE-SFP-QPP	12.2R2
"Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)" on page 89	PB-8GE-TYPE2-SFP-IQ2	12.2R2
Services PICs		
"MultiServices PICs (T4000 Router)" on page 133	PB-MS-400-2	12.2
"Tunnel Services PICs (T4000 Router)" on page 137	PB-TUNNEL	12.2R2
SONET/SDH PICs		
"SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T4000 Router)" on page 139	PB-4OC3-1OC12-SON2-SFP	12.2R2
"SONET/SDH OC12c/STM4 EOL PIC (T4000 Router)" on page 171	PB-4OC12-SON-MM	12.2R2
	PB-4OC12-SON-SMIR	
"SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T4000 Router)" on page 144	PB-4OC3-4OC12-SON-SFP	12.2R2
"SONET/SDH OC48c/STM16 EOL PICs (T4000 Router)" on page 175	PC-4OC48-SON-SMSR	12.1R2
	PB-1OC48-SON-SMSR	12.2R2
"SONET/SDH OC48c/STM16 EOL PIC with SFP (T4000 Router)" on page 179	PB-1OC48-SON-SFP	12.2R2
"SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T4000 Router)" on page 156	PB-1OC48-SON-B-SFP	12.2R2

PIC/FPC Compatibility (Type 3)

Table 14 on page 11 provides a PIC/FPC compatibility matrix for the current Type 3 PICs for the T4000 router and Type 3 FPCs.

Table 14: T4000 PIC/FPC Compatibility Type 3

Type 3 PIC	PIC Model Number	T640-FPC3-ES
Channelized IQE		

Table 14: T4000 PIC/FPC Compatibility Type 3 (continued)

Type 3 PIC	PIC Model Number	T640-FPC3-ES
"Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T4000 Router)" on page 62	PC-4CHOC12-STM4-IQE-SFP	13.2
Gigabit Ethernet PICs		
"Gigabit Ethernet PICs with SFP (T4000 Router)" on page 83	PC-10GE-SFP	12.1R2
"Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)" on page 89	PC-8GE-TYPE3-SFP-IQ2	12.1R2
"Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP (T4000 Router)" on page 92	PC-8GE-TYPE3-SFP-IQ2	12.1R2

Table 14: T4000 PIC/FPC Compatibility Type 3 (continued)

Type 3 PIC	PIC Model Number	T640-FPC3-ES
10-Gigabit Ethernet PICs		
"10-Gigabit Ethernet PIC with XENPAK (T4000 Router)" on page 97	PC-1XGE-XENPAK	12.2R2
"10-Gigabit Ethernet DWDM OTN EOL PIC (T4000 Router)" on page 169	PC-1XGE-DWDM-OTN	12.1R2
"10-Gigabit Ethernet IQ2 PIC with XFP (T4000 Router)" on page 100	PC-1XGE-TYPE3-XFP-IQ2	12.1R2
"10-Gigabit Ethernet IQ2E PIC with XFP (T4000 Router)" on page 103	PC-1XGE-TYPE3-XFP-IQ2E	12.1R2
Services PICs		
"MultiServices PICs (T4000 Router)" on page 133	PC-MS-500-3	12.1R2
"Tunnel Services PICs (T4000 Router)" on page 137	PC-TUNNEL	12.1R2
SONET/SDH PICs		
"SONET/SDH OC48c/STM16 EOL PICs (T4000 Router)" on page 175	PC-4OC48-SON-SMSR	12.1R2
"SONET/SDH OC48c/STM16 PIC with SFP (T4000 Router)" on page 148	PC-4OC48-SON-SFP	12.1R2
"SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T4000 Router)" on page 152	PC-4OC48-STM16-IQE-SFP	13.2
"SONET/SDH OC192/STM64 PICs with XFP (T4000 Router)" on page 160	PC-1OC192-SON-XFP	13.2

PIC/FPC Compatibility (Type 4)

Table 15 on page 14 provides a PIC/FPC compatibility matrix for the current Type 4 PICs for the T4000 router and Type 4 FPCs.

Table 15: T4000 PIC/FPC Compatibility Type 4

Type 4 PIC	PIC Model Number	T640-FPC4-1P-ES	T1600-FPC4-ES
10-Gigabit Ethernet PICs			
"10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (T4000 Router)" on page 110	PD-5-10XGE-SFPP	12.1R2	12.1 NOTE: To support PD-5-10XGE-SFPP, the hardware version of the T1600-FPC4-ES (part number 710-013037) REV13 or later is required.
"10-Gigabit Ethernet LAN/WAN PIC with XFP (T4000 Router)" on page 117	PD-4XGE-XFP	12.1R2	12.1
40-Gigabit Ethernet PICs			
"40-Gigabit Ethernet PIC with CFP (T4000 Router)" on page 121	PD-1XLE-CFP	—	13.2
100-Gigabit Ethernet PICs			
"100-Gigabit Ethernet PIC with CFP (T4000 Router)" on page 125	PD-1CE-CFP-FPC4 (PIC and FPC) NOTE: This PIC is available only packaged in an assembly with the T1600-FPC4-ES FPC.	—	12.1R2
SONET/SDH PICs			
"SONET/SDH OC192/STM64 PICs with XFP (T4000 Router)" on page 160	PD-4OC192-SON-XFP	12.1R2	12.1
"SONET/SDH OC768c/STM256 PIC (T4000 Router)" on page 165	PD-1OC768-SON-SR	12.1R2	12.1

PIC/FPC Compatibility (Type 5)

Table 16 on page 15 provides a PIC/FPC compatibility matrix for the current Type 5 PICs for the T4000 router and Type 5 FPCs.

Table 16: T4000 PIC/FPC Compatibility Type 5

Type 5 PIC	PIC Model Number	T4000-FPC5-3D	T4000-FPC5-LSR
10-Gigabit Ethernet PICs			
"10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T4000 Router)" on page 106	PF-12XGE-SFPP	12.1	12.3R2
"10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (T4000 Router)" on page 110	PF-24XGE-SFPP	12.2	12.3R2
100-Gigabit Ethernet PICs			
"100-Gigabit Ethernet PIC with CFP (T4000 Router)" on page 125	PF-1CGE-CFP	12.1	12.3R2

- Related Documentation
- T4000 PIC Description
 - T4000 PICs Supported on page 3
 - T4000 FPCs Supported

CHAPTER 2

Network Interface Specifications

- Determining Transceiver Support and Specifications for M Series and T Series Routers on page 17
- 10-Gigabit Ethernet DWDM OTN PIC (PC-1XGE-DWDM-OTN) Optical Interface Specifications on page 18
- 10-Gigabit Ethernet DWDM Transceiver (XFP-10G-CBAND-T50-ZR) Wavelengths on page 22
- SONET/SDH OC3/STM1 Optical Interface Specifications on page 24
- SONET/SDH OC12/STM4 Optical Interface Specifications on page 25
- SONET/SDH OC48/STM16 Optical Interface Specifications on page 27
- SONET/SDH OC192/STM64 Optical Interface Specifications on page 29
- SONET/SDH OC768/STM256 Optical Interface Specifications on page 32

Determining Transceiver Support and Specifications for M Series and T Series Routers

You can find information about the pluggable transceivers supported on your Juniper Networks device by using the Hardware Compatibility Tool. In addition to transceiver and connector type, the optical and cable characteristics—where applicable—are documented for each transceiver. The Hardware Compatibility Tool allows you to search by product, displaying all the transceivers supported on that device, or category, displaying all the transceivers by interface speed or type. The Hardware Compatibility Tool is located at <https://apps.juniper.net/hct/>.

Some transceivers support additional monitoring using the operational mode CLI command **show interfaces diagnostics optics**. Use the Hardware Compatibility Tool to determine if your transceiver supports monitoring. See the Junos OS documentation for your device for a description of the monitoring fields.



CAUTION: If you face a problem running a Juniper Networks device that uses 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.

10-Gigabit Ethernet DWDM OTN PIC (PC-1XGE-DWDM-OTN) Optical Interface Specifications

- [10-Gigabit Ethernet DWDM OTN Optical Interface Specifications on page 18](#)
- [10-Gigabit Ethernet DWDM OTN Supported Wavelengths on page 20](#)
- [PC-1XGE-DWDM-OTN Optical Signal-to-Noise Ratio \(OSNR\) Performance on page 22](#)

10-Gigabit Ethernet DWDM OTN Optical Interface Specifications

[Table 17 on page 18](#) shows the optical interface specifications for the 10-Gigabit Ethernet DWDM OTN PIC transceiver.

Table 17: 10-Gigabit Ethernet DWDM OTN Optical Interface Specifications

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

Table 17: 10-Gigabit Ethernet DWDM OTN Optical Interface Specifications (continued)

Line interface	<ul style="list-style-type: none"> Line rate: <ul style="list-style-type: none"> 10GE LAN PHY: 10.3125 Gbps (pass-through) G.709 LAN PHY without fixed stuff bytes: 11.049 Gbps G.709 LAN PHY with fixed stuff bytes: 11.0957 Gbps Transmit line rate deviation: G.709 LAN PHY modes: +/-20 ppm Dispersion window: +/-1200 ps/nm or +/-1600 ps/nm (maximum) FEC type (software selectable): Generic Reed-Solomon RS (255, 239) code computed as specified in Annex A/G. 709 (GFEC) or enhanced (EFEC)
Optical transmitter	<ul style="list-style-type: none"> Transmitter type: LiNbO₃ MZI (Lithium Niobate Mach-Zehnder Interferometer) Modulation format: Nonreturn-to-zero (NRZ) Channel-plan wavelength range: 1528.77 through 1563.86 nm Channel-plan frequency range: 191.7 through 196.1 THz Channel spacing: 50 GHz Channel tunability: 89 channels—see Table 18 on page 21 Output power (on): +3 to +7 dBm Output power (off): ≤ -40 dBm Output power stability: -1.5 to +1.0 dB Wavelength accuracy: +/-25 pm, +/-3.125 GHz Tuning time: Warm tune – 10 seconds; cold start – 40 seconds Extinction ratio: ≥ 11 dB Crossing ratio: 45 to 55 percent Side-mode suppression ratio: ≥ 30 dB Optical spectral width: ≤ 25 GHz (informational, not a specification) Average relative intensity noise (RIN): <ul style="list-style-type: none"> 10 MHz to 1 GHz: -110 dB/Hz 1 GHz to 10 GHz: -145 dB/Hz Output OSNR: <ul style="list-style-type: none"> Minimum: 50 dB (0.1 nm resolution bandwidth) Typical: 55 dB (0.1 nm resolution bandwidth) Polarization extinction ratio: 20 dB Eye mask compliance: 802.3—2005 Jitter generation compliance: GR-253/G.8251
Optical receiver	<ul style="list-style-type: none"> Receiver type: Avalanche photodiode (APD) Average receive power (input power range): see Input Power Range in Table 19 on page 22 Jitter tolerance compliance: GR-253/G.8251/802.3ae (LAN PHY) Rx DTV setting: <ul style="list-style-type: none"> No FEC (pass-through): Static (factory optimized value) GFEC: Managed by electronic dispersion compensation (EDC) EFEC: Managed by EDC Rx wavelength range: 1527 to 1567 nm Overload (receiver saturation): -5 dBm (high OSNR), -8 dBm (low OSNR) Damage input power: +5 dBm Optical return loss: ≥ 27 dB

Table 17: 10-Gigabit Ethernet DWDM OTN Optical Interface Specifications (continued)

Optical performance	<p>Optical Applications—Power-Limited Receiver (High OSNR):</p> <ul style="list-style-type: none"> • Sensitivity: <ul style="list-style-type: none"> • No FEC: -5 to -24 dBm (>33 dB/0.1 nm OSNR, 0 ps/nm CD) at 10^{-12} BER (10.3 Gbps) • GFEC: -5 to -28 dBm at 8×10^{-5} pre-FEC BER (>33 dB/0.1 nm OSNR, 0 ps/nm CD) (10^{-15} post-FEC BER) (11.05 and 11.1 Gbps) • EFEC: -5 to -28 dBm at 1×10^{-3} pre-FEC BER (>33 dB/0.1 nm OSNR, 0 ps/nm CD) (10^{-15} post-FEC BER) (11.05 and 11.1 Gbps) • Chromatic dispersion (CD) power penalty: <ul style="list-style-type: none"> • No FEC: 3 dB (typical penalty at +/-1200 ps/nm without EDC) • GFEC or EFEC: 3 dB (typical penalty at +/-1600 ps/nm with EDC) <p>Optical Applications—Noise-Limited Receiver (Low OSNR):</p> <ul style="list-style-type: none"> • Required OSNR: <ul style="list-style-type: none"> • No FEC (10.3 Gbps): <ul style="list-style-type: none"> • 26 dB/0.1 nm (-8 to -22 dBm Rx input power range, 0 ps/nm CD, at 10^{-12} BER) • 26 dB/0.1 nm (-8 to -20 dBm Rx input power range, +/-1000 ps/nm without EDC, at 10^{-12} BER) • 30 dB/0.1 nm (-8 to -20 dBm Rx input power range, +/-1200 ps/nm without EDC, at 10^{-12} BER) • GFEC (11.05 and 11.1 Gbps): <ul style="list-style-type: none"> • 15.5 dB/0.1 nm (-8 to -20 dBm Rx input power range, 0 ps/nm, at $\leq 10^{-5}$ pre-FEC BER, $\leq 10^{-15}$ post-FEC BER) • 17 dB/0.1 nm (-8 to -20 dBm Rx input power range, +/-1200 ps/nm with EDC, at $\leq 10^{-5}$ pre-FEC BER, $\leq 10^{-15}$ post-FEC BER) • EFEC (11.05 and 11.1 Gbps): <ul style="list-style-type: none"> • 12 dB/0.1 nm (-8 to -20 dBm Rx input power range, 0 ps/nm, at $\leq 10^{-4}$ pre-FEC BER, $\leq 10^{-15}$ post-FEC BER) • 14 dB/0.1 nm (-8 to -20 dBm Rx input power range, +/-1200 ps/nm with EDC, at $\leq 10^{-4}$ pre-FEC BER, $\leq 10^{-15}$ post-FEC BER) • 16 dB/0.1 nm (-8 to -20 dBm Rx input power range, 0 ps/nm CD, 10^{-15} post-FEC BER) • CD OSNR penalty: <ul style="list-style-type: none"> • GFEC: 1.5 dB (typical penalty at +/-1200 ps/nm with Rx input power range from -8 to -20 dBm). • EFEC: 2 dB (typical penalty at +/-1200 ps/nm with Rx input power range from -8 to -20 dBm). <p>For more detailed information, see Table 19 on page 22.</p>
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10-Gigabit Ethernet DWDM OTN Supported Wavelengths

[Table 18 on page 21](#) provides the supported wavelengths for the 100-GHz grid and the 50-GHz offset in both THz and nm.

Table 18: 10-Gigabit Ethernet DWDM OTN Supported Wavelengths

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

PC-1XGE-DWDM-OTN Optical Signal-to-Noise Ratio (OSNR) Performance

The OSNR performance listed in [Table 19 on page 22](#) is for an appropriate level of optical filtering of the amplified spontaneous emission (ASE) reaching the receiver and is derived using a 0.22-nm 3-dB full-width Gaussian filter. When no FEC is used, there is no OTN framing.

Table 19: PC-1XGE-DWDM-OTN Optical Signal-to-Noise Ratio (OSNR) Performance

OSNR (dB/0.1 nm)	OSNR (dB/0.5 nm)	FEC Type	Pre-FEC BER	Post-FEC BER	Input-Power Range (ROP) (dBm)	CD Tolerance (ps/nm)
33	26	None	10^{-12}	NA	-5 to -24	0
33	26	None	10^{-12}	NA	-5 to -21	+/-1200 (no EDC)
26	19	None	10^{-12}	NA	-8 to -22	0
26	19	None	10^{-12}	NA	-8 to -20	+/-1000 (no EDC)
30	23	None	10^{-12}	NA	-8 to -20	+/-1200 (no EDC)
33	26	GFEC	8×10^{-5}	10^{-15}	-5 to -28	0
33	26	GFEC	8×10^{-5}	10^{-15}	-5 to -25	+/-1600 (with EDC)
15.5	8.5	GFEC	10^{-5}	10^{-15}	-8 to -20	0
17	10	GFEC	10^{-5}	10^{-15}	-8 to -20	+/-1200 (with EDC)
33	26	EFEC	10^{-3}	10^{-15}	-5 to -28	0
33	26	EFEC	10^{-3}	10^{-15}	-5 to -25	+/-1600 (with EDC)
12	5	EFEC	7×10^{-4}	10^{-15}	-8 to -20	0
14	7	EFEC	7×10^{-4}	10^{-15}	-8 to -20	+/-1200 (with EDC)

10-Gigabit Ethernet DWDM Transceiver (XFP-10G-CBAND-T50-ZR) Wavelengths

[Table 20 on page 23](#) provides the supported wavelengths for the 100-GHz grid and the 50-GHz offset in both THz and nm.

Table 20: Programmable Wavelengths Supported by 10-Gigabit Ethernet DWDM Transceivers

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

- Related Documentation**
- [Ethernet DWDM Interface Wavelength Overview](#)
 - [Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength](#)

SONET/SDH OC3/STM1 Optical Interface Specifications

- [SONET/SDH OC3/STM1 Specifications on page 24](#)
- [SONET/SDH OC3/STM1 Intermediate Reach \(IR-1\) Specifications on page 24](#)
- [SONET/SDH OC3/STM1 Long Reach \(LR-1\) Specifications on page 25](#)

SONET/SDH OC3/STM1 Specifications

Table 21 on page 24 shows the multimode SONET/SDH OC3/STM1 optical interface specifications.

Table 21: 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 22 on page 24 shows the SONET/SDH OC3/STM1 intermediate reach (IR-1) optical interface specifications.

Table 22: 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

Table 22: SONET/SDH OC3/STM1 Intermediate Reach Optical Interface Specifications (continued)

Parameter	Intermediate Reach (IR-1)
Receiver saturation	–8 dBm
Receiver sensitivity	–28 dBm

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

Table 23 on page 25 shows the SONET/SDH OC3/STM1 long reach (LR-1) optical interface specifications.

Table 23: 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 OC12/STM4 Optical Interface Specifications

- SONET/SDH OC12/STM4 Short Reach (SR-1) Specifications on page 25
- SONET/SDH OC12/STM4 Intermediate Reach (IR-1) Specifications on page 26
- SONET/SDH OC12/STM4 Long Reach (LR-1) Specifications on page 26
- SONET/SDH OC12/STM4 Long Reach (LR-2) Specifications on page 27

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

Table 24 on page 25 shows the SONET/SDH OC12/STM4 short reach (SR-1) optical interface specifications.

