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# T4000 Core Router Hardware Guide



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Modified: 2018-07-08

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*T4000 Core Router Hardware Guide*

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## Documentation and Release Notes

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

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

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at <https://www.juniper.net/books>.

## Documentation Conventions

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Table 1 on page xxvi 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 xxvi defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
<b>Bold text like this</b>	Represents text that you type.	To enter configuration mode, type the <b>configure</b> command:  user@host> <b>configure</b>
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> <b>show chassis alarms</b>  No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> <li>Introduces or emphasizes important new terms.</li> <li>Identifies guide names.</li> <li>Identifies RFC and Internet draft titles.</li> </ul>	<ul style="list-style-type: none"> <li>A policy <i>term</i> is a named structure that defines match conditions and actions.</li> <li><i>Junos OS CLI User Guide</i></li> <li>RFC 1997, <i>BGP Communities Attribute</i></li> </ul>
<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@# <b>set system domain-name</b> <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"><li>To configure a stub area, include the <b>stub</b> statement at the <b>[edit protocols ospf area area-id]</b> hierarchy level.</li><li>The console port is labeled <b>CONSOLE</b>.</li></ul>
< > (angle brackets)	Encloses optional keywords or variables.	<b>stub &lt;default-metric <i>metric</i>&gt;;</b>
(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.	<b>broadcast   multicast</b>  <b>(<i>string1</i>   <i>string2</i>   <i>string3</i>)</b>
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	<b>rsvp { # Required for dynamic MPLS only</b>
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	<b>community name members [ <i>community-ids</i> ]</b>
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"><li>In the Logical Interfaces box, select <b>All Interfaces</b>.</li><li>To cancel the configuration, click <b>Cancel</b>.</li></ul>
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select <b>Protocols&gt;Ospf</b> .

## Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can provide feedback by using either of the following methods:

- Online feedback rating system—On any page of the Juniper Networks TechLibrary site at <https://www.juniper.net/documentation/index.html>, simply click the stars to rate the content, and use the pop-up form to provide us with information about your experience. Alternately, you can use the online feedback form at <https://www.juniper.net/documentation/feedback/>.

- E-mail—Send your comments to [techpubs-comments@juniper.net](mailto:techpubs-comments@juniper.net). Include the document or topic name, URL or page number, and software version (if applicable).

## Requesting Technical Support

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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

- [System Overview on page 3](#)
- [T4000 Router Release Notes on page 9](#)
- [Chassis Components and Description on page 11](#)
- [Cooling System Components and Descriptions on page 25](#)
- [Host Subsystem Components and Descriptions on page 29](#)
- [Line Card Components and Descriptions on page 57](#)
- [Power System Components and Descriptions on page 75](#)
- [Switch Fabric Components and Descriptions on page 79](#)



## CHAPTER 1

# System Overview

- [T4000 Router Description on page 3](#)
- [T4000 Hardware Component Overview on page 5](#)
- [T4000 Component Redundancy on page 7](#)

### T4000 Router Description

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The Juniper Networks T4000 Core Router is a complete routing system that provides Gigabit Ethernet, SONET/SDH, and other high-speed interfaces for large networks and network applications, such as those supported by Internet service providers (ISPs). The T4000 router accommodates up to eight Flexible PIC Concentrators (FPCs), each of which can be configured with a variety of network media types. The router provides up to 2.0 terabits per second (Tbps), full duplex (4.0 Tbps of any-to-any, nonblocking, half-duplex) switching.

The router architecture cleanly separates control operations from packet forwarding operations. This design eliminates processing and traffic bottlenecks, permitting the router to achieve high performance.

- Control operations in the router are performed by the host subsystem, which runs the Junos operating system (Junos OS) to handle routing protocols, traffic engineering, policy, policing, monitoring, and configuration management.
- Forwarding operations in the router are performed by the Packet Forwarding Engines, which consist of hardware, including ASICs, designed by Juniper Networks. Application-specific integrated circuits (ASICs) are a definitive part of the router design; they enable the router to achieve data forwarding rates that match current fiber-optic capacity. The T4000 router provides up to a total of 2.4 billion packets per second (Mpps) of forwarding.

[Figure 1 on page 4](#) and [Figure 2 on page 5](#) illustrate the front and rear of a T4000 router.

Figure 1: Front View of the T4000 Router

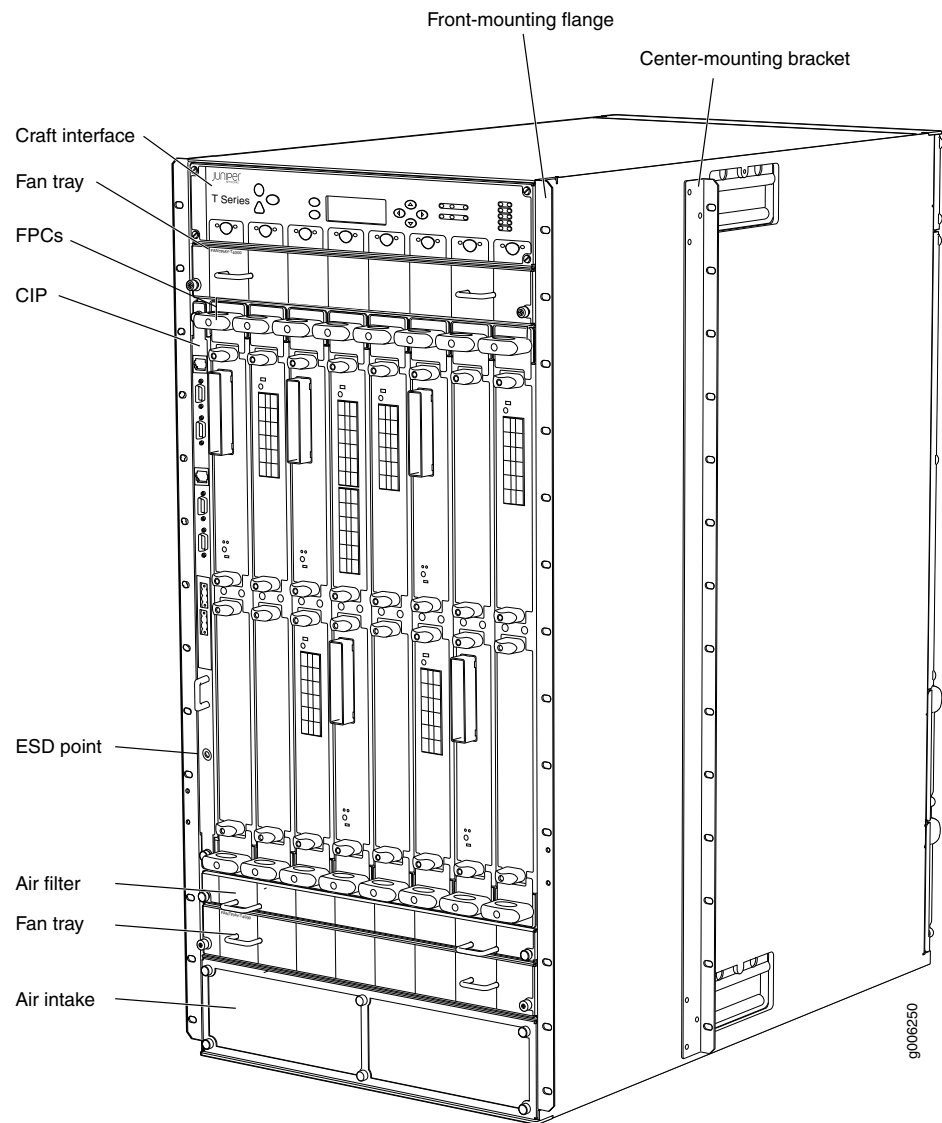
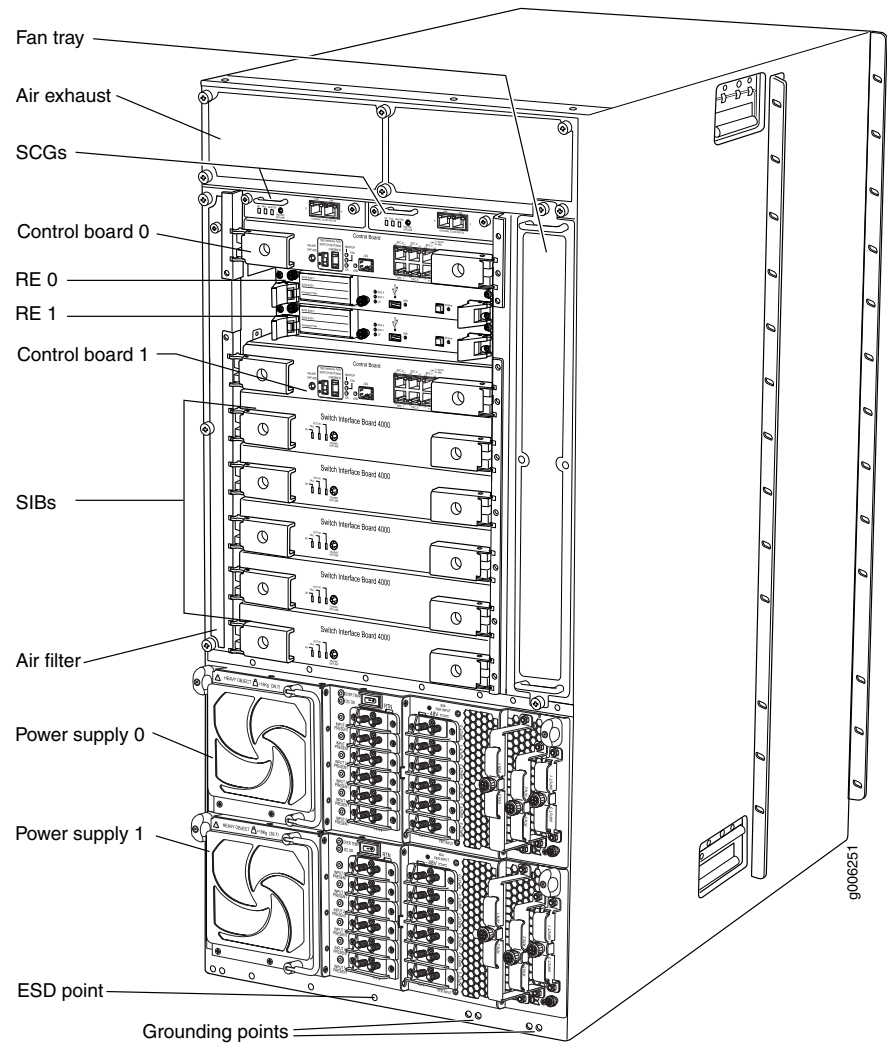


Figure 2: Rear View of the T4000 Router



- Related Documentation
- [T4000 Chassis Description on page 11](#)
  - [Overview of Installing the T4000 Router on page 119](#)

T4000 Hardware Component Overview

The T4000 Core Router supports the components in [Table 3 on page 5](#), listed in alphabetic order.

Table 3: T4000 Hardware Components

Component	Hardware Model Number	CLI Name	Description
Cable management system	N/A	N/A	"T4000 Cable Management System" on page 13

Table 3: T4000 Hardware Components (continued)

Component	Hardware Model Number	CLI Name	Description
Chassis	N/A	N/A	"T4000 Chassis Description" on page 11
Cooling system, including fan trays and air filters			"T4000 Cooling System Description" on page 25
Front fan trays	FANTRAY-T4000	Front Top Fan Tray Front Bottom Fan Tray	
Rear fan tray	FAN-REAR-TXP-LCC FAN-R-TXP-3D-LCC	Rear Fan Tray	
Air filter kit	FLTR-KIT-T640	N/A	
Control board	CB-LCC	LCC Control Board	"T4000 Control Board Description" on page 30
Craft interface	CRAFT-T-SERIES	T4000 FPM Display	"T4000 Craft Interface Description" on page 16
FPC	See "T4000 FPCs Supported" on page 61		"T4000 FPC Description" on page 57
Host subsystem	See control board and Routing Engine.		"T4000 Host Subsystem Description" on page 29
Midplane	N/A	T-series Backplane	"T4000 Midplane Description" on page 18
PIC	See the <i>T4000 Core Router Interface Module Reference</i> .	See <i>show chassis hardware</i>	"T4000 PIC Description" on page 62
Power system	PWR-T-6-60-DC	Power Entry Module 6x60	"T4000 Power System Description" on page 75
Routing Engine			"T4000 Routing Engine Description" on page 33
8G C1800 Routing Engine	RE-DUO-C1800-8G	RE-DUO-1800	"T4000 RE-C1800 Routing Engine Description" on page 34
16G C1800 Routing Engine	RE-DUO-C1800-16G	RE-DUO-1800-16G	
SONET Clock Generator (SCG)			"T4000 SONET Clock Generators (SCGs) Description" on page 20
SCG with RJ-48 ports	SCG-T-EC	T640 Sonet Clock Gen.	
SCG with DB-9 ports	SCG-T	T640 Sonet Clock Gen.	



Table 3: T4000 Hardware Components (continued)

Component	Hardware Model Number	CLI Name	Description
Switch Interface Board (SIB)	SIB-I-T4000	SIB-HC-3D	"T4000 Switch Interface Board (SIB) Description" on page 79
	SIB-TXP-3D-LCC		

- Related Documentation**
- [T4000 Router Description on page 3](#)
  - [T4000 Component Redundancy on page 7](#)

## T4000 Component Redundancy

The T4000 Core Router is designed so that no single point of failure can cause the entire system to fail. The following major hardware components are redundant:

- Switch Interface Boards (SIBs)—The router has five SIBs. For more information, see ["T4000 Switch Interface Board \(SIB\) Description" on page 79](#).
- Host subsystem—The host subsystem consists of a Routing Engine functioning together with a control board. The router can have one or two host subsystems. If two host subsystems are installed, one functions as the master and the other functions as the backup. If the master host subsystem (or either of its components) fails, the backup can take over as the master. To operate, each host subsystem requires a Routing Engine installed in an adjacent slot to a control board. For more information, see ["T4000 RE-C1800 Routing Engine Description" on page 34](#), ["T4000 LCC-CB" on page 30](#), and ["T4000 Host Subsystem Description" on page 29](#).

If the Routing Engines are configured for nonstop active routing, the backup Routing Engine automatically synchronizes its configuration and state with the master Routing Engine. Any update to the master Routing Engine state is replicated on the backup Routing Engine. If the backup Routing Engine assumes mastership, packet forwarding continues through the router without interruption. For more information about nonstop active routing, see the *Junos OS High Availability Library for Routing Devices*.

- SONET Clock Generators (SCGs)—The router has a standard configuration of one SCG. A second can be purchased to function as backup. If one SCG fails, the other becomes the master SCG. Mastership of the SCGs is independent of the host subsystem, so routing functions are not affected. For more information, see ["T4000 SONET Clock Generators \(SCGs\) Description" on page 20](#).
- Power supplies—The router has two power supplies, which share the load evenly. If one power supply fails, the other power supply can provide full power to the router indefinitely. For more information, see ["T4000 Power System Description" on page 75](#).
- Cooling system—The cooling system has redundant components, which are controlled by the host subsystem. If one of the fans fails, the host subsystem increases the speed of the remaining fans to provide sufficient cooling for the router indefinitely. For more information, see ["T4000 Cooling System Description" on page 25](#).

**Related Documentation** • [T4000 Router Description on page 3](#)

## CHAPTER 2

# T4000 Router Release Notes

- [Outstanding Issues with the T4000 Router on page 9](#)
- [Errata with the T4000 Router Documentation on page 9](#)

### Outstanding Issues with the T4000 Router

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This topic lists outstanding hardware issues with the T4000 Core Router.

- To support the 10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (model number PD-5-10XGE-SFPP) in the T1600-FPC4-ES (part number 710-013037), **REV 13** and later is required.

T1600-FPC4-ES (part number 710-013037), **REV 12** and earlier does not support the 10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (model number PD-5-10XGE-SFPP).

For information about software issues, see the *Junos OS Release Notes*.

#### Related Documentation

- [Errata with the T4000 Router Documentation on page 9](#)

### Errata with the T4000 Router Documentation

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The name of the *T1600 Core Router PIC Guide* has changed to *T1600 Core Router Interface Module Reference*. Some documentation references still refer to the *T1600 Core Router PIC Guide*.

#### Related Documentation

- [Outstanding Issues with the T4000 Router on page 9](#)



## CHAPTER 3

# Chassis Components and Description

- [T4000 Chassis Description on page 11](#)
- [T4000 Cable Management System on page 13](#)
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [T4000 Craft Interface Description on page 16](#)
- [T4000 Midplane Description on page 18](#)
- [T4000 SONET Clock Generators \(SCGs\) Description on page 20](#)
- [T4000 SONET Clock Generators \(SCGs\) LEDs on page 22](#)

### T4000 Chassis Description

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The T4000 Core Router chassis is a rigid sheet metal structure that houses all the other router components (see [Figure 3 on page 12](#) and [Figure 4 on page 13](#)). The chassis measures 37.45 in. (95.1 cm) high, 31 in. (78.7 cm) deep, and 17.43 in. (44.3 cm) wide. The chassis can be installed into many types of racks or cabinets.

The chassis includes the following features (see [Figure 3 on page 12](#) and [Figure 4 on page 13](#)):

- Front-mounting flanges for mounting in a four-post rack or cabinet or front-mounting in an open-frame rack.
- Center-mounting metal brackets for center-mounting in an open-frame rack.
- Handles on each side to facilitate positioning the router in the rack. Do not use the handles to lift the router.
- Two electrostatic discharge (ESD) points (banana plug receptacles), one front and one rear.



**CAUTION:** Before removing or installing components of a router, attach an ESD strap to an ESD point, and place the other end of the strap around your bare wrist. Failure to use an ESD strap could result in damage to the router.



**WARNING:** The router must be connected to earth ground during normal operation.

*Figure 3: Front View of Router Chassis*

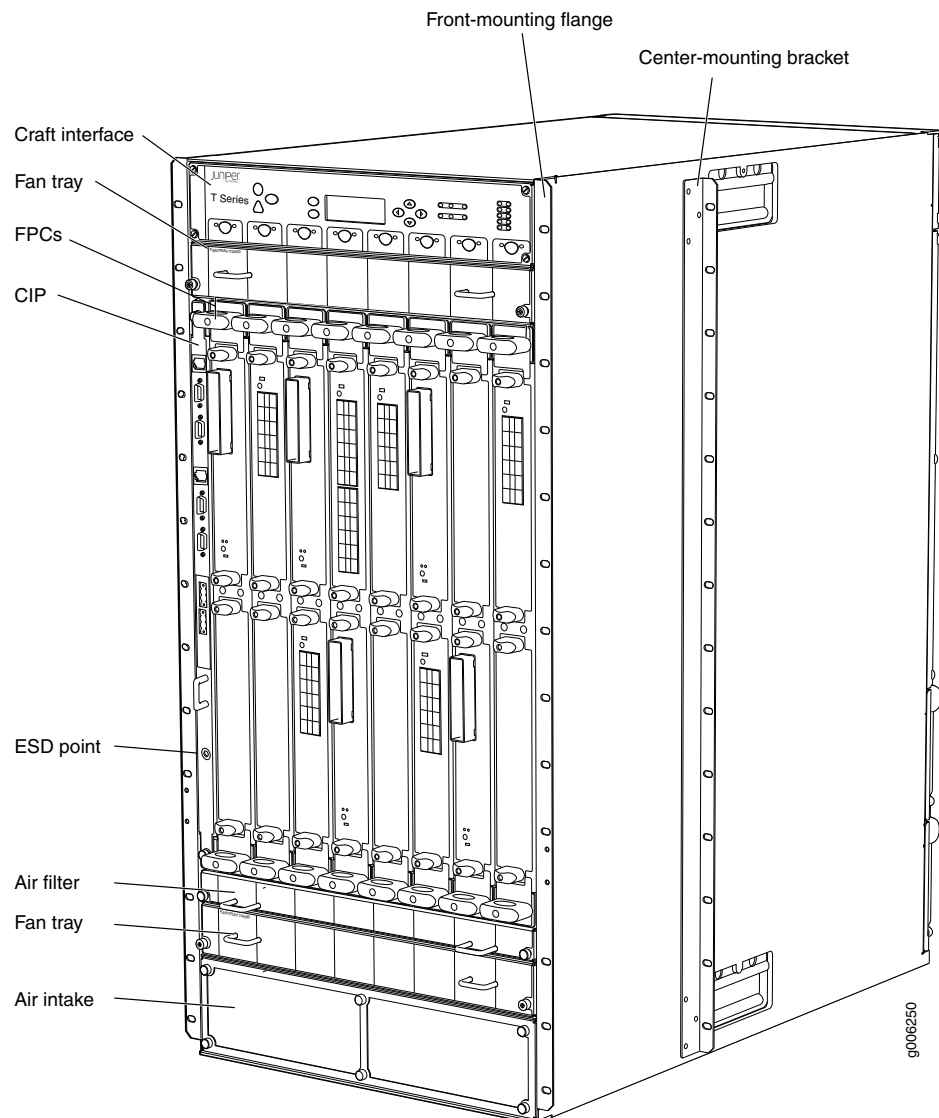
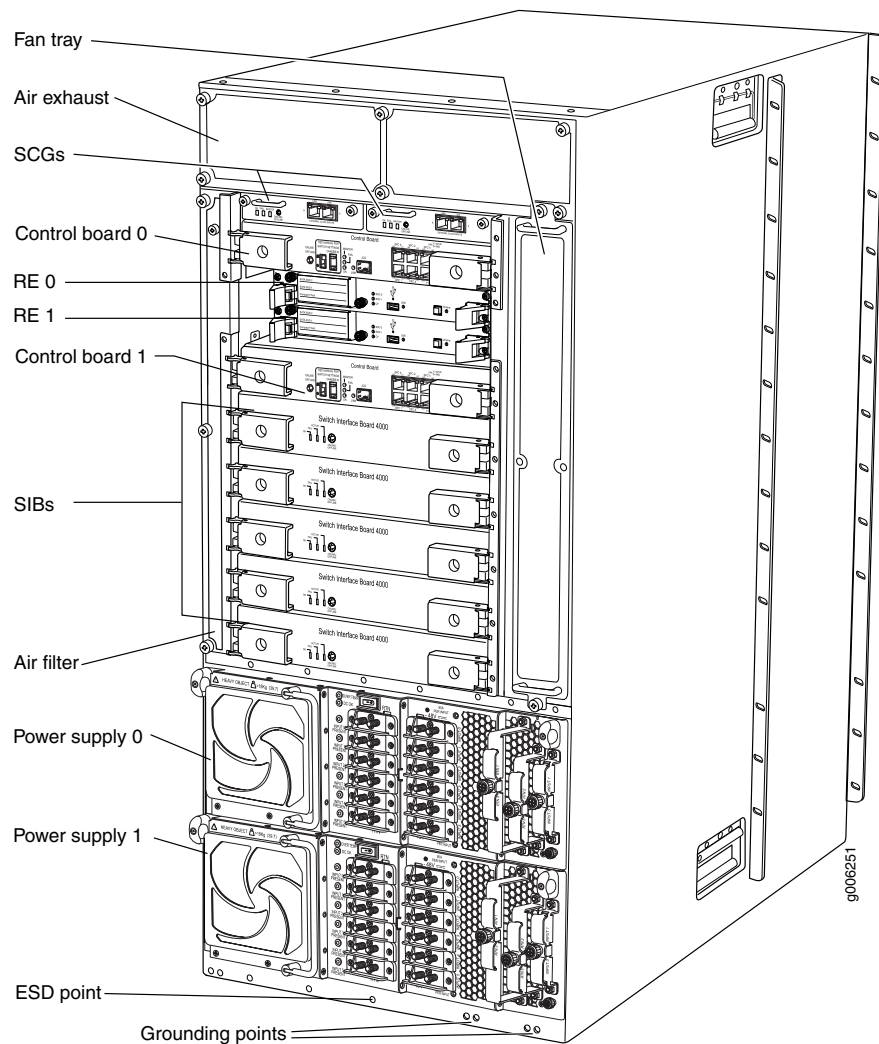


Figure 4: Rear View of Router Chassis



#### Related Documentation

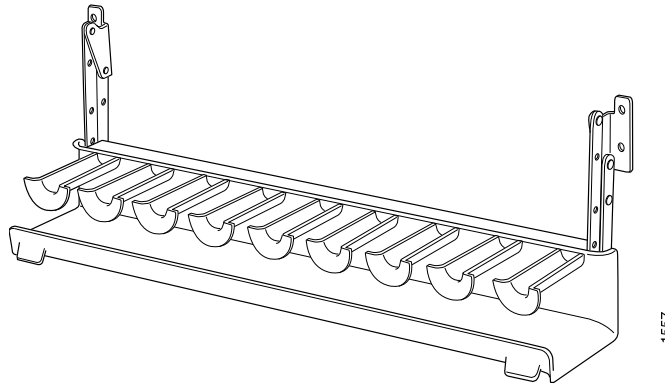
- [T4000 Router Description on page 3](#)
- [T4000 Router Physical Specifications on page 91](#)
- [T4000 Component Serial Number Locations on page 379](#)

## T4000 Cable Management System

The front cable management system (see [Figure 5 on page 14](#)) consists of a row of nine semicircular plastic bobbins mounted on the front of the router below the FPC card cage. The PIC cables pass between the bobbins and into the tray, keeping the cables organized and securely in place. The curvature of the bobbins also helps maintain the proper bend radius for optical PIC cables.

You can pull the front cable management system up and outward to lock it into the maintenance position. This allows you to access the lower fan tray and the front air filter.

**Figure 5: Front Cable Management System**



For T4000 routers connected to a TX Matrix Plus router, you can use the optional rear cable management system (model number CBL-MGR-TXP-3D-LCC) to organize, support, and provide strain relief for the cables connected to the TXP-LCC-3D SIBs and the cables connected to the LCC-CBs. The rear cable management system consists of one cable management arm. The cables are routed to the left side of the T4000 router, and then toward the top of the chassis, where you can route the cables to the TX Matrix Plus router. The cable management system adds 9.5 in. (24.1 cm) to the depth of the T4000 chassis, and 2.4 in. (6.2 cm) to the left side of the chassis.

The LCC rear cable management system can be used for any configuration including, TXP-T1600 configuration, TXP-T1600-3D configuration, TXP-T4000-3D configuration, and TXP-Mixed-LCC-3D configuration.

See the *TX Matrix Plus Router Hardware Guide* for instructions on installing and using the T4000 rear cable management system.

- Related Documentation**
- [T4000 Chassis Description on page 11](#)
  - [T4000 FPC Description on page 57](#)
  - [T4000 PIC Description on page 62](#)

## T4000 Connector Interface Panel (CIP) Description

- [T4000 Connector Interface Panel \(CIP\) Components on page 14](#)
- [Management Ports on page 15](#)
- [T4000 Alarm Relay Contacts on page 16](#)

## T4000 Connector Interface Panel (CIP) Components

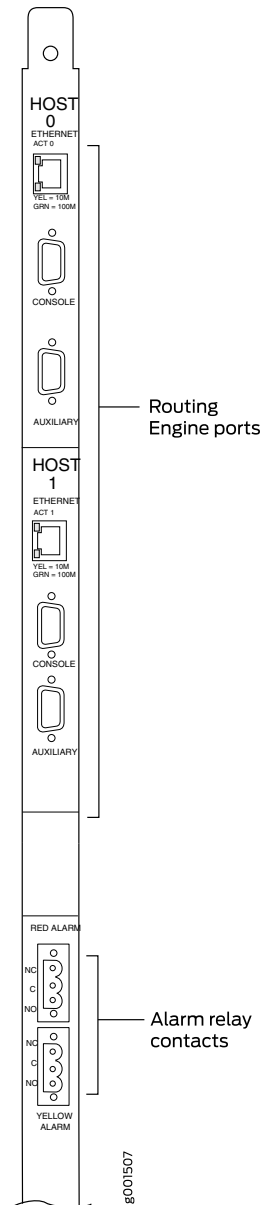
The Connector Interface Panel (CIP) consists of Ethernet, console, and auxiliary ports for the Routing Engines and alarm relay contacts (see [Figure 6 on page 15](#)). The CIP is



located at the left side of the FPC card cage, above the front electrostatic discharge point.

The CIP is hot-pluggable.

**Figure 6: CIP**



## Management Ports

The CIP has two sets of management ports (see [Figure 6 on page 15](#)) that you use to connect the Routing Engines to external management devices. The upper set of ports, labeled **HOST 0**, connects to the Routing Engine in slot **RE0**; and the lower set, labeled

**HOST 1**, connects to the Routing Engine in slot **RE1**. From these management devices, you can use the CLI to configure the router.

Each set includes the following ports:

- **ETHERNET**—Connects the Routing Engine through an Ethernet connection to a management LAN (or any other device that plugs into an Ethernet connection) for out-of-band management. The port uses an autosensing RJ-45 connector to support both 10- and 100-Mbps connections. Two small LEDs on the left edge of the port indicate the connection in use: the yellow LED lights for a 10-Mbps connection, and the green LED lights for a 100-Mbps connection.
- **CONSOLE**—Connects the Routing Engine to a system console through an RS-232 (EIA-232) serial cable.
- **AUXILIARY**—Connects the Routing Engine to a laptop, modem, or other auxiliary device through an RS-232 (EIA-232) serial cable.

## T4000 Alarm Relay Contacts

The CIP has two alarm relay contacts for connecting the router to external alarm devices (see [Figure 6 on page 15](#)). Whenever a system condition triggers either the red or yellow alarm on the craft interface, the alarm relay contacts are also activated. The alarm relay contacts are located below the Routing Engine ports. The terminal blocks that plug into the alarm relay contacts are supplied with the router. They accept wire of any gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>), which is not provided. Use the gauge of wire appropriate for the external device you are connecting.

### Related Documentation

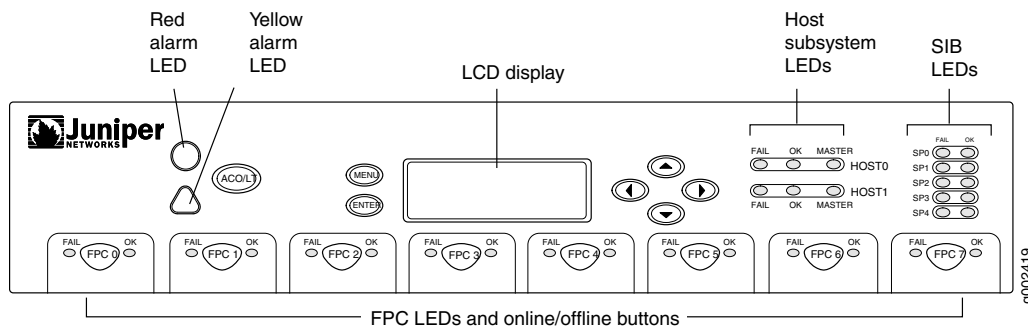
- [Overview of Connecting the T4000 Router to External Devices on page 177](#)
- [Tools and Parts Required to Connect the T4000 Router to External Devices on page 178](#)
- [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)
- [Connecting the T4000 Router to an External Alarm-Reporting Device on page 182](#)
- [Connecting the T4000 Router to a Management Ethernet Device on page 180](#)

## T4000 Craft Interface Description

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The craft interface allows you to view status and troubleshooting information at a glance and to perform many system control functions. It is hot-insertable and hot-removable. The craft interface is located on the front of the T4000 Core Router above the FPCs (see [Figure 7 on page 17](#)).

Figure 7: Front Panel of the Craft Interface



- [Craft Interface Front Panel on page 17](#)
- [Craft Interface LCD on page 17](#)

## Craft Interface Front Panel

The front panel of the craft interface contains:

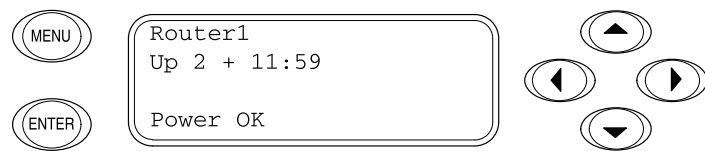
- A four-line LCD display, along with six navigation buttons. The LCD display operates in Idle mode or alarm mode.
- **ONLINE/OFFLINE** button for each FPC that you use to take the FPC offline and bring it online. The button is located next to the FPC LEDs on the bottom of the craft interface.
- LEDs
  - Yellow **Minor Alarm** LED, Red **Major Critical Alarm** LED, and alarm cutoff/lamp test **ACO/LT** button
  - Host subsystem **Master**, **OK**, and **FAIL** LEDs
  - SIB **OK** and **FAIL** LEDs
  - FPC **OK** and **FAIL** LEDs for the fans

## Craft Interface LCD

A four-line LCD is located in the craft interface, along with six navigation buttons. The LCD operates in two modes:

- LED idle mode
- LED alarm mode

During normal operation, the LCD operates in idle mode and reports current status information, as shown in [Figure 8 on page 18](#).

**Figure 8: LCD in Idle Mode**

1263

The lines in the display report the following information:

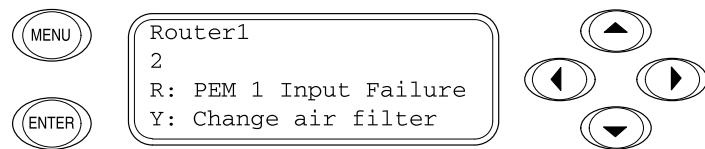
- First line—Router name.
- Second line—Length of time the router has been running, reported in the following form:

*Up days + hours:minutes*

- Third and fourth lines—Status messages, which rotate at 2-second intervals. Some conditions, such as removal or insertion of a system component, can interrupt the messages.

To add a message that alternates every 2 seconds with the default status messages, use the **set chassis display message** command.

When a red or yellow alarm occurs, the LCD switches to alarm mode and reports the alarm condition, as shown in [Figure 9 on page 18](#).

**Figure 9: LCD in Alarm Mode**

1264

The lines in the display report the following information:

- First line—Router name.
- Second line—Number of active alarms.
- Third and fourth lines—Individual alarm messages, with the most severe condition shown first. The prefix on each line indicates whether the alarm is a red (R) or yellow (Y) alarm.

#### Related Documentation

- [T4000 Craft Interface LEDs](#)
- [T4000 Alarm Messages Overview on page 347](#)

## T4000 Midplane Description

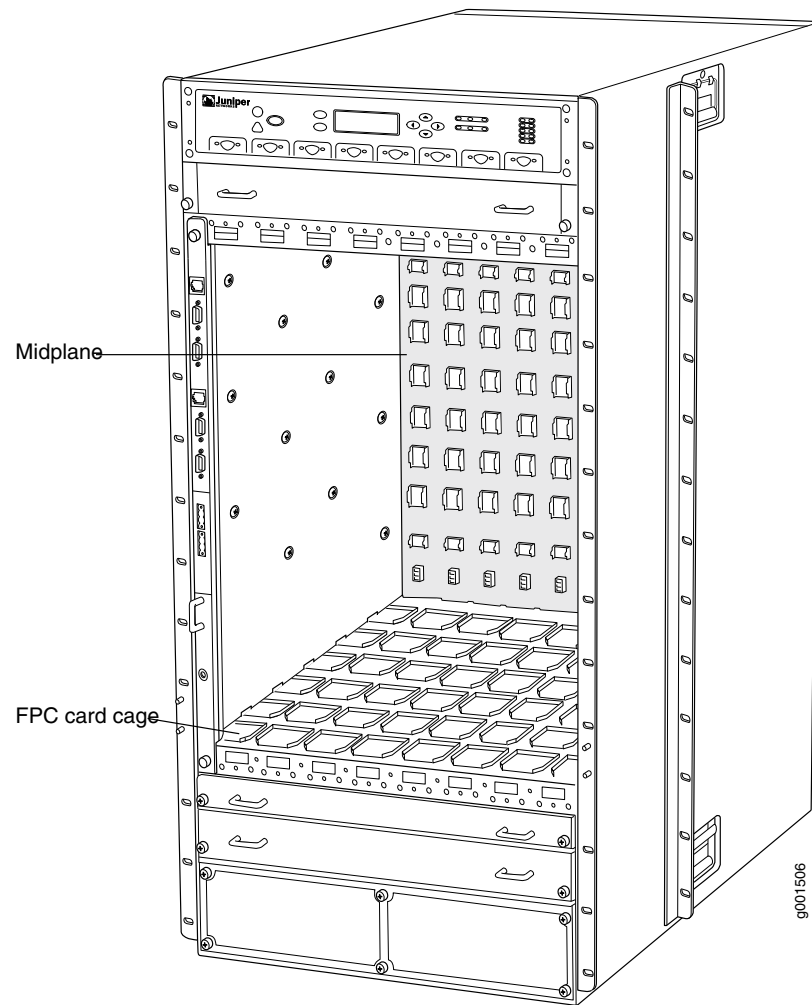
The midplane is located in the center of the chassis and forms the rear of the FPC card cage (see [Figure 10 on page 19](#)). The FPCs install into the midplane from the front of the

chassis, and the SIBs, Routing Engines, and control boards and SCGs install into the midplane from the rear of the chassis. The power supplies and cooling system components also connect to the midplane.

The midplane performs the following major functions:

- Data path—Data packets are transferred across the midplane from the Packet Forwarding Engine on the originating FPC to the SIBs, and from the SIBs across the midplane to the Packet Forwarding Engine on the destination FPC.
- Power distribution—The router power supplies are connected to the midplane, which distributes power to all the router components.
- Signal path—The midplane provides the signal path to the FPCs, SIBs, Routing Engines, CB, and other system components for monitoring and control of the system.

*Figure 10: Midplane*



- Related Documentation**
- [T4000 Router Description on page 3](#)
  - [T4000 Chassis Description on page 11](#)
  - [T4000 Component Redundancy on page 7](#)

## T4000 SONET Clock Generators (SCGs) Description

- [SCG Slots on page 20](#)
- [SCG Function on page 20](#)
- [SCG Redundancy on page 20](#)
- [Supported SCGs on page 20](#)
- [SCG Components on page 21](#)

### SCG Slots

The SCGs are installed into the upper rear of the chassis in the slots labeled **SCG0** and **SCG1**.

### SCG Function

SCGs provide 19.44-MHz Stratum 3 clock signal for the SONET/SDH interfaces on the router.

### SCG Redundancy

One SCG is shipped as part of the standard router configuration, but up to two SCGs can be installed to provide redundancy. A nonredundant SCG is hot-pluggable. For redundant SCGs, the master SCG is hot-pluggable. If the master SCG is functioning, the backup SCG is hot-removable and hot-insertable. Removing the backup SCG does not affect the functioning of the router. Taking the master SCG offline might result in a brief loss of SONET clock lock while the backup SCG becomes the master.

### Supported SCGs

The T4000 router supports the SCG in [Table 4 on page 20](#).



**NOTE:** Redundant SCGs must be the same model number, except during upgrade.

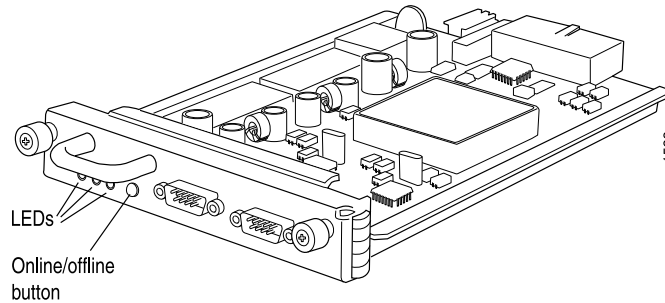
*Table 4: Supported SCG*

Name	Model Number	First Supported Junos OS Release
SCG with RJ-48 ports	SCG-T-EC	12.1
SCG with DB-9 ports	SCG-T	12.1

## SCG Components

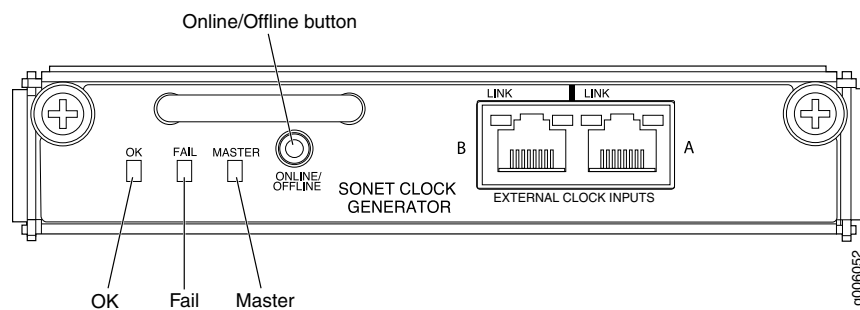
The SCG with DB-9 ports is shown in [Figure 11 on page 21](#).

**Figure 11: SCG with DB-9 Ports**



The SCG with RJ-48 ports is shown in [Figure 12 on page 21](#).

**Figure 12: SCG with RJ-48 ports**



Each SCG consists of the following components:

- 19.44-MHz Stratum 3 clock.
- Field-programmable gate array (FPGA) that performs multiplexing of clock sources.
- SCG online/offline button, located on the SCG faceplate.
- Two external clock inputs.



**NOTE:** The external clock ports are not supported on the SCG with DB-9 ports.

For information about configuring external clock synchronization for T Series routers, see the *Junos OS Administration Library*.

For information about configuring an interface transmit clock, see the *Junos OS Network Interfaces Library for Routing Devices*.

- Three LEDs—**OK**, **FAIL**, and **MASTER**, located on the SCG faceplate, that display the status of the SCG.

- Related Documentation**
- [T4000 SONET Clock Generators \(SCGs\) LEDs on page 22](#)
  - [Connecting the T4000 Router to an External Clocking Device](#)
  - [Maintaining the T4000 SCGs on page 333](#)
  - [Troubleshooting the T4000 SCGs on page 349](#)

## T4000 SONET Clock Generators (SCGs) LEDs

Three LEDs, located on the SCG faceplate, display the status of the SCG.

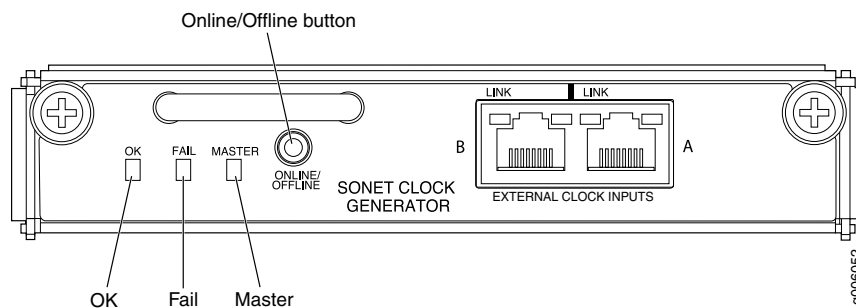
[Table 5 on page 22](#) describes the functions of the SCG LEDs. Two **LINK** LEDs, located on the left of each RJ-48 port, display the status of the external clock inputs links. The other LEDs on the right of each port are not used.



**NOTE:** The external clock inputs on the SCG with DB-9 ports are not functional.

[Figure 13 on page 22](#) shows the LEDs on the SCG with RJ-48 ports.

**Figure 13: SCG with RJ-48 ports**



[Table 5 on page 22](#) describes the functions of the SCG LEDs. The **LINK** LED is not applicable to the SCG with DB-9 ports.

**Table 5: SCG LEDs**

Label	Color	State	Description
OK	Green	On steadily	SCG is online and is functioning normally.
		Off	SCG is not online or not functioning normally.
FAIL	Yellow	On steadily	SCG has failed.
		Off	SCG is offline or functioning normally.



Table 5: SCG LEDs (continued)

Label	Color	State	Description
MASTER	Blue	On steadily	SCG is functioning as master.
		Off	SCG is not functioning as the master.
LINK	Green	On Steadily	Link is online and active.
		Off	No link.

**Related  
Documentation**

- [T4000 SONET Clock Generators \(SCGs\) Description on page 20](#)
- [Connecting the T4000 Router to an External Clocking Device](#)
- [Maintaining the T4000 SCGs on page 333](#)
- [Troubleshooting the T4000 SCGs on page 349](#)



## CHAPTER 4

# Cooling System Components and Descriptions

- [T4000 Cooling System Description on page 25](#)

## T4000 Cooling System Description

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The cooling system components work together to keep all router components within the acceptable temperature range. The host subsystem monitors the temperature of the router components. When the router is operating normally, the fans function at normal speed. If a fan fails or the ambient temperature rises above a threshold, the speed of the remaining fans is set to full speed. If the ambient maximum temperature specification is exceeded and the system cannot be adequately cooled, the Routing Engine shuts down some or all of the hardware components.

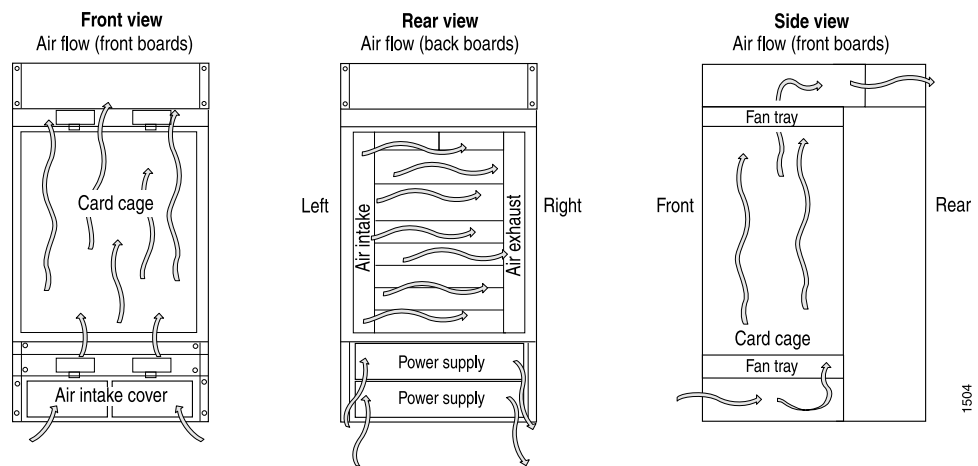
In addition to the fans, the front fan trays are equipped with a fan tray controller (FTC) board. The FTC board is a transition board that distributes the fan-related signals between the Routing Engine and the fans, and controls the speed as required.

- [Airflow on page 25](#)
- [Fan Trays on page 26](#)
- [Air Filters on page 27](#)
- [Power Supply Cooling System on page 27](#)

## Airflow

[Figure 14 on page 26](#) shows the airflow through the router.

Figure 14: Airflow Through the Chassis



## Fan Trays

The cooling system contains the following fan trays:

- One upper front fan tray and one lower front fan tray that cool the components installed in the front card cage (the FPCs, PICs, CIP, and the midplane).
- Rear fan tray containing eight fans.



**NOTE:** FAN-R-TXP-3D-LCC contains sixteen fans.

The upper and lower front fan trays contain six fans. Both fan trays are interchangeable with each other.

One rear fan tray cools the components installed in the rear card cage (the Routing Engines, control boards, SCGs, and the SIBs). The rear fan tray is not interchangeable with the front fan trays.

All fan trays are hot-insertable and hot-removable.



**CAUTION:** To maintain proper cooling, do not operate the routing node with the rear fan tray removed for more than one minute.

The T4000 router supports the fan trays listed in [Table 6 on page 26](#).

**Table 6: T4000 Supported Fan Trays**

Name	Model Number	First Supported Junos OS Release
Front Upper Fan Tray	FANTRAY-T4000	12.1
Front Lower Fan Tray	FANTRAY-T4000	12.1

*Table 6: T4000 Supported Fan Trays (continued)*

Name	Model Number	First Supported Junos OS Release
Rear Fan Tray	FAN-REAR-TXP-LCC	12.1
Rear Fan Tray	FAN-R-TXP-3D-LCC	13.1

## Air Filters

The cooling system contains a front air filter and a rear air filter. All air filters are hot-insertable and hot-removable.

## Power Supply Cooling System

Each DC power supply contains two blowers that cool that power supply.