Table 24: SONET/SDH OC12/STM4 Short Reach (SR-1) Optical Interface Specifications

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

Table 24: SONET/SDH OC12/STM4 Short Reach (SR-1) Optical Interface Specifications (continued)

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

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

Table 25 on page 26 shows the SONET/SDH OC12/STM4 short reach (IR-1) optical interface specifications.

Table 25: 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 26 on page 26 shows the SONET/SDH OC12/STM4 short reach (LR-1) optical interface specifications.

Table 26: SONET/SDH OC12/STM4 Long Reach (LR-1) Optical Interface Specifications

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

Table 26: SONET/SDH OC12/STM4 Long Reach (LR-1) Optical Interface Specifications (continued)

Parameter	Long Reach (LR-1)
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 27 on page 27 shows the SONET/SDH OC12/STM4 short reach (LR-2) optical interface specifications.

Table 27: 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

SONET/SDH OC48/STM16 Optical Interface Specifications

- SONET/SDH OC48/STM16 Short Reach (SR-1) Specifications on page 28
- SONET/SDH OC48/STM16 Intermediate Reach (IR-1) Specifications on page 28
- SONET/SDH OC48/STM16 Long Reach (LR-1) Specifications on page 28
- SONET/SDH OC48/STM16 Long Reach (LR-2) Specifications on page 29

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

Table 28 on page 28 shows the SONET/SDH OC48/STM16 short reach (SR-1) optical interface specifications.

Table 28: SONET/SDH OC48/STM16 Short Reach (SR-1) Optical Interface Specifications

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

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

Table 29 on page 28 shows the SONET/SDH OC48/STM16 intermediate reach (IR-1) optical interface specifications.

Table 29: 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 30 on page 29 shows the SONET/SDH OC48/STM16 long reach (LR-1) optical interface specifications.

Table 30: SONET/SDH OC48/STM16 Long Reach (LR-1) Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode
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 31 on page 29 shows the SONET/SDH OC48/STM16 long reach (LR-2) optical interface specifications.

Table 31: 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

SONET/SDH OC192/STM64 Optical Interface Specifications

- SONET/SDH OC192/STM64 Very Short Reach (VSR) on page 30
- SONET/SDH OC192/STM64 Short Reach (SR-1) on page 30
- SONET/SDH OC192/STM64 Short Reach (SR-2) on page 31
- SONET/SDH OC192/STM64 Intermediate Reach (IR-2) on page 31
- SONET/SDH OC192/STM64 Long reach (LR-1) on page 32
- SONET/SDH OC192/STM64 Long reach (LR-2) on page 32

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

Table 32 on page 30 shows the SONET/SDH OC192/STM64 very short reach (VSR) optical interface specifications.

Table 32: 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 33 on page 30 shows the SONET/SDH OC192/STM64 short reach (SR-1) optical interface specifications.

Table 33: 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)
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 34 on page 31 shows the SONET/SDH OC192/STM64 short reach (SR-2) optical interface specifications.

Table 34: 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 35 on page 31 shows the SONET/SDH OC192/STM64 Intermediate reach (IR-2) optical interface specifications.

Table 35: SONET/SDH OC192/STM64 Intermediate Reach (IR-2) Optical Interface Specifications

Parameter	Intermediate Reach (IR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 24.8 miles (40 km) <small>NOTE: Distances greater than 30 km are considered to be engineered links.</small>
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 36 on page 32 shows the SONET/SDH OC192/STM64 long reach (LR-1) optical interface specifications.

Table 36: 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 37 on page 32 shows the SONET/SDH OC192/STM64 long reach (LR-2) optical interface specifications.

Table 37: 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

SONET/SDH OC768/STM256 Optical Interface Specifications

Table 38 on page 33 shows the SONET/SDH OC768/STM256 short reach (SR-1) optical interface specifications.

Table 38: SONET/SDH OC768/STM256 Short Reach (SR-1) Optical Interface Specifications

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

PART 2

PIC Descriptions

- [ATM2 IQ PIC Descriptions on page 37](#)
- [Channelized PIC Descriptions on page 43](#)
- [Channelized Enhanced IQ \(IQE\) PIC Descriptions on page 51](#)
- [DS3 and E3 PIC Descriptions on page 77](#)
- [Fast Ethernet PIC Descriptions on page 81](#)
- [Gigabit Ethernet PIC Descriptions on page 83](#)
- [10-Gigabit Ethernet PIC Descriptions on page 97](#)
- [40-Gigabit Ethernet PIC Descriptions on page 121](#)
- [100-Gigabit Ethernet PIC Descriptions on page 125](#)
- [Services PIC Descriptions on page 133](#)
- [SONET/SDH PIC Descriptions on page 139](#)
- [End-of-Life PIC Descriptions on page 169](#)

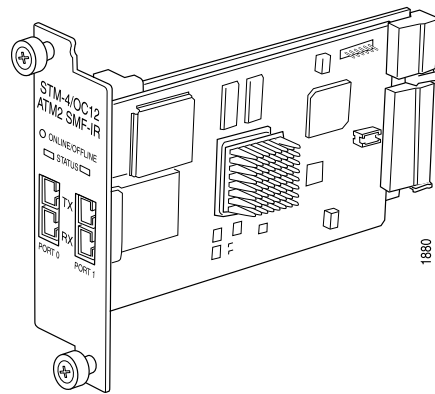
CHAPTER 3

ATM2 IQ PIC Descriptions

- [ATM2 OC12/STM4 IQ PIC \(T4000 Router\) on page 37](#)

ATM2 OC12/STM4 IQ PIC (T4000 Router)

Figure 1: 2-Port ATM2 OC12/STM4 IQ PIC



- [Software Release on page 37](#)
- [Hardware Features on page 37](#)
- [Software Features on page 38](#)
- [Cables and Connectors on page 40](#)
- [LEDs on page 40](#)
- [Alarms, Errors, and Events on page 40](#)

Software Release

2-port: Junos OS Release 12.2R2 and later (Type 2)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Two OC12 ports
- Power requirement: 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: PB-2OC12-ATM2-SMIR
- ATM2 IQ 2-port OC12 PICs have dual 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

Table 39: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Circuit cross-connect for leveraging ATM access networks	12.2R2
User-configurable virtual circuit (VC) and virtual path (VP) support	12.2R2
Support for idle cell or unassigned cell transmission	12.2R2
OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI), and loop cells	12.2R2
Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP	12.2R2
Local and remote loopback	12.2R2
ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC	12.2R2
Simple Network Management Protocol (SNMP): <ul style="list-style-type: none"> • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB 	12.2R2

Table 39: Software Features Supported (continued)

Software Feature	T4000 First Supported Junos OS Release
Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping	12.2R2
Per-VC or per-VP traffic shaping	12.2R2
Support for F4 OAM cells	12.2R2
Support for 16-bit VCI range	12.2R2

Cables and Connectors

- Duplex SC 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 25](#)

LEDs

Table 40: ATM2 OC12/STM4 IQ PIC LEDs

Label	Color	State	Description
STATUS	—	Off	Not enabled
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures
	Red	On steadily	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 framing (SEF)
- Severely errored framing seconds (SEFS-S)
- Severely errored seconds (SES-S, SES-L, SES-P)
- Unavailable seconds (UAS-L, UAS-P)

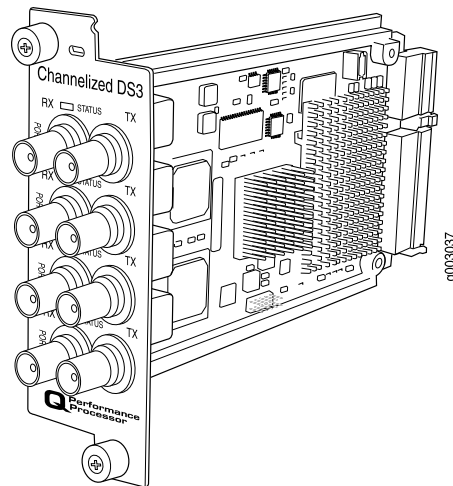
- Related Documentation**
- *T4000 PIC Description*
 - [T4000 PICs Supported on page 3](#)

CHAPTER 4

Channelized PIC Descriptions

- [Channelized DS3 IQ PIC \(T4000 Router\) on page 43](#)
- [Channelized STM1 IQ PIC \(T4000 Router\) on page 46](#)
- [Channelized OC3 IQ PIC \(T4000 Router\) on page 48](#)

Channelized DS3 IQ PIC (T4000 Router)



- [Software Release on page 43](#)
- [Hardware Features on page 44](#)
- [Software Features on page 44](#)
- [Cables and Connectors on page 44](#)
- [LEDs on page 45](#)
- [Alarms, Errors, and Events on page 45](#)
- [Instrumentation \(counters\) on page 45](#)

Software Release

Junos OS Release 12.1R2 and later (Type 1)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

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

Table 41: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	12.1R2
Simple Network Management Protocol (SNMP): DS1 MIB, DS3 MIB	12.1R2
Dynamic, arbitrary channel configuration	12.1R2
Encapsulations: <ul style="list-style-type: none"> • Circuit cross-connect (CCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP) 	12.1R2

Cables and Connectors

Standard DS3 BNC coaxial cable interfaces

LEDs

Table 42: Channelized DS3 IQ PIC LEDs

Label	Color	State	Description
STATUS	—	Off	Not enabled
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures
	Red	On steadily	Active with a local alarm; router has detected a failure

Alarms, Errors, and Events

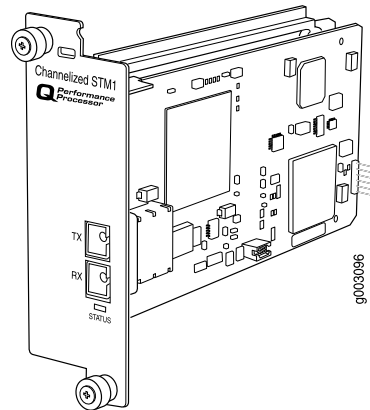
- Alarm indication signal (AIS)
- Excessive zeros (EXZ)
- Far-end block error (FEBE)
- Frame error
- Idle code, Idle received
- Line code violation (LCV)
- Loss of signal (LOS)
- Out of frame (OOF)
- Parity bit (P-bit) disagreements
- Path parity error
- Yellow alarm bit (X-bit) disagreements

Instrumentation (counters)

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

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

Channelized STM1 IQ PIC (T4000 Router)

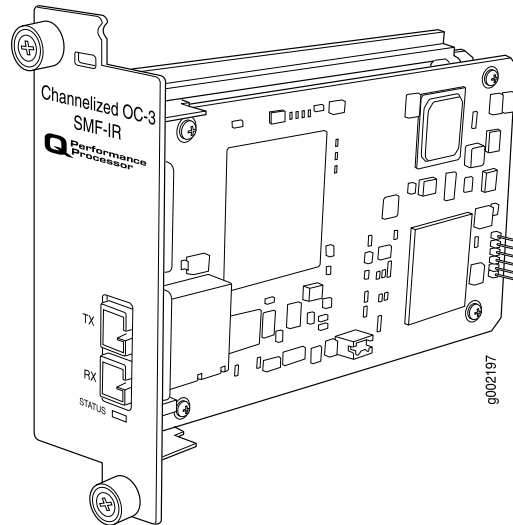


Software release	<ul style="list-style-type: none"> Junos OS Release 12.1R2 and later (Type 1) <p>For information on which FPCs support this PIC, see “T4000 PIC/FPC Compatibility” on page 8.</p>
Description	<ul style="list-style-type: none"> One STM1 port Power requirement: 0.39 A @ 48 V (18.6 W) Fine-grained queuing per logical interface Channelization: STM1c, fractional E1, framed and unframed DS0 Model number: PB-1CHSTM1-SMIR-QPP
Hardware features	<ul style="list-style-type: none"> Packet buffering, Layer 2 parsing 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) SNMP: SONET/SDH MIB, T1/E1 MIB Dynamic, arbitrary channel configuration Full bit error rate test (BERT) patterns at E1 and DS0 levels Encapsulations: <ul style="list-style-type: none"> High-Level Data Link Control (HDLC) Frame Relay Circuit cross-connect (CCC) Translational cross-connect (TCC) 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 fixed transceiver Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 24 <p>NOTE: This PIC supports only SDH.</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	<ul style="list-style-type: none"> • 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) <p>Error detection:</p> <ul style="list-style-type: none"> • 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 framing (SEF) • Severely errored framing seconds (SEFS-S) • Severely errored seconds (SES-S, SES-L, SES-P) • Unavailable seconds (UAS-L, UAS-P)
Instrumentation (counters)	<ul style="list-style-type: none"> • Layer 2 per-queue and per-channel packet and byte counters

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

Channelized OC3 IQ PIC (T4000 Router)



Software release	<ul style="list-style-type: none"> Junos OS Release 12.1R2 and later (Type 1) <p>For information on which FPCs support this PIC, see "T4000 PIC/FPC Compatibility" on page 8.</p>
Description	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Subrate and scrambling: <ul style="list-style-type: none"> 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

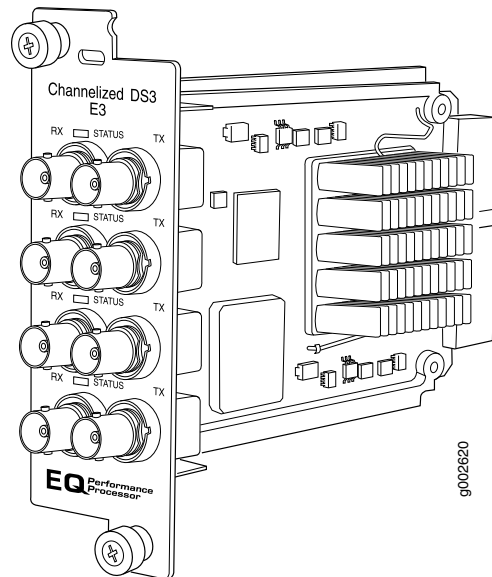
Software features	<ul style="list-style-type: none"> • Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB • Dynamic, arbitrary channel configuration • 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 SONET/SDH OC3/STM1 intermediate-reach (IR-1) fiber • Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 24
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-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 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	<ul style="list-style-type: none"> • <i>T4000 PIC Description</i> • T4000 PICs Supported on page 3

CHAPTER 5

Channelized Enhanced IQ (IQE) PIC Descriptions

- [Channelized DS3/E3 Enhanced IQ \(IQE\) PIC \(T4000 Router\) on page 52](#)
- [Channelized E1/T1 Enhanced IQ \(IQE\) PIC \(T4000 Router\) on page 55](#)
- [Channelized OC3/STM1 Enhanced IQ \(IQE\) PIC with SFP \(T4000 Router\) on page 58](#)
- [Channelized OC12/STM4 Enhanced IQ \(IQE\) PICs with SFP \(T4000 Router\) on page 62](#)
- [Channelized OC48/STM16 Enhanced IQ \(IQE\) PIC with SFP \(T4000 Router\) on page 69](#)

Channelized DS3/E3 Enhanced IQ (IQE) PIC (T4000 Router)



Software release	<ul style="list-style-type: none"> Junos OS Release 12.1R2 and later (Type 1) <p>For information on which FPCs support this PIC, see “T4000 PIC/FPC Compatibility” on page 8.</p>
Description	<ul style="list-style-type: none"> Four E3 or Channelized DS3 ports E3 or Channelized DS3 is configurable on a per-port granularity DS3 channelization: <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 interfaces 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 channels
- 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 and EX9200 Switches* 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

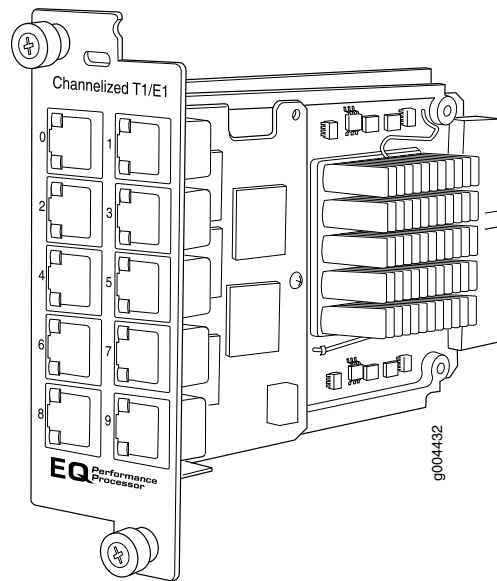
Cables and connectors

- Standard DS3 BNC coaxial cable interfaces

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 reporting for error statistics and failure counts • DS1 alarms: <ul style="list-style-type: none"> • Alarm indication signal (AIS) • Loss of frame (LOF) • Remote alarm indication signal (RAIS) • DS1 error detection: <ul style="list-style-type: none"> • 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) • DS3 alarms: <ul style="list-style-type: none"> • Alarm indication signal (AIS) • Loss of frame (LOF) • Loss of signal (LOS) • Phase lock loop (PLL) • DS3 error detection: <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Layer 2 per-queue and per-channel packet and byte counters

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

Channelized E1/T1 Enhanced IQ (IQE) PIC (T4000 Router)



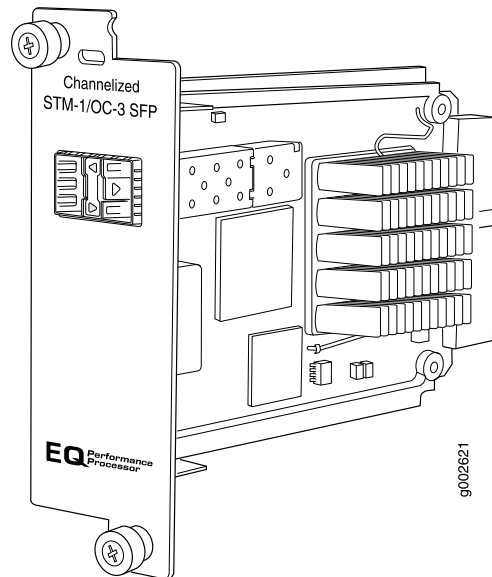
Software release	<ul style="list-style-type: none"> • Junos OS Release 12.1R2 and later (Type 1) <p>For information on which FPCs support this PIC, see “T4000 PIC/FPC Compatibility” on page 8.</p>
Description	<ul style="list-style-type: none"> • Ten E1 or T1 ports • DS1 and E1 interfaces are selectable on a per-port granularity • E1 channelization per PIC: <ul style="list-style-type: none"> • 10 E1 channels • 310 DS0 channels • T1 channelization per PIC: <ul style="list-style-type: none"> • 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	<p>Ports are numbered:</p> <ul style="list-style-type: none"> • 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	<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)