### Related Documentation

- [T4000 Router Description on page 3](#)
- [Maintaining the T4000 Fan Trays on page 335](#)
- [Troubleshooting the T4000 Cooling System on page 351](#)
- [T4000 Router Environmental Specifications on page 88](#)



## CHAPTER 5

# Host Subsystem Components and Descriptions

- [T4000 Host Subsystem Description on page 29](#)
- [T4000 Control Board Description on page 30](#)
- [T4000 LCC-CB on page 30](#)
- [T4000 LCC-CB Control Board LEDs on page 31](#)
- [T4000 Routing Engine Description on page 33](#)
- [T4000 RE-C1800 Routing Engine Description on page 34](#)
- [T4000 RE-C1800 LEDs on page 35](#)
- [Routing Engine Specifications on page 36](#)
- [Supported Routing Engines by Router on page 40](#)

## T4000 Host Subsystem Description

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The host subsystem provides the routing and system management functions of the router. The host subsystem consists of a Routing Engine and an adjacent control board. To operate, each host subsystem functions as a unit; the Routing Engine requires the corresponding control board, and vice versa.



**NOTE:** You can install one or two host subsystems on the router. We recommend that you install two host subsystems for redundant protection. If you install only one host subsystem, we recommend that you install it in slots RE0 and CB0.

Each host subsystem has three LEDs, located on the upper right of the craft interface, that display its status. In addition, there are LEDs on each Routing Engine and control board.

### Related Documentation

- [T4000 Routing Engine Description on page 33](#)
- [T4000 RE-C1800 Routing Engine Description on page 34](#)
- [T4000 LCC-CB on page 30](#)

- [T4000 Craft Interface LEDs](#)
- [T4000 RE-C1800 LEDs on page 35](#)
- [T4000 LCC-CB Control Board LEDs on page 31](#)

## T4000 Control Board Description

The T4000 chassis supports up to two control boards. The Routing Engine requires an adjacent control board to provide control and monitoring functions for the router. These functions include determining Routing Engine mastership, controlling power and reset for the other router components, monitoring and controlling fan speed, and monitoring system status.

You can install up to two control boards in the chassis. Control boards install into the upper rear of the chassis in the slots labeled **CB0** and **CB1** (referred to as **CB-0** and **CB-1**, top to bottom). If two control boards are installed, one functions as the master and the other as its backup. If the master fails or is removed, the backup restarts and becomes the master.

Each control board requires a Routing Engine to be installed in the adjacent slot. **CB0** installs above **RE0**, and **CB1** installs below **RE1**. Control boards cannot function if a Routing Engine is not present in the adjacent slot.

If the host system is redundant, the backup control board is hot-removable and hot-insertable, but the master control board is hot-pluggable. A control board that is not redundant is hot-pluggable.

The T4000 router supports the control board listed in [Table 7 on page 30](#)

**Table 7: T4000 Supported Control Board**

Name	Model Number	First Supported Junos OS Release
Line-card chassis control board (LCC-CB)	CB-LCC	12.1

### Related Documentation

- [T4000 LCC-CB on page 30](#)
- [T4000 Craft Interface LEDs](#)
- [T4000 LCC-CB Control Board LEDs on page 31](#)

## T4000 LCC-CB

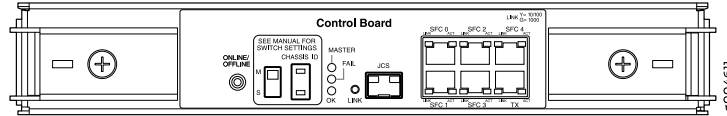
Each LCC-CB consists of the following components:

- 100-MB Ethernet switch for intermodule communication.
- PCI bus to the Routing Engines.



- Switch processor mezzanine board (SPMB).

Figure 15: LCC-CB



The following components are located on the LCC-CB faceplate:

- Two configuration switches:
  - The **M/S** configuration switch must be set to **S**.
  - The **CHASSIS ID** configuration switch must be set to **0**.



**CAUTION:** If the configuration switches are set incorrectly, a kernel error occurs during the boot process. Use the `show log messages` operational-mode CLI command to confirm the error:

```
hostname> show log messages | match error
```

```
...
```

```
May 21 00:00:00 hostname /kernel: ERROR: CB Chassis number number is invalid
```

To resolve the error, ensure the switches are set properly, and reboot the router.

- Three LEDs labeled **MASTER**, **FAIL**, and **OK**, which indicate the control board status.
- The online/offline button.
- Six RJ-45 ports labeled **SFC0** through **SFC5**, which is currently not supported. The two LEDs for each port labeled **LINK** and **ACT** are also not currently supported.
- One JCS port, which is not currently supported. The **LINK** LED for this port is also not currently supported.

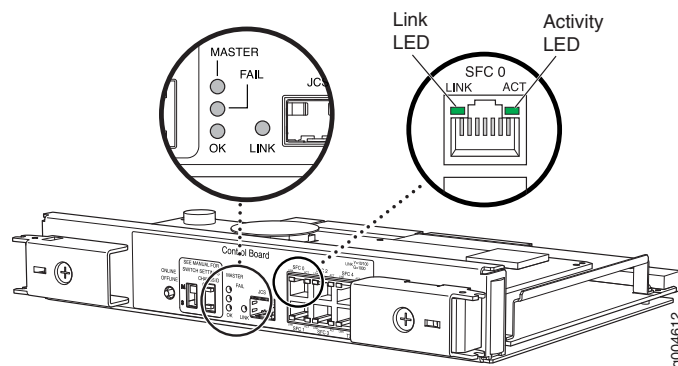
#### Related Documentation

- [T4000 Control Board Description on page 30](#)
- [T4000 Craft Interface LEDs](#)
- [T4000 LCC-CB Control Board LEDs on page 31](#)

## T4000 LCC-CB Control Board LEDs

Status LEDs and port LEDs are located on the faceplate of the LCC-CB (see [Figure 16 on page 32](#)).

Figure 16: LCC-CB LEDs



- [LCC-CB LEDs on page 32](#)
- [LCC-CB Port LEDs on page 32](#)

## LCC-CB LEDs

The LEDs located in the middle of the LCC-CB indicate its status. [Table 8 on page 32](#) describes the functions of the LCC-CB LEDs.

Table 8: LCC-CB LEDs

Label	Color	State	Description
MASTER	Blue	On steadily	LCC-CB is functioning as the master.
	—	Off	LCC-CB is functioning as the backup.
FAIL	Yellow	On steadily	LCC-CB has failed.
	—	Off	No faults have been detected on the LCC-CB.
OK	Green	On steadily	LCC-CB is online and is functioning normally.
		Blinking	LCC-CB is powering up, but not online.
	—	Off	LCC-CB is offline.

## LCC-CB Port LEDs

The six RJ-45 ports labeled **SFC0** through **SFC4**, the port labeled **JCS**, and the LEDs for each port labeled **LINK** or **ACT** are not currently supported.

- Related Documentation**
- [T4000 Host Subsystem Description on page 29](#)
  - [T4000 Control Board Description on page 30](#)
  - [T4000 Craft Interface LEDs](#)

## T4000 Routing Engine Description

The Routing Engine runs Junos OS. The software processes that run on the Routing Engine maintain the routing tables, manage the routing protocols used on the router, control the router interfaces and some chassis components, and provide the interface for system management and user access to the router.

You can install one or two Routing Engines in the router. The Routing Engines install into the upper rear of the chassis in the slots labeled **RE0** and **RE1**. Each Routing Engine requires a control board to be installed in the adjacent slot. **RE0** installs below **CB0**, and **RE1** installs above **CB1**. A Routing Engine does not power up without a control board present in the adjacent slot.

If two Routing Engines are installed, one functions as the master and the other acts as the backup. If the master Routing Engine fails or is removed and the backup is configured appropriately, the backup takes over as the master. If the host system is redundant, the backup Routing Engine is hot-removable and hot-insertable, but the master Routing Engine is hot-pluggable. A Routing Engine that is not redundant requires that you power down the router before replacement.



**NOTE:** For specific information about Routing Engine components (for example, the amount of DRAM), issue the `show chassis routing-engine` command.

The ports for connecting the Routing Engine to external management devices are located on the Connector Interface Panel (CIP).

The T4000 router supports the Routing Engine in [Table 9 on page 33](#).

**Table 9: T4000 Supported Routing Engines**

Name	Model Number	First Supported Junos OS Release
RE-C1800	RE-DUO-C1800-8G	12.1
RE-C1800  "T4000 RE-C1800 Routing Engine Description" on page 34  <b>NOTE:</b> These Routing Engines require the LCC-CB when a T4000 router is connected to a TX Matrix Plus router.	RE-DUO-C1800-16G	12.1R2

### Related Documentation

- [T4000 Host Subsystem Description on page 29](#)
- [T4000 Control Board Description on page 30](#)
- [T4000 Craft Interface LEDs](#)

- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)

## T4000 RE-C1800 Routing Engine Description

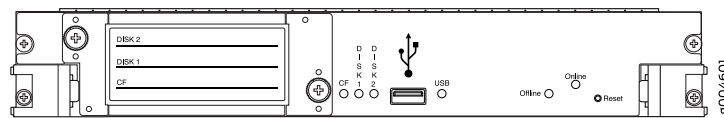
- [RE-C1800 Routing Engine Components on page 34](#)
- [RE-C1800 Boot Order on page 35](#)

### RE-C1800 Routing Engine Components

Each RE-C1800 Routing Engine ([Figure 17 on page 34](#)) consists of the following components:

- CPU—Runs Junos OS to maintain the routing tables and routing protocols.
- DRAM—Provides storage for the routing and forwarding tables and for other Routing Engine processes.
- EEPROM—Stores the serial number of the Routing Engine.
- Interfaces for management access—Provide information about Routing Engine status to devices (console, laptop, or terminal server) connected to the management ports located on the CIP.

**Figure 17: RE-C1800**



The faceplate of the RE-C1800 contains the following:

- USB port—Provides a removable media interface through which you can install Junos OS manually. Junos OS supports USB version 1.1 and version 2.0 devices.
- CompactFlash card slot—Provides primary storage for software images, configuration files, and microcode.
- Two solid-state disk (SSD) slots—Provides secondary storage for log files, memory dumps, and rebooting the system if the CompactFlash card fails.



**NOTE:** DISK2 is not currently supported.

- Reset button—Reboots the Routing Engine when pressed.
- Offline button—Takes the Routing Engine offline when pressed.
- Four LEDs—CF, DISK1, DISK2, and ONLINE.
- Extractor clips—Control the locking system that secures the Routing Engine.

## RE-C1800 Boot Order

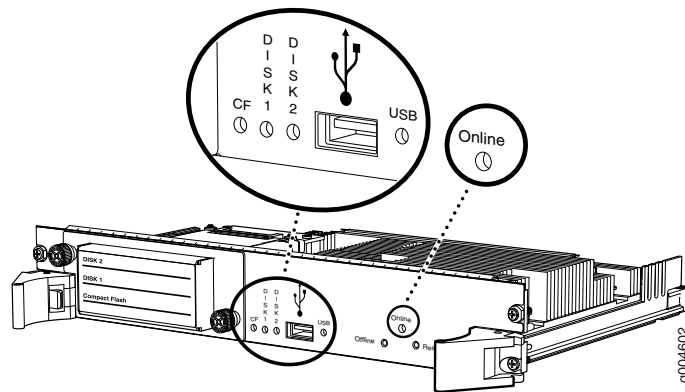
The RE-C1800 Routing Engine boots from the storage media in this order: the USB device, then the CompactFlash card (if present), then **DISK1**, then the LAN.

- Related Documentation**
- [T4000 Host Subsystem Description on page 29](#)
  - [T4000 Routing Engine Description on page 33](#)
  - [T4000 Control Board Description on page 30](#)
  - [T4000 Craft Interface LEDs](#)

## T4000 RE-C1800 LEDs

Figure 18 on page 35 shows the RE-C1800 LEDs. Table 10 on page 35 describes the functions of the LEDs on the faceplate of the Routing Engine.

*Figure 18: RE-C1800 LEDs*



**NOTE:** The LEDs on the Routing Engine do not necessarily indicate routing-related activity.

*Table 10: Routing Engine C1800 LEDs*

Label	Color	State	Description
CF	Green	On steadily	Indicates disk activity on the CompactFlash card.
	—	Off	There is no disk activity on the CompactFlash card.
DISK1	Green	On steadily	Indicates activity for the disk.
	—	Off	There is no activity for the disk.

Table 10: Routing Engine C1800 LEDs (continued)

Label	Color	State	Description
DISK2	Green	On steadily	Not applicable.
	—	Off	<b>NOTE:</b> The <b>DISK2</b> LED is not currently supported.
ONLINE	Green	On steadily	Routing Engine is functioning normally.
	Red	On steadily	Routing Engine is not functioning normally.
	—	Off	Routing Engine is not online or not functioning normally.
USB	Green	On steadily	Indicates activity on the USB port.
	—	Off	There is no activity on the USB port.

- Related Documentation**
- [T4000 Host Subsystem Description on page 29](#)
  - [T4000 Routing Engine Description on page 33](#)
  - [T4000 RE-C1800 Routing Engine Description on page 34](#)
  - [T4000 Craft Interface LEDs](#)

## Routing Engine Specifications

Table 11 on page 37 lists the current specifications for Routing Engines supported on M Series, MX Series, and T Series routers. Table 12 on page 39 lists the specifications for end-of-life Routing Engines.



**NOTE:** For a list of the routing engines that are supported on the M Series, MX Series, T Series, and PTX routers, see “Supported Routing Engines by Router” on page 40.



**NOTE:** For information about PTX Series Routing Engine specifications, see *Routing Engines Supported on PTX Series Routers*. For information about

Table 11: Routing Engine Specifications

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-400-768	400-MHz Celeron	768 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	9.0	—
RE-A1000-2048	1.0-GHz Pentium	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.1	—
RE-A2000-4096	2.0-GHz Pentium	4096 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.1	—
RE-S1000-2048	1.3-GHz Pentium	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.2	SCB, SCBE
RE-S2000-4096	2.0-GHz Pentium	4096 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.2	SCB, SCBE
RE-C1800	1.8-GHz	8 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	T1600 router in a routing matrix: 9.6R2	CB-T for a standalone router.
						Standalone T640 or T1600 router: 11.2	CB-LCC for a router in a routing matrix.
	1.8 Ghz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	32-bit Junos OS on a standalone T1600 router: 11.4R2 32-bit Junos OS on a T1600 router in a routing matrix: 11.4R2  64-bit Junos OS on a standalone T1600 router: 11.4R2 64-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	CB-T for a standalone router.  CB-LCC for a router in a routing matrix.
RE-C2600	2.6-GHz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	TX Matrix Plus router: 9.6R2	—

Table 11: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-A-1800x2	1800-MHz	8 GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	—
RE-S-1800x2	1800-MHz	8 GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	SCB, SCBE
RE-S-1800x4	1800-MHz	8GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	SCB, SCBE, SCBE2
RE-S-MX104	1.8-GHz	4 GB	Gigabit Ethernet	—	8 GB NAND Flash	13.2	—
<del>RE-B-1800x4G</del>	1.73-GHz	4 GB	Gigabit Ethernet	64 GB SSD	4 GB CompactFlash card	12.1R2, 11.4R4, and 12.2R1	—
<del>RE-M-1800x4</del>	1.8- GHz	16 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	12.3R2	SCB, SCBE
<del>RE-S-1800x3GS</del>	1.8- Ghz	32 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	<ul style="list-style-type: none"> <li>12.3R4</li> <li>13.2R1</li> </ul>	SCB, SCBE SCBE2
<del>RE-M-1800x3GS</del>	1.8- Ghz	32 GB	Gigabit Ethernet	32 GB SSD	4GB Fixed Internal CompactFlash card	<ul style="list-style-type: none"> <li>12.3R4</li> <li>13.2R1</li> </ul>	—
RE-S-X6-64G	2 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	-	15.1F4, 16.1	SCBE2
<del>RE-M-X6-64G</del>	2.3 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	15.1F5-S1, 16.1R2, and 16.2R1	—
<del>RE-M-X6-64G</del>	2.3 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	—	15.1F7	—
<del>RE-M-X6-64G</del>	2.3 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	-	15.1F7	—
RE-S-1600x8	1.6 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	—	17.3R1	—



Table 11: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-S-1600x8	1.6 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	–	17.3R1	–
RE-S-64G	2.1 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	–	17.2R1	–
RE-S-X6-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 100-GB SSDs	–	18.1R1	–
RE-S-X8-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 100-GB SSDs	–	18.1R1	–



**NOTE:** Use shielded CAT5e cable for connecting the AUX, CONSOLE, and MGMT ports in RE-S-X6-64G, REMX2K-X8-64G, and REMX2008-X8-64G Routing Engines.

Table 12: End-of-Life Routing Engine Specifications

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	EOL Details
RE-333-256	333-MHz Pentium II	256 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.4	<a href="#">PSN-2003-01-063</a>
RE-333-768	333-MHz Pentium II	768 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.4	<a href="#">PSN-2003-01-063</a>
RE-600-512	600-MHz Pentium III	512 MB	Fast Ethernet	30 GB hard disk	256 MB CompactFlash card	5.4	<a href="#">PSN-2004-07-019</a>
RE-600-2048	600-MHz Pentium III	2048 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	5.3	<a href="#">PSN-2008-02-018</a>
RE-850-1536	850-MHz Pentium III	1536 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	7.2	<a href="#">PSN-2011-04-226</a>
RE-M40	200-MHz Pentium	256 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.2	<a href="#">FA-HW-0101-001</a>

Table 12: End-of-Life Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	EOL Details
RE-M40-333-768	333-MHz Pentium II	768 MB	Fast Ethernet	10 GB hard disk	80 MB CompactFlash card	4.2	<a href="#">PSN-2003-01-063</a>
RE-M600-2048	600-MHz Pentium III	2048 MB	Fast Ethernet	30 GB hard disk	128 MB CompactFlash card	5.4	<a href="#">PSN-2004-11-020</a>
RE-1600-2048	1.6-GHz Pentium M	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	6.2	<a href="#">PSN-2008-02-019</a>



**NOTE:** The memory in [Table 11 on page 37](#) indicates the amount of total memory. To determine the amount of available memory, issue the `show chassis routing-engine` CLI command.

On routers that accept two Routing Engines, you cannot mix Routing Engine types except for a brief period (one minute or so) during an upgrade or downgrade to two Routing Engines of the same type.

#### Related Documentation

- [Supported Routing Engines by Router on page 40](#)

## Supported Routing Engines by Router

The following tables list the Routing Engines that each router supports, the first supported release for the Routing Engine in the specified router, the management Ethernet interface, and the internal Ethernet interfaces for each Routing Engine.

- [M7i Routing Engines on page 41](#)
- [M10i Routing Engines on page 41](#)
- [M40e Routing Engines on page 42](#)
- [M120 Routing Engines on page 42](#)
- [M320 Routing Engines on page 43](#)
- [MX5, MX10, MX40, and MX80 Routing Engine on page 43](#)
- [MX104 Routing Engines on page 44](#)
- [MX240 Routing Engines on page 44](#)
- [MX480 Routing Engines on page 45](#)
- [MX960 Routing Engines on page 46](#)
- [MX2008 Routing Engines on page 47](#)
- [MX2010 Routing Engines on page 47](#)

- [MX2020 Supported Routing Engines on page 48](#)
- [MX10003 Routing Engines on page 49](#)
- [PTX1000 Routing Engines on page 49](#)
- [PTX3000 Routing Engines on page 49](#)
- [PTX5000 Routing Engines on page 50](#)
- [PTX10008 and PTX10016 Routing Engines on page 51](#)
- [T320 Routing Engines on page 51](#)
- [T640 Routing Engines on page 51](#)
- [T1600 Routing Engines on page 52](#)
- [T4000 Routing Engines on page 53](#)
- [TX Matrix Routing Engines on page 54](#)
- [TX Matrix Plus Routing Engines on page 54](#)
- [TX Matrix Plus \(with 3D SIBs\) Routing Engines on page 54](#)

## M7i Routing Engines

[Table 13 on page 41](#) lists the Routing Engines supported by the M7i router. The M7i router supports 32-bit Junos OS only.

*Table 13: M7i Routing Engines*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-400-768 (EOL details: <a href="#">TSB16445</a> )	RE-5.0	9.0	fxp0	fxp1
RE-850-1536 (EOL details: <a href="#">TSB15553</a> )	RE-850	7.2	fxp0	fxp1
RE-B-1800X1-4G	RE-B-1800x1	11.4R4 12.1R2	fxp0	em0

## M10i Routing Engines

[Table 14 on page 41](#) lists the Routing Engines supported by the M10i router. The M10i router supports 32-bit Junos OS only.

*Table 14: M10i Routing Engines*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-400-768 (EOL details: <a href="#">TSB16445</a> )	RE-5.0	9.0	fxp0	fxp1 fxp2

Table 14: M10i Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-850-1536 (EOL details: <a href="#">TSB15553</a> )	RE-850	7.2	fxp0	fxp1 fxp2
RE-B-1800X1-4G	RE-B-1800x1	11.4R4 12.1R2	fxp0	em0

## M40e Routing Engines

Table 15 on page 42 lists the Routing Engines supported by the M40e router.

Table 15: M40e Routing Engines

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: <a href="#">TSB14373</a> )	RE-3.0 or RE-3.0 (RE-600)	5.3	fxp0	fxp1 fxp2
RE-A-1000-2048	RE-A-1000	8.1	fxp0	fxp1 fxp2

## M120 Routing Engines

Table 16 on page 42 lists the Routing Engines supported by the M120 router.

Table 16: M120 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-1000-2048	RE-A-1000	8.0R2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	RE-A-2000	8.0R2	–	fxp0	em0 bcm0
RE-A-1800X2-8G	RE-A-1800x2	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	fxp1 fxp2

Table 16: M120 Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-1800X2-16G	RE-A-1800x2	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	fxp1 fxp2
RE-A-1800X4-16G	RE-A-1800x4	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1

## M320 Routing Engines

Table 17 on page 43 lists the Routing Engines supported by the M320 router.

Table 17: M320 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-1600-2048 (EOL details: <a href="#">TSB14374</a> )	RE-4.0	6.2	—	fxp0	fxp1 fxp2
RE-A-2000-4096	RE-A-2000	8.1	—	fxp0	em0 bcm0
RE-A-1800X2-8G	RE-A-1800x2	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 bcm0
RE-A-1800X2-16G	RE-A-1800x2	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 bcm0
RE-A-1800X4-8G	RE-A-1800x4	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> <li>12.2</li> </ul>	10.4	fxp0	em0 em1

## MX5, MX10, MX40, and MX80 Routing Engine

Table 18 on page 44 lists the Routing Engines supported by the MX5, MX10, MX40, and MX80 routers.

**Table 18: MX5, MX10, MX40, and MX80 Routing Engine**

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
Built-in Routing Engine	<b>Routing Engine RE-MX80</b>	12.3	-	fxp0	em0 em1  <i>NOTE:</i> em1 is used to communicate with the MS-MIC when it is inserted.

## MX104 Routing Engines

Table 19 on page 44 lists the Routing Engines supported by MX104 routers.

**Table 19: MX104 Routing Engines**

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-MX104	<b>Routing Engine</b>	13.2	—	fxp0	fxp1 fxp2

## MX240 Routing Engines

Table 20 on page 44 lists the Routing Engines supported by MX240 routers.

**Table 20: MX240 Supported Routing Engines**

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1300-2048 (EOL details: <a href="#">TSB16556</a> )	<b>RE-S-1300</b>	9.0	—	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: <a href="#">TSB16735</a> )	<b>RE-S-2000</b>	9.0	—	fxp0	fxp1 fxp2
RE-S-1800X2-8G (EOL details: <a href="#">TSB16556</a> )	<b>RE-S-1800x2</b>	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800x2-16G (EOL details: <a href="#">TSB16556</a> )	<b>RE-S-1800x2</b>	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1

Table 20: MX240 Supported Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X4-8G	RE-S-1800X4	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800X4-16G	RE-S-1800x4	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	RE-S-1800X4	<ul style="list-style-type: none"> <li>12.3R4</li> <li>13.2R1</li> </ul>	<ul style="list-style-type: none"> <li>12.3R4</li> <li>13.2R1</li> </ul>	fxp0	em0, em1
RE-S-X6-64G	RE-S-2X00x6	—	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	RE-S-2X00x6 -LT	—	18.1R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	RE-S-2X00x6-128	—	18.1R1	fxp0	ixlv0, igb0 em0

## MX480 Routing Engines

Table 21 on page 45 lists the Routing Engines supported by MX480 routers.