- Enhanced fine-grained queuing per logical interface. See the *Class of Service Feature Guide for Routing Devices and EX9200 Switches* 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	<ul style="list-style-type: none"> • 120-ohm RJ-48C connector (female)
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"> • DS1 alarms: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T4000 Router)



Software release	<ul style="list-style-type: none"> Junos OS Release 12.1R2 and later (Type 1) <p>For information on which FPCs support this PIC, see “T4000 PIC/FPC Compatibility” on page 8.</p>
Description	<ul style="list-style-type: none"> Two OC3 or STM1 ports SONET or SDH is configurable on a per-port granularity SONET channelization: <ul style="list-style-type: none"> 2 OC3 channels 6 DS3 channels 168 DS1 channels 1011 DS0 channels SDH channelization: <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Ports are numbered 0 and 1 from left to right
Software features	<ul style="list-style-type: none"> 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 <i>Class of Service Feature Guide for Routing Devices and EX9200 Switches</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
- 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 (IR-1) (model number: SFP-OC3-LR)

Optical interface specifications—see [“SONET/SDH OC3/STM1 Optical Interface Specifications” on page 24](#)

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 clock (LOC)
 - 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 clock (VLOC)
 - 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 clock (LOC)
 - 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 clock (TU-LOC)
- 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)
 - Loss of signal seconds (LOSS)
 - 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)
- 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**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T4000 Router)

Figure 2: 1-Port IQE PIC

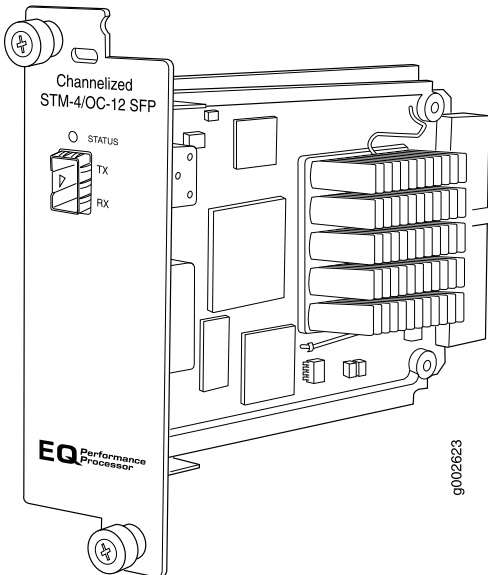


Figure 3: 4-Port IQE PIC (Type 2)

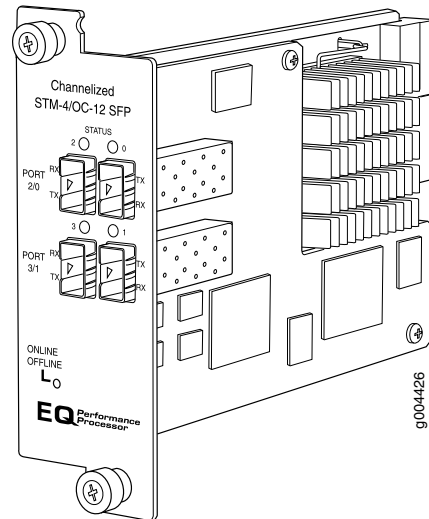
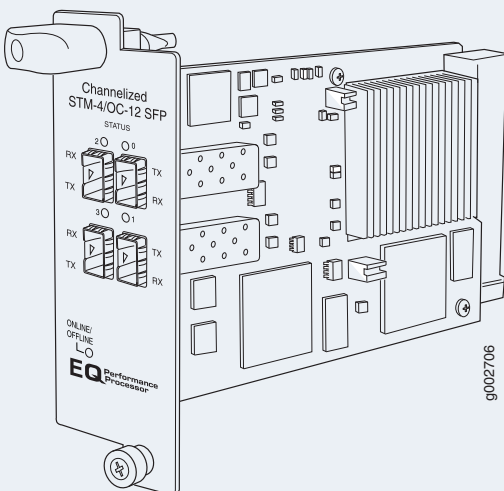


Figure 4: 4-Port IQE PIC (Type 3)



- [Software Release on page 63](#)
- [Hardware Features on page 63](#)
- [Software Features on page 64](#)
- [Cables and Connectors on page 65](#)

- [LEDs on page 66](#)
- [Alarms, Errors, and Events on page 66](#)
- [Instrumentation \(counters\) on page 68](#)

Software Release

- Junos OS Release 12.1R2 (Type 1)
- Junos OS Release 12.2R2 (Type 2)
- Junos OS Release 13.2 (Type 3)

For information on which FPCs support these PICs, see "[T4000 PIC/FPC Compatibility](#)" on page 8.

Hardware Features

- Four OC12/STM4 ports
- SONET or SDH is configurable on a per-port granularity
- 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
 - 672 DS1 channels
 - 974 DS0 channels
- Power requirement: 1.08 A @ -48V (52 W)
- Model number (Type 1): PB-1CHOC12-STM4-IQE-SFP
- Model number (Type 2): PB-4CHOC12-STM4-IQE-SFP
- Model number (Type 3): PC-4CHOC12-STM4-IQE-SFP
- 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

Table 43: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	12.1R2
Enhanced fine-grained queuing per logical interface. See the Junos OS Class of Service Library for Routing Devices for more information about class of service features.	12.1R2
Subrate and scrambling: <ul style="list-style-type: none"> • Digital Link/Quick Eagle • Kentrox • Larscom • ADTRAN • Verilink 	12.1R2
Packet buffering, Layer 2 parsing	12.1R2
M13/C-bit parity encoding	12.1R2
DS3 far-end alarm and control (FEAC) channel support	12.1R2
Local line, remote line, and remote payload loopback testing	12.1R2
Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB	12.1R2
Dynamic, arbitrary channel configuration	12.1R2
Full bit error rate test (BERT)	12.1R2

Table 43: Software Features Supported (continued)

Software Feature	T4000 First Supported Junos OS Release
Encapsulations: <ul style="list-style-type: none"> • 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 	12.1R2
<ul style="list-style-type: none"> • Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16) • Point-to-Point Protocol (PPP) • PPP for CCC • PPP for TCC 	12.1R2
Encapsulations available only for DS1: <ul style="list-style-type: none"> • Multilink Frame Relay end-to-end (MLFR FRF.15) • Multilink PPP (MLPPP) • PPP over Frame Relay 	12.1R2

Cables and Connectors

- Duplex LC 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 25](#)

LEDs

Table 44: Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP LEDs

Label	Color	State	Description
STATUS	—	Off	Not enabled
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures
	Red	On steadily	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)

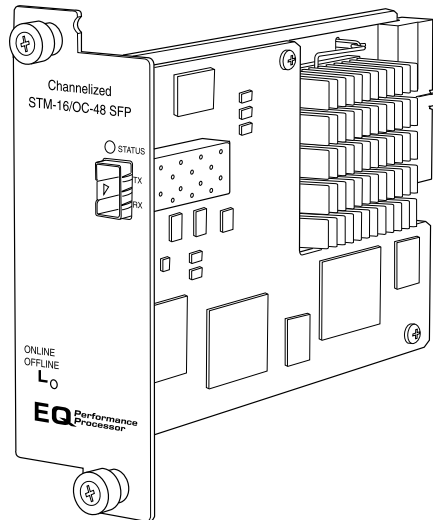
- Severely errored seconds (SES)
- Severely errored framing seconds (SEFS)
- Unavailable seconds (UAS)
- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Yellow alarm
- DS3 error detection:
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing 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

- | | |
|----------------------------------|---|
| Related
Documentation | <ul style="list-style-type: none">• <i>T4000 PIC Description</i>• T4000 PICs Supported on page 3 |
|----------------------------------|---|

Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T4000 Router)



- [Software Release on page 69](#)
- [Hardware Features on page 69](#)
- [Software Features on page 70](#)
- [Cables and Connectors on page 71](#)
- [LEDs on page 72](#)
- [Alarms, Errors, and Events on page 72](#)
- [Instrumentation \(counters\) on page 74](#)
- [PICs Supported in the Fourth Slot of T640-FPC2-E and T640-FPC2-E2 with Type 2 IQE PICs on page 75](#)

Software Release

Junos OS Release 12.2R2 and later (Type 2)

For information on which FPCs support this PIC, see “[T4000 PIC/FPC Compatibility](#)” on [page 8](#).

Hardware Features

- 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
- Port is numbered 0.

Software Features

Table 45: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	12.2R2
Enhanced fine-grained queuing per logical interface. See the Junos OS Class of Service Library for Routing Devices for more information about class of service features.	12.1R2
Subrate and scrambling: <ul style="list-style-type: none"> • Digital Link/Quick Eagle • Kentrox • Larscom • ADTRAN • Verilink 	12.2R2
Packet buffering, Layer 2 parsing	12.2R2
M13/C-bit parity encoding	12.2R2
DS3 far-end alarm and control (FEAC) channel support	12.2R2
Local line, remote line, and remote payload loopback testing	12.2R2
Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB	12.2R2

Table 45: Software Features Supported (continued)

Software Feature	T4000 First Supported Junos OS Release
Dynamic, arbitrary channel configuration	12.2R2
Full bit error rate test (BERT)	12.2R2
Encapsulations:	12.2R2
<ul style="list-style-type: none"> • 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:	12.2R2
<ul style="list-style-type: none"> • 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 27](#)

LEDs

Table 46: Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP LEDs

Label	Color	State	Description
STATUS	—	Off	Not enabled
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures
	Red	On steadily	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

PICs Supported in the Fourth Slot of T640-FPC2-E and T640-FPC2-E2 with Type 2 IQE PICs

Table 47: PICs Supported in Fourth Slot of T640-FPC2-E and T640-FPC2-E2 with Type 2 IQE PICs

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

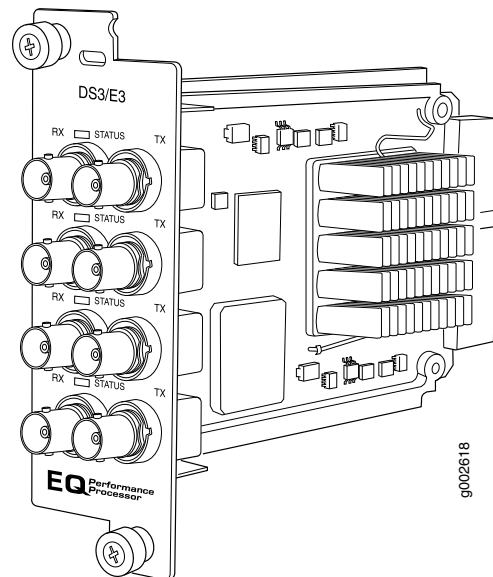
- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

CHAPTER 6

DS3 and E3 PIC Descriptions

- [DS3/E3 Enhanced IQ \(IQE\) PIC \(T4000 Router\) on page 77](#)

DS3/E3 Enhanced IQ (IQE) PIC (T4000 Router)



Software release	<ul style="list-style-type: none">• Junos OS Release 12.1R2 and later (Type 1) <p>For information on which FPCs support this PIC, see “T4000 PIC/FPC Compatibility” on page 8.</p>
Description	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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 and EX9200 Switches* 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	<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"> • DS3 alarms: <ul style="list-style-type: none"> • Alarm indication signal (AIS) • Loss of frame (LOF) • Loss of signal (LOS) • Phase lock loop (PLL) • DS3 error detection: <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Layer 2 per-queue and per-channel packet and byte counters

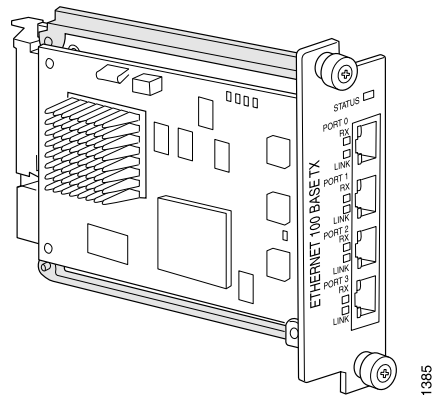
- Related Documentation**
- *T4000 PIC Description*
 - [T4000 PICs Supported on page 3](#)

CHAPTER 7

Fast Ethernet PIC Descriptions

- Fast Ethernet PIC (T4000 Router) on page 81

Fast Ethernet PIC (T4000 Router)



Software release	<ul style="list-style-type: none">• Junos OS Release 12.1R2 and later (Type 1) <p>For information on which FPCs support this PIC, see “T4000 PIC/FPC Compatibility” on page 8.</p>
Description	<ul style="list-style-type: none">• 4 100Base-TX ports• Power requirement: 0.14 A @ 48 V (6.8 W)• Model number: PB-4FE-TX
Hardware features	<ul style="list-style-type: none">• 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• MTUs up to 1533 bytes• 1,024 autosensing 802.1q VLANs per port
Software features	<ul style="list-style-type: none">• 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 | <p>4-port PIC:</p> <ul style="list-style-type: none">• Connector: Two-pair, Category 5 unshielded twisted-pair connectivity through an RJ-45 connector• Pinout: MDI noncrossover |
|-----------------------|---|

- | | |
|------|---|
| LEDs | <p>Status LED, one bicolor:</p> <ul style="list-style-type: none">• Off—PIC ports not enabled.• Green—PIC is operating normally.• Red—PIC has an error or failure. <p>4-port PIC—One pair of port LEDs:</p> <ul style="list-style-type: none">• 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. |
|------|---|

- | | |
|------------------------------|--|
| Related Documentation | <ul style="list-style-type: none">• T4000 PIC Description• T4000 PICs Supported on page 3 |
|------------------------------|--|

CHAPTER 8

Gigabit Ethernet PIC Descriptions

- [Gigabit Ethernet PICs with SFP \(T4000 Router\) on page 83](#)
- [Gigabit Ethernet IQ PIC with SFP \(T4000 Router\) on page 86](#)
- [Gigabit Ethernet IQ2 PICs with SFP \(T4000 Router\) on page 89](#)
- [Gigabit Ethernet Enhanced IQ2 \(IQ2E\) PIC with SFP \(T4000 Router\) on page 92](#)

Gigabit Ethernet PICs with SFP (T4000 Router)

Figure 5: 2-Port Gigabit Ethernet PIC

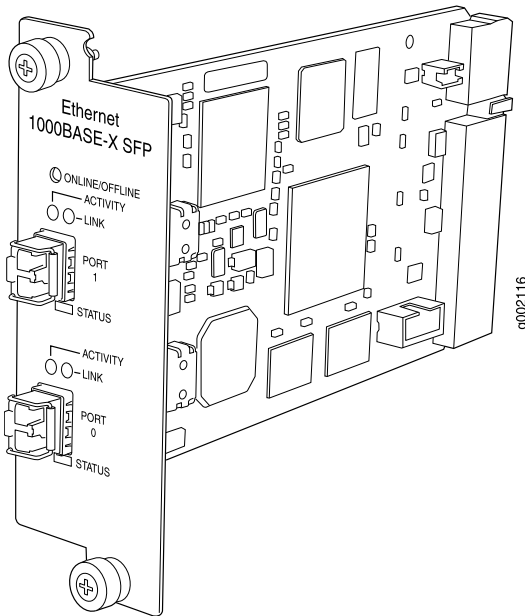
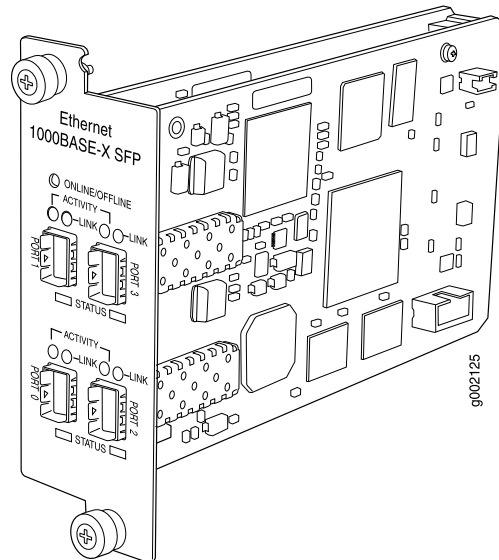


Figure 6: 4-Port Gigabit Ethernet PIC



- [Software Release on page 84](#)
- [Hardware Features on page 84](#)
- [Software Features on page 84](#)
- [Cables and Connectors on page 85](#)
- [LEDs on page 86](#)

Software Release

- 2-port: Junos OS Release 12.2R2 and later (Type 2)
- 4-port: Junos OS Release 12.2R2 and later (Type 2)
- 10-port: Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Ten Gigabit Ethernet ports
- Power requirement: 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 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
- 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

Table 48: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Virtual Router Redundancy Protocol (VRRP) support	12.2R2
802.1q virtual LANs (VLANs) support	12.2R2
960 destination MAC filters per port	12.2R2
Optical diagnostics and related alarms	12.2R2
Passive monitoring for IPv4 packets	12.2R2



NOTE: The 10-port Gigabit Ethernet PIC with SFP does not support MAC accounting and policing, MAC learning, TPID, or flexible Ethernet encapsulation.

The 10-port Gigabit Ethernet PIC supports 64 source MAC filters per port.

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 the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
 - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
- Copper transceiver:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000BASE-T (model number: SFP-1GE-T)
 - Pinout: MDI crossover
 - Copper interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>



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

LEDs

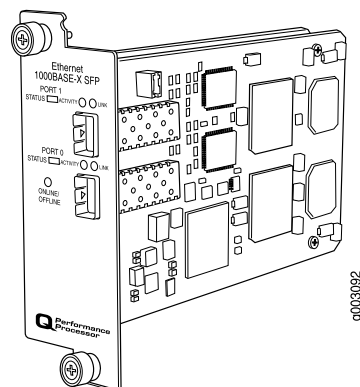
Table 49: Gigabit Ethernet PICs with SFP LEDs

Label	Color	State	Description
STATUS	—	Off	PIC is not enabled.
	Green	On steadily	PIC is operating normally.
	Red	On steadily	PIC has an error or failure.
LINK for each port	Green	On steadily	The port is online.
	—	Off	The port is down.
ACT for each port	Green	Flashing	The port is receiving data.
	—	Off	The port might be on but is not receiving data.

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

Gigabit Ethernet IQ PIC with SFP (T4000 Router)

Figure 7: 2-Port Gigabit Ethernet IQ PIC



- [Software Release on page 87](#)
- [Hardware Features on page 87](#)
- [Software Features on page 87](#)
- [Cables and Connectors on page 87](#)
- [Gigabit Ethernet IQ PIC with SFP LEDs on page 88](#)

Software Release

2-port: Junos OS Release 12.2R2 and later (Type 2):

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Two Gigabit Ethernet ports
- Power requirement: 0.46 A @ 48 V (22 W)
- Fine-grained queuing per logical interface
- Model number: PB-2GE-SFP-QPP
- High-performance throughput on each port at speeds up to 1 Gbps
- Full-duplex mode
- Large MTUs of up to 9192 bytes

Software Features

Table 50: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Optical diagnostics and related alarms	12.2R2
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	12.2R2
Virtual Router Redundancy Protocol (VRRP) support	12.2R2
802.1q virtual LANs (VLANs)	12.2R2
VLAN stacking and rewriting	12.2R2
Flexible Ethernet encapsulation	12.2R2
MAC policing, accounts, and filters	12.2R2

Cables and Connectors

- You can install any transceiver supported by the PIC.
- Fiber-optic small form-factor pluggable (SFP) transceivers:
 - Duplex LC 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 the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
- 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
- Copper transceiver:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000BASE-T (model number: SFP-1GE-T)
 - Pinout: MDI crossover
 - Copper interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>



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

Gigabit Ethernet IQ PIC with SFP LEDs

Table 51: LEDs

Label	Color	State	Description
STATUS	—	Off	PIC is not enabled.
	Green	On steadily	At least one port is online.
LINK one per port	—	Off	Port is down.
	Green	On steadily	Link is established.
ACTIVITY one per port	—	Off	No activity.
	Green	On steadily	Link has activity.

- Related Documentation**
- *T4000 PIC Description*
 - [T4000 PICs Supported on page 3](#)

Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)

Figure 8: 4-Port Gigabit Ethernet IQ2 PIC (Type 1)

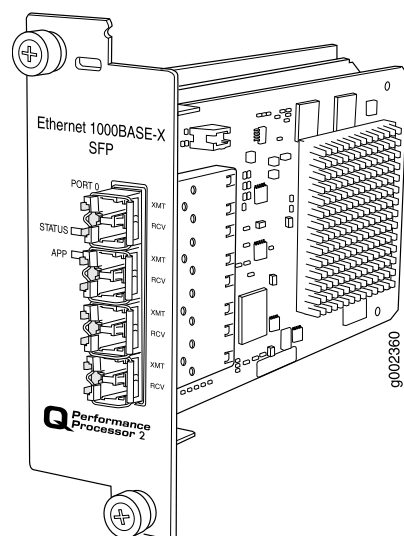
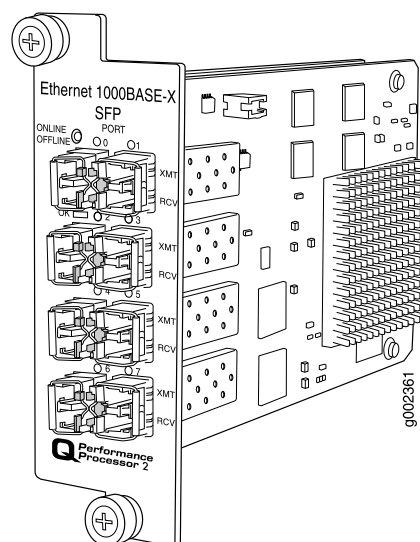


Figure 9: 8-Port Gigabit Ethernet IQ2 PIC (Type 2)



- [Software Release on page 89](#)
- [Hardware Features on page 89](#)
- [Software Features on page 90](#)
- [Cables and Connectors on page 90](#)
- [LEDs on page 91](#)

Software Release

- 4-port: Junos OS Release 12.1R2 and later (Type 1)
- 8-port: Junos OS Release 12.2R2 and later (Type 2)
- 8-port: Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Eight Gigabit Ethernet ports
- Power requirement: 1.25 A @48 V (60 W)
- Model number for 4-Port Gigabit Ethernet IQ2 PIC: PB-4GE-TYPE1-SFP-IQ2
- Model number for 8-port Type 2 Gigabit Ethernet IQ2 PIC: PB-8GE-TYPE2-SFP-IQ2
- Model number for 8-port Type 3 Gigabit Ethernet IQ2 PIC: PC-8GE-TYPE3-SFP-IQ2
- 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

Table 52: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Optical diagnostics and related alarms	12.1R2
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	12.1R2
Virtual Router Redundancy Protocol (VRRP) support	12.1R2
Hierarchical shaping	12.1R2
Fine-grained queuing and shaping per logical interface at both ingress and egress	12.1R2
802.1q virtual LANs (VLANs)	12.1R2
VLAN stacking and rewriting	12.1R2
Channels defined by two stacked VLAN tags	12.1R2
Multiple tag protocol identifiers (TPID) support	12.1R2
IP service for nonstandard TPID and stacked VLAN tags	12.1R2
802.1p rewrite per channel	12.1R2
Flexible mapping of channels and scheduler resources at both ingress and egress	12.1R2
Flexible Ethernet encapsulation	12.1R2
MAC learning, policing, accounting, and filtering	12.1R2

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 SFP transceivers:

- Duplex LC 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 the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
- 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
- Copper transceiver:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000BASE-T (model number: SFP-1GE-T)
 - Pinout: MDI crossover
 - Copper interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

LEDs

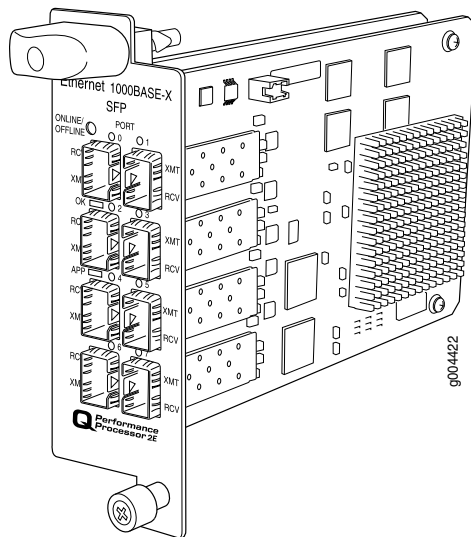
Table 53: Gigabit Ethernet IQ2 PICs with SFP LEDs

Label	Color	State	Description
OK or Status LED, one tricolor	—	Off	PIC is offline and it is safe to remove it from the router.
	Green	On steadily	PIC is operating normally.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure.

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

Gigabit Ethernet Enhanced IQ2E (IQ2E) PIC with SFP (T4000 Router)

Figure 10: 8-Port Gigabit Ethernet IQ2E PIC (Type 3)



- [Software Release on page 92](#)
- [Hardware Features on page 92](#)
- [Software Features on page 93](#)
- [Cables and Connectors on page 94](#)
- [LEDs on page 94](#)

Software Release

8-port: Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Eight Gigabit Ethernet ports
- Power requirement:
 - 8-port (Type 3): 1.25 A @48 V (60 W)
- Model number: PC-8GE-TYPE3-SFP-IQ2E
- 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

Table 54: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Optical diagnostics and related alarms	12.1R2
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	12.1R2
Drop statistics reported per queue for each of four priority-based drop profiles	12.1R2
Four levels of strict priorities with priority propagation among scheduling levels	12.1R2
Hierarchical shaping and hierarchical scheduler	12.1R2
Virtual Router Redundancy Protocol (VRRP) support	12.1R2
Fine-grained queuing and shaping per logical interface at both ingress and egress	12.1R2
802.1q virtual LANs (VLANs)	12.1R2
VLAN stacking and rewriting	12.1R2
Channels defined by two stacked VLAN tags	12.1R2
Multiple tag protocol identifiers (TPID) support	12.1R2
IP service for nonstandard TPID and stacked VLAN tags	12.1R2
802.1p rewrite per channel	12.1R2
Flexible mapping of channels and scheduler resources at both ingress and egress	12.1R2
16,000 schedulers (2,000 schedulers with 8 queues each or 4,000 schedulers with 4 queues each)	12.1R2
Scheduler resources dynamically allocated across ports	12.1R2
Flexible Ethernet encapsulation	12.1R2
MAC learning, policing, accounting, and filtering	12.1R2

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 connector (Rx and Tx)
 - Small form-factor pluggable (SFP) transceivers:
 - 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 the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
 - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
- Copper transceiver:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000BASE-T (model number: SFP-1GE-T)
 - Pinout: MDI crossover

Copper interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

LEDs

Table 55: Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP LEDs

Label	Color	State	Description
OK or Status LED, one tricolor	—	Off	PIC is offline and it is safe to remove it from the router.
	Green	On steadily	PIC is operating normally.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure.

Table 55: Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP LEDs (continued)

Label	Color	State	Description
APP LED, one bicolor	—	Off	Monitoring application is not running.
	Green	On steadily	Monitoring application is running under acceptable load.
Port LEDs, labeled 0 through 9, one per port	—	Off	Port is not enabled.
	Green	On steadily	Port is online with no alarms or failures.

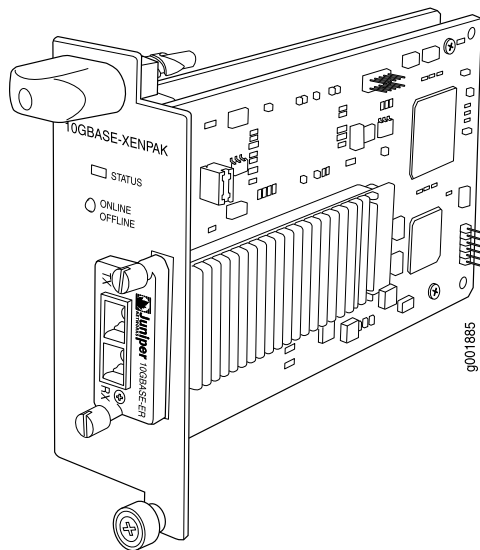
- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

CHAPTER 9

10-Gigabit Ethernet PIC Descriptions

- [10-Gigabit Ethernet PIC with XENPAK \(T4000 Router\) on page 97](#)
- [10-Gigabit Ethernet IQ2 PIC with XFP \(T4000 Router\) on page 100](#)
- [10-Gigabit Ethernet IQ2E PIC with XFP \(T4000 Router\) on page 103](#)
- [10-Gigabit Ethernet LAN/WAN PIC with SFP+ \(T4000 Router\) on page 106](#)
- [10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ \(T4000 Router\) on page 110](#)
- [10-Gigabit Ethernet LAN/WAN PIC with XFP \(T4000 Router\) on page 117](#)

10-Gigabit Ethernet PIC with XENPAK (T4000 Router)



- [Software Release on page 98](#)
- [Hardware Features on page 98](#)
- [Software Features on page 98](#)
- [Cables and Connectors on page 98](#)
- [LEDs on page 99](#)

Software Release

Junos OS Release 12.2R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- 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
- 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

Table 56: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Virtual Router Redundancy Protocol (VRRP) support	12.2R2
802.1q virtual LANs (VLANs) support	12.2R2
IEEE 802.3ad Link Aggregation	12.2R2
RMON EtherStats	12.2R2
Optical diagnostics and related alarms : <ul style="list-style-type: none"> • Transceiver temperature • Laser bias current • Laser output power • Receive optical power 	12.2R2

Cables and Connectors

- Duplex SC connector (RX and TX)
- 10-Gigabit Ethernet XENPAK transceivers:

- 10GBASE-SR, LAN Rate (model number: XENPAK-1XGE-SR)
- 10GBASE-LR, LAN Rate (model number: XENPAK-1XGE-LR)
- 10GBASE-ER, LAN Rate (model number: XENPAK-1XGE-ER)
- 10GBASE-ZR, LAN Rate (model number: XENPAK-1XGE-ZR) EOL (see [PSN-2010-02-649](https://www.juniper.net/psn/2010-02-649))

Optical interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

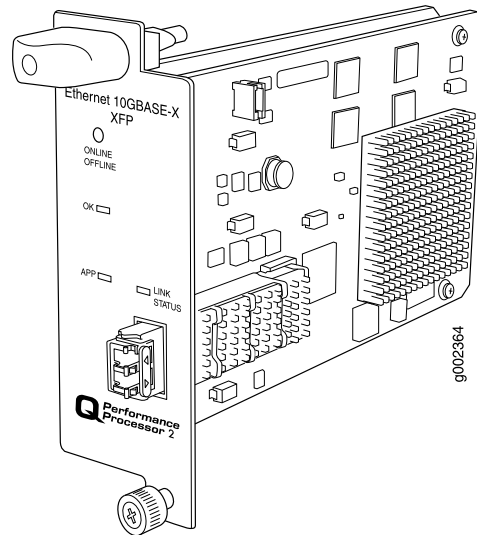
LEDs

Table 57: 10-Gigabit Ethernet PIC with XENPAK LEDs

Label	Color	State	Description
STATUS	—	Off	PIC is not enabled.
	Green	On steadily	PIC is operating normally.
	Red	On steadily	PIC has an error or failure.
Port LED LINK	—	Off	The port is down.
	Green	On steadily	The port is online.
Port LED Rx	—	Off	The port might be on but is not receiving data.
	Green	On steadily	The port is receiving data.

- Related Documentation**
- *T4000 PIC Description*
 - [T4000 PICs Supported on page 3](#)

10-Gigabit Ethernet IQ2 PIC with XFP (T4000 Router)



- [Software Release on page 100](#)
- [Hardware Features on page 100](#)
- [Software Features on page 101](#)
- [Cables and Connectors on page 101](#)
- [LEDs on page 102](#)

Software Release

Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- One 10-Gigabit Ethernet port
- Power requirements: 1.2 A @48 V (56 W)
- Model number: PC-1XGE-TYPE3-XFP-IQ2
- 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

Table 58: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	12.1R2
Configurable WAN-PHY mode options: <ul style="list-style-type: none"> • loopback • mpls • path-trace • trigger 	12.1R2
Virtual Router Redundancy Protocol (VRRP) support	12.1R2
Hierarchical shaping	12.1R2
Fine-grained queuing and shaping per logical interface at both ingress and egress	12.1R2
802.1q virtual LANs (VLANs)	12.1R2
VLAN stacking and rewriting	12.1R2
Channels defined by two stacked VLAN tags	12.1R2
Multiple tag protocol identifiers (TPID) support	12.1R2
IP service for nonstandard TPID and stacked VLAN tags	12.1R2
802.1p rewrite per channel	12.1R2
Flexible mapping of channels and scheduler resources at both ingress and egress	12.1R2
Flexible Ethernet encapsulation	12.1R2
MAC learning, policing, accounting, and filtering	12.1R2

Cables and Connectors

- You can install any transceiver supported by the PIC.
- Fiber-optic 10-Gigabit small form-factor pluggable (XFP) transceivers:
 - Duplex LC 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 the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

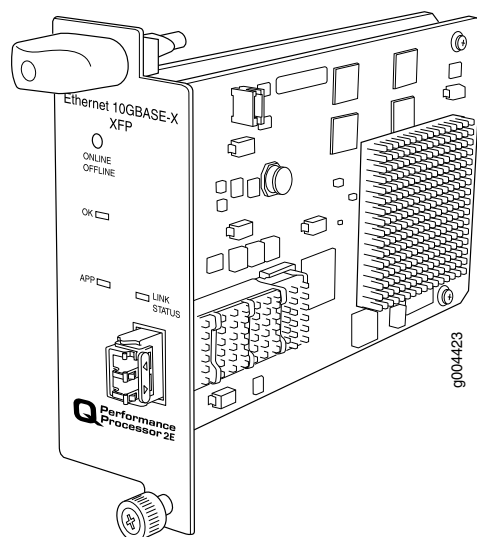
LEDs

Table 59: 10-Gigabit Ethernet IQ2 PIC with XFP LEDs

Label	Color	State	Description
OK LED, one tricolor	—	Off	PIC is offline and safe to remove from the router.
	Green	On steadily	PIC is operating normally.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure.
APP LED	—	Off	Monitoring application is not running.
	Yellow	On steadily	Monitoring application is overloaded.
	Green	On steadily	Monitoring application is running under acceptable load.
LINK STATUS LED	—	Off	Port is down.
	Green	On steadily	Port is online. Link is established.

- Related Documentation**
- *T4000 PIC Description*
 - [T4000 PICs Supported on page 3](#)

10-Gigabit Ethernet IQ2E PIC with XFP (T4000 Router)



- [Software Release on page 103](#)
- [Hardware Features on page 103](#)
- [Software Features on page 104](#)
- [Cables and Connectors on page 105](#)
- [LEDs on page 105](#)

Software Release

Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see “[T4000 PIC/FPC Compatibility](#)” on [page 8](#).

Hardware Features

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

Table 60: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	12.1R2
Drop statistics reported per queue for each of four priority-based drop profiles	12.1R2
Four levels of strict priorities with priority propagation among scheduling levels	12.1R2
Hierarchical shaping and hierarchical scheduler	12.1R2
Configurable WAN-PHY mode options: <ul style="list-style-type: none"> • loopback • mpls • path-trace • trigger 	12.1R2
Virtual Router Redundancy Protocol (VRRP) support	12.1R2
Fine-grained queueing and shaping per logical interface at both ingress and egress	12.1R2
802.1q virtual LANs (VLANs)	12.1R2
VLAN stacking and rewriting	12.1R2
Channels defined by two stacked VLAN tags	12.1R2
Multiple tag protocol identifiers (TPID) support	12.1R2
IP service for nonstandard TPID and stacked VLAN tags	12.1R2
802.1p rewrite per channel	12.1R2
Flexible mapping of channels and scheduler resources at both ingress and egress	12.1R2
16,000 schedulers (2,000 schedulers with 8 queues each or 4,000 schedulers with 4 queues each)	12.1R2
Scheduler resources dynamically allocated across ports	12.1R2
Flexible Ethernet encapsulation	12.1R2
MAC learning, policing, accounting, and filtering	12.1R2

Cables and Connectors

- You can install any transceiver supported by the PIC.
- Fiber-optic 10-Gigabit small form-factor pluggable (XFP) transceivers:
 - Duplex LC 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 the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

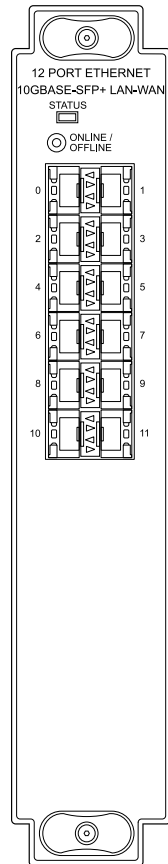
LEDs

Table 61: 10-Gigabit Ethernet IQ2E PIC with XFP LEDs

Label	Color	State	Description
OK LED, one tricolor	—	Off	PIC is offline and safe to remove from the router.
	Green	On steadily	PIC is operating normally.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure.
APP LED	—	Off	Monitoring application is not running.
	Yellow	On steadily	Monitoring application is overloaded.
	Green	On steadily	Monitoring application is running under acceptable load.
LINK STATUS LED	—	Off	Port is down.
	Green	On steadily	Port is online. Link is established.