Table 21: MX480 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1300-2048 (EOL details: <a href="#">TSB16556</a> )	RE-S-1300	8.4	—	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: <a href="#">TSB16735</a> )	RE-S-2000	8.4	—	fxp0	fxp1 fxp2
RE-S-1800X2-8G (EOL details: <a href="#">TSB16556</a> )	RE-S-1800x2	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800X2-16G (EOL details: <a href="#">TSB16556</a> )	RE-S-1800x2	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1

Table 21: MX480 Supported Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X4-8G	RE-S-1800X4	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800X4-16G	RE-S-1800x4	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	RE-S-1800X4	<ul style="list-style-type: none"> <li>12.3R4</li> <li>13.2R1</li> </ul>	<ul style="list-style-type: none"> <li>12.3R4</li> <li>13.2R1</li> </ul>	fxp0	em0 em1
RE-S-X6-64G	RE-S-2X00x6	—	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	RE-S-2X00x6-LT	—	18.1R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	RE-S-2X00x6-128	—	18.1R1	fxp0	ixlv0, igb0 em0

## MX960 Routing Engines

Table 22 on page 46 lists the Routing Engines supported by MX960 routers.

Table 22: MX960 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1300-2048 (EOL details: <a href="#">TSB16556</a> )	RE-S-1300	8.2	—	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: <a href="#">TSB16735</a> )	RE-S-2000	8.2	—	fxp0	fxp1 fxp2
RE-S-1800X2-8G (EOL details: <a href="#">TSB16556</a> )	RE-S-1800x2	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800X2-16G (EOL details: <a href="#">TSB16556</a> )	RE-S-1800x2	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1



Table 22: MX960 Supported Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X4-8G	RE-S-1800x4	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800X4-16G	RE-S-1800x4	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	RE-S-1800x4	<ul style="list-style-type: none"> <li>12.3R4</li> <li>13.2R1</li> </ul>	<ul style="list-style-type: none"> <li>12.3R4</li> <li>13.2R1</li> </ul>	fxp0	em0 em1
RE-S-X6-64G	RE-S-2X00x6	—	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G (For MX960-VC)	RE-S-2X00x6	—	17.1R1	fxp0	ixlv0, igb0
RE-S-X6-128G	RE-S-2X00x6-128	—	18.1R1	fxp0	ixlv0, igb0 em0

## MX2008 Routing Engines

Table 23 on page 47 lists the Routing Engines supported by MX2008 routers.

Table 23: MX2008 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
REMX2008-X8-64G	RE-MX2008-X8-64G	15.1F7	fxp0	ixlv0 ixlv1
REMX2008-X8-64G-LT	RE-MX2008-X8-64G-LT	17.2R1	fxp0	ixlv0 ixlv1

## MX2010 Routing Engines

Table 24 on page 48 lists the Routing Engines supported by MX2010 routers.

**Table 24: MX2010 Supported Routing Engines**

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-MX2000-1800X4	RE-S-1800x4	12.3R2	fxp0	em0 em1
REMX2K-1800-32G-S	RE-S-1800x4	<ul style="list-style-type: none"> <li>• 12.3R4</li> <li>• 13.2R1</li> </ul>	fxp0	em0 em1
REMX2K-X8-64G	RE-S-2X00x8	<ul style="list-style-type: none"> <li>• 15.1F5-S1</li> <li>• 16.1R2</li> <li>• 16.2R1</li> </ul>	fxp0	ixlv0 ixlv1 em0
REMX2K-X8-128G	RE-MX200X8-128G	18.1R1	fxp0	ixlv0 ixlv1

## MX2020 Supported Routing Engines

Table 25 on page 48 lists the Routing Engines supported by MX2020 routers.

**Table 25: MX2020 Supported Routing Engines**

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-MX2000-1800X4	RE-S-1800x4	12.3R2	fxp0	em0 em1
REMX2K-1800-32G-S	RE-S-1800x4	<ul style="list-style-type: none"> <li>• 12.3R4</li> <li>• 13.2R1</li> </ul>	fxp0	em0 em1
REMX2K-X8-64G	RE-S-2X00x8	<ul style="list-style-type: none"> <li>• 15.1F5-S1</li> <li>• 16.1R2</li> <li>• 16.2R1</li> </ul>	fxp0	ixlv0 ixlv1 em0
REMX2K-X8-128G	RE-MX200X8-128G	18.1R1	fxp0	ixlv0 ixlv1 em0

## MX10003 Routing Engines

Table 26 on page 49 lists the Routing Engines supported by MX10003 routers.

*Table 26: MX10003 Supported Routing Engines*

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
JNP10003-RE1	RE-S-2X00x6	17.3R1	fxp0	em3 em4

## PTX1000 Routing Engines

Table 27 on page 49 lists the Routing Engine supported on the PTX1000.



**NOTE:** The PTX1000 supports 64-bit Junos OS only.

*Table 27: PTX1000 Routing Engines*

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
Built-in Routing Engine	RE-PTX1000	<ul style="list-style-type: none"> <li>16.1X65-D30</li> <li>17.2R1</li> </ul>	em0	bme0 em1

## PTX3000 Routing Engines

Table 28 on page 49 lists the Routing Engines supported on the PTX3000.



**NOTE:** The PTX3000 supports 64-bit Junos OS only.

*Table 28: PTX3000 Routing Engines*

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-DUO-C2600-16G	RE-DUO-2600	13.2R2	em0	ixgbe0 ixgbe1

Table 28: PTX3000 Routing Engines (continued)

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RCB-PTX-X6-32G	RE-PTX-2X00x6	16.1R4	em0	ixlv0
		17.1R1		ixlv1
		This Routing Engine does not support Junos OS Release 16.2.		

## PTX5000 Routing Engines

Table 29 on page 50 lists the Routing Engines supported on the PTX5000.



### NOTE:

- PTX5000 supports 64-bit Junos OS only.
- The PTX5000 router supports two midplanes. The midplane identified as Midplane-8S in the CLI output is supported in Junos OS releases, 12.1X48, 12.3, and 13.2. The enhanced midplane, identified as Midplane-8SeP is supported from Junos OS release 14.1 onwards.

The RE-DUO-2600 routing engine with Junos OS 13.2 or earlier is not supported on the PTX5000BASE2 midplane.

Table 29: PTX5000 Routing Engines

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-DUO-C2600-16G	RE-DUO-2600	12.1X48	em0	ixgbe0
		12.3		ixgbe1
		13.2		
		NOTE: The PTX5000 does not support Junos OS Releases 12.1, 12.2, or 13.1.		
RE-PTX-X8-64G	RE-PTX-2X00x8	15.1F4	em0	ixlv0
		16.1R1		ixlv1
				em1
RE-PTX-X8-128G	RE-PTX-2X00x8-128G	18.1R1	em0	ixlv0
				ixlv1
				em1

## PTX10008 and PTX10016 Routing Engines

Table 30 on page 51 lists the Routing Engines supported on the PTX10008 and PTX10016 routers.

Table 30: PTX10008 and PTX10016 Routing Engines

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
JNP10K-RE0	RE-PTX-2X00x4	17.2R1	em0, em1	bme0 bme1

## T320 Routing Engines

Table 31 on page 51 lists the Routing Engines supported by the T320 router.

Table 31: T320 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: <a href="#">TSB14373</a> )	RE-3.0 or RE-3.0 (RE-600)	5.3	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: <a href="#">TSB14374</a> )	RE-4.0	6.2	fxp0	fxp1 fxp2
RE-A-2000-4096	RE-A-2000	8.1	fxp0	fxp1 fxp2

The T320 router supports the CB-T control board.

## T640 Routing Engines

Table 32 on page 51 lists the Routing Engines supported by the T640 router.

Table 32: T640 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: <a href="#">TSB14373</a> )	RE-3.0 or RE-3.0 (RE-600)	5.3	—	fxp0	fxp1 fxp2

Table 32: T640 Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-1600-2048 (EOL details: <a href="#">TSB14374</a> )	RE-4.0	6.2	—	fxp0	fxp1 fxp2
RE-A-2000-4096	RE-A-2000	8.1	—	fxp0	em0 bcm0
RE-DUO-C1800-8G	RE-DUO-1800	32-bit Junos OS on a standalone T640 router: 11.2  32-bit Junos OS on a T640 router in a routing matrix: 11.4R9	64-bit Junos OS on a standalone T640 router: 11.3  64-bit Junos OS on a T640 router in a routing matrix: 11.4R9	em0	bcm0 em1
RE-DUO-C1800-16G	RE-DUO-1800	32-bit Junos OS on a standalone T640 router: 11.4R2  32-bit Junos OS on a T640 router in a routing matrix: 11.4R9	64-bit Junos OS on a standalone T640 router: 11.4R2  64-bit Junos OS on a T640 router in a routing matrix: 11.4R9	em0	bcm0 em1

The T640 standalone router supports CB-T control board and CB-LCC in a T640 routing matrix.

## T1600 Routing Engines

Table 33 on page 52 lists the Routing Engines supported by the T1600 router.



**NOTE:** (Two RE-DUO-C1800-8G or two RE-DUO-C1800-16G are required to connect to a Routing Matrix)

Table 33: T1600 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: <a href="#">TSB14373</a> )	RE-3.0 or RE-3.0 (RE-600)	8.5	—	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: <a href="#">TSB14374</a> )	RE-4.0 (RE-1600)	8.5	—	fxp0	fxp1 fxp2

**Table 33: T1600 Routing Engines (continued)**

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-2000-4096	<b>RE-A-2000</b>	8.5	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	<b>RE-TXP-LCC</b> or <b>RE-DUO-1800</b>	32-bit Junos OS on a T1600 router in a routing matrix: 9.6  <b>NOTE:</b> Junos OS Releases 9.6 through 10.4 support RE-DUO-C1800-8G only during upgrade to a line-card chassis (LCC) in a routing matrix.  32-bit Junos OS on a standalone T1600 router: 11.1	64-bit Junos OS on a T1600 router in a routing matrix: 9.6  64-bit Junos OS on a standalone T1600 router: 11.1	em0	bcm0 em1
RE-DUO-C1800-16G	<b>RE-DUO-1800</b>	32-bit Junos OS on a standalone T1600 router: 11.4R2  32-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	64-bit Junos OS on a standalone T1600 router: 11.4R2  64-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	em0	bcm0 em1

## T4000 Routing Engines

Table 34 on page 53 lists the Routing Engines supported by the T4000 router.



**NOTE:** The T4000 router supports 64-bit Junos OS only.

**Table 34: T4000 Routing Engines**

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-DUO-C1800-8G	<b>RE-DUO-1800</b>	Standalone T4000 router: 12.1 T4000 router in a routing matrix: 13.1	em0	bcm0 em1
RE-DUO-C1800-16G	<b>RE-DUO-1800</b>	Standalone T4000 router: 12.1R2 T4000 router in a routing matrix: 13.1	em0	bcm0 em1

The T4000 router supports the CB-LCC control board.

## TX Matrix Routing Engines

Table 35 on page 54 lists the Routing Engines supported by the TX Matrix router.

Table 35: TX Matrix Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: <a href="#">TSB14373</a> )	<b>RE-3.0 or RE-3.0 (RE-600)</b>	7.0	–	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: <a href="#">TSB14374</a> )	<b>RE-4.0 (RE-1600)</b>	7.0	–	fxp0	fxp1 fxp2
RE-A-2000-4096	<b>RE-A-2000</b>	8.5	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	<b>RE-DUO-1800</b>	11.4R9	11.4R9	em0	bcm0 em1
RE-DUO-C1800-16G	<b>RE-DUO-1800</b>	11.4R9	11.4R9	em0	bcm0 em1

The TXP router supports two control boards, CB-TX and CB-LCC. The CB-LCC is required for both RE-DUO-C1800-8G and RE-DUO-C1800-16G Routing Engines.

## TX Matrix Plus Routing Engines

Table 36 on page 54 lists the Routing Engines supported by the TX Matrix Plus router.

Table 36: TX Matrix Plus Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-DUO-C2600-16G	<b>RE-TXP-SFC or RE-DUO-2600</b>	32-bit Junos OS: 9.6	64-bit Junos OS: 11.4	em0	ixgbe0 ixgbe1

The TX Matrix Plus router supports the CB-TXP control board.

## TX Matrix Plus (with 3D SIBs) Routing Engines

Table 37 on page 55 lists the Routing Engines supported by the TX Matrix Plus router with 3D SIBs.



*Table 37: Routing Engines on TX Matrix Plus with 3D SIBs*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-DUO-C2600-16G	RE-TXP-SFC or RE-DUO-2600	-	64-bit Junos OS: 11.4	em0	ixgbe0 ixgbe1

- Related Documentation**
- [Routing Engine Specifications on page 36](#)
  - *Understanding Internal Ethernet Interfaces*
  - *Understanding Management Ethernet Interfaces*



## CHAPTER 6

# Line Card Components and Descriptions

- [T4000 FPC Description on page 57](#)
- [T4000 FPCs Supported on page 61](#)
- [T4000 PIC Description on page 62](#)
- [T4000 PICs Supported on page 63](#)
- [T4000 End-of-Life PICs Supported on page 67](#)
- [T4000 PIC/FPC Compatibility on page 68](#)

### T4000 FPC Description

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FPCs are hot-removable and hot-insertable.

- [T4000 FPC Slots on page 57](#)
- [T4000 FPC Function on page 57](#)
- [T4000 FPC Components on page 58](#)
- [Identifying the FPCs on page 58](#)
- [FPC Terminology on page 60](#)

### T4000 FPC Slots

Up to eight FPCs install vertically in the front of the router. The FPC slots are numbered **FPC0** through **FPC7**, left to right. If a slot is not occupied by an FPC, an FPC blank panel must be installed to shield the empty slot and to allow cooling air to circulate properly through the router.

### T4000 FPC Function

FPCs house the PICs that connect the T4000 Core Router to network media. The main function of an FPC is to connect the PICs installed in it to the other T4000 router components. The Packet Forwarding Engine receives incoming packets from the PICs installed on the FPC and forwards them through the switch planes to the appropriate destination port. In a maximum configuration with eight Type 5 FPCs installed, the Packet Forwarding Engines can forward up to 4000 million packets per second (Mpps) for all packet sizes. The T4000 Core Router provides up to 2000 gigabits per second (Gbps), full duplex switching (4000 Gbps of any-to-any, nonblocking, half-duplex switching).

When you install an FPC into a functioning router, the Routing Engine downloads the FPC software, the FPC runs its diagnostics, and the PICs housed on the FPC are enabled. Forwarding on other FPCs continues uninterrupted during this process.

## T4000 FPC Components

Each FPC consists of the following components:

- FPC card carrier
- One or two Packet Forwarding Engines
  - Each T1600-FPC4-ES has two Packet Forwarding Engines. Each Packet Forwarding Engine consists of Layer 2/Layer 3 Packet Processing ASICs, Switch Interface ASICs, T Series Internet Processor ASICs, and a Memory Mezzanine Board (MMB) which includes the Queuing and Memory Interface ASICs.
  - Each T4000-FPC5-3D or T4000-FPC5-LSR has two Packet Forwarding Engines. Each Packet Forwarding Engine consists of a Packet Processing ASIC, Interface ASIC, and Switch Interface ASIC.
- Processor Mezzanine Board (PMB), which includes a 1.2-GHz CPU, system controller, 4 GB of DDR3 RAM, and two 10/100/1000Mbps three-speed Ethernet interfaces
- Two LEDs—**OK** and **FAIL**—located on the craft interface above the FPC, that display the status of the FPC
- FPC online/offline button, located on the craft interface above the FPC

## Identifying the FPCs

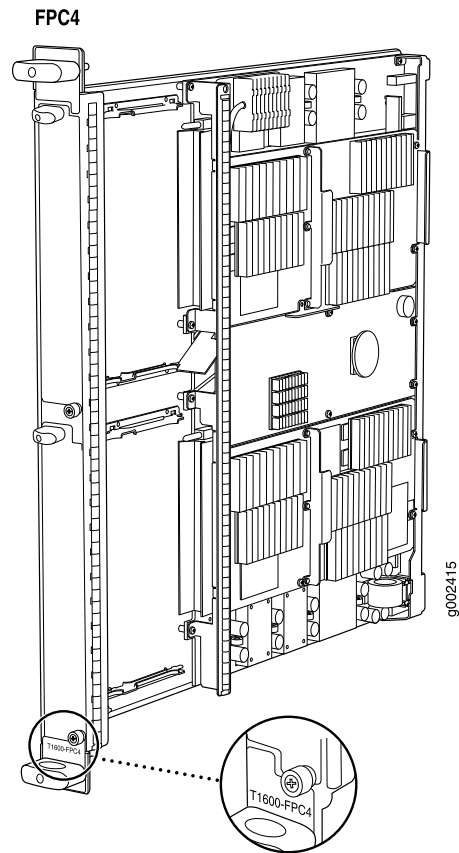
Check the label on the faceplate to identify the FPC. See [Table 38 on page 58](#).

*Table 38: Identifying the FPCs Supported by the Router*

FPC	Label on the FPC Faceplate
T1600 Enhanced Scaling FPC4	T1600-FPC4
T4000 FPC5	<ul style="list-style-type: none"> <li>• T4000-FPC5-3D</li> <li>• T4000-FPC5-LSR</li> </ul>

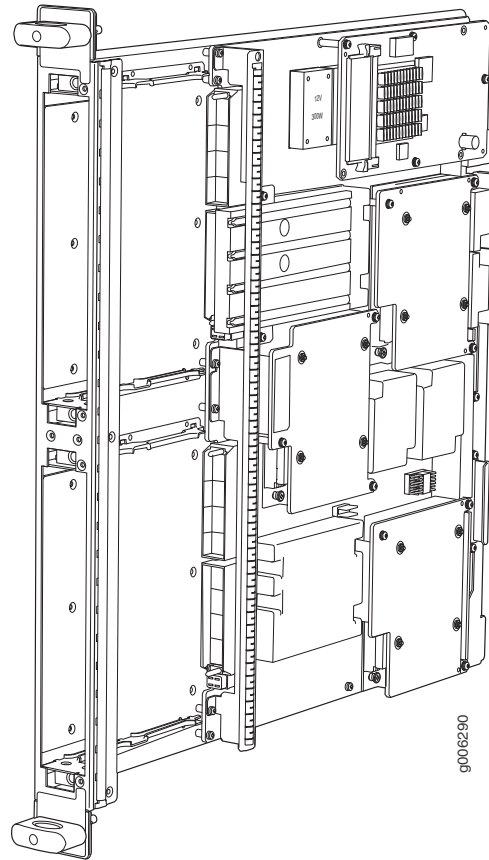
The enhanced scaling T1600-FPC4 is shown in [Figure 19 on page 59](#).

*Figure 19: Enhanced Scaling T1600-FPC4*



The T4000 FPC5 (T4000-FPC5-3D and T4000-FPC5-LSR) is shown in [Figure 20 on page 60](#).

*Figure 20: FPC5 Supported by the Router*

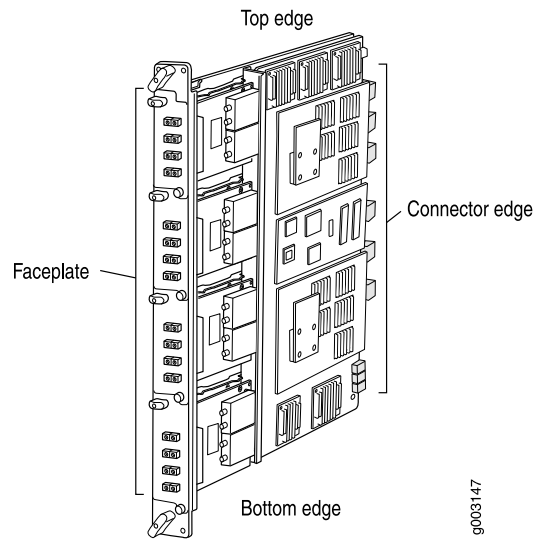


## FPC Terminology

Regardless of whether you are holding an FPC vertically or horizontally, this document uses the same terms for all four edges of the FPC (see [Figure 21 on page 61](#)):

- Faceplate—Edge of the FPC that has slots into which you insert the PICs
- Connector edge—Edge opposite the faceplate; this edge has the connectors that attach to the midplane
- Top edge—Edge at the top of the FPC when it is vertical
- Bottom edge—Edge at the bottom of the FPC when it is vertical

Figure 21: FPC Edges



- Related Documentation**
- [T4000 FPCs Supported on page 61](#)
  - [T4000 Craft Interface LEDs](#)
  - [Maintaining T4000 FPCs on page 337](#)
  - [Troubleshooting the T4000 FPCs on page 358](#)

## T4000 FPCs Supported

T4000 Core Routers support the FPCs listed in [Table 39 on page 61](#). You can install any combination of the following FPCs. The First Junos OS Release Supported column indicates the first release that the FPC is supported in the T4000 router.

Table 39: FPCs Supported by the T4000 Router

FPC Type	FPC Name	FPC Model Number	CLI Name	Maximum Number of PICs	Maximum Throughput per FPC	First Junos OS Release Supported
1	Enhanced Scaling FPC1	T640-FPC1-ES	<b>FPC Type 1-ES</b>	4	4 Gbps	12.1R2
2	Enhanced Scaling FPC2	T640-FPC2-ES	<b>FPC Type 2-ES</b>	4	16 Gbps	12.2
3	Enhanced Scaling FPC3	T640-FPC3-ES	<b>FPC Type 3-ES</b>	4	40 Gbps	12.1R2
4	T1600 Enhanced Scaling FPC4	T1600-FPC4-ES	<b>FPC Type 4-ES</b>	2	100 Gbps	12.1

Table 39: FPCs Supported by the T4000 Router (continued)

FPC Type	FPC Name	FPC Model Number	CLI Name	Maximum Number of PICs	Maximum Throughput per FPC	First Junos OS Release Supported
	Enhanced Scaling FPC4-1P	T640-FPC4-1P-ES <b>NOTE:</b> T640-FPC4-ES is not supported.	<b>FPC Type 4.1-ES</b>	1	100 Gbps	12.1R2
5	T4000 FPC5	T4000-FPC5-3D	<b>FPC Type 5-3D</b>	2	240 Gbps	12.1
		T4000-FPC5-LSR	<b>FPC Type 5-LSR</b>	2	240 Gbps	12.3R2
						13.1

- Related Documentation**
- [T4000 FPC Description on page 57](#)
  - [T4000 PIC/FPC Compatibility on page 68](#)

## T4000 PIC Description

PICs provide the physical connection to various network media types, receiving incoming packets from the network and transmitting outgoing packets to the network. During this process, each PIC performs framing and line-speed signaling for its media type. Before transmitting outgoing data packets, the PICs encapsulate the packets received from the FPCs. Each PIC is equipped with an ASIC that performs control functions specific to the media type of that PIC.

The router supports various PICs, including ATM, Ethernet, and SONET/SDH interfaces. Blank PICs resemble other PICs but do not provide any physical connection or activity. When a slot is not occupied by a PIC, you must insert a blank PIC to fill the empty slot and ensure proper cooling of the system.

PICs are hot-removable and hot-insertable. Type 1 and Type 2 PICs have captive screws at their upper and lower corners. Type 3 PICs have an upper ejector handle and a lower captive screw. Type 4 and Type 5 PICs have an upper ejector handle and a lower ejector handle. [Table 40 on page 62](#) indicates the number of PICs supported by each FPC.

Table 40: Number of PICs Supported in Each FPC

FPC Name	FPC Model Number	Maximum Number of PICs
Enhanced Scaling FPC1	T640-FPC1-ES	4
Enhanced Scaling FPC2	T640-FPC2-ES	4
Enhanced Scaling FPC3	T640-FPC3-ES	4
T1600 Enhanced Scaling FPC4	T1600-FPC4-ES	2



*Table 40: Number of PICs Supported in Each FPC (continued)*

FPC Name	FPC Model Number	Maximum Number of PICs
Enhanced Scaling FPC4-1P	T640-FPC4-1P-ES	1
NOTE: T640-FPC4-ES is not supported.		
T4000 FPC5	T4000-FPC5-3D	2
T4000 FPC5	T4000-FPC5-LSR	2

- Related Documentation**
- [T4000 PICs Supported](#)
  - [Maintaining T4000 PICs](#)
  - [Troubleshooting T4000 PICs](#)

## T4000 PICs Supported

Table 41 on page 63 through Table 48 on page 66 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 63](#)
- [Channelized PICs on page 63](#)
- [Gigabit Ethernet PICs on page 64](#)
- [10-Gigabit Ethernet PICs on page 64](#)
- [40-Gigabit Ethernet PICs on page 65](#)
- [100-Gigabit Ethernet PICs on page 65](#)
- [Services PICs on page 66](#)
- [SONET/SDH PICs on page 66](#)

## ATM IQ PICs

Table 41 on page 63 lists the ATM IQ PICs supported by the T4000 router.

*Table 41: 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)	2	PB-2OC12-ATM2-SMIR	Optical: SC	12.2R2

## Channelized PICs

Table 42 on page 64 lists the Channelized PICs supported by the T4000 router.

**Table 42: Channelized PICs Supported in the T4000 Router**

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

## Gigabit Ethernet PICs

Table 43 on page 64 lists the Gigabit Ethernet PICs supported by the T4000 router.

**Table 43: Gigabit Ethernet PICs Supported in the T4000 Router**

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
<i>Gigabit Ethernet PICs with SFP (T4000 Router)</i>	2	PB-2GE-SFP	Optical: LC	12.2R2
	4	PB-4GE-SFP	Optical: LC	12.2R2
	10	PC-10GE-SFP	Optical: LC	12.1R2
<i>Gigabit Ethernet IQ PIC with SFP (T4000 Router)</i>	2	PB-2GE-SFP-QPP	Optical: LC	12.2R2
<i>Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)</i>	8	PC-8GE-TYPE3-SFP-IQ2	Optical: LC	12.1R2
	8	PB-8GE-TYPE2-SFP-IQ2	Optical: LC	12.2R2
<i>Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP (T4000 Router)</i>	8	PC-8GE-TYPE3-SFP-IQ2E	Optical: LC	12.1R2

## 10-Gigabit Ethernet PICs

Table 44 on page 65 lists the 10-Gigabit Ethernet PICs supported by the T4000 router.

**Table 44: 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)	1	PC-1XGE-XENPAK	Optical: SC	12.2R2
10-Gigabit Ethernet IQ2 PIC with XFP (T4000 Router)	1	PC-1XGE-TYPE3-XFP-IQ2	Optical: LC	12.1R2
10-Gigabit Ethernet IQ2E PIC with XFP (T4000 Router)	1	PC-1XGE-TYPE3-XFP-IQ2E	Optical: LC	12.1R2
10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T4000 Router)	12	PF-12XGE-SFPP	Optical: LC	12.1
10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (T4000 Router)	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)	4	PD-4XGE-XFP	Optical: LC	12.1R2

## 40-Gigabit Ethernet PICs

Table 45 on page 65 lists the 40-Gigabit Ethernet PICs supported by the T4000 router.

**Table 45: 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)	4	PD-1XLE-CFP	Optical: SC	13.2

## 100-Gigabit Ethernet PICs

Table 46 on page 66 lists the 100-Gigabit Ethernet PICs supported by the T4000 router.

**Table 46: 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)	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)  <b>NOTE:</b> 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 47 on page 66 lists the services PICs supported by the T4000 router.

**Table 47: Services PICs Supported in the T4000 Router**

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

## SONET/SDH PICs

Table 48 on page 66 lists the SONET/SDH PICs supported by the T4000 router.

**Table 48: 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)	4	PB-4OC3-1OC12-SON2-SFP	Optical: LC	12.2R2
SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T4000 Router)	4	PB-4OC3-4OC12-SON-SFP	Optical: LC	12.2R2

Table 48: 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)	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)	4	PC-4OC48-STM16-IQE-SFP	Optical: LC	13.2
SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T4000 Router)	1	PB-1OC48-SON-B-SFP	Optical: LC	12.2R2
SONET/SDH OC192/STM64 PICs with XFP (T4000 Router)	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)	1	PD-1OC768-SON-SR	Optical: SC	12.1

- Related Documentation**
- [T4000 PIC Description on page 62](#)
  - [T4000 End-of-Life PICs Supported on page 67](#)
  - [T4000 PIC/FPC Compatibility on page 68](#)

## T4000 End-of-Life PICs Supported

Table 49 on page 67 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 49: 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)	1	PC-1XGE-DWDM-OTN	Optical: SC	12.1R2

**Table 49: End-of-Life PICs Supported in the T4000 Router (continued)**

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
SONET/SDH OC12c/STM4 EOL PIC (T4000 Router)	4	PB-4OC12-SON-MM PB-4OC12-SON-SMIR	Optical: SC	12.2R2
SONET/SDH OC48c/STM16 EOL PICs (T4000 Router)	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)	1	PB-1OC48-SON-SFP	Optical: LC	12.2R2
SONET/SDH OC192/STM64 EOL PIC (T4000 Router)	1	PC-1OC192-SON-SR2	Optical: SC	12.1R2

- Related Documentation**
- [T4000 PIC Description on page 62](#)
  - [T4000 PICs Supported on page 63](#)
  - [T4000 PIC/FPC Compatibility on page 68](#)

## 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 68](#)
- [PIC/FPC Compatibility \(Type 2\) on page 70](#)
- [PIC/FPC Compatibility \(Type 3\) on page 71](#)
- [PIC/FPC Compatibility \(Type 4\) on page 73](#)
- [PIC/FPC Compatibility \(Type 5\) on page 73](#)

### PIC/FPC Compatibility (Type 1)

[Table 50 on page 68](#) provides a PIC/FPC compatibility matrix for the current Type 2 PICs for the T4000 router and Type 2 FPCs.

**Table 50: T4000 PIC/FPC Compatibility Type 1**

Type 1 PIC	PIC Model Number	T640-FPC1-ES
<b>Channelized IQ PICs</b>		
Channelized DS3 IQ PIC (T4000 Router)	PB-4CHDS3-QPP	12.1R2

Table 50: T4000 PIC/FPC Compatibility Type 1 (continued)

Type 1 PIC	PIC Model Number	T640-FPC1-ES
<i>Channelized OC3 IQ PIC (T4000 Router)</i>	PB-1CHOC3-SMIR-QPP	12.1.R2
<i>Channelized STM1 IQ PIC (T4000 Router)</i>	PB-1CHSTM1-SMIR-QPP	12.1.R2
<b>Channelized IQE PICs</b>		
<i>Channelized DS3/E3 Enhanced IQ (IQE) PIC (T4000 Router)</i>	PB-4CHDS3-E3-IQE-BNC	12.1.R2
<i>Channelized E1/T1 Enhanced IQ (IQE) PIC (T4000 Router)</i>	PB-1OCHE1-T1-IQE-RJ48	12.1.R2
<i>Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T4000 Router)</i>	PB-2CHOC3-STM1-IQE-SFP	12.1.R2
<i>Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T4000 Router)</i>	PB-1CHOC12-STM4-IQE-SFP	12.1.R2
<b>DS3 and E3 PICs</b>		
<i>DS3/E3 Enhanced IQ (IQE) PIC (T4000 Router)</i>	PB-4DS3-E3-IQE-BNC	12.1.R2
<b>Fast Ethernet and Gigabit Ethernet PICs</b>		
<i>Fast Ethernet PIC (T4000 Router)</i>	PB-4FE-TX	12.1.R2
<i>Gigabit Ethernet PICs with SFP (T4000 Router)</i>	PB-1GE-SFP	12.1.R2
<b>Gigabit Ethernet IQ2 PICs</b>		
<i>Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)</i>	PB-4GE-TYPE1-SFP-IQ2	12.1.R2
<b>Gigabit Ethernet IQ2E PICs</b>		
<i>Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP (T4000 Router)</i>	PB-4GE-TYPE1-SFP-IQ2E	12.1.R2
<b>Services PICs</b>		
<i>Tunnel Services PICs (T4000 Router)</i>	PB-TUNNEL1	12.1.R2
<b>SONET/SDH PICs</b>		

Table 50: T4000 PIC/FPC Compatibility Type 1 (continued)

Type 1 PIC	PIC Model Number	T640-FPC1-ES
SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T4000 Router)	PB-4OC3-1OC12-SON-SFP	12.1.R2
SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T4000 Router)	PB-1OC12-SON-SFP	12.1.R2

## PIC/FPC Compatibility (Type 2)

Table 51 on page 70 provides a PIC/FPC compatibility matrix for the current Type 2 PICs for the T4000 router and Type 2 FPCs.

Table 51: T4000 PIC/FPC Compatibility Type 2

Type 2 PIC	PIC Model Number	T640-FPC2-ES
<b>ATM PICs</b>		
ATM2 OC12/STM4 IQ PIC (T4000 Router)	PB-2OC12-ATM2-SMIR	12.2.R1
<b>Channelized IQ PICs</b>		
Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T4000 Router)	PB-4CHOC12-STM4-IQE-SFP	12.2R2
Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T4000 Router)	PB-1CHOC48-STM16-IQE-SFP	12.2R2
<b>Gigabit Ethernet PICs</b>		
Gigabit Ethernet PICs with SFP (T4000 Router)	PB-2GE-SFP	12.2R2
	PB-4GE-SFP	12.2R2
Gigabit Ethernet IQ PIC with SFP (T4000 Router)	PB-2GE-SFP-QPP	12.2R2
Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)	PB-8GE-TYPE2-SFP-IQ2	12.2R2
<b>Services PICs</b>		
MultiServices PICs (T4000 Router)	PB-MS-400-2	12.2
Tunnel Services PICs (T4000 Router)	PB-TUNNEL	12.2R2
<b>SONET/SDH PICs</b>		



**Table 51: T4000 PIC/FPC Compatibility Type 2 (continued)**

Type 2 PIC	PIC Model Number	T640-FPC2-ES
<i>SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T4000 Router)</i>	PB-4OC3-1OC12-SON2-SFP	12.2R2
<i>SONET/SDH OC12c/STM4 EOL PIC (T4000 Router)</i>	PB-4OC12-SON-MM	12.2R2
	PB-4OC12-SON-SMIR	
<i>SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T4000 Router)</i>	PB-4OC3-4OC12-SON-SFP	12.2R2
<i>SONET/SDH OC48c/STM16 EOL PICs (T4000 Router)</i>	PC-4OC48-SON-SMSR	12.1R2
	PB-1OC48-SON-SMSR	12.2R2
<i>SONET/SDH OC48c/STM16 EOL PIC with SFP (T4000 Router)</i>	PB-1OC48-SON-SFP	12.2R2
<i>SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T4000 Router)</i>	PB-1OC48-SON-B-SFP	12.2R2

### PIC/FPC Compatibility (Type 3)

[Table 52 on page 71](#) provides a PIC/FPC compatibility matrix for the current Type 3 PICs for the T4000 router and Type 3 FPCs.

**Table 52: T4000 PIC/FPC Compatibility Type 3**

Type 3 PIC	PIC Model Number	T640-FPC3-ES
<b>Channelized IQE</b>		
<i>Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T4000 Router)</i>	PC-4CHOC12-STM4-IQE-SFP	13.2
<b>Gigabit Ethernet PICs</b>		
<i>Gigabit Ethernet PICs with SFP (T4000 Router)</i>	PC-10GE-SFP	12.1R2
<i>Gigabit Ethernet IQ2 PICs with SFP (T4000 Router)</i>	PC-8GE-TYPE3-SFP-IQ2	12.1R2
<i>Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP (T4000 Router)</i>	PC-8GE-TYPE3-SFP-IQ2	12.1R2

Table 52: T4000 PIC/FPC Compatibility Type 3 (continued)

Type 3 PIC	PIC Model Number	T640-FPC3-ES
<b>10-Gigabit Ethernet PICs</b>		
<i>10-Gigabit Ethernet PIC with XENPAK (T4000 Router)</i>	PC-1XGE-XENPAK	12.2R2
<i>10-Gigabit Ethernet DWDM OTN EOL PIC (T4000 Router)</i>	PC-1XGE-DWDM-OTN	12.1R2
<i>10-Gigabit Ethernet IQ2 PIC with XFP (T4000 Router)</i>	PC-1XGE-TYPE3-XFP-IQ2	12.1R2
<i>10-Gigabit Ethernet IQ2E PIC with XFP (T4000 Router)</i>	PC-1XGE-TYPE3-XFP-IQ2E	12.1R2
<b>Services PICs</b>		
<i>MultiServices PICs (T4000 Router)</i>	PC-MS-500-3	12.1R2
<i>Tunnel Services PICs (T4000 Router)</i>	PC-TUNNEL	12.1R2
<b>SONET/SDH PICs</b>		
<i>SONET/SDH OC48c/STM16 EOL PICs (T4000 Router)</i>	PC-4OC48-SON-SMSR	12.1R2
<i>SONET/SDH OC48c/STM16 PIC with SFP (T4000 Router)</i>	PC-4OC48-SON-SFP	12.1R2
<i>SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T4000 Router)</i>	PC-4OC48-STM16-IQE-SFP	13.2
<i>SONET/SDH OC192/STM64 PICs with XFP (T4000 Router)</i>	PC-1OC192-SON-XFP	13.2

## PIC/FPC Compatibility (Type 4)

Table 53 on page 73 provides a PIC/FPC compatibility matrix for the current Type 4 PICs for the T4000 router and Type 4 FPCs.

Table 53: T4000 PIC/FPC Compatibility Type 4

Type 4 PIC	PIC Model Number	T640-FPC4-1P-ES	T1600-FPC4-ES
<b>10-Gigabit Ethernet PICs</b>			
10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (T4000 Router)	PD-5-10XGE-SFP	12.1R2	12.1
			NOTE: To support PD-5-10XGE-SFP, 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)	PD-4XGE-XFP	12.1R2	12.1
<b>40-Gigabit Ethernet PICs</b>			
40-Gigabit Ethernet PIC with CFP (T4000 Router)	PD-1XLE-CFP	—	13.2
<b>100-Gigabit Ethernet PICs</b>			
100-Gigabit Ethernet PIC with CFP (T4000 Router)	PD-ICE-CFP-FPC4 (PIC and FPC)	—	12.1R2
	NOTE: This PIC is available only packaged in an assembly with the T1600-FPC4-ES FPC.		
<b>SONET/SDH PICs</b>			
SONET/SDH OC192/STM64 PICs with XFP (T4000 Router)	PD-4OC192-SON-XFP	12.1R2	12.1
SONET/SDH OC768c/STM256 PIC (T4000 Router)	PD-1OC768-SON-SR	12.1R2	12.1

## PIC/FPC Compatibility (Type 5)

Table 54 on page 73 provides a PIC/FPC compatibility matrix for the current Type 5 PICs for the T4000 router and Type 5 FPCs.

Table 54: T4000 PIC/FPC Compatibility Type 5

Type 5 PIC	PIC Model Number	T4000-FPC5-3D	T4000-FPC5-LSR
<b>10-Gigabit Ethernet PICs</b>			

Table 54: T4000 PIC/FPC Compatibility Type 5 (continued)

Type 5 PIC	PIC Model Number	T4000-FPC5-3D	T4000-FPC5-LSR
10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T4000 Router)	PF-12XGE-SFPP	12.1	12.3R2
10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (T4000 Router)	PF-24XGE-SFPP	12.2	12.3R2
<b>100-Gigabit Ethernet PICs</b>			
100-Gigabit Ethernet PIC with CFP (T4000 Router)	PF-10GE-CFP	12.1	12.3R2

- Related Documentation**
- [T4000 PIC Description on page 62](#)
  - [T4000 PICs Supported on page 63](#)
  - [T4000 FPCs Supported on page 61](#)

## CHAPTER 7

# Power System Components and Descriptions

- [T4000 Power System Description on page 75](#)
- [T4000 Six-Input DC Power Supply LEDs on page 77](#)

### T4000 Power System Description

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- [Power Supply Slots on page 75](#)
- [Power Supply Function on page 75](#)
- [Supported Power Supplies on page 75](#)
- [Power Supply Components on page 76](#)
- [Redundancy on page 76](#)

### Power Supply Slots

The T4000 router has two redundant, load-sharing power supplies, located at the lower rear of the chassis in slots **PEM0** and **PEM1** (top to bottom). Power supplies are hot-removable and hot-insertable.

### Power Supply Function

The power supplies connect to the midplane, which distributes the different output voltages produced by the power supplies to the T4000 router components, depending on their voltage requirements.

### Supported Power Supplies

The T4000 router supports the power supply in [Table 55 on page 75](#).

*Table 55: Supported Power Supplies*

Name	Model Number	First Supported Junos OS Release
Six-input DC power supply	PWR-T-6-60-DC	12.1

## Power Supply Components

Each six-input DC power supply weighs approximately 39.7 lb (18.0 kg) and consists of six inputs, two blowers, a front and side air filter, and LEDs to monitor the status of the power supply. Each power supply is cooled by its own internal cooling system.

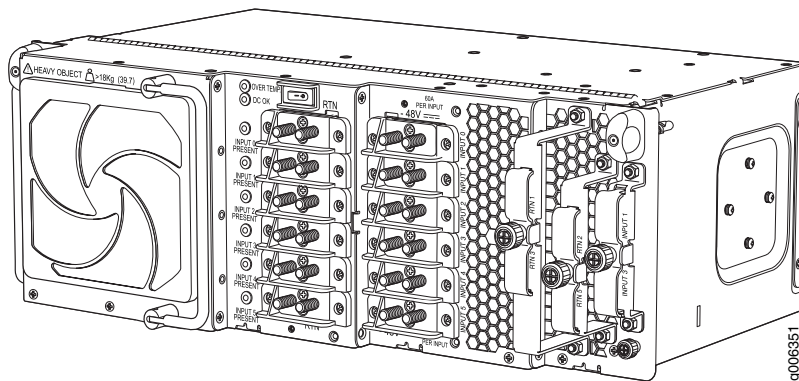
[Figure 22 on page 76](#) shows the six-input DC power supply.

The six-input DC power supply inputs are labeled **INPUT 0**, **INPUT 1**, **INPUT 2**, **INPUT 3**, **INPUT 4**, and **INPUT 5**, from top to bottom. Each 60 A input consists of –48 VDC and return.



**NOTE:** There are no circuit breakers or passive fuses in the router.

**Figure 22: DC Power Supply**



[Table 56 on page 76](#) describes which components are powered by each input.

**Table 56: Components Powered by Each Six-Input DC Power Supply Input**

Input	Components
<b>INPUT 0</b>	Fan trays
<b>INPUT 1 through INPUT 5</b>	FPCs, Routing Engines, control boards, SIBs, craft interface, SCGs, and other components in the router.

## Redundancy

When the T4000 router is operating normally and both power supplies are switched on, load sharing between them occurs automatically. When one power supply fails or is turned off, the other power supply immediately assumes the entire electrical load for the system. A single power supply can provide full power for as long as the router is operational. For power management of the T4000 router, see [“T4000 Power Management \(Three 80-A Cables on a Six-Input DC Power Supply\)” on page 103](#) and [“T4000 Power Management \(Four 60-A Cables on a Six-Input DC Power Supply\)” on page 103](#).

- Related Documentation**
- [T4000 Six-Input DC Power Supply LEDs on page 77](#)
  - [Maintaining the T4000 Power System on page 338](#)
  - [Troubleshooting the T4000 Power System on page 363](#)

## T4000 Six-Input DC Power Supply LEDs

The LEDs on the faceplate of each power supply (see [Table 57 on page 77](#)) indicate the status of the power supply. The **DC OK**, **OVERTEMP**, and **INPUT PRESENT** LEDs are located on the faceplate of the power supply. A power supply failure also triggers the red alarm LED on the craft interface.

[Table 57 on page 77](#) describes the six-input DC power supply LEDs on the faceplate.

*Table 57: Power Supply LEDs*

LED	Color	State	Description
<b>INPUT PRESENT</b> —One per input	Green	On steadily	Input is receiving voltage within the required range of –40 V through –72 V.
	–	Off	Input voltage is not present, or the voltage is not within the required range of –40 V through –72 V.
<b>DC OK</b> —One per power supply	Blue	On steadily	When input 0 and at least one other input is properly energized and the power switch is ON, this input indicates that the power supply is functioning normally.
	–	Off	Power supply is starting up or is not receiving any input voltage. The power switch on the power supply faceplate or the customer site external circuit breakers might be off. A fault might have occurred.
<b>OVERTEMP</b> —One per power supply	Yellow	On steadily	Power supply has exceeded the recommended temperature and has been powered off.
	–	Off	The power supply is within the recommended temperature, or the power supply is not receiving any input voltage.

- Related Documentation**
- [T4000 Power System Description on page 75](#)
  - [Maintaining the T4000 Power System on page 338](#)
  - [Troubleshooting the T4000 Power System on page 363](#)





CHAPTER 8

# Switch Fabric Components and Descriptions

- [T4000 Switch Interface Board \(SIB\) Description on page 79](#)
- [T4000-SIB Description on page 80](#)
- [T4000 TXP-LCC-3D SIB Description on page 80](#)
- [T4000 SIB LEDs on page 81](#)

## T4000 Switch Interface Board (SIB) Description

SIBs create the switch fabric for the T4000 Core Router. Each T4000 router contains five SIBs, located at the center rear of the chassis in the slots labeled **SIB0** through **SIB4** (top to bottom). One of the five SIBs acts as a backup to the remaining four SIBs. If a SIB fails, the backup SIB becomes active, and traffic forwarding continues without any degradation. When the failed SIB is replaced, it becomes the new backup. SIBs are hot-insertable and hot-removable.

The T4000 router supports the SIB listed in [Table 58 on page 79](#).

Table 58: T4000 Supported SIB

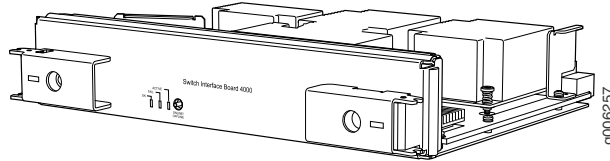
Name	Model Number	First Supported Junos OS Release
T4000-SIB	SIB-I-T4000	12.1
<b>NOTE:</b> This SIB is required for a standalone T4000 router.		
TXP-LCC-3D SIB	SIB-TXP-3D-LCC	13.1
<b>NOTE:</b> This SIB is required for a T4000 line-card chassis connected to a TX Matrix Plus Router.		

- Related Documentation
- [T4000-SIB Description on page 80](#)
  - [T4000 TXP-LCC-3D SIB Description on page 80](#)
  - [T4000 Router Description on page 3](#)

## T4000-SIB Description

Figure 23 on page 80 shows a T4000-SIB that is required for a standalone T4000 router.

Figure 23: T4000-SIB



Each T4000-SIB consists of the following components:

- Switch fabric ASICs.
- High-speed links to each FPC.
- SIB online/offline button, located on the SIB faceplate. The button is to signal a removal request by a user.
- Three LEDs—**ACTIVE**, **OK**, and **FAIL**—located on the SIB faceplate that display the status of the T4000-SIB. The **OK** and **FAIL** LEDs are replicated on the craft interface.

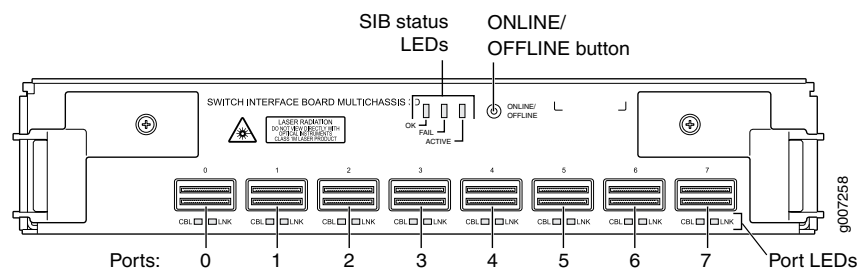
### Related Documentation

- [T4000 Switch Interface Board \(SIB\) Description on page 79](#)
- [T4000 SIB LEDs on page 81](#)
- [Maintaining the T4000 SIBs on page 339](#)
- [Replacing a T4000-SIB on page 319](#)

## T4000 TXP-LCC-3D SIB Description

Figure 24 on page 80 shows a TXP-LCC-3D SIB (model number SIB-TXP-3D-LCC) that is required to connect a T4000 line card chassis (LCC) to TXP-F13-3D SIBs in a TX Matrix Plus router. See *TX Matrix Plus Router Hardware Guide*.