- Related Documentation**
- *T4000 PIC Description*
 - [T4000 PICs Supported on page 3](#)

10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T4000 Router)



- [Software Release on page 106](#)
- [Hardware Features on page 106](#)
- [Software Features on page 107](#)
- [Cables and Connectors on page 108](#)
- [LEDs on page 109](#)
- [Alarms on page 109](#)

Software Release

Junos OS Release 12.1 and later (Type 5)

For information about which FPCs support these PICs, see ["T4000 PIC/FPC Compatibility" on page 8](#).

Hardware Features

- Twelve 10-Gigabit Ethernet SFP+ ports
- Power requirements: 0.69 A @48 V (33 W)

- Model number: PF-12XGE-SFPP
- **ONLINE/OFFLINE** button
- Large maximum transmission units (MTUs) of up to 9192 bytes

Software Features

Table 62: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
LAN-PHY mode selectable per port	12.1R1
WAN-PHY mode selectable per port	12.1R2
Interface hold timer	12.1R1
SNMP support to access all 10 Gigabit Ethernet port counters	12.1R1
Graceful Routing Engine switchover (GRES) support	12.1R2
Layer 2 protocols: <ul style="list-style-type: none"> • Flexible Ethernet service • Ethernet circuit cross-connect (CCC) • Ethernet translational Ethernet circuit cross-connect (TCC) • Ethernet VPLS • VLAN CCC • Extended VLAN CCC • Extended VLAN TCC • VLAN VPLS 	12.1R1
Layer 3 protocols: <ul style="list-style-type: none"> • IPv4 • IPv6 • MPLS 	12.1R1
MAC filtering, accounting, policing, and learning for source media access control (MAC) on logical interfaces	12.1R2
Flexible encapsulation	12.1R1
Single, stacked, and flexible VLAN tagging modes	12.1R1
Native VLAN configuration to allow untagged frames to be received on the tagged interfaces	12.1R1
IEEE 802.3ad link aggregation (on single chassis)	12.1R1

Table 62: Software Features Supported (continued)

Software Feature	T4000 First Supported Junos OS Release
Defining the VLAN rewrite operation to be applied to the incoming and outgoing frames on logical interfaces on this PIC.	12.1R1
NOTE: Only the Tag Protocol Identifier (TPID) 0x8100 is supported.	
Interoperability with other 10-Gigabit Ethernet PICs on M Series and T Series routers in LAN-PHY and WAN-PHY modes.	12.1R1
Behavior aggregate (BA) classification (IPv4 DSCP, IPv6 DSCP, Inet precedence, IEEE 802.1P, IEEE 802.1AD, MPLS EXP) and fixed classification.	12.1R1
Support for mixed-mode configuration for dual rate of 1 Gbps or 10 Gbps.	13.3R1

Cables and Connectors

You can install any transceiver supported by the PIC.

- Duplex LC connector (Rx and Tx)
- Fiber-optic 10-Gigabit small form-factor pluggable (SFP+) transceivers



NOTE: For configuring 1-Gbps speed, SFP optics is required; SFPP does not support 1 Gbps.

- 10GBASE-SR (model number: SFPP-10GE-SR)
- 10GBASE-LR (model number: SFPP-10GE-LR)
- 10GBASE-ER (model number: SFPP-10GE-ER): Junos OS Release 12.1R2 and later
- 10GBASE-ZR (model number: SFPP-10GE-ZR): Junos OS Release 12.3 and later
- 10GBASE-ZR (model number: SFPP-10G-OTN-XT)
 - Supported in Junos OS Release 12.3R5, 13.2R3, 13.3, and later
 - NEBS compliant
 - Dual-rate extended temperature transceiver that supports LAN-PHY and WAN-PHY modes, and OTN rates

Optical interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

LEDs

Table 63: 10-Gigabit Ethernet LAN/WAN PIC with SFP+ LEDs

Label	Color	State	Description
STATUS	—	Off	PIC is powered down and offline.
	Green	On steadily	PIC is online with all voltages in range.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure.

Alarms

Alarms are vendor-specific. Some transceiver vendors might not support every alarm.

- Input laser power
- Input loss of lock
- Input loss of signal
- Input Rx path
- Output A/D data not ready
- Output CDR (clock data recovery)
- Output laser bias current
- Output laser power
- Output laser safety
- Output Tx path
- Module temperature
- Module MOD_NR (module not ready)
- Module P_DOWN (module down)
- Module unplugged or down
- Wire unplugged or down

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (T4000 Router)

Figure 11: 10-Port Type 4 PIC with Oversubscription

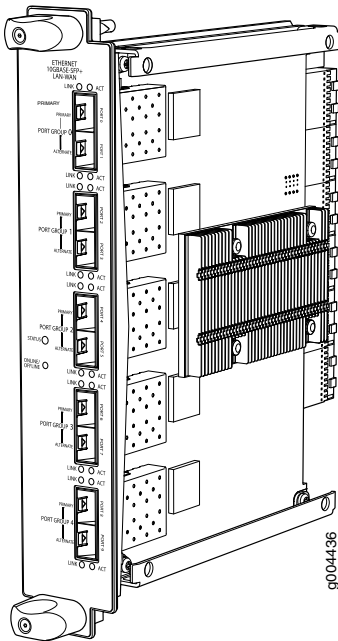
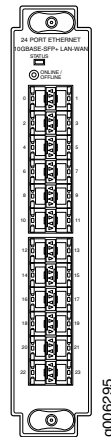


Figure 12: 24-Port Type 5 PIC with Oversubscription



- [Software Release on page 110](#)
- [Hardware Features on page 111](#)
- [Software Features on page 111](#)
- [Cables and Connectors on page 114](#)
- [LEDs on page 115](#)
- [Alarms, Errors, and Events on page 116](#)

Software Release

- Junos OS Release 12.1R2 and later (Type 4)



NOTE: In some Juniper Networks documentation, the 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PD-5-10XGE-SFPP) is referred to as the 10-port 10-Gigabit Oversubscribed Ethernet PIC or 10-port 10-Gigabit OSE PIC.

In oversubscribed Ethernet mode (default), all 10 ports are enabled and oversubscription is permitted. In line-rate mode, this PIC does not allow oversubscription and supports only 5 ports (0, 2, 4, 6, and 8).

- Junos OS Release 12.2 and later (Type 5)



NOTE: In oversubscribed Ethernet mode (default), all 24 ports are enabled and oversubscription is permitted. In line-rate mode, this PIC does not allow oversubscription and supports only 12 ports (0 through 11).

For information about which FPCs support these PICs, see “T4000 PIC/FPC Compatibility” on page 8.

Hardware Features

Type 4 PIC

- Ten 10-Gigabit Ethernet SFP+ ports (only ports 0, 2, 4, 6, and 8 are supported in line-rate mode)
- Total bandwidth: 50 Gbps
- Power requirements: 3.3 A @ –48 V (158.4 W)
- Model number for 10-port Type 4 PIC with Oversubscription: PD-5-10XGE-SFPP
- High-performance throughput:
 - WAN-PHY mode at 9.953 Gbps
 - LAN-PHY mode at 10.3 Gbps
- Full-duplex mode
- Large maximum transmission units (MTUs) of up to 9192 bytes

Type 5 PIC

- Twenty-four 10-Gigabit Ethernet SFP+ ports (only ports 0 through 11 are supported in line-rate mode)
- Power requirements: 0.94 A @48 V (45 W)
- Model number for 24-Port Type 5 PIC with Oversubscription: PF-24XGE-SFPP

Software Features

Table 64: Software Features Supported on 10-Port Type 4 PIC with Over subscription

Software Feature	T4000 First Supported Junos OS Release
Two modes of operation: 5 ports in line-rate mode, 10 ports in oversubscribed mode	12.1R2
Intelligent handling of oversubscribed traffic	12.1R2
Flexible mapping of port-assigned queues and scheduler resources at both ingress and egress	12.1R2
Strict-priority queue available on a per-port basis	12.1R2

Table 64: Software Features Supported on 10-Port Type 4 PIC with Over subscription (continued)

Software Feature	T4000 First Supported Junos OS Release
QoS available on a per-port basis	12.1R2
Weighted round-robin (WRR)	12.1R2
Layer 2 Protocol support: <ul style="list-style-type: none"> Ethernet CCC, Ethernet TCC, Ethernet VPLS VLAN CCC Extended VLAN TCC VLAN VPLS Flexible Ethernet services 	12.1R2
Layer 3 Protocol support <ul style="list-style-type: none"> IPv4 IPv6 MPLS 	12.1R2
VLAN support <ul style="list-style-type: none"> 4000 VLANs per PIC Flex-VLAN tagging support Interrupt driven link-down detection Pause frame support Jumbo frame support 	12.1R2
MAC learning, aging, and filtering	12.1R2
MAC policing	12.1R2
Virtual Router Redundancy Protocol (VRRP) support	12.1R2
IEEE 802.3ad link aggregation (For routers in a routing matrix, Junos OS Release 11.2 and later is required)	12.1R2
NOTE: For PICS that support oversubscription, the PIC must be in line-rate mode to support aggregated Ethernet.	
DSCP rewrite	12.1R2

Table 65: Software Features Supported on 24-Port Type 5 PIC with Oversubscription

Software Feature	T4000 First Supported Junos OS Release
Modes of operation: <ul style="list-style-type: none"> 12 ports in line-rate mode 24 ports in oversubscribed mode 	12.2R1

Table 65: Software Features Supported on 24-Port Type 5 PIC with Oversubscription (continued)

Software Feature	T4000 First Supported Junos OS Release
Mixed-rate mode operation (configurable 1-Gbps or 10-Gbps speed)	13.3R1
Intelligent handling of oversubscribed traffic	12.2R1
LAN-PHY mode or WAN-PHY mode selectable per port	12.2R1
IEEE 802.3ad link aggregation (on single chassis) (For routers in a routing matrix, Junos OS Release 11.2 and later is required)	12.2R1
NOTE: For PICs that support oversubscription, the PIC must be in line-rate mode to support aggregated Ethernet.	
Interface hold timer	12.2R1
Graceful Routing Engine switchover (GRES)	12.2R1
SNMP support to access all 10 Gigabit Ethernet port counters	12.2R1
Layer 2 Protocol support:	12.2R1
<ul style="list-style-type: none"> • Ethernet CCC, Ethernet TCC, Ethernet VPLS • VLAN CCC • Extended VLAN TCC • VLAN VPLS • Flexible Ethernet services 	
Layer 3 Protocol support	12.2R1
<ul style="list-style-type: none"> • IPv4 • IPv6 • MPLS 	
MAC filtering, accounting, policing, and learning for source media access control (MAC) on logical interfaces	12.2R1
Flexible encapsulation	12.2R1
Single, stacked, and flexible VLAN tagging modes	12.2R1
Native VLAN configuration to allow untagged frames to be received on the tagged interfaces	12.2R1
IEEE 802.3ad Link Aggregation (on single chassis)	12.2R1
NOTE: For PICs that support oversubscription, the PIC must be in line-rate mode to support aggregated Ethernet.	

Table 65: Software Features Supported on 24-Port Type 5 PIC with Oversubscription (continued)

Software Feature	T4000 First Supported Junos OS Release
Defining the VLAN rewrite operation to be applied to the incoming and outgoing frames on logical interfaces on this PIC. NOTE: Only the Tag Protocol Identifier (TPID) 0x8100 is supported.	12.2R1
Interoperability with other 10-Gigabit Ethernet PICs on M Series and T Series routers in LAN-PHY and WAN-PHY modes.	12.2R1
Behavior aggregate (BA) classification (IPv4 DSCP, IPv6 DSCP, Inet precedence, IEEE 802.1P, IEEE 802.1AD, MPLS EXP) and fixed classification.	12.2R1

Cables and Connectors

You can install any transceiver supported by the PIC.

- Duplex LC/PC connector (Rx and Tx)
- Fiber-optic 10-Gigabit small form-factor pluggable (SFP+) transceivers.



NOTE: For 1-Gigabit speed, SFP optics is required; SFPP does not support 1-Gigabit.

Type 4 PIC:

- 10GBASE-ER (model number: SFPP-10GE-ER)
- 10GBASE-LR (model number: SFPP-10GE-LR)
- 10GBASE-SR (model number: SFPP-10GE-SR)
- 10BASE-ZR (model number: SFPP-10GE-ZR): Junos OS Release 12.3 and later
- 10GBASE-ZR (model number: SFPP-10G-OTN-XT)
 - Supported in Junos OS Release 12.3R5, 13.2R3, 13.3, and later
 - NESB compliant
 - Dual-rate extended temperature transceiver that supports LAN-PHY and WAN-PHY modes, and OTN rates

Type 5 PIC:

- 10GBASE-SR (model number: SFPP-10GE-SR)
- 10GBASE-LR (model number: SFPP-10GE-LR)
- 10GBASE-ER (model number: SFPP-10GE-ER): Junos OS Release 12.1R2 and later

- 10BASE-ZR (model number: SFPP-10GE-ZR): Junos OS Release 12.3 and later
- 10GBASE-ZR (model number: SFPP-10G-OTN-XT)
 - Supported in Junos OS Release 12.3R5, 13.2R3, 13.3, and later
 - NEBS compliant
 - Dual-rate extended temperature transceiver that supports LAN-PHY and WAN-PHY modes, and OTN rates

Optical interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

- 1000BASE-SX (model number: SFP-1GE-SX)
- 1000BASE-LX (model number: SFP-1GE-LX)

Optical interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

LEDs

Port LEDs, one pair for each port. The ports on the Type 4 PIC are labeled **PORT 0** through **PORT 9**. The ports on the Type 5 PIC are labeled **0** through **23**.

The link status LEDs on the Type 4 PIC are labeled **LINK**. The Type 5 PIC has no labels for the link status LED.

The link activity LED on the Type 4 PIC is labeled **ACT**. The Type 5 PIC has no label for the link activity LED.

Table 66: 10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ LEDs

Label	Color	State	Description
STATUS	—	Off	PIC is offline and safe to remove from the router.
	Green	On steadily	PIC is operating normally.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure.
Port LED LINK	—	Off	Port is not enabled.
	Green	On steadily	Port is online with no alarms or failures.
	Red	On steadily	The router has detected a failure with alarms.
Link activity LED ACT	—	Off	No packet activity detected on the port.
	Green	On steadily	Port is sending or receiving packets.

Alarms, Errors, and Events

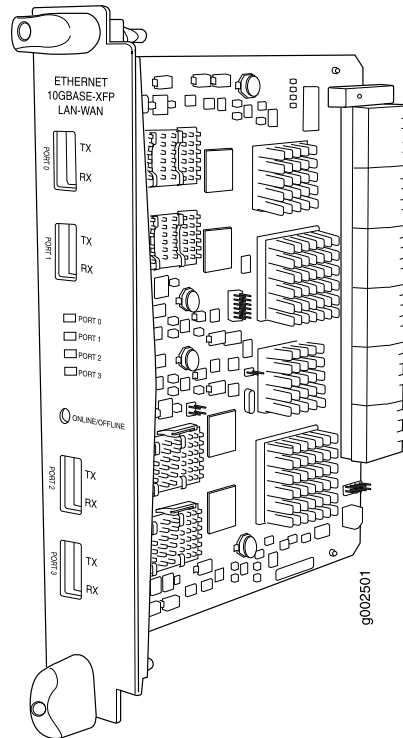
Alarms are vendor-specific. Some transceiver vendors might not support every alarm.

- Input laser power
- Input loss of lock
- Input loss of signal
- Input Rx path
- Output A/D data not ready
- Output CDR (clock data recovery)
- Output laser bias current
- Output laser power
- Output laser safety
- Output Tx path
- Module temperature
- Module MOD_NR (module not ready)
- Module P_DOWN (module down)
- Module unplugged or down
- Wire unplugged or down

Related Documentation

- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

10-Gigabit Ethernet LAN/WAN PIC with XFP (T4000 Router)



- [Software Release on page 117](#)
- [Hardware Features on page 117](#)
- [Software Features on page 118](#)
- [Cables and Connectors on page 118](#)
- [LEDs on page 119](#)
- [Alarms, Errors, and Events on page 119](#)

Software Release

Junos OS Release 12.1R2 and later (Type 4)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Four 10-Gigabit Ethernet ports
- Power requirements: 0.9 A @48 V (43 W)
- Model number: PD-4XGE-XFP
- 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

Table 67: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Configurable WAN-PHY mode options: <ul style="list-style-type: none"> • loopback • mpls • path-trace • trigger 	12.1R2
Optical diagnostics, monitoring, and alarms	12.1R2
Flexible Ethernet Services Encapsulation	12.1R2
802.1q virtual LANs (VLANs)	12.1R2
Ethernet OAM 802.1ag continuity check	12.1R2
Ethernet OAM 802.3ah (remote loopback is not supported for this PIC)	12.1R2
VLAN stacking	12.1R2
Channels defined by two stacked VLAN tags	12.1R2
Multiple tag protocol identifiers (TPID) support	12.1R2
IP service for nonstandard TPID and stacked VLAN tags	12.1R2
MAC learning, accounting, and filtering	12.1R2
Virtual Router Redundancy Protocol (VRRP) support	12.1R2

Cables and Connectors

You can install any transceiver supported by the PIC.

- Connector: Duplex LC (Rx and Tx)
- Fiber-optic 10-Gigabit small form-factor pluggable (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 the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
- DWDM Tunable XFP transceivers:
 - 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR)
 - Optical interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>
 - DWDM supported wavelengths—see “10-Gigabit Ethernet DWDM Transceiver (XFP-10G-CBAND-T50-ZR) Wavelengths” on page 22

LEDs

Table 68: 10-Gigabit Ethernet LAN/WAN PIC with XFP LEDs

Label	Color	State	Description
Port LED, labeled PORT 0 through PORT 3 , one for each port	—	Off	Port is not enabled.
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	Active with a local alarm; router has detected a failure.