Figure 24: TXP-LCC-3D SIB



Each TXP-LCC-3D SIB consists of the following components:

- Eight ports labeled **0** through **7**. Each port has a **CBL** and **LINK** LED.
- Switch fabric ASICs.
- High-speed links to each FPC.
- SIB online/offline button, located on the SIB faceplate. The button is to signal a removal request by a user.
- Three LEDs—**OK**, **FAIL**, and **ACTIVE**—located on the SIB faceplate that display the status of the TXP-LCC-3D SIB. The **OK** and **FAIL** LEDs are replicated on the craft interface.

- Related Documentation
- [T4000 Switch Interface Board \(SIB\) Description on page 79](#)
  - [T4000 SIB LEDs on page 81](#)
  - [Maintaining the T4000 SIBs on page 339](#)
  - [Replacing a T4000-SIB on page 319](#)

T4000 SIB LEDs

Table 59 on page 81 describes the functions of the T4000-SIB LEDs and TXP-LCC-3D SIB LEDs. If all three LEDs are off, the SIB is not receiving power. The craft interface has three additional LEDs that show the status of each SIB.

Table 59: T4000 and TXP-LCC-3D SIB LEDs

Label	Color	State	Description
ACTIVE	Green	On steadily	SIB is in active mode.
		Off	SIB is in standby mode.  <b>NOTE:</b> This LED has significance only if the ONLINE LED is lit.
OK	Green	On steadily	SIB is functioning normally.
		Blinking	SIB is starting up.
		Off	SIB has been inserted or is ready for removal.
FAIL	Red	On steadily	SIB has failed.
		Off	SIB is functioning normally.

The TXP-LCC-3D SIB port LEDs are located beneath each port (see [Figure 25 on page 82](#)). Each port has a **Link** and **CBL** LED. [Table 60 on page 82](#) describes the functions of these LEDs.

Figure 25: TXP-3D-LCC SIB LEDs

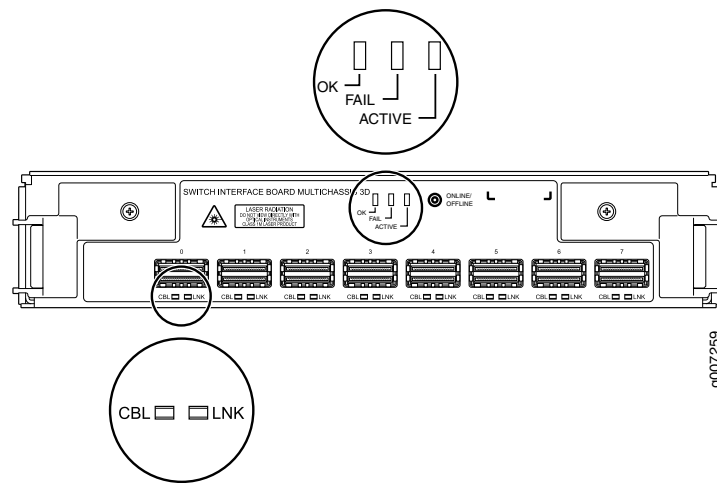


Table 60: TXP-LCC-3D SIB Port LEDs

Label	Color	State	Description
LINK	Green	On steadily	The link between the TXP-F13-3D SIB port and the TXP-LCC-3D SIB port has been established successfully.
		Blinking	The link between the TXP-LCC-3D SIB port and the loopback connector has been established successfully.
	Yellow	On steadily	The link is being established.
		Blinking	The switching plane cable might be connected to either the wrong TXP-LCC-3D SIB port or the wrong TXP-F13-3D port.
	Red	On steadily	The link between the TXP-F13-3D SIB port and the TXP-LCC-3D SIB port failed. There might be a hardware problem, or the fiber-optic port or cable might need to be cleaned.
–	–	Off	The cable is not connected on both sides, or either the TXP-F13-3D SIB or the TXP-LCC-3D SIB is powered off.
CBL	Green	On steadily	Full optical power is being received.
	Yellow	On steadily	Diminished optical power is being received. The switching plane cable or the switching plane port might need cleaning, or the cable might be damaged.
	Red	Off	Optical power has crossed operating thresholds. The switching plane cable is not connected to the TXP-F13-3D SIB port, or is not connected to the TXP-LCC-3D SIB port. If the cable is connected on both sides, the cable might be cut.
	Off	–	No optical power is detected. Cable is damaged or absent.

- Related Documentation**
- [T4000 Switch Interface Board \(SIB\) Description on page 79](#)
  - [T4000 TXP-LCC-3D SIB Description on page 80](#)



## PART 2

# Site Planning, Preparation, and Specifications

- [Planning and Preparing the Site on page 87](#)
- [Calculating System Power Requirements on page 97](#)
- [DC Power Specifications A on page 101](#)
- [Network Cable and Transceiver Planning on page 109](#)
- [Management Cable and Transceiver Specifications and Pinouts on page 113](#)





## CHAPTER 9

# Planning and Preparing the Site

- [Overview of Preparing the Site for the T4000 Router on page 87](#)
- [T4000 Router Environmental Specifications on page 88](#)
- [General Site Guidelines on page 89](#)
- [T4000 Chassis Grounding Cable and Lug Specifications on page 90](#)
- [T4000 Clearance Requirements for Airflow and Hardware Maintenance on page 91](#)
- [T4000 Router Physical Specifications on page 91](#)
- [Site Electrical Wiring Guidelines on page 93](#)
- [Rack Requirements for the T4000 Router on page 93](#)

### Overview of Preparing the Site for the T4000 Router

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To prepare a site for router installation:

1. Verify that environmental factors such as temperature and humidity do not exceed router tolerances.  
[See “T4000 Router Environmental Specifications” on page 88.](#)
2. Verify that the site and installation plan meets all safety guidelines and requirements.  
[See “General Safety Guidelines and Warnings” on page 393.](#)
3. Measure distance between external power sources and the router installation site.  
[See:](#)
  - [T4000 DC Power Distribution on page 104](#)
  - [T4000 DC Power Cable and Lugs Specifications on page 105](#)
  - [T4000 DC Power Requirements on page 97](#)
  - [T4000 DC Power Supply Specifications on page 102](#)
  - [T4000 DC Power System Electrical Specifications on page 101](#)
4. Locate sites for connection of system grounding.  
[See “T4000 Chassis Grounding Cable and Lug Specifications” on page 90.](#)

5. Calculate the power consumption and requirements.  
See [“T4000 DC Power Requirements” on page 97](#).
6. Verify that the plan for power installation meets all electrical safety guidelines. See:
  - [General Electrical Safety Guidelines and Warnings on page 421](#)
  - [T4000 DC Power Electrical Safety Guidelines on page 424](#)
7. Verify that your rack meets the minimum requirements for the installation of the router.  
See [“Rack Requirements for the T4000 Router” on page 93](#).
8. Plan the location of the rack, including required space for airflow and maintenance.  
See [“T4000 Clearance Requirements for Airflow and Hardware Maintenance” on page 91](#).
9. Plan to secure the rack to the floor and building structure.  
See [“Rack Requirements for the T4000 Router” on page 93](#).
10. Acquire cables and connectors:
  - Determine the number of cables needed based on your planned configuration.
  - Review the maximum distance allowed for each cable. Choose the length of cable based on the distance between the hardware components being connected.See the *T4000 Core Router Interface Module Reference*.
11. Plan the cable routing and management.  
See [“Maintaining T4000 PICs” on page 338](#).

**Related  
Documentation**

- [Overview of Installing the T4000 Router on page 119](#)

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## T4000 Router Environmental Specifications

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[Table 61 on page 88](#) specifies the environmental specifications required for normal router operation. In addition, the site should be as dust-free as possible.

**Table 61: Router Environmental Specifications**

Description	Value
Altitude	No performance degradation to 10,000 ft (3048 m)
Relative humidity	Normal operation ensured in relative humidity range of 5% to 90%, noncondensing

**Table 61: Router Environmental Specifications (continued)**

Description	Value
Temperature	Normal operation ensured in temperature range of 32°F (0°C) to 104°F (40°C)  Nonoperating storage temperature in shipping : –40°F (–40°C) to 158°F (70°C)
Seismic	Designed to meet Telcordia Technologies Zone 4 earthquake requirements
Maximum thermal output	DC power: 33583.6 BTU/hour (9840 W W)



**NOTE:** Install the router only in restricted areas, such as dedicated equipment rooms and equipment closets, in accordance with Articles 110-16, 110-17, and 110-18 of the National Electrical Code, ANSI/NFPA 70.

**Related Documentation**

- [Routine Maintenance Procedures for the T4000 Router on page 331](#)
- [General Safety Guidelines and Warnings on page 393](#)
- [Qualified Personnel Warning on page 396](#)
- [Restricted Access Warning on page 402](#)

## General Site Guidelines

Efficient device operation requires proper site planning and maintenance and proper layout of the equipment, rack or cabinet (if used), and wiring closet.

To plan and create an acceptable operating environment for your device and prevent environmentally caused equipment failures:

- Keep the area around the chassis free from dust and conductive material, such as metal flakes.
- Follow prescribed airflow guidelines to ensure that the cooling system functions properly and that exhaust from other equipment does not blow into the intake vents of the device.
- Follow the prescribed electrostatic discharge (ESD) prevention procedures to prevent damaging the equipment. Static discharge can cause components to fail completely or intermittently over time.
- Install the device in a secure area, so that only authorized personnel can access the device.

- Related Documentation**
- [Prevention of Electrostatic Discharge Damage on page 423](#)

## T4000 Chassis Grounding Cable and Lug Specifications

To meet safety and electromagnetic interference (EMI) requirements and to ensure proper operation, the router must be adequately grounded before power is connected. Two pairs of threaded inserts (PEM nuts) are provided on the right rear of the chassis for connecting the router to earth ground. The left pair of grounding points fits M6 screws (European), and the right pair fits UNC 1/4–20 screws (American). The grounding points are spaced at 0.625-in. (15.86-mm) centers.

You must supply a grounding cable. [Table 62 on page 90](#) summarizes the specifications for the grounding cable and lug.

**Table 62: Grounding Cable Specifications**

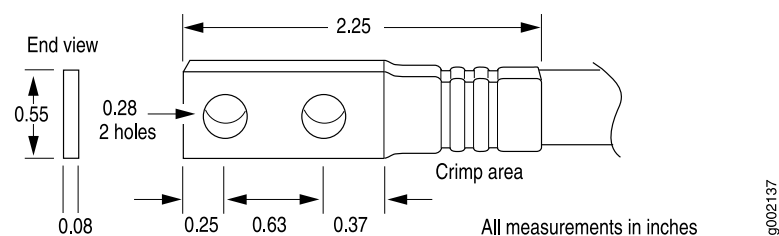
<b>Cable specification</b>	8-AWG (8.35 mm <sup>2</sup> ), minimum 90°C wire, or as required by the local code.
<b>Connector specification</b>	Cable lug; at 0.625-in. (15.86-mm) center line.



**CAUTION:** Before router installation begins, a licensed electrician must attach a cable lug to the grounding cable that you supply. A cable with an incorrectly attached lug can damage the router.

The accessory box shipped with the router includes one 4-AWG (21.2 mm<sup>2</sup>) cable lug that attaches to the grounding cable and is used to secure the grounding cable to the grounding points (see [Figure 26 on page 90](#)). (The cable lug shown in [Figure 26 on page 90](#) is also used for the DC power cables.)

**Figure 26: Grounding Cable Lug**



- Related Documentation**
- [Tools and Parts Required to Ground the T4000 Router on page 173](#)
  - [Connecting the T4000 Grounding Cable on page 174](#)

## T4000 Clearance Requirements for Airflow and Hardware Maintenance

When planning the installation site, you need to allow sufficient clearance around the rack (see [Figure 27 on page 91](#)):

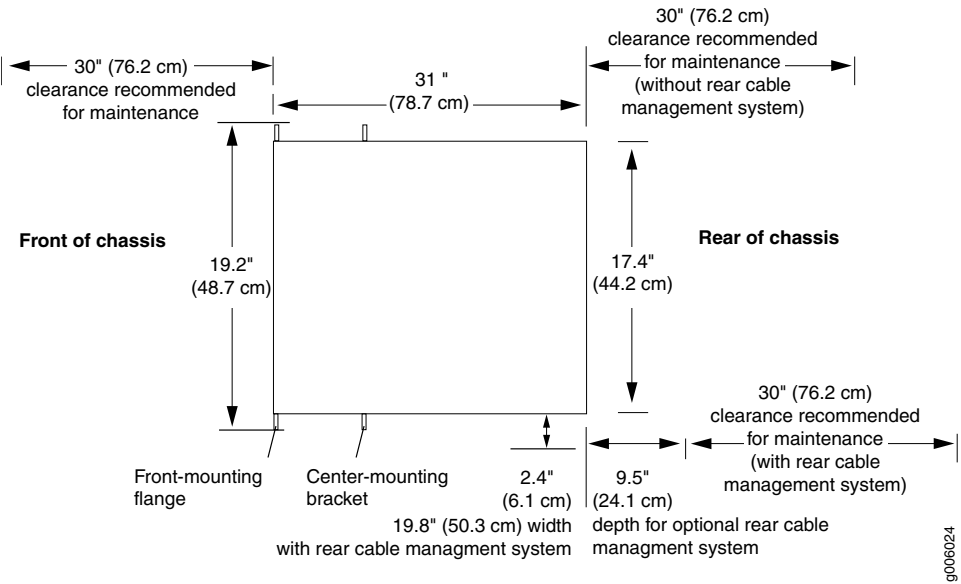
- For the cooling system to function properly, the airflow around the chassis must be unrestricted.



**NOTE:** If you mount the router in a cabinet, be sure that ventilation is sufficient to prevent overheating.

- For service personnel to remove and install hardware components, there must be adequate space at the front and back of the router. At least 24 in. (61 cm) are required both in front of and behind the router. NEBS GR-63 recommends that you allow at least 30 in. (72.6 cm) behind the rack.

Figure 27: Chassis Dimensions and Clearance Requirements



- Related Documentation**
- [T4000 Cooling System Description on page 25](#)
  - [Rack Requirements for the T4000 Router on page 93](#)
  - [T4000 Router Physical Specifications on page 91](#)

## T4000 Router Physical Specifications

Table 63 on page 92 lists the router's physical specifications.

*Table 63: Physical Specifications*

Description	Value
Chassis dimensions	37.45 in. (95.1 cm) high 17.43 in. (44.3 cm) wide 31 in. (78.7 cm) deep Total depth (including front cable management system) 35.5 in. (90.2 cm)  11.5 in. (29.2 cm) from front of chassis to center-mounting brackets
Router weight	Chassis with midplane: 205 lb (93 kg)  Minimum configuration: 392 lb (177.8 kg)  Maximum configuration: 663.6 lb (301.0 kg)
Control board weight	5 lb each (2 kg)
Routing Engine weight	2.4 lb (1 kg)
Craft interface weight	3.3 lb (1.5 kg)
FPC weight	FPC4 with PICs installed: Up to 33 lb (15.0 kg)  FPC4 without PICs installed: up to 29 lb (11.3 kg)  FPC5 with PICs installed: Up to 33.5 lb (15.2 kg)  FPC5 without PICs installed: 31.6 lb (14.4 kg)  Blank panel in FPC slot: 9 lb (4.0 kg)
CIP weight	8.8 lb (4 kg)
Air filter weight	1 lb (0.45 kg)
Power supply weight	39.7 lb (18.0 kg)
SCG weight	1.9 lb each (1 kg)
SIB weight	7.1 lb (3.2 kg)
SIB weight for SIB-TXP-3D-LCC	9.4 lb (4.2 kg)
Front fan tray weight	20.4 lb (9.3 kg)
Rear fan tray weight	10 lb (4.5 kg)
Rear fan tray weight for FAN-R-TXP-3D-LCC	13 lb (5.9 kg)

- Related Documentation**
- [T4000 Router Description on page 3](#)
  - [T4000 Chassis Description on page 11](#)
  - [T4000 Installation Safety Guidelines on page 120](#)

## Site Electrical Wiring Guidelines

Table 64 on page 93 describes the factors you must consider while planning the electrical wiring at your site.



**WARNING:** It is particularly important to provide a properly grounded and shielded environment and to use electrical surge-suppression devices.

*Table 64: Site Electrical Wiring Guidelines*

Site Wiring Factor	Guidelines
Signaling limitations	<p>If your site experiences any of the following problems, consult experts in electrical surge suppression and shielding:</p> <ul style="list-style-type: none"> <li>• Improperly installed wires cause radio frequency interference (RFI).</li> <li>• Damage from lightning strikes occurs when wires exceed recommended distances or pass between buildings.</li> <li>• Electromagnetic pulses (EMPs) caused by lightning damage unshielded conductors and electronic devices.</li> </ul>
Radio frequency interference	<p>To reduce or eliminate RFI from your site wiring, do the following:</p> <ul style="list-style-type: none"> <li>• Use a twisted-pair cable with a good distribution of grounding conductors.</li> <li>• If you must exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.</li> </ul>
Electromagnetic compatibility	<p>If your site is susceptible to problems with electromagnetic compatibility (EMC), particularly from lightning or radio transmitters, seek expert advice.</p> <p>Some of the problems caused by strong sources of electromagnetic interference (EMI) are:</p> <ul style="list-style-type: none"> <li>• Destruction of the signal drivers and receivers in the device</li> <li>• Electrical hazards as a result of power surges conducted over the lines into the equipment</li> </ul>

- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [General Electrical Safety Guidelines and Warnings on page 421](#)

## Rack Requirements for the T4000 Router

The router can be installed in many types of racks, including four-post (telco) racks and open-frame racks. An example of an open-frame rack is shown in [Figure 28 on page 95](#).

For open-frame racks, center-mounting is preferable to front-mounting because the more even distribution of weight provides greater stability.

The router is designed for installation in a 19-in. rack as defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310-D) published by the Electronics Components Industry Association (<http://www.ecianow.org/>).

With the use of adapters, the router can fit into a 600-mm-wide rack, as defined in the four-part *Equipment Engineering (EE); European Telecommunications Standard for Equipment Practice* (document numbers ETS 300 119-1 through 119-4) published by the European Telecommunications Standards Institute (<http://www.etsi.org>). Use approved wing devices to narrow the opening between the rails.

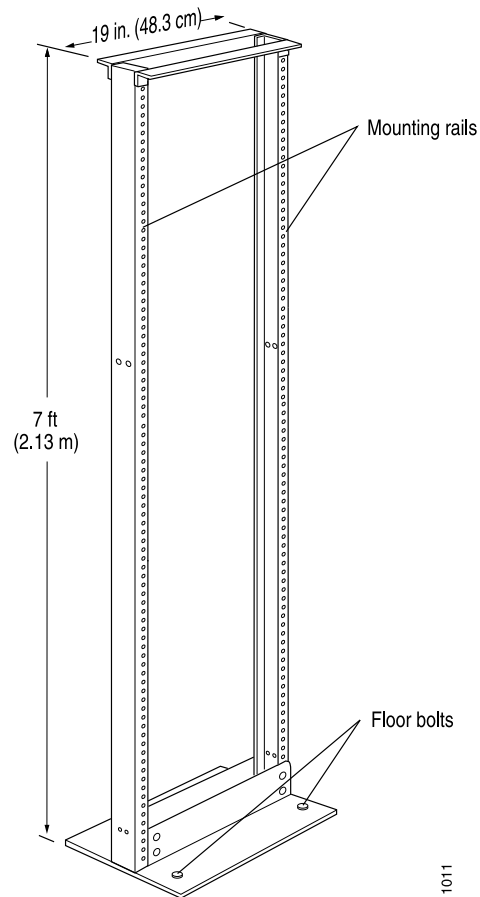
The rack rails must be spaced widely enough to accommodate the router chassis's external dimensions: 37.45 in. (95.1 cm) high, 31 in. (78.7 cm) deep, and 17.43 in. (44.3 cm) wide, excluding the front and rear cable management systems. The outer edges of the mounting brackets extend the width to 19 in. (48.3 cm). The spacing of rails and adjacent racks must also allow for the clearances around the router and rack.

The mounting holes for connecting the mounting brackets to the chassis are spaced 0.984 in. (25 mm) apart.

The chassis height of 37.45 in. (95.1 cm) is approximately 21.4 U. A U is the standard rack unit defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310-D) published by the Electronics Industry Association. You can stack two routers in a rack that has at least 42.8 U (74.9 in. or 1.90 m) of usable vertical space.

The rack must be strong enough to support the weight of the fully configured router, up to 606 lb (275 kg). If you stack two fully configured routers in one rack, it must be capable of supporting about 1212 lb (550 kg).



*Figure 28: Typical Open-Frame Rack*

Always secure the rack to the structure of the building. If your geographical area is subject to earthquakes, bolt the rack to the floor. For maximum stability, also secure the rack to ceiling brackets.

- Related Documentation**
- [T4000 Router Physical Specifications on page 91](#)
  - [T4000 Clearance Requirements for Airflow and Hardware Maintenance on page 91](#)



# Calculating System Power Requirements

- [T4000 DC Power Requirements on page 97](#)

## T4000 DC Power Requirements

To allow for future growth so that you can operate the router in any hardware configuration without upgrading the power infrastructure, we recommend that you provision 56 A @ –48 VDC per input for the 60-A DC power cables connected to each power supply.

[Table 65 on page 97](#) lists the power requirements for various hardware components when the router is operating under typical voltage conditions.

You can use the information in [Table 65 on page 97](#) and the PIC requirements in *T4000 Core Router Interface Module Reference* to calculate power consumption for various hardware configurations, input current from a different source voltage, and thermal output, as shown in the following examples for a DC-powered router.

**Table 65: Typical DC Power Requirements for T4000 Components**

Component	Current Requirement (Amps @ –48 VDC)
Base system, not including FPCs and PICs (includes five SIB-I-T4000 SIBs, one host subsystem, one SCG, cooling system at normal speed, and craft interface) and two power supplies	30.8 A
Base system, not including FPCs and PICs (includes five TXP-LCC-3D SIBs, one host subsystem, one SCG, cooling system with FAN-R-TXP-3D-LCC rear fan tray at normal speed, and craft interface) and two power supplies	31.0 A
SIB-I-T4000 SIB	4.7 A
TXP-LCC-3D SIB	4.2 A
T1600 Enhanced Scaling FPC4	11.3 A
T4000 FPC5	13.6 A
Line-card chassis control board (LCC-CB)	1.0 A

Table 65: Typical DC Power Requirements for T4000 Components (continued)

Component	Current Requirement (Amps @ -48 VDC)
C1800 Routing Engine	1.7 A
SCG	0.2 A
Redundant backup six-input DC power supply	5.2 A
Cooling system with FAN-REAR-TXP-LCC (normal speed)	8.2 A
Cooling system with FAN-REAR-TXP-LCC (full speed)	23.6 A
Cooling system with FAN-R-TXP-3D-LCC rear fan tray (normal speed)	9.5 A
Cooling system with FAN-R-TXP-3D-LCC rear fan tray (full speed)	26.7 A
Craft interface	0.2 A
PIC—Generalized typical value	0.625 A
PIC—Generalized maximum value	3.3 A

- Example of calculating power consumption for a minimum configuration:  
 Base System + 1 Type 4 FPC + 1 PIC  
 $30.8 \text{ A} + 11.3 \text{ A} + 0.625 \text{ A} = 42.7 \text{ A @ } -48 \text{ VDC} = 2050 \text{ W}$
- Example of calculating power consumption for a maximum configuration with eight FPCs:  
 Base System + 1 LCC-CB + 1 RE-C1800 + 1 SCG + 8 T1600-Type 4 FPCs + 16 PICs +  
 (cooling system full speed - normal speed)  
 $30.8 \text{ A} + 1.0 \text{ A} + 1.7 \text{ A} + 0.2 \text{ A} + 8 (11.3 \text{ A}) + 16 (3.3 \text{ A}) + (23.6 \text{ A} - 8.2 \text{ A})$   
 $30.8 \text{ A} + 1.0 \text{ A} + 1.7 \text{ A} + 0.2 \text{ A} + 90.4 \text{ A} + 52.8 \text{ A} + 15.4 \text{ A} = 192.3 \text{ A @ } -48 \text{ VDC} = 9230 \text{ W}$
- Current requirement adjustment for fans running at full speed (high temperature environment or cooling component failure):  
 Calculated system current (X) – Cooling (normal) + Cooling (full speed) =  
 $X \text{ A} - 6.7 \text{ A} + 22 \text{ A} = X \text{ A} + 15.3 \text{ A}$
- Input current from a DC source other than -48 VDC (based on maximum configuration):  
 $(-54 \text{ VDC input}) \times (\text{input current X}) = (-48 \text{ VDC}) \times (\text{input current Y})$   
 $54 \times X = 48 \times 94.1 \text{ A}$   
 $X = 48 \times 94.1 \text{ A} / 54 = 83.6 \text{ A}$
- Example of calculating typical system thermal output for a configuration:  
 Watts DC/0.293 = BTU/hr

$$9230 \text{ W} / 0.293 = 31,501 \text{ BTU/hr}$$

**Related  
Documentation**

- [T4000 DC Power System Electrical Specifications on page 101](#)
- [Overview of Preparing the Site for the T4000 Router on page 87](#)
- [T4000 DC Power Distribution on page 104](#)
- [T4000 Power System Description on page 75](#)



## CHAPTER 11

# DC Power Specifications A

- T4000 DC Power System Electrical Specifications on page 101
- T4000 DC Power Supply Specifications on page 102
- T4000 Power Management (Four 60-A Cables on a Six-Input DC Power Supply) on page 103
- T4000 Power Management (Three 80-A Cables on a Six-Input DC Power Supply) on page 103
- T4000 DC Power Distribution on page 104
- T4000 DC Power Cable and Lugs Specifications on page 105

### T4000 DC Power System Electrical Specifications

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Table 66 on page 101 lists the DC power system electrical specifications.

*Table 66: DC Power System Electrical Specifications*

Item	Specification
DC input voltage	Operating range: –40.0 to –72.0 VDC
DC system current rating	205 A @ –48 VDC (nominal) (9840 W) Input 0: 25 A @ –48 VDC (nominal) (1200 W) Input 1 through 5: 180 A @ –48 VDC (nominal) (8640 W)

For each power supply, we recommend that you provision at least 56 A @ –48 VDC per input. Doing so enables you to operate the router in any configuration without upgrading the power infrastructure. Although Input 0 in the DC power supply requires less power, we recommend provisioning the same amount of power for each input to avoid the possibility of connecting the lower-powered DC cable to Input 1 through Input 5.

Circuit breaker current rating of 100 A per feed maximum shall be incorporated external to the equipment. The voltage rating of this breaker shall be 80 V minimum. For each power supply input, use a facility circuit breaker rated for 100 A (–48 VDC) maximum or as required by local code. You must provision a circuit breaker for each DC power supply input rated for at least 125% of the continuous current that the system draws at –48 VDC.

- Related Documentation**
- [T4000 Power System Description on page 75](#)
  - [T4000 DC Power Supply Specifications on page 102](#)
  - [T4000 DC Power Requirements on page 97](#)
  - [T4000 DC Power Cable and Lugs Specifications on page 105](#)
  - [T4000 DC Power Distribution on page 104](#)

## T4000 DC Power Supply Specifications

Table 67 on page 102 lists the DC power supply electrical specifications.

**Table 67: Power Supply Electrical Specifications**

Item	Specification
DC input voltage	<p>Nominal –48 VDC, –60 VDC</p> <p>Operating range: –40.0 to –72.0 VDC</p> <p><b>NOTE:</b> If the input voltage from the DC power source drops below –37.5 to –39.5 VDC, the router automatically shuts down. During automatic shutdown, the circuit remains active. When the input voltage returns to –43.0 to –44.00 VDC, the router automatically starts up again and the system returns to normal operation within 30 minutes. No operator intervention is required.</p>
Input DC current rating (per input)	<p>Input 0: 45 A @ –48 VDC (nominal) (2160 W) (54 A @ –40 VDC)</p> <p>Input 1: 56 A @ –48 VDC (nominal) (2688 W) (67.2 A @ –40 VDC)</p> <p>Input 2: 56 A @ –48 VDC (nominal) (2688 W) (67.2 A @ –40 VDC)</p> <p>Input 3: 56 A @ –48 VDC (nominal) (2688 W) (67.2 A @ –40 VDC)</p> <p>Input 4: 56 A @ –48 VDC (nominal) (2688 W) (67.2 A @ –40 VDC)</p> <p>Input 5: 56 A @ –48 VDC (nominal) (2688 W) (67.2 A @ –40 VDC)</p>

- Related Documentation**
- [T4000 Power System Description on page 75](#)
  - [T4000 DC Power Requirements on page 97](#)
  - [T4000 DC Power Cable and Lugs Specifications on page 105](#)
  - [T4000 DC Power Distribution on page 104](#)



## T4000 Power Management (Four 60-A Cables on a Six-Input DC Power Supply)

For Junos OS Release 12.3 and later, the power management feature ensures that the router has enough power to support an FPC before the FPC is brought online. To configure the power management feature, see [“Configuring DC Power on a T4000 Router” on page 213](#). Depending on the type of FPCs installed, the router might not support a fully loaded chassis when you connect four 60-A DC power cables to a six 60-A input power supply.

If the power is underprovisioned for your hardware configuration, power management limits the number of FPCs brought online based on the following rules:

- When a T1600 Enhanced Scaling FPC4 (Model: T1600-FPC4-ES) is installed, the maximum number of FPCs that can be online is six.
- When there are no T1600-FPC4-ES installed, the maximum number of FPCs that can be online is seven.

For example, if there are six online FPCs and you insert a T1600-FPC4-ES, the power management feature will not power on the FPC.



**NOTE:** In the event of a chassis restart, master switchover, or router reboot, the power management feature powers on the FPCs based on the setting of the `set chassis fru-poweron-sequence` command.



**CAUTION:** If you do not configure the power management feature and you are connecting four 60-A DC power cables to the six-input power supply and the maximum power draw is exceeded, FRU states might change from Online to Offline or Present, or the interfaces might flap, or some traffic might drop.

### Related Documentation

- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Configuring DC Power on a T4000 Router on page 213](#)
- [T4000 Power Management Overview](#)

## T4000 Power Management (Three 80-A Cables on a Six-Input DC Power Supply)

For Junos OS Release 12.3 and later, the power management feature ensures that the router has enough power to support an FPC before the FPC is brought online. To configure the power management feature, see [“Configuring DC Power on a T4000 Router” on page 213](#). Depending on the type of FPCs installed, the router might not support a fully loaded chassis when you connect three 80-A DC power cables to a six 60-A input power supply using terminal jumpers.

If the power is underprovisioned for your hardware configuration, power management limits the number of FPCs brought online based on the following rules:

- A maximum of six T1600 Enhanced Scaling FPC4 (Model: T1600-FPC4-ES) can be online.
- When one T1600-FPC4-ES is installed, a maximum of seven FPCs can be online.
- When there are no T1600-FPC4-ES installed, a maximum of eight FPCs (a fully loaded chassis) can be online.

For example, if there are seven online FPCs and you insert an T1600-FPC4-ES, the power management feature will not power on the FPC.



**NOTE:** In the event of a chassis restart, master switchover, or router reboot, the power management feature powers on the FPCs based on the setting of the `set chassis fru-poweron-sequence` command.



**CAUTION:** If you do not configure the power management feature and you are connecting three 80-A DC power cables to the six-input power supply and the maximum power draw is exceeded, FRU states might change from Online to Offline or Present, or the interfaces might flap, or some traffic might drop.

#### Related Documentation

- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- [Configuring DC Power on a T4000 Router on page 213](#)
- [T4000 Power Management Overview](#)

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## T4000 DC Power Distribution

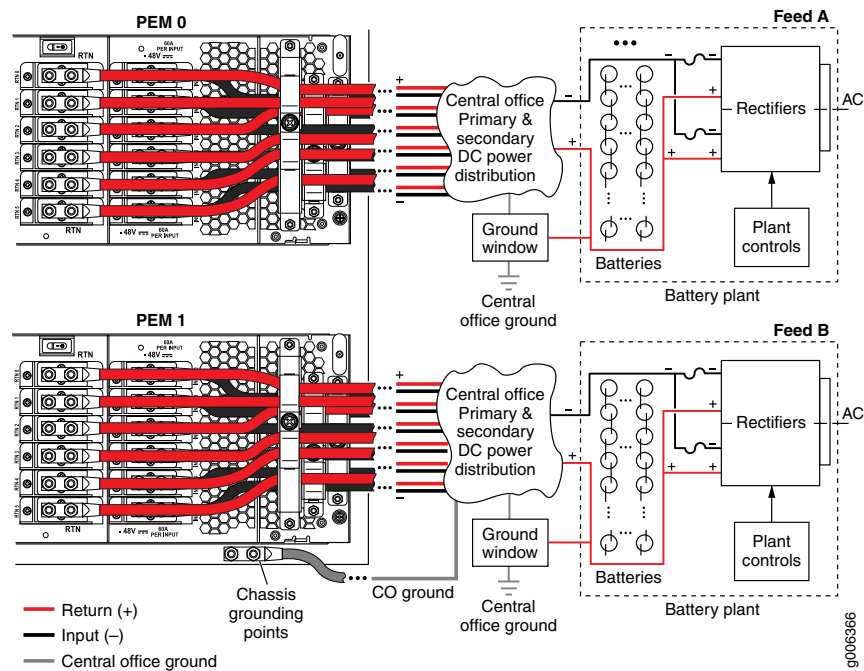
Most sites distribute DC power through a main conduit that leads to frame-mounted DC power distribution panels, one of which might be located at the top of the rack that houses the router. A pair of cables (one input and one return) connects each set of terminal studs to the power distribution panel.



**NOTE:** All inputs on the DC power supply in slot 0 must be powered by dedicated power feeds derived from feed A, and all inputs on the DC power supply in slot 1 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.

Figure 29 on page 105 shows a typical DC source cabling arrangement.

Figure 29: Typical DC Source Cabling to the Router



#### Related Documentation

- [T4000 Power System Description on page 75](#)
- [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- [Replacing a T4000 Six-Input DC Power Supply on page 307](#)
- [T4000 DC Power Electrical Safety Guidelines on page 424](#)

## T4000 DC Power Cable and Lugs Specifications

- [DC Power Cables on page 105](#)
- [DC Power Lugs on page 106](#)

### DC Power Cables

You must supply DC power cables that meet the following specifications: 4-AWG (21.2 mm<sup>2</sup>), minimum 90°C wire, or as required by the local code.

Table 68 on page 106 summarizes the number of DC power cables required, which you must supply.

Table 68: DC Power Cables Required

Number of Inputs Connected	Power Cables Required
5	10
6	12



**WARNING:** For field-wiring connections, use copper conductors only.



**WARNING:** DC Power cables must not block access to router components or drape where people could trip on them.

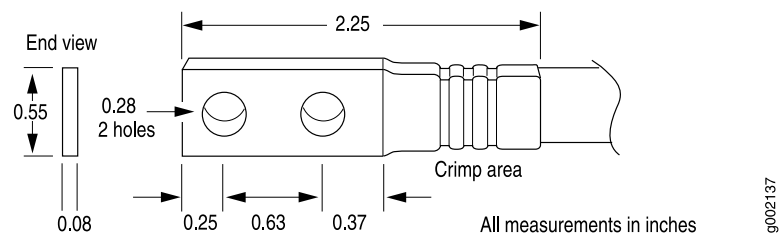


**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.

## DC Power Lugs

The accessory box shipped with the router includes cable lugs for 4-AWG (21.2 mm<sup>2</sup>) cable lugs. The cable lugs are dual hole, and sized to fit 1/4–20 UNC terminal studs at 15.86-mm (0.625-in.) center line.

Figure 30: DC Power Cable Lug



The cable lug shown in [Figure 30 on page 106](#) is also used for grounding the chassis.



**CAUTION:** Before router installation begins, a licensed electrician must attach a cable lug to the power cables that you supply. A cable with an incorrectly attached lug can damage the router.

### Related Documentation

- [T4000 Power System Description on page 75](#)

- [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- [Replacing a T4000 Six-Input DC Power Supply on page 307](#)
- [T4000 DC Power Electrical Safety Guidelines on page 424](#)



## CHAPTER 12

# Network Cable and Transceiver Planning

- [Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion on page 109](#)
- [Calculating Power Budget and Power Margin for Fiber-Optic Cables on page 110](#)

## Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion

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This topic describes signal loss, attenuation, and dispersion in fiber-optic cable.

- [Signal Loss in Multimode and Single-Mode Fiber-Optic Cable on page 109](#)
- [Attenuation and Dispersion in Fiber-Optic Cable on page 109](#)

### Signal Loss in Multimode and Single-Mode Fiber-Optic Cable

Multimode fiber is large enough in diameter to allow rays of light to reflect internally (bounce off the walls of the fiber). Interfaces with multimode optics typically use LEDs as light sources. However, LEDs are not coherent sources. They spray varying wavelengths of light into the multimode fiber, which reflects the light at different angles. Light rays travel in jagged lines through a multimode fiber, causing signal dispersion. When light traveling in the fiber core radiates into the fiber cladding, higher-order mode loss results. Together these factors limit the transmission distance of multimode fiber compared with single-mode fiber.

Single-mode fiber is so small in diameter that rays of light can reflect internally through one layer only. Interfaces with single-mode optics use lasers as light sources. Lasers generate a single wavelength of light, which travels in a straight line through the single-mode fiber. Compared with multimode fiber, single-mode fiber has higher bandwidth and can carry signals for longer distances.

Exceeding the maximum transmission distances can result in significant signal loss, which causes unreliable transmission.

### Attenuation and Dispersion in Fiber-Optic Cable

Correct functioning of an optical data link depends on modulated light reaching the receiver with enough power to be demodulated correctly. *Attenuation* is the reduction in power of the light signal as it is transmitted. Attenuation is caused by passive media components, such as cables, cable splices, and connectors. Although attenuation is significantly lower for optical fiber than for other media, it still occurs in both multimode

and single-mode transmission. An efficient optical data link must have enough light available to overcome attenuation.

*Dispersion* is the spreading of the signal over time. The following two types of dispersion can affect an optical data link:

- Chromatic dispersion—Spreading of the signal over time resulting from the different speeds of light rays.
- Modal dispersion—Spreading of the signal over time resulting from the different propagation modes in the fiber.

For multimode transmission, modal dispersion, rather than chromatic dispersion or attenuation, usually limits the maximum bit rate and link length. For single-mode transmission, modal dispersion is not a factor. However, at higher bit rates and over longer distances, chromatic dispersion rather than modal dispersion limits maximum link length.

An efficient optical data link must have enough light to exceed the minimum power that the receiver requires to operate within its specifications. In addition, the total dispersion must be less than the limits specified for the type of link in Telcordia Technologies document GR-253-CORE (Section 4.3) and International Telecommunications Union (ITU) document G.957.

When chromatic dispersion is at the maximum allowed, its effect can be considered as a power penalty in the power budget. The optical power budget must allow for the sum of component attenuation, power penalties (including those from dispersion), and a safety margin for unexpected losses.

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## Calculating Power Budget and Power Margin for Fiber-Optic Cables

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Use the information in this topic and the specifications for your optical interface to calculate the power budget and power margin for fiber-optic cables.



**TIP:** You can use the [Hardware Compatibility Tool](#) to find information about the pluggable transceivers supported on your Juniper Networks device.

To calculate the power budget and power margin, perform the following tasks:

1. [Calculating Power Budget for Fiber-Optic Cable on page 110](#)
2. [Calculating Power Margin for Fiber-Optic Cable on page 111](#)

### Calculating Power Budget for Fiber-Optic Cable

To ensure that fiber-optic connections have sufficient power for correct operation, you need to calculate the link's power budget, which is the maximum amount of power it can transmit. When you calculate the power budget, you use a worst-case analysis to provide a margin of error, even though all the parts of an actual system do not operate at the worst-case levels. To calculate the worst-case estimate of power budget ( $P_B$ ), you assume minimum transmitter power ( $P_T$ ) and minimum receiver sensitivity ( $P_R$ ):



$$P_B = P_T - P_R$$

The following hypothetical power budget equation uses values measured in decibels (dB) and decibels referred to one milliwatt (dBm):

$$P_B = P_T - P_R$$

$$P_B = -15 \text{ dBm} - (-28 \text{ dBm})$$

$$P_B = 13 \text{ dB}$$

### Calculating Power Margin for Fiber-Optic Cable

After calculating a link's power budget, you can calculate the power margin ( $P_M$ ), which represents the amount of power available after subtracting attenuation or link loss (LL) from the power budget ( $P_B$ ). A worst-case estimate of  $P_M$  assumes maximum LL:

$$P_M = P_B - LL$$

$P_M$  greater than zero indicates that the power budget is sufficient to operate the receiver.

Factors that can cause link loss include higher-order mode losses, modal and chromatic dispersion, connectors, splices, and fiber attenuation. [Table 69 on page 111](#) lists an estimated amount of loss for the factors used in the following sample calculations. For information about the actual amount of signal loss caused by equipment and other factors, refer to vendor documentation.

**Table 69: Estimated Values for Factors Causing Link Loss**

Link-Loss Factor	Estimated Link-Loss Value
Higher-order mode losses	Single-mode—None
	Multimode—0.5 dB
Modal and chromatic dispersion	Single-mode—None
	Multimode—None, if product of bandwidth and distance is less than 500 MHz-km
Connector	0.5 dB
Splice	0.5 dB
Fiber attenuation	Single-mode—0.5 dB/km
	Multimode—1 dB/km

The following sample calculation for a 2-km-long multimode link with a power budget ( $P_B$ ) of 13 dB uses the estimated values from [Table 69 on page 111](#) to calculate link loss (LL) as the sum of fiber attenuation (2 km @ 1 dB/km, or 2 dB) and loss for five connectors (0.5 dB per connector, or 2.5 dB) and two splices (0.5 dB per splice, or 1 dB) as well as higher-order mode losses (0.5 dB). The power margin ( $P_M$ ) is calculated as follows:

$$P_M = P_B - LL$$

$$P_M = 13 \text{ dB} - 2 \text{ km (1 dB/km)} - 5 (0.5 \text{ dB}) - 2 (0.5 \text{ dB}) - 0.5 \text{ dB}$$

$$P_M = 13 \text{ dB} - 2 \text{ dB} - 2.5 \text{ dB} - 1 \text{ dB} - 0.5 \text{ dB}$$

$$P_M = 7 \text{ dB}$$

The following sample calculation for an 8-km-long single-mode link with a power budget ( $P_B$ ) of 13 dB uses the estimated values from [Table 69 on page 111](#) to calculate link loss (LL) as the sum of fiber attenuation (8 km @ 0.5 dB/km, or 4 dB) and loss for seven connectors (0.5 dB per connector, or 3.5 dB). The power margin ( $P_M$ ) is calculated as follows:

$$P_M = P_B - LL$$

$$P_M = 13 \text{ dB} - 8 \text{ km (0.5 dB/km)} - 7(0.5 \text{ dB})$$

$$P_M = 13 \text{ dB} - 4 \text{ dB} - 3.5 \text{ dB}$$

$$P_M = 5.5 \text{ dB}$$

In both examples, the calculated power margin is greater than zero, indicating that the link has sufficient power for transmission and does not exceed the maximum receiver input power.

# Management Cable and Transceiver Specifications and Pinouts

- [T4000 Routing Engine Interface Cable Specifications on page 113](#)
- [T4000 Alarm Relay Contact Wire Specifications on page 114](#)
- [DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports on page 114](#)
- [RJ-45 Connector Pinouts for the T4000 Management ETHERNET Port on page 115](#)

## T4000 Routing Engine Interface Cable Specifications

[Table 70 on page 113](#) lists the specifications for the cables that connect to the management ports on the connector interface panel (CIP).

*Table 70: Cable Specifications for Routing Engine Management*

Port	Cable Specification	Cable/Wire Supplied	Maximum Length	Router Receptacle
Routing Engine console or auxiliary interface	RS-232 (EIA-232) serial cable	One 6-ft (1.83-m) length with DB-9/DB-9 connectors	6 ft (1.83 m)	DB-9 male
Routing Engine Ethernet interface	Category 5 cable or equivalent suitable for 100Base-T operation	One 15-ft (4.57-m) length with RJ-45/RJ-45 connectors	328 ft (100 m)	RJ-45 autosensing

**Related Documentation**

- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [Connecting the T4000 Router to a Management Ethernet Device on page 180](#)
- [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)
- [DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports on page 114](#)
- [RJ-45 Connector Pinouts for the T4000 Management ETHERNET Port on page 115](#)

## T4000 Alarm Relay Contact Wire Specifications

For management and service operations, you can connect the router to external alarm-reporting devices through the alarm relay contacts on the CIP. You must provide a wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>).

- Related Documentation**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [Connecting the T4000 Router to an External Alarm-Reporting Device on page 182](#)

## DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports

The ports on the CIP labeled **AUXILIARY** and **CONSOLE** are DB-9 receptacles that accept RS-232 (EIA-232) cable. The **AUXILIARY** port connects the Routing Engine to a laptop, modem, or other auxiliary unit, and the **CONSOLE** port connects it to a management console. The ports are configured as data terminal equipment (DTE). [Table 71 on page 114](#) describes the DB-9 connector pinouts.

*Table 71: DB-9 Connector Pinouts*

Pin	Signal	Direction	Description
1	DCD	<—	Carrier Detect
2	RxD	<—	Receive Data
3	TxD	—>	Transmit Data
4	DTR	—>	Data Terminal Ready
5	Ground	—	Signal Ground
6	DSR	<—	Data Set Ready
7	RTS	—>	Request To Send
8	CTS	<—	Clear To Send
9	RING	<—	Ring Indicator

- Related Documentation**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [T4000 Routing Engine Interface Cable Specifications on page 113](#)
  - [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)

## RJ-45 Connector Pinouts for the T4000 Management ETHERNET Port

The port on the CIP labeled **ETHERNET** is an autosensing 10/100-Mbps Ethernet Ethernet RJ-45 receptacle that accepts an Ethernet cable for connecting the Routing Engine to a management LAN (or other device that supports out-of-band management).

[Table 72 on page 115](#) describes the RJ-45 connector pinouts.

*Table 72: RJ-45 Connector Pinouts*

Pin	Signal
1	TX+
2	TX –
3	RX+
4	Termination network
5	Termination network
6	RX–
7	Termination network
8	Termination network

### Related Documentation

- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [Connecting the T4000 Router to a Management Ethernet Device on page 180](#)
- [T4000 Routing Engine Interface Cable Specifications on page 113](#)



## PART 3

# Initial Installation and Configuration

- [Installation Overview on page 119](#)
- [Unpacking the Router on page 123](#)
- [Installing the Mounting Hardware on page 129](#)
- [Overview of Installing the Router into a Rack on page 137](#)
- [Installing the Router into a Rack With a Mechanical Lift on page 139](#)
- [Installing the Router into a Rack Without a Mechanical Lift on page 147](#)
- [Connecting the Router to Ground on page 173](#)
- [Connecting the Router to External Devices on page 177](#)
- [Connecting the Router to Power on page 185](#)
- [Powering On the Router on page 207](#)
- [Configuring the JUNOS Software on page 209](#)
- [Upgrading to a T4000 Router From a T640 or T1600 Router on page 217](#)





# Installation Overview

- [Overview of Installing the T4000 Router on page 119](#)
- [T4000 Installation Safety Guidelines on page 120](#)

## Overview of Installing the T4000 Router

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You must proceed through the installation process in the following order:

1. Review all safety guidelines and warnings for the router.



**WARNING:** To avoid harm to yourself or the router as you install and maintain it, you must follow the safety procedures for working with Internet routers, as well as the guidelines and warnings for working with and near electrical equipment. However, providing an exhaustive set of guidelines for working with electrical equipment is beyond the scope of this documentation.

See [“General Safety Guidelines and Warnings” on page 393](#).

2. Prepare the installation site for the router.

See [“Overview of Preparing the Site for the T4000 Router” on page 87](#).

3. Unpack the router and verify the parts received.

See [“Overview of Unpacking the T4000 Router” on page 123](#).