Alarms, Errors, and Events

Alarms are vendor-specific. Some transceiver vendors might not support every alarm.

- Input laser power
- Input loss of lock
- Input loss of signal
- Input Rx path
- Output A/D data not ready
- Output CDR (clock data recovery)
- Output laser bias current
- Output laser power
- Output laser safety
- Output Tx path
- Module temperature
- Module MOD_NR (module not ready)

- Module P_DOWN (module down)
- Module unplugged or down
- Wire unplugged or down

**Related
Documentation**

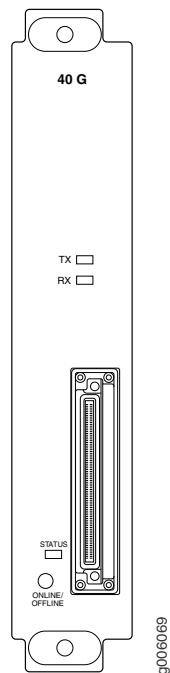
- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

CHAPTER 10

40-Gigabit Ethernet PIC Descriptions

- [40-Gigabit Ethernet PIC with CFP \(T4000 Router\) on page 121](#)

40-Gigabit Ethernet PIC with CFP (T4000 Router)



- [Software Release on page 121](#)
- [Hardware Features on page 122](#)
- [Software Features on page 122](#)
- [Cables and Connectors on page 123](#)
- [LEDs on page 123](#)
- [Alarms, Errors, and Events on page 123](#)

Software Release

Junos OS Release 13.2

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- One 40-Gigabit Ethernet port
- Power requirement: 1.46 A @ –48 V (70.0 W)
- Model number: PD-1XLE-CFP
- Maximum transmission units (MTUs) up to 9192 bytes

Software Features

Table 69: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Media Access Control (MAC) accounting	13.2R1
NOTE: MAC accounting on this PIC is not supported when aggregated Ethernet is configured.	
Source and destination MAC address filtering	13.2R1
Ethernet OAM 802.3ah (remote loopback is not supported for this PIC)	13.2R1
Layer 2 filtering and accounting based on Layer 2 headers	13.2R1
Multiple tag protocol identifiers (TPIDs) used for filtering and counting	13.2R1
Flexible virtual LAN (VLAN) tagging	13.2R1
Channels defined by two stacked VLAN tags	13.2R1
Layer 2 protocols: <ul style="list-style-type: none"> • Flexible Ethernet service • Ethernet circuit cross-connect (CCC) • Ethernet translational cross-connect (TCC) • Ethernet virtual private LAN service (VPLS) • VLAN CCC • Extended VLAN TCC • VLAN VPLS 	13.2R1
Layer 3 protocols: <ul style="list-style-type: none"> • IPV4 • IPV6 • MPLS 	13.2R1
Optical control features (vendor dependent)	13.2R1

Table 69: Software Features Supported (continued)

Software Feature	T4000 First Supported Junos OS Release
IEEE 802.3ad Link Aggregation	13.2R1
Graceful Routing Engine switchover (GRES)	13.2R1

Cables and Connectors

- Duplex SC/PC connector (RX and TX)
- 40-Gigabit Ethernet CFP transceiver: 40GBASE-LR4 (model number: CFP-40GBASE-LR4)
- Optical interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

LEDs

Table 70: 40-Gigabit Ethernet PIC with CFP LEDs

Label	Color	State	Description
STATUS	—	Off	PIC is not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has a remote or local fault.
Port LED Rx	—	Off	Port might be on, but there is a local or remote fault.
	Green	On steadily	Port is receiving data.
Port LED Tx	—	Off	Port might be on, but there is a local fault.
	Green	On steadily	Port is transmitting data.

Alarms, Errors, and Events

- Alarm indication signal (AIS)
- Laser bias current high/low alarms and warnings
- Laser Rx power high/low alarms and warnings
- Module not ready alarm
- Module power down alarm
- Module temperature high/low alarms and warnings

- Rx CDR loss of lock alarm
- Rx loss of signal alarm
- Rx not ready alarm
- Tx CDR loss of lock alarm
- Tx data not ready alarm
- Tx laser fault alarm
- Tx not ready alarm

**Related
Documentation**

- *T4000 PIC Description*
- [T4000 PIC/FPC Compatibility on page 8](#)
- [T4000 PICs Supported on page 3](#)

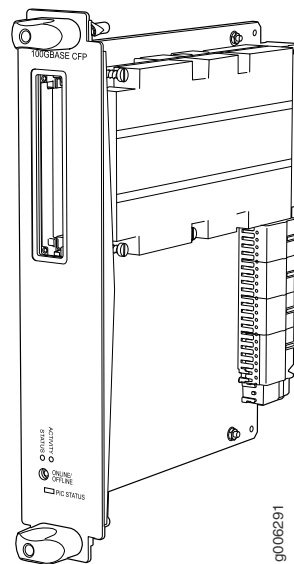
CHAPTER 11

100-Gigabit Ethernet PIC Descriptions

- [100-Gigabit Ethernet PIC with CFP \(T4000 Router\) on page 125](#)

100-Gigabit Ethernet PIC with CFP (T4000 Router)

Figure 13: Type 5 100-Gigabit Ethernet PIC



- [Software Release on page 125](#)
- [Hardware Features on page 126](#)
- [Software Features on page 126](#)
- [Cables and Connectors on page 129](#)
- [LEDs on page 130](#)
- [Alarms, Errors, and Events on page 131](#)

Software Release

- Junos OS Release 12.1R1 and later (Type 5)
- Junos OS Release 12.1R2 and later (Type 4)



NOTE: The Type 4 100-Gigabit Ethernet PIC is available only packaged in an assembly with the T1600-FPC4-ES FPC.

For information on which FPCs support these PICs, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

Type 5 PIC

- One 100-Gigabit Ethernet port
- Power requirements with LR4 transceiver: 1.19 A @48 V (57 W)
- Model number: PF-1CGE-CFP

Type 4 PIC

- One 100-Gigabit Ethernet port
- Power requirements for PD-1CE-CFP-FPC4 (PIC and FPC): 9.48 A @48 V (455 W)
- Model number: PD-1CE-CFP-FPC4
- **PIC 0** and **PIC 1** are connected by a bridge board.
- There are two physical interfaces when the 100-Gigabit Ethernet PIC is online. Each physical interface represents one of two internal 50-Gigabit Ethernet Packet Forwarding Engines (PFEs) in the FPC. PFE0 is physical interface 0, PFE1 is physical interface 1.

The following example shows the CLI representation of the physical interface. The interface type is **et**, **fpc** is the FPC slot number, the PIC slot is always **0**, and the PFEs are **0:0** for PFE0 and **0:1** for PFE1.

- **et-fpc/0/0:0**
- **et-fpc/0/0:1**
- You must also configure two logical interfaces under each physical interface. The following CLI example shows the logical interfaces.
 - **et-fpc/0/0:0.0** and **et-fpc/0/0:0.1**
 - **et-fpc/0/0:1.0** and **et-fpc/0/0:1.1**
- Support for MTUs up to 9192 bytes

Software Features

Table 71: Software Features Supported on Type 5 PIC

Software Feature	T4000 First Supported Junos OS Release
Interface hold timer	12.1R1

Table 71: Software Features Supported on Type 5 PIC (continued)

Software Feature	T4000 First Supported Junos OS Release
Support for 100 Gigabit Ethernet MIBs	12.1R1
Graceful Routing Engine switchover (GRES)	12.1R1
Layer 3 protocols: <ul style="list-style-type: none"> • IPV4 • IPV6 • MPLS 	12.1R1
MAC filtering, accounting, policing, and learning for source media access control (MAC) on logical interfaces	12.1R1
Layer 2 protocols: <ul style="list-style-type: none"> • Flexible Ethernet service • Ethernet circuit cross-connect (CCC) • Ethernet translational cross-connect (TCC) • Ethernet virtual private LAN service (VPLS) • VLAN CCC • Extended VLAN TCC • VLAN VPLS 	12.1R1
Flexible encapsulation	12.1R1
Single, stacked, and flexible VLAN tagging modes	12.1R1
Native VLAN configuration to allow untagged frames to be received on the tagged interfaces	12.1R1
IEEE 802.3ad Link Aggregation (on single chassis)	12.1R1
Defining the VLAN rewrite operation to be applied to the incoming and outgoing frames on logical interfaces on this PIC	12.1R1
NOTE: Only the Tag Protocol Identifier (TPID) 0x8100 is supported.	
Behavior aggregate (BA) classification (IPv4 DSCP, IPv6 DSCP, Inet precedence, IEEE 802.1P, IEEE 802.1AD, MPLS EXP) and fixed classification.	12.1R1
Type 5 (model number PF-1CGE-CFP) interoperability with the 100-Gigabit Ethernet PIC (model number PD-ICE-CFP-FOC4) supported in Junos OS Release 12.1R2 and later	12.1R1

Table 72: Software Features Supported on Type 4 PIC

Software Feature	T4000 First Supported Junos OS Release
Media Access Control (MAC) accounting	12.1R2
NOTE: MAC accounting on this PIC is not supported when aggregated Ethernet is configured.	
Source and destination MAC address filtering	12.1R2
Ethernet OAM 802.3ah (remote loopback is not supported for this PIC)	12.1R2
Layer 2 filtering and accounting based on Layer 2 headers	12.1R2
Multiple tag protocol identifiers (TPIDs) used for filtering and counting	12.1R2
Flexible virtual LAN (VLAN) tagging	12.1R2
Channels defined by two stacked VLAN tags	12.1R2
Layer 2 protocols: <ul style="list-style-type: none"> • Flexible Ethernet service • Ethernet circuit cross-connect (CCC) • Ethernet translational cross-connect (TCC) • Ethernet virtual private LAN service (VPLS) • VLAN CCC • Extended VLAN TCC • VLAN VPLS 	12.1R2
Layer 3 protocols: <ul style="list-style-type: none"> • IPV4 • IPV6 • MPLS 	12.1R2
Optical control features (vendor dependent)	12.1R2
IEEE 802.3ad Link Aggregation	12.1R2
NOTE: Aggregated Ethernet must be configured on this PIC to support interoperability with 100-Gigabit Ethernet PIC (model number PF-1CGE-CFP) or the 100-Gigabit Ethernet MIC (model number MIC3-3D-1X100GE-CFP) .	
Graceful Routing Engine switchover (GRES)	12.1R2

Table 72: Software Features Supported on Type 4 PIC (continued)

Software Feature	T4000 First Supported Junos OS Release
Interoperability for Type 4 (model number: PD-ICE-CFP-FPC4)	12.1R2
<ul style="list-style-type: none"> VLAN-steering provides interoperability with 100-Gigabit Ethernet interfaces from other vendors Interoperability between 100-Gigabit Ethernet PIC (model number PD-ICE-CFP-FPC4) and the 100-Gigabit Ethernet PIC (model number PF-1CGE-CFP) supported in Junos OS Release 12.1R2 and later Interoperability between 100-Gigabit Ethernet PIC (model number PD-ICE-CFP-FPC4) and the 100-Gigabit Ethernet MIC (model number MIC3-3D-1X100GE-CFP) supported in Junos OS Release 12.1R2 	

Cables and Connectors

- You can install any 100-Gigabit Ethernet CFP transceiver supported by the PIC.
 - 100GBASE-LR4 (model number: CFP-100GBASE-LR4)
 - Duplex SC connector (RX and TX)
 - Junos OS Release 12.1 and later
 - 100GBASE-LR4 (model number: CFP-GEN2-100GBASE-LR4 and part number: 740-047682)
 - Duplex LC connector (RX and TX)
 - Junos OS Release 12.3R5, 13.2R3, 13.3R1, and later releases



NOTE: The “GEN2” optics have been redesigned with newer versions of internal components for reduced power consumption.

- 100GBASE-ER4 (model number: CFP-100GBASE-ER4)
 - Duplex LC connector (RX and TX)
 - Junos OS Release 12.3 and later
- 100GBASE-ER4 (model number: CFP-GEN2-CGE-ER4 and part number: 740-049763)
 - Duplex LC connector (RX and TX)
 - Junos OS Release 12.3R5, 13.2R3, 13.3R1, and later releases



NOTE: The “GEN2” optics have been redesigned with newer versions of internal components for reduced power consumption.

- 100GBASE-SR10 (model number: CFP-100GBASE-SR10)

- 24-fiber MPO
- Junos OS Release 12.3 and later
- Optical interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct/>

LEDs

Table 73: Type 5 LEDs

Label	Color	State	Description
STATUS	—	Off	PIC is powered down and offline.
	Green	On steadily	PIC is online with all voltages in range.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure.
Link STATUS LED	—	Off	Port is off.
	Red	On steadily	Port detecting failure with alarms.
	Green	On steadily	Port is online and link is up.
Link ACTIVITY LED	—	Off	No link activity.
	Green	Flashing	Indicates link activity for the port.

Table 74: Type 4 PIC LEDs

Label	Color	State	Description
Two tricolor STATUS LEDs (PIC0 and PIC1)	—	Off	PIC is powered down and offline.
	Green	On steadily	PIC is online with no alarms or failures.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has a remote or local fault.
Rx LED (PIC1)	—	Off	Port might be on, but there is a local or remote fault.
	Green	On steadily	Port is receiving data.
Tx LED (PIC1)	—	Off	Port might be on, but there is a local fault.
	Green	On steadily	Port is transmitting data.

Alarms, Errors, and Events

Alarms are vendor-specific. Some transceiver vendors might not support every alarm.

- Input laser power
- Input loss of lock
- Input loss of signal
- Input Rx path
- Output A/D data not ready
- Output CDR (clock data recovery)
- Output laser bias current
- Output laser power
- Output laser safety
- Output Tx path
- Module temperature
- Module MOD_NR (module not ready)
- Module P_DOWN (module down)
- Module unplugged or down
- Wire unplugged or down

Related Documentation

- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

CHAPTER 12

Services PIC Descriptions

- [MultiServices PICs \(T4000 Router\) on page 133](#)
- [Tunnel Services PICs \(T4000 Router\) on page 137](#)

MultiServices PICs (T4000 Router)

Figure 14: MultiServices 400 PIC

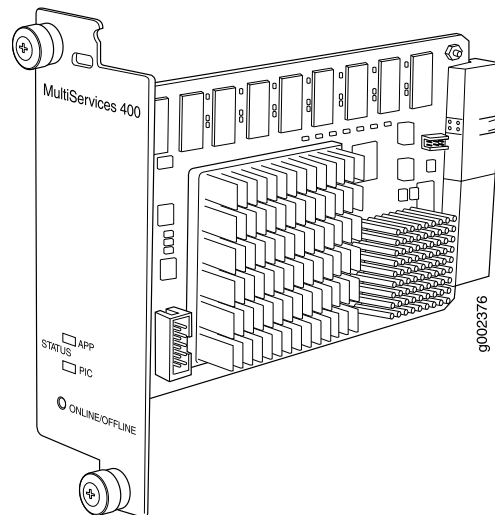
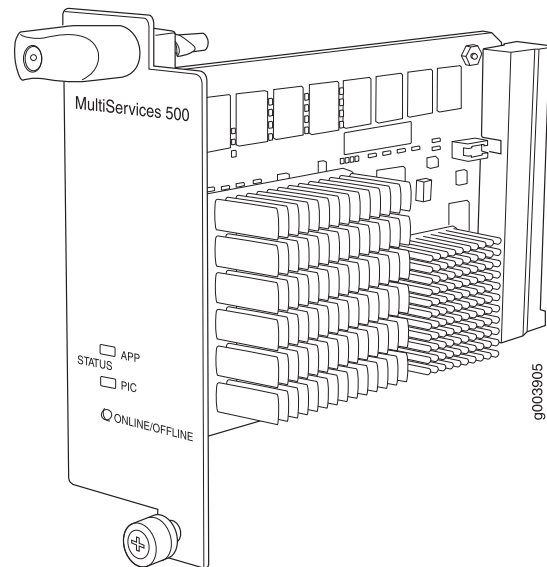


Figure 15: MultiServices 500 PIC

- [Software Release on page 134](#)
- [Hardware Features on page 134](#)
- [Software Features on page 135](#)
- [LEDs on page 136](#)

Software Release

- MultiServices 400: Junos OS Release 12.2R1 and later (Type 2)
- MultiServices 500: Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Individual licenses must be purchased for services.
- Power requirement:
 - Multiservices 400: 0.69 A @ 48 V (33 W)
 - Multiservices 500: 0.83 A @ 48 V (40 W)
- Model number for Multiservices 400 PIC: PB-MS-400-2
- Model number for Multiservices 500 PIC: PB-MS-500-3
- Multiservices 400: up to 3.2 million flows
- Multiservices 500: 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 75 on page 135](#). For more information about the software features available for services PICs, see the *Junos OS Services Interfaces Library for Routing Devices*.

Table 75: MultiServices PICs Software Features Supported on the T4000 Router

GRE Key	–	–
GRE dont-fragment	–	–
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	–	–
Network Address Translation (NAT) for IP addresses	–	–
Port Address Translation (PAT) for port numbers	–	–
IP Security (IPSec) encryption	–	–
Flow aggregation	–	12.1R2
Active flow monitoring exports cflowd version 5 and version 8 records	–	12.1R2
Active flow monitoring exports flow monitoring version 9 records, based on RFC 3954	–	12.1R2
Passive flow monitoring	12.2	–
Passive flow collection	12.2	–
Flow-tap	–	–
Dynamic flow capture	12.2	–
Real-time performance monitoring	–	–
Link Services	–	–
Traffic sampling	–	12.1R2

Table 75: MultiServices PICs Software Features Supported on the T4000 Router (continued)

Tunnel services:	—	—
<ul style="list-style-type: none"> • 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	—	—
Layer 2 Tunneling Protocol (L2TP)	—	—
Voice services:	—	—
<ul style="list-style-type: none"> • Compressed Real-Time Transport Protocol (CRTP) 		
Encapsulations:	—	—
<ul style="list-style-type: none"> • Multilink Frame Relay (MLFR) • Multilink Point-to-Point Protocol (MLPP) 		

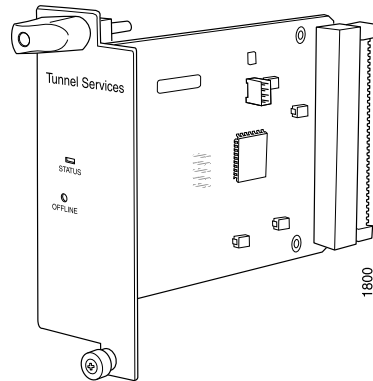
LEDs

Table 76: MultiServices PIC LEDs

Label	Color	State	Description
PIC STATUS LED, one tricolor	—	Off	PIC is offline and it is safe to remove it from the chassis.
	Green	On steadily	PIC is operating normally.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure and no further harm can be done by removing it from the chassis.
Application APP STATUS LED, one bicolor	—	Off	Service is not running.
	Green	On steadily	Service is running under acceptable load.
	Yellow	On steadily	Service is overloaded.

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

Tunnel Services PICs (T4000 Router)



- [Software Release on page 137](#)
- [Hardware Features on page 137](#)
- [Software Features on page 137](#)
- [LEDs on page 138](#)

Software Release

- Junos OS Release 12.1R2 and later (Type 1)
- Junos OS Release 12.2R2 and later (Type 2)
- Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Power requirement: 0.07 A @ 48 V (3.4 W)
- Model number for Type 1 Tunnel Services PIC: PB-TUNNEL1
- Model number for Type 2 Tunnel Services PIC: PB-TUNNEL
- Model number for Type 3 Tunnel Services PIC: PC-TUNNEL
- Loopback function that encapsulates and de-encapsulates packets
- OC12/STM4 tunneling bandwidth on Type 1 FPC
- OC48/STM16 tunneling bandwidth on Type 2 FPC
- OC192/STM64 tunneling bandwidth on Type 3 FPC

Software Features

For a list of the software features available for services PICs, see the *Junos Services Interfaces Configuration Release*.

- IP-IP unicast tunneling
- GRE unicast tunneling
- PIM sparse mode unicast tunneling

LEDs

Table 77: Tunnel Services PIC LEDs

Label	Color	State	Description
One STATUS LED, tricolor	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	Active with a local alarm; router has detected a failure.

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

CHAPTER 13

SONET/SDH PIC Descriptions

- [SONET/SDH OC3/STM1 \(Multi-Rate\) PICs with SFP \(T4000 Router\) on page 139](#)
- [SONET/SDH OC12/STM4 \(Multi-Rate\) PICs with SFP \(T4000 Router\) on page 144](#)
- [SONET/SDH OC48c/STM16 PIC with SFP \(T4000 Router\) on page 148](#)
- [SONET/SDH OC48/STM16 Enhanced IQ \(IQE\) PIC with SFP \(T4000 Router\) on page 152](#)
- [SONET/SDH OC48/STM16 \(Multi-Rate\) PIC with SFP \(T4000 Router\) on page 156](#)
- [SONET/SDH OC192/STM64 PICs with XFP \(T4000 Router\) on page 160](#)
- [SONET/SDH OC768c/STM256 PIC \(T4000 Router\) on page 165](#)

SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T4000 Router)

Figure 16: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 1)

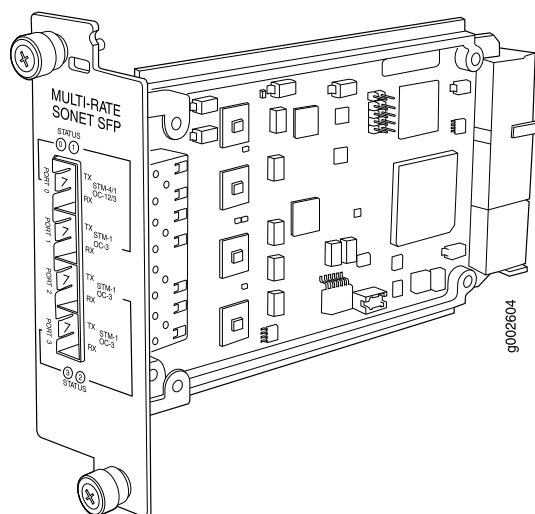
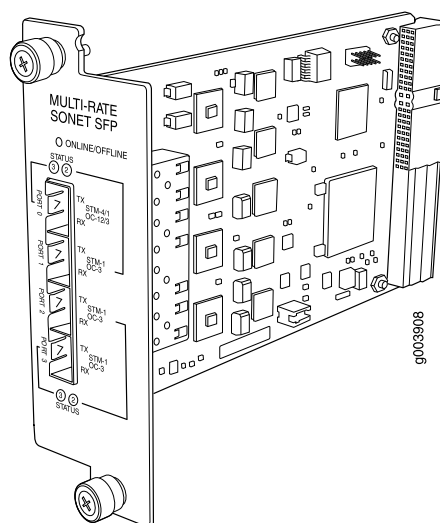


Figure 17: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 2)



- [Software Release on page 140](#)
- [Hardware Features on page 140](#)
- [Software Features on page 140](#)
- [Cables and Connectors on page 141](#)

- [LEDs on page 142](#)
- [Alarms, Errors, and Events on page 142](#)

Software Release

- 4-port: Junos OS Release 12.1R2 and later (Type 1)
- 4-port: Junos OS Release 12.2R2 and later (Type 2)

For information on which FPCs support this PIC, see “[T4000 PIC/FPC Compatibility](#)” on [page 8](#).

Hardware Features

- Rate-selectable using one of the following rates:
 - 1-port OC12/STM4
 - 1-port OC12c/STM4c
 - 4-port OC3c/STM1c
- 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
- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 78: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release (Type 1 PIC)	T4000 First Supported Junos OS Release (Type 2 PIC)
Optical diagnostics and related alarms	12.1R2	12.2R2
Per-port SONET/SDH framing	12.1R2	12.2R2
IEEE 802.3ad Link Aggregation	12.1R2	12.2R2
Alarm and event counting and detection	12.1R2	12.2R2
Dual-router automatic protection switching (APS)	12.1R2	12.2R2
Multiprotocol Label Switching (MPLS) fast reroute	12.1R2	12.2R2

Table 78: Software Features Supported (continued)

Software Feature	T4000 First Supported Junos OS Release (Type 1 PIC)	T4000 First Supported Junos OS Release (Type 2 PIC)
Encapsulations:	12.1R2	12.2R2
<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

You can install any transceiver supported by the PIC. For information about installing and removing transceivers.

- Duplex LC 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 24

- SONET/SDH OC12/STM4 small form-factor pluggable (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 25



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 *request chassis pic*.

LEDs

Table 79: SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP LEDs

Label	Color	State	Description
One tricolor per port	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	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**

- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T4000 Router)

Figure 18: 1-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC

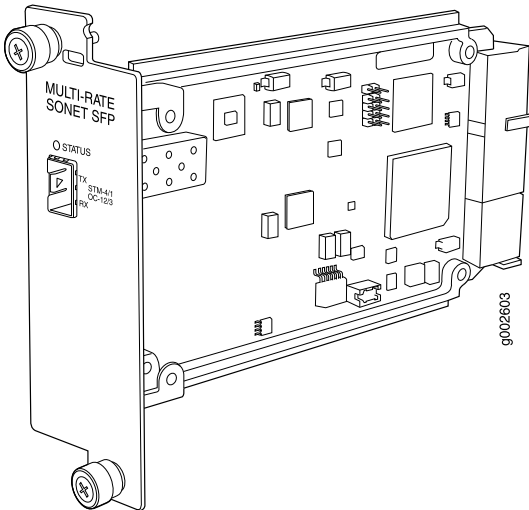
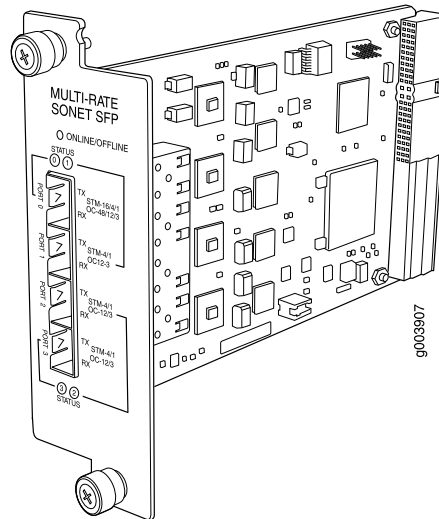


Figure 19: 4-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC



- [Software Release on page 144](#)
- [Hardware Features on page 144](#)
- [Software Features on page 145](#)
- [Cables and Connectors on page 146](#)
- [LEDs on page 146](#)
- [Alarms, Errors, and Events on page 147](#)

Software Release

- Junos OS Release 12.1R2 and later
- Junos OS Release 12.2R2 and later (Type 2)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- 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/STM16c
- 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
- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 80: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release for 1-port PIC	T4000 First Supported Junos OS Release for 4-port PIC
Optical diagnostics and related alarms	12.1R2	12.2R2
Per-port SONET/SDH framing	12.1R2	12.2R2
Link aggregation	12.1R2	12.2R2
Alarm and event counting and detection	12.1R2	12.2R2
Dual-router automatic protection switching (APS)	12.1R2	12.2R2
Multiprotocol Label Switching (MPLS) fast reroute	12.1R2	12.2R2
Encapsulations:	12.1R2	12.2R2
<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

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 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 24](#)

- SONET/SDH OC12/STM4 small form-factor pluggable (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 25](#)



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 *request chassis pic*.

LEDs

Table 81: SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP LEDs

Label	Color	State	Description
One tricolor per port	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	Active with a local alarm; router has detected a failure.

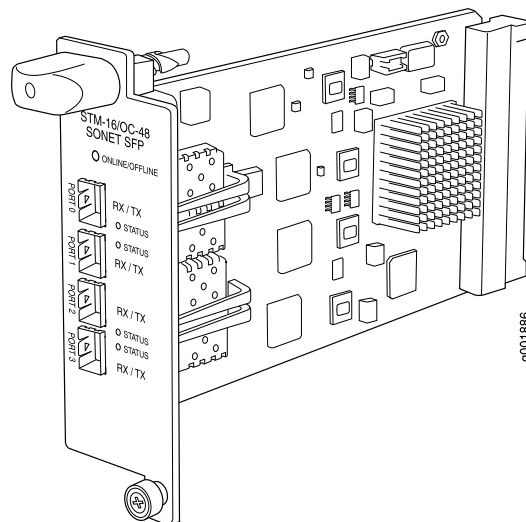
Alarms, Errors, and Events

- 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**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

SONET/SDH OC48c/STM16 PIC with SFP (T4000 Router)



- [Software Release on page 148](#)
- [Hardware Features on page 149](#)
- [Software Features on page 149](#)
- [Cables and Connectors on page 149](#)
- [LEDs on page 150](#)
- [Alarms, Errors, and Events on page 150](#)

Software Release

Junos OS Release 12.1R2 and later

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Four OC48 ports
- Power requirement: 0.46 A @ 48 V (22.1 W)
- Model number: PC-4OC48-SON-SFP
- Multiplexing and demultiplexing on the 1-port PIC
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 82: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Optical diagnostics and related alarms	12.1R2
Configuration of SONET or SDH framing on a per-port basis	12.1R2
SONET/SDH framing	12.1R2
IEEE 802.3ad Link Aggregation	12.1R2
Alarm and event counting and detection	12.1R2
Dual-router automatic protection switching (APS)	12.1R2
Multiprotocol Label Switching (MPLS) fast reroute	12.1R2
Layer 2 protocols: <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) 	12.1R2

Cables and Connectors

You can install any transceiver supported by the PIC. For information about installing and removing.

- Duplex LC connector (Rx and Tx)

- SONET/SDH OC48/STM16 fiber-optic 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 27



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 *request chassis pic*.

LEDs

Table 83: SONET/SDH OC48c/STM16 PIC with SFP LEDs

Label	Color	State	Description
STATUS LED, one tricolor per port	—	Off	Not enabled
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures
	Red	On steadily	Active with a local alarm; router has detected a failure

Alarms, Errors, and Events

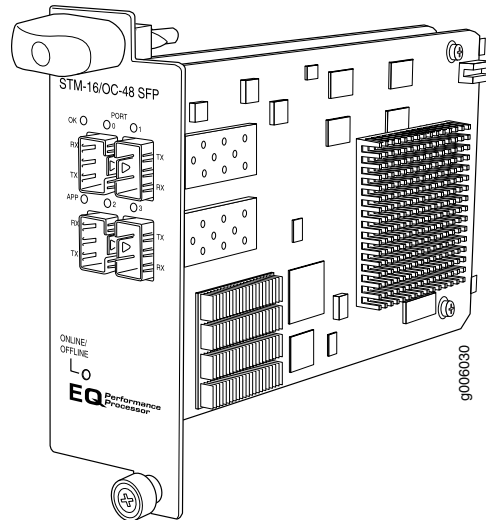
- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Far-end bit error: remote error indication—line (REI-L), far-end line 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**

- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T4000 Router)



- [Software Release on page 152](#)
- [Hardware Features on page 152](#)
- [Software Features on page 153](#)
- [Cables and Connectors on page 153](#)
- [LEDs on page 154](#)
- [Alarms, Errors, and Events on page 154](#)

Software Release

Junos OS Release 13.2 and later (Type 3)

For information on which FPCs support this PIC, see “T4000 PIC/FPC Compatibility” on [page 8](#).

Hardware Features

- 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
- 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

Table 84: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)	13.2R1
Fine-grained egress queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices and EX9200 Switches</i> for more information about class-of-service features	13.2R1
Packet buffering	13.2R1
Local line and remote payload loopback testing	13.2R1
Optical diagnostics and monitoring	13.2R1
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.	13.2R1
Encapsulations:	13.2R1
<ul style="list-style-type: none"> • 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 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 27



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 *request chassis pic*.

LEDs

Table 85: SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP LEDs

Label	Color	State	Description
Ok LED, one tricolor	—	Off	PIC is offline and safe to remove from the router.
	Green	On steadily	PIC is operating normally.
	Yellow	On steadily	PIC is initializing.
	Red	On steadily	PIC has an error or failure.
APP LED, one green per port	—	Off	Service is not running.
	Green	On steadily	Green—Service is running under acceptable load.
Port LEDs, one tricolor per port	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	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:



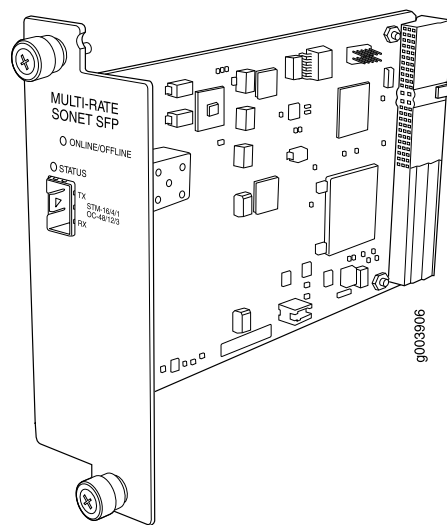
NOTE: Transceivers from some vendors do not support these fields.

- 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**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T4000 Router)



- [Software Release on page 156](#)
- [Hardware Features on page 156](#)
- [Software Features on page 157](#)
- [Cables and Connectors on page 157](#)
- [LEDs on page 158](#)
- [Alarms, Errors, and Events on page 158](#)

Software Release

Junos OS Release 12.2R2 and later (Type 2)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Rate-selectable using one of the following rates:
 - 1-port OC3c/STM1c
 - 1-port OC12/STM4

- 1-port OC12c/STM4c
- 1-port OC48/STM16
- 1-port OC48c/STM16c
- Power requirement: 0.20 A @ 48 V (9.5 W)
- Model number: PB-1OC48-SON-B-SFP
- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 86: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Optical diagnostics and related alarms	12.2R2
Per-port SONET/SDH framing	12.2R2
IEEE 802.3ad Link Aggregation	12.2R2
Alarm and event counting and detection	12.2R2
Dual-router automatic protection switching (APS)	12.2R2
Multiprotocol Label Switching (MPLS) fast reroute	12.2R2
Layer 2 protocols:	12.2R2
<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

You can install any transceiver supported by the PIC. For information about installing and removing transceivers.

- Duplex LC 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 24](#)

- 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 25](#)

- SONET/SDH OC48/STM16 fiber-optic 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 27](#)



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 *request chassis pic*.

LEDs

Table 87: SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP LEDs

Label	Color	State	Description
One tricolor per port	—	Off	Not enabled
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures
	Red	On steadily	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**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

SONET/SDH OC192/STM64 PICs with XFP (T4000 Router)

Figure 20: 1-Port SONET/SDH OC192/STM64 PIC

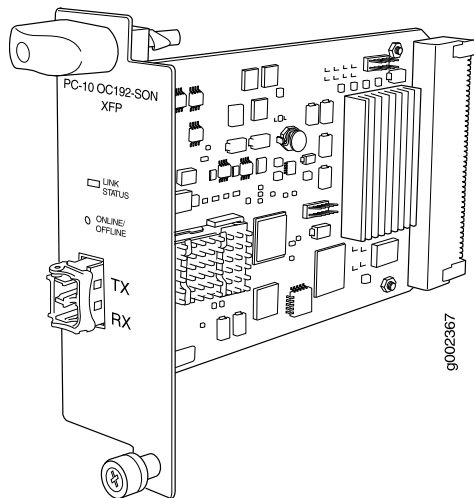
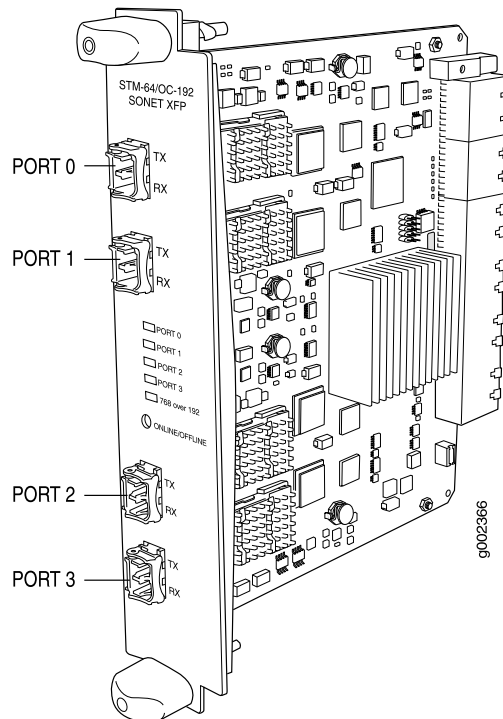


Figure 21: 4-Port SONET/SDH OC192/STM64 PIC



- [Software Release on page 160](#)
- [Hardware Features on page 161](#)
- [Software Features on page 161](#)
- [Cables and Connectors on page 162](#)
- [LEDs on page 162](#)
- [Alarms, Errors, and Events on page 163](#)

Software Release

- 1-port: Junos OS Release 12.1R2 and later (Type 3)

- 4-port: Junos OS Release 12.1 and later (Type 4)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility”](#) on page 8.

Hardware Features

- One or four OC192 ports



NOTE: Four OC192 links can be aggregated into one OC768 link or two OC256 links. The four fiber links should be on the same fiber path or the same fiber.

- Power requirement:
 - 1-port (Type 3): 0.52 A @ 48 V (25 W)
 - 4-port (Type 4): 1.11 A @ 48 V (53.1 W)
- Model number for 1-port SONET/SDH OC192/STM64 PIC: PC-1OC192-SON-XFP
- Model number for 4-port SONET/SDH OC192/STM64 PIC: PD-4OC192-SON-XFP
- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 88: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release for Type 3 PIC	T4000 First Supported Junos OS Release for Type 4 PIC
Configuration of SONET or SDH framing on a per-port basis on the 4-port Type 4 PIC .	12.1R2	12.1R1
SONET/SDH framing	12.1R2	12.1R1
IEEE 802.3ad Link Aggregation	12.1R2	12.1R1
Alarm and event counting and detection	12.1R2	12.1R1
Dual-router automatic protection switching (APS)	12.1R2	12.1R1
Multiprotocol Label Switching (MPLS) fast reroute	12.1R2	12.1R1

Table 88: Software Features Supported (continued)

Software Feature	T4000 First Supported Junos OS Release for Type 3 PIC	T4000 First Supported Junos OS Release for Type 4 PIC
Encapsulations:	12.1R2	12.1R1
<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

- Duplex LC connector (Rx and Tx)
- SONET/SDH OC192c/STM64 XFP transceivers:
 - Short reach (SR-1) (model number: XFP-10G-L-OC192-SR1)
 - Intermediate reach (IR-1) (model number: XFP-10G-E-OC192-IR2)
 - Long reach (LR-1) (model number: XFP-10G-Z-OC192-LR2)

Optical interface specifications—see [“SONET/SDH OC192/STM64 Optical Interface Specifications” on page 29](#)



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 *request chassis pic*.

LEDs

Table 89: 1-Port SONET/SDH OC192/STM64 PIC LEDs

Label	Color	State	Description
LINK STATUS LED	—	Off	Port is down.
	Green	On steadily	Port is online. Link is established.

Table 90: 4-Port SONET/SDH OC192/STM64 PIC LEDs

Label	Color	State	Description
Port LEDs labeled PORT 0 through PORT 3 , one tricolor LED per port	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	Active with a local alarm; router has detected a failure.
One 768 over 192 LED	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	Active with a local alarm; router has detected a failure.

Alarms, Errors, and Events

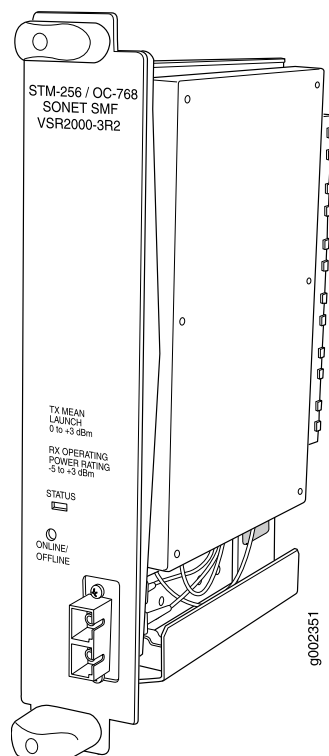
- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Far-end bit error: remote error indication—line (REI-L), far-end line 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**

- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

SONET/SDH OC768c/STM256 PIC (T4000 Router)



- [Software Release on page 165](#)
- [Hardware Features on page 165](#)
- [Software Features on page 166](#)
- [Cables and Connectors on page 166](#)
- [LEDs on page 167](#)
- [Alarms, Errors, and Events on page 167](#)

Software Release

Junos OS Release 12.1 and later (Type 4)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- One OC768 port
- Power requirement: 1.37 A @ 48 V (65.7 W)
- Model number: PD-1OC768-SON-SR
- Multiplexing and demultiplexing
- Rate policing on input

- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 91: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
SONET/SDH framing	12.1
IEEE 802.3ad Link Aggregation	12.1
Alarm and event counting and detection	12.1
Dual-router automatic protection switching (APS)	12.1
Multiprotocol Label Switching (MPLS) fast reroute	12.1
Layer 2 protocols: <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) 	12.1
Optical diagnostics and related alarms <ul style="list-style-type: none"> • Laser bias • Transmit optical power • Receiver optical power • Laser temperature 	12.1

Cables and Connectors

- Duplex SC connector (Rx and Tx)
- SONET/SDH OC768c/STM265 Short reach (SR-1) fixed transceiver

Optical interface specifications—see “[SONET/SDH OC768/STM256 Optical Interface Specifications](#)” on page 32



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 *request chassis pic*.

LEDs

Table 92: SONET/SDH OC768c/STM256 PIC LEDs

Label	Color	State	Description
STATUS	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	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**

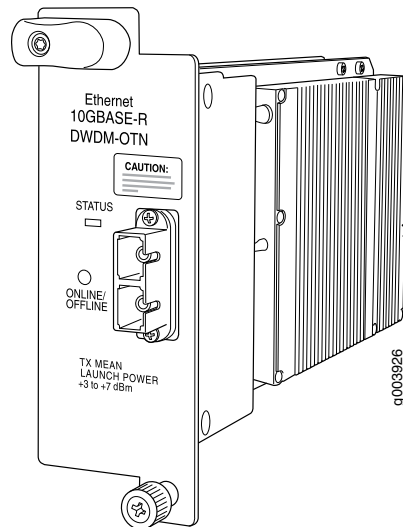
- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

CHAPTER 14

End-of-Life PIC Descriptions

- [10-Gigabit Ethernet DWDM OTN EOL PIC \(T4000 Router\) on page 169](#)
- [SONET/SDH OC12c/STM4 EOL PIC \(T4000 Router\) on page 171](#)
- [SONET/SDH OC48c/STM16 EOL PICs \(T4000 Router\) on page 175](#)
- [SONET/SDH OC48c/STM16 EOL PIC with SFP \(T4000 Router\) on page 179](#)
- [SONET/SDH OC192/STM64 EOL PIC \(T4000 Router\) on page 182](#)

10-Gigabit Ethernet DWDM OTN EOL PIC (T4000 Router)



- [Software Release on page 169](#)
- [Hardware Features on page 170](#)
- [Software Features on page 170](#)
- [Cables and Connectors on page 170](#)
- [LEDs on page 171](#)

Software Release

Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- One 10-Gigabit Optical Transport Network (OTN) port for transport of 10-Gigabit Ethernet (10GBASE-R) traffic
- 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-OTN
- C-band ITU-Grid with 50 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
- 89 individual wavelengths

Software Features

Table 93: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
Enhanced optical monitoring capabilities	12.1R2
CLI configurable wavelength support	12.1R2
Virtual Router Redundancy Protocol (VRRP) support	12.1R2
802.1q virtual LANs (VLANs) support	12.1R2
IEEE 802.3ad Link Aggregation	12.1R2
RMON EtherStats	12.1R2

Cables and Connectors

- Duplex SC/PC connector (RX and TX)
- Fixed transceiver
- Dense wavelength division multiplexing (DWDM) optical transport network (OTN) transceiver.

Optical interface specifications—see [“10-Gigabit Ethernet DWDM OTN PIC \(PC-1XGE-DWDM-OTN\) Optical Interface Specifications”](#) on page 18

LEDs

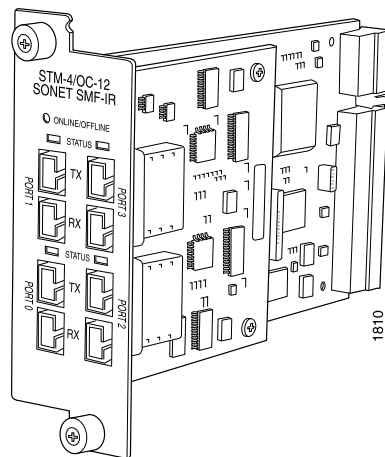
Table 94: 10-Gigabit Ethernet DWDM OTN EOL PIC LEDs

Label	Color	State	Description
STATUS LED, one bicolor	—	Off	PIC is not enabled.
	Green	On steadily	PIC is operating normally.
	Red	On steadily	PIC has an error or is in line-side loopback.

- Related Documentation**
- [T4000 PIC Description](#)
 - [T4000 PICs Supported on page 3](#)

SONET/SDH OC12c/STM4 EOL PIC (T4000 Router)

Figure 22: 4-Port SONET/SDH OC12c/STM4 PIC



- [Software Release on page 171](#)
- [Hardware Features on page 172](#)
- [Software Features on page 172](#)
- [Cables and Connectors on page 172](#)
- [LEDs on page 173](#)
- [Alarms, Errors, and Events on page 173](#)

Software Release

Junos OS Release 12.2R2 and later (Type 2)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- Four ports
- Power requirement: 0.23 A @ 48 V (10.8 W)
- Model number: PB-4OC12-SON-MM
- Model number: PB-4OC12-SON-SMIR
- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 95: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
SONET/SDH framing	12.2R2
IEEE 802.3ad Link Aggregation	12.2R2
Alarm and event counting and detection	12.2R2
Dual-router automatic protection switching (APS)	12.2R2
Multiprotocol Label Switching (MPLS) fast reroute	12.2R2
Layer 2 protocols: <ul style="list-style-type: none"> • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Point-to-Point Protocol (PPP) 	12.2R2

Cables and Connectors

- Duplex SC connector (Rx and Tx)
- SONET/SDH OC12/STM4 fixed transceiver:
 - 4-port: Multimode
 - 4-port: Single-mode Intermediate reach (IR-1)

Optical interface specifications—see [“SONET/SDH OC12/STM4 Optical Interface Specifications” on page 25](#)



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 *request chassis pic*.

LEDs

Table 96: SONET/SDH OC12c/STM4 EOL PIC LEDs

Label	Color	State	Description
One tricolor per port	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	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**

- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

SONET/SDH OC48c/STM16 EOL PICs (T4000 Router)

Figure 23: 1-Port SONET/SDH OC48c/STM16 PIC

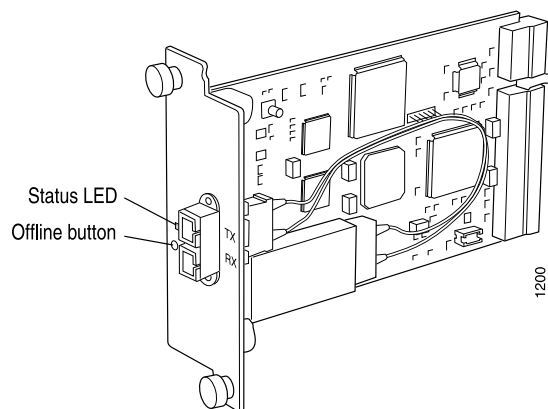
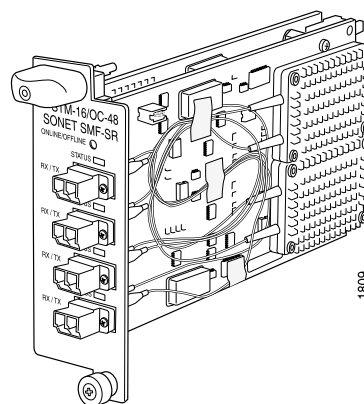


Figure 24: 4-Port SONET/SDH OC48c/STM16 PIC



- [Software Release on page 175](#)
- [Hardware Features on page 175](#)
- [Software Features on page 176](#)
- [Cables and Connectors on page 176](#)
- [LEDs on page 177](#)
- [Alarms, Errors, and Events on page 177](#)

Software Release

- 1-port: Junos OS Release 12.2R2 and later (Type 2)
- 4-port: Junos OS Release 12.1R2 and later (Type 3)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- One or four OC48 ports
- 1-port: 0.38 A @ 48 V (8 W)
- 4-port: 0.86 A @ 48 V (41.4 W)
- Model number for 1-port SONET/SDH OC48c/STM16 PIC: PB-1OC48-SON-SMSR
- Model number for 4-port SONET/SDH OC48c/STM16 PIC: PC-4OC48-SON-SMSR
- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 97: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release (Type 2)	T4000 First Supported Junos OS Release (Type 3)
SONET/SDH framing	12.2R2	12.1R2
IEEE 802.3ad Link Aggregation	12.2R2	12.1R2
Alarm and event counting and detection	12.2R2	12.1R2
Dual-router automatic protection switching (APS)	12.2R2	12.1R2
Multiprotocol Label Switching (MPLS) fast reroute	12.2R2	12.1R2
Layer 2 protocols:	12.2R2	12.1R2
<ul style="list-style-type: none"> • 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 Connector (Rx and Tx)
- 1-port and 4-port: SONET/SDH OC48/STM16 fixed transceiver: short reach (SR-1)
- 1-port: Long reach (LR-1)
- Optical interface specifications—see [“SONET/SDH OC48/STM16 Optical Interface Specifications” on page 27](#)



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 *request chassis pic*.

LEDs

Table 98: SONET/SDH OC48c/STM16 EOL PICs LEDs

Label	Color	State	Description
STATUS LED, one tricolor per port	—	Off	Not enabled.
	Green	On steadily	Online with no alarms or failures.
	Yellow	On steadily	Online with alarms for remote failures.
	Red	On steadily	Active with a local alarm; router has detected a failure.

Alarms, Errors, and Events

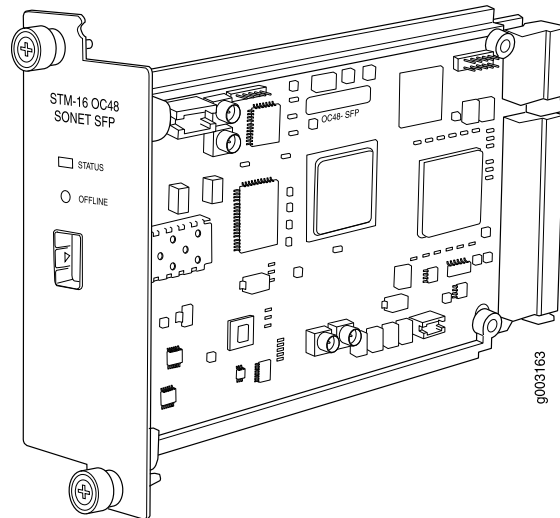
- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - Bit interleaved parity (BIP) error B2
 - Bit interleaved parity (BIP) error B3
 - 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**

- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

SONET/SDH OC48c/STM16 EOL PIC with SFP (T4000 Router)



- [Software Release on page 179](#)
- [Hardware Features on page 179](#)
- [Software Features on page 180](#)
- [Cables and Connectors on page 180](#)
- [LEDs on page 181](#)
- [Alarms, Errors, and Events on page 181](#)

Software Release

Junos OS Release 12.2R2 and later (Type 2)

For information on which FPCs support this PIC, see [“T4000 PIC/FPC Compatibility” on page 8](#).

Hardware Features

- One OC48 port
- Power requirement: 0.33 A @ 48 V (16 W)
- Model number: PB-1OC48-SON-SFP
- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 99: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
SONET/SDH framing	12.2R2
IEEE 802.3ad Link Aggregation	12.2R2
Alarm and event counting and detection	12.2R2
Dual-router automatic protection switching (APS)	12.2R2
Multiprotocol Label Switching (MPLS) fast reroute	12.2R2
Layer 2 protocols:	12.2R2
<ul style="list-style-type: none"> • 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 Connector (Rx and Tx)
- SONET/SDH OC48/STM16 fiber-optic 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 27



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 *request chassis pic*.

LEDs

Table 100: SONET/SDH OC48c/STM16 EOL PIC with SFP LEDs

Label	Color	State	Description
One tricolor per port	—	Off	Not enabled
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures
	Red	On steadily	Active with a local alarm; router has detected a failure

Alarms, Errors, and Events

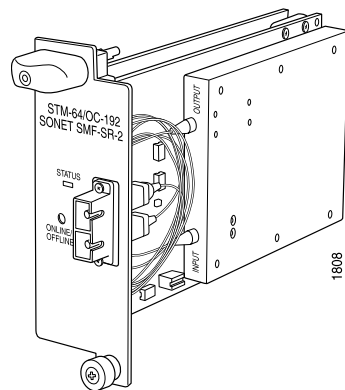
- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - Bit interleaved parity (BIP) error B2
 - Bit interleaved parity (BIP) error B3
 - 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**

- [T4000 PIC Description](#)
- [T4000 PICs Supported on page 3](#)

SONET/SDH OC192/STM64 EOL PIC (T4000 Router)



- [Software Release on page 183](#)
- [Hardware Features on page 183](#)
- [Software Features on page 183](#)
- [Cables and Connectors on page 184](#)

- [LEDs on page 184](#)
- [Alarms, Errors, and Events on page 184](#)

Software Release

Junos OS Release 12.1R2 and later (Type 3)

Hardware Features

- One OC192 port
- Power requirement: 0.45 A @ 48 V (21.6 W)
- Model number: PC-1OC192-SON-SR2
- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software Features

Table 101: Software Features Supported

Software Feature	T4000 First Supported Junos OS Release
SONET/SDH framing	12.1R2
IEEE 802.3ad Link Aggregation	12.1R2
Alarm and event counting and detection	12.1R2
Dual-router automatic protection switching (APS)	12.1R2
Multiprotocol Label Switching (MPLS) fast reroute	12.1R2
Layer 2 protocols: <ul style="list-style-type: none"> • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Point-to-Point Protocol (PPP) 	12.1R2

Cables and Connectors

SONET/SDH OC192/STM64 fixed transceiver: Short reach (SR-2): duplex SC connector (Rx and Tx)

- Optical interface specifications—see “[SONET/SDH OC192/STM64 Optical Interface Specifications](#)” on page 29



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 *request chassis pic*.

LEDs

Table 102: SONET/SDH OC192/STM64 EOL PIC LEDs

Label	Color	State	Description
STATUS LED, one tricolor	—	Off	Not enabled
	Green	On steadily	Online with no alarms or failures
	Yellow	On steadily	Online with alarms for remote failures
	Red	On steadily	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**

- *T4000 PIC Description*
- [T4000 PICs Supported on page 3](#)