4. Install the mounting hardware. See:

- [“Installing the T4000 Mounting Hardware for a Four-Post Rack or Cabinet” on page 129](#).
- [“Installing the T4000 Mounting Hardware for an Open-Frame Rack” on page 133](#).

5. Install the router into the rack. See:

- [Overview of Installing the T4000 Router into a Rack on page 137](#)
- [Overview of Installing a T4000 Router Using a Mechanical Lift on page 139](#)

- [Overview of Installing a T4000 Router Without a Mechanical Lift on page 147](#)
- 6. Ground the router.  
See [“Connecting the T4000 Grounding Cable” on page 174.](#)
- 7. Connect the router to external devices. See:
  - [Overview of Connecting the T4000 Router to External Devices on page 177](#)
  - [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)
  - [Connecting the T4000 Router to an External Alarm-Reporting Device on page 182](#)
  - [Connecting the T4000 Router to an External Clocking Device](#)
  - [Connecting PIC Cables to the T4000 Router on page 183](#)
  - [Connecting the T4000 Router to a Management Ethernet Device on page 180](#)
- 8. Connect the power. See:
  - [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
  - [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
  - [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
  - [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- 9. Power on the router.  
See [“Powering On the T4000 Router” on page 207.](#)

**Related  
Documentation**

- [T4000 Router Description on page 3](#)

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## T4000 Installation Safety Guidelines

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Observe the following guidelines before and during router installation:

- [General Installation Safety Guidelines on page 120](#)
- [Chassis Lifting Guidelines on page 121](#)

### General Installation Safety Guidelines

Before installing or moving the router, verify that the intended site meets the specified power, environmental, and clearance requirements. See the following documentation:

- [T4000 Clearance Requirements for Airflow and Hardware Maintenance on page 91](#)
- [Rack Requirements for the T4000 Router on page 93](#)
- [T4000 Router Environmental Specifications on page 88](#)
- [T4000 DC Power Requirements on page 97](#)

## Chassis Lifting Guidelines

The weight of a fully configured router is about 663.6 lb (301.0 kg). Observe the following guidelines for lifting and moving the router:

- Do not attempt to lift a fully configured router by yourself. Using a mechanical lift to maneuver the router into a rack is recommended. If a lift cannot be used, a minimum of 4 people are required to lift the router, and you must remove components from the chassis before lifting.
- Before lifting or moving the router, disconnect all external cables.
- As when lifting any heavy object, lift most of the weight with your legs rather than your back. Keep your knees bent and your back relatively straight and avoid twisting your body as you lift. Balance the load evenly and be sure that your footing is solid.

### Related Documentation

- [Overview of Preparing the Site for the T4000 Router on page 87](#)



## CHAPTER 15

# Unpacking the Router

- [Overview of Unpacking the T4000 Router on page 123](#)
- [Tools and Parts Required to Unpack the T4000 Router on page 123](#)
- [Unpacking the T4000 Router on page 124](#)
- [Verifying the T4000 Router Parts Received on page 125](#)

## Overview of Unpacking the T4000 Router

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To unpack the router:

1. Gather the tools required to unpack the router.  
[See “Tools and Parts Required to Unpack the T4000 Router” on page 123.](#)
2. Remove the router, accessory box, tool kit, and all parts from the shipping crate.  
[See “Unpacking the T4000 Router” on page 124](#)
3. Verify that all parts have been received.  
[See “Verifying the T4000 Router Parts Received” on page 125.](#)

### Related Documentation

- [Overview of Installing the T4000 Router on page 119](#)

## Tools and Parts Required to Unpack the T4000 Router

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To unpack the router and prepare for installation, you need the following tools:

- Phillips (+) screwdriver, number 2
- 1/2-in. or 13-mm open-end or socket wrench to remove bracket bolts from the shipping pallet
- Blank panels to cover any slots not occupied by a component

### Related Documentation

- [Overview of Unpacking the T4000 Router on page 123](#)

- [Unpacking the T4000 Router on page 124](#)
- [Verifying the T4000 Router Parts Received on page 125](#)

## Unpacking the T4000 Router

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The router is shipped in a wooden crate. A wooden pallet forms the base of the crate. The router chassis is bolted to this pallet. Quick Start installation instructions and a cardboard accessory box are also included in the shipping crate.

The shipping crate measures:

- 51 in. (129 cm) high
- 35 in. (89 cm) wide
- 43 in. (110 cm) deep

The total weight of the crate containing the router and accessories can range up to 392 lb (178 kg).



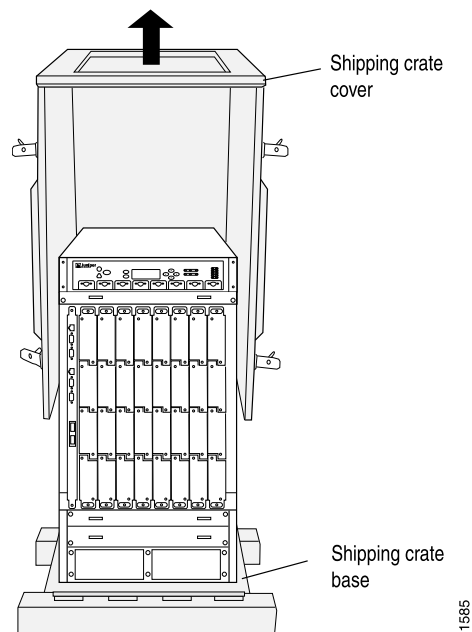
**NOTE:** The router is maximally protected inside the shipping crate. Do not unpack it until you are ready to begin installation.

To unpack the router (see [Figure 31 on page 125](#)):

1. Move the shipping crate to a staging area as close to the installation site as possible, where you have enough room to remove the components from the chassis. While the chassis is bolted to the pallet, you can use a forklift or pallet jack to move it.
2. Position the shipping crate with the arrows pointing up.
3. Open all the latches on the shipping crate.
4. Remove the front door of the shipping crate cover and set it aside.
5. Slide the remainder of the shipping crate cover off the pallet.
6. Remove the foam covering the top of the router.
7. Remove the accessory box and the Quick Start documentation.
8. Verify the parts received against the lists in [“Verifying the T4000 Router Parts Received” on page 125](#).

9. Remove the vapor corrosion inhibitor (VCI) packs attached to the pallet, being careful not to break the VCI packs open.
10. To remove the brackets holding the chassis on the pallet, use a 1/2-in. socket wrench and a number 2 Phillips screwdriver to remove the bolts and screws from the brackets.
11. Store the brackets and bolts inside the accessory box.
12. Save the shipping crate cover, pallet, and packing materials in case you need to move or ship the router at a later time.

*Figure 31: Contents of the Shipping Crate*



- Related Documentation**
- [Overview of Unpacking the T4000 Router on page 123](#)
  - [Tools and Parts Required to Unpack the T4000 Router on page 123](#)
  - [Verifying the T4000 Router Parts Received on page 125](#)

## Verifying the T4000 Router Parts Received

A packing list is included in each shipment. Check the parts in the shipment against the items on the packing list. The packing list specifies the part numbers and descriptions of each part in your order.

If any part is missing, contact a customer service representative.

The main shipment contains the router chassis with installed components, listed in [Table 73 on page 126](#), and an accessory box, which contains the parts listed in [Table 74 on page 127](#).

**Table 73: Router Parts List**

Component	Quantity
Chassis, including midplane, craft interface	1
FPCs	Up to 8
PICs	Up to 4 per FPC
SIBs	5
Routing Engines	1 or 2
Control boards	1 or 2 (one for each Routing Engine)
SCGs	1 or 2
Power supplies	2
CIP	1
Front fan trays	2
Rear fan tray	1
Quick Start installation	1
Large mounting shelf—Required for all mounting options.	1
Small mounting shelf—Required only for four-post rack or cabinet	1
Spacer bars (attached to the back of the front-mounting flanges on the chassis—Required only for four-post rack or cabinet	2
Blank panels for slots without components installed	One blank panel for each slot not occupied by a component



**Table 74: Accessory Box Parts List**

Part	Quantity
Affidavit for T1 connection	1
Connectors for alarm relay cables	2
DB-9 (male) to DB-25 (female) adapter	1
ESD wrist strap with cable	1
Ethernet cable, 15-ft length, to connect Routing Engine to management device	1
PCMCIA Card holder and hook-and-loop fasteners (male and female)	1 of each
DC power and grounding cable lugs	36 lugs are included.  One lug is for the grounding cable. The remaining cable lugs are for the DC power cables. The number of cable lugs varies depending on the power supply and how many cables are being connected.
Screws to fasten grounding cable to chassis	2
Washers for grounding cable lug	2
Optional cable management restraints	2
Product warranty	1
Read me first document	1
Screws to mount chassis	Bag of 14
Serial cable, 6-ft length, to connect Routing Engine to management console	1
End User License Agreement	1

**Related Documentation**

- [Overview of Unpacking the T4000 Router on page 123](#)
- [Unpacking the T4000 Router on page 124](#)



## CHAPTER 16

# Installing the Mounting Hardware

- Installing the T4000 Mounting Hardware for a Four-Post Rack or Cabinet on page 129
- Installing the T4000 Mounting Hardware for an Open-Frame Rack on page 133

### Installing the T4000 Mounting Hardware for a Four-Post Rack or Cabinet

1. Installing Cage Nuts, if Needed on page 129
2. Installing the Large Mounting Shelf on page 130
3. Installing the Small Shelf on page 131
4. Installing the Spacer Bars on page 132

#### Installing Cage Nuts, if Needed

To install the cage nuts, if needed, in the mounting holes specified in [Table 75 on page 129](#):

1. On the front rack rails, install cage nuts in the holes specified for the large shelf and the spacer bars.
2. On the rear rack rails, install cage nuts in the holes specified for the small shelf.

The front-mounting flanges have holes for rack-mounting screws, spaced at 5.25 in. (13.34 cm). [Table 75 on page 129](#) specifies the holes in which you insert mounting screws (an X indicates a mounting hole location), and cage nuts if needed. The hole distances are relative to one of the standard U divisions on the rack. The bottom of all mounting shelves is at 0.04 in. (0.02 U) above a U division.

**Table 75: Four-Post or Cabinet Rack Mounting Hole Locations**

Hole	Distance Above U Division		Large Shelf	Spacer Bars	Small Shelf
60	34.75 in. (88.3 cm)	19.86 U		X	
51	29.51 in. (74.9 cm)	16.86 U		X	
42	24.26 in. (61.6 cm)	13.86 U		X	
33	19.01 in. (48.3 cm)	10.86 U		X	

*Table 75: Four-Post or Cabinet Rack Mounting Hole Locations (continued)*

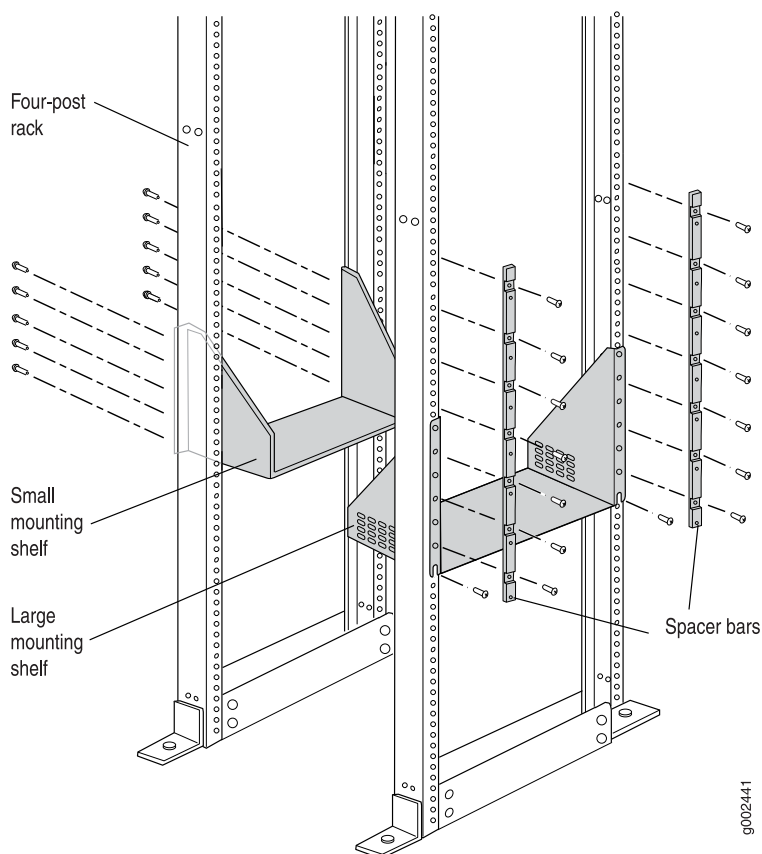
Hole	Distance Above U Division		Large Shelf	Spacer Bars	Small Shelf
24	13.76 in. (34.9 cm)	7.86 U		X	
15	8.51 in. (21.6 cm)	4.86 U		X	X
12	6.76 in. (17.1 cm)	3.86 U			X
9	5.01 in. (12.7 cm)	2.86 U			X
6	3.26 in. (8.3 cm)	1.86 U		X	X
3	1.51 in. (3.8 cm)	0.86 U			X
2	0.88 in. (2.2 cm)	0.50 U	X		

## Installing the Large Mounting Shelf

To install the large mounting shelf:

1. On the front of each front rack rail, partially insert a mounting screw into the lowest hole specified in [Table 75 on page 129](#) for the large shelf and the spacer bars.
2. Install the large shelf on the front rack rails. Rest the bottom slot of each flange on a mounting screw.
3. Partially insert a mounting screw into the top hole in each flange of the large shelf.
4. Tighten all the screws completely.

Figure 32: Installing the Mounting Hardware for a Four-Post Rack or Cabinet



### Installing the Small Shelf

To install the small shelf:

1. On the back of each rear rack rail, partially insert a mounting screw into the lowest hole specified in [Table 75 on page 129](#) for the small shelf.
2. Install the small shelf on the back rack rails. Rest the bottom slot of each flange on a mounting screw. The small shelf installs on the back of the rear rails, extending toward the center of the rack. The bottom of the small shelf on the rear rack rails must align with the bottom of the large shelf on the front rack rails.
3. Partially insert screws into the open holes in the flanges of the small shelf.
4. Tighten all the screws completely.

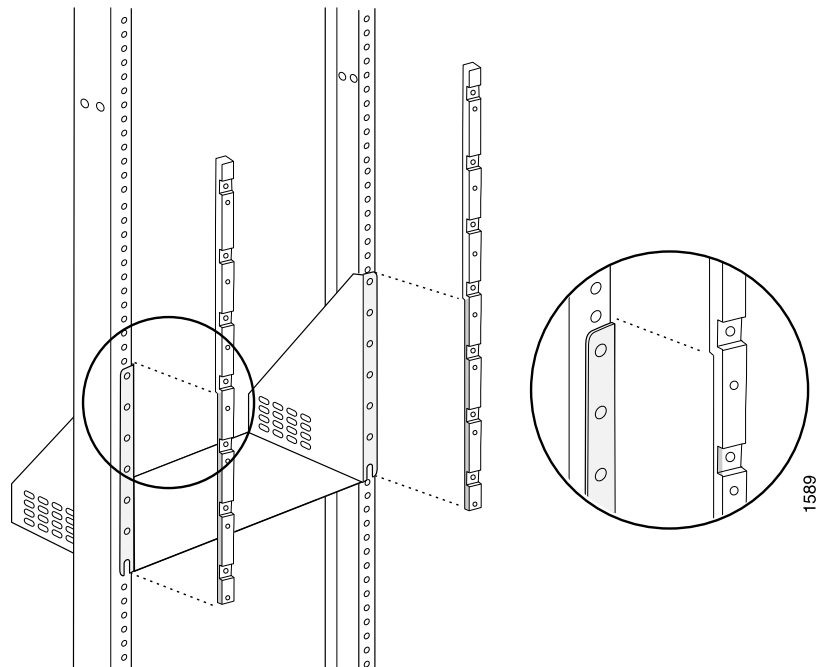
## Installing the Spacer Bars

The router is shipped with each spacer bar attached to the rear of each front-mounting flange.

To install the spacer bars:

1. Remove each spacer bar by removing the screws that fasten the spacer bar to the front-mounting flange.
2. Place one of the spacer bars over a flange of the large shelf. Position the notch in the rear of the spacer bar so the upper part of the bar is flush with the rack rail and the lower part is flush with the flange of the shelf (see [Figure 33 on page 132](#)).
3. Insert a mounting screw into each of the nonthreaded holes in the recesses of the spacer bar to secure the spacer bar. Each hole should have a cage nut behind it.
4. Repeat Steps 2 and 3 for the other spacer bar.
5. Tighten all the screws completely.

**Figure 33: Positioning the Spacer Bar on the Rack**



### Related Documentation

- [Rack Requirements for the T4000 Router on page 93](#)
- [Installing the T4000 Mounting Hardware for an Open-Frame Rack on page 133](#)

## Installing the T4000 Mounting Hardware for an Open-Frame Rack

In an open-frame rack, center-mounting is generally preferable to front-mounting because the more even distribution of weight provides greater stability. If you center-mount the chassis, you use the center-mounting brackets attached to the chassis. If you front-mount the chassis, you use the front-mounting flanges, and must remove the center-mounting brackets.

1. [Installing the Cage Nuts, if Needed on page 133](#)
2. [Installing the Large Mounting Shelf on page 133](#)
3. [Removing the Center-Mounting Brackets from the Chassis on page 134](#)
4. [Removing the Spacer Bars on page 135](#)

### Installing the Cage Nuts, if Needed

1. Check that cage nuts are installed in the mounting holes specified in [Table 76 on page 133](#).
2. Install cage nuts, if needed.

[Table 76 on page 133](#) specifies the mounting holes in which you insert the mounting screws (an X indicates a mounting hole location), and cage nuts if needed. The hole distances are relative to one of the standard U divisions on the rack. For reference, the bottom of all mounting shelves is at 0.04 in. (0.02 U) above a U division.

**Table 76: Open-Frame Rack Mounting Hole Locations**

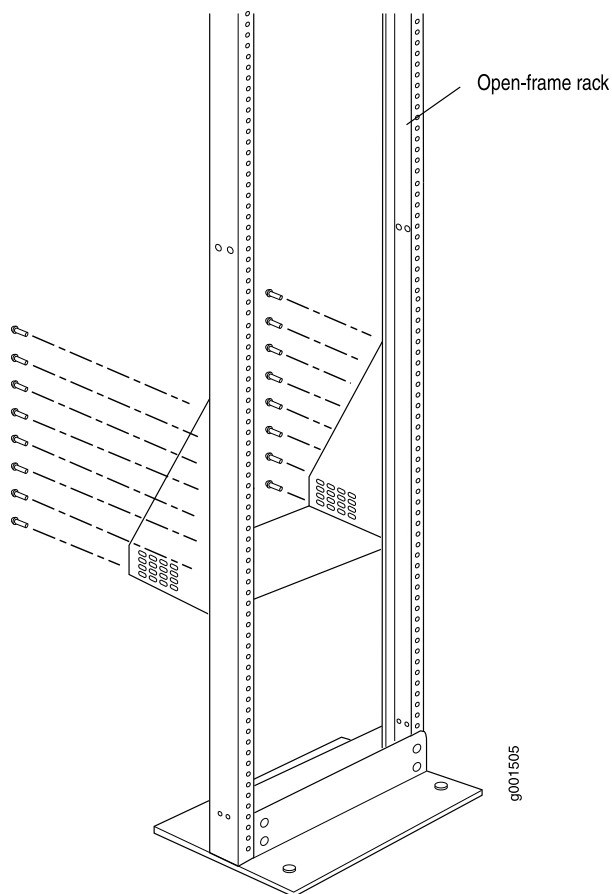
Hole	Distance Above U Division		Large Shelf
59	34.13 in. (86.7 cm)	19.50 U	X
53	30.63 in. (77.8 cm)	17.50 U	X
50	28.88 in. (73.3 cm)	16.50 U	X
44	25.38 in. (64.5 cm)	14.50 U	X
41	23.63 in. (60.0 cm)	13.50 U	X
35	20.13 in. (51.1 cm)	11.50 U	X
32	18.38 in. (46.7 cm)	10.50 U	X
31	17.75 in. (45.1 cm)	10.14 U	X

### Installing the Large Mounting Shelf

To install the large mounting shelf (see [Figure 34 on page 134](#)) in an open-frame rack:

1. On the rear of each rack rail, partially insert a mounting screw into the lowest hole specified in [Table 76 on page 133](#) for the large shelf.
2. Install the large shelf on the rack. Rest the bottom slot of each flange on a mounting screw.
3. Partially insert screws into the open holes in the flanges of the large shelf.
4. Tighten all the screws completely.

*Figure 34: Installing the Mounting Hardware for an Open-Frame Rack*



## Removing the Center-Mounting Brackets from the Chassis

Before front-mounting the router in an open-frame rack, you must remove the center-mounting brackets from the chassis.

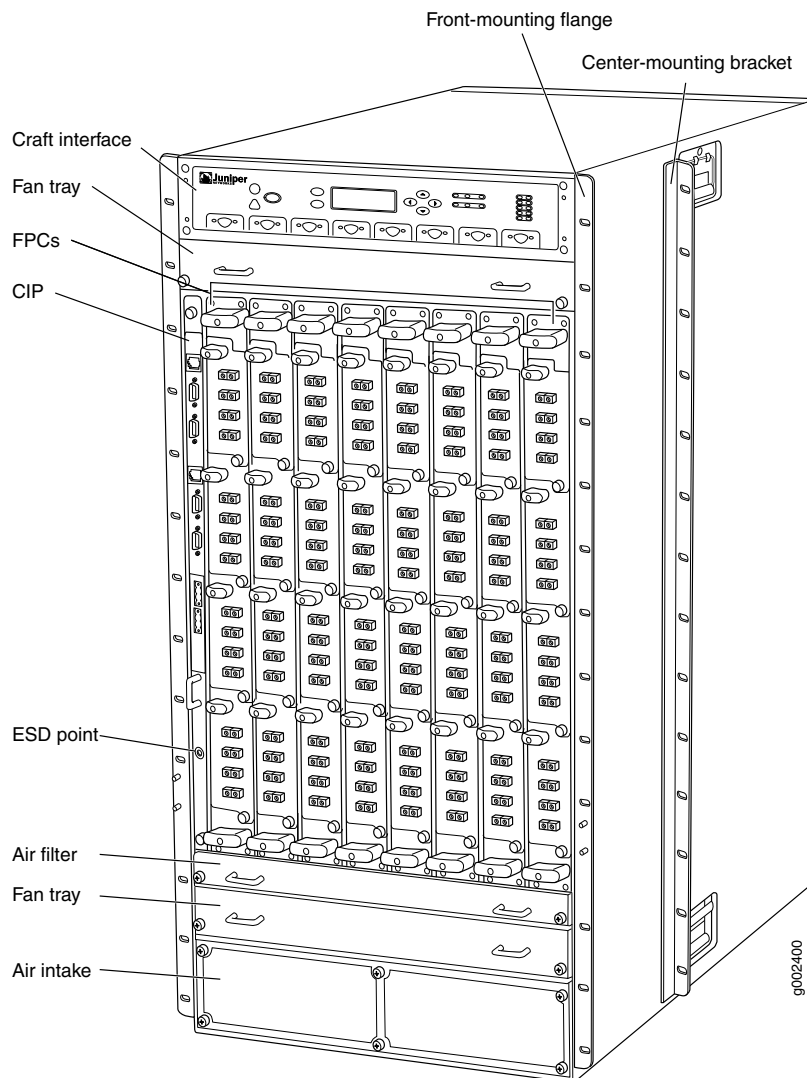
To remove the center-mounting brackets (see [Figure 35 on page 135](#)):

1. Loosen the screws at the top and bottom of each bracket.



2. Remove each bracket.

*Figure 35: Removing the Center-Mounting Bracket*



## Removing the Spacer Bars

The router is shipped with each spacer bar attached to the rear of each front-mounting flange. If you are installing the chassis in an open-frame rack, removing the spacer bars is optional.

To remove the spacer bars:

1. Remove the screws that fasten the spacer bar to the front-mounting flange
2. Remove the spacer bars.

- Related Documentation**
- [Rack Requirements for the T4000 Router on page 93](#)
  - [Installing the T4000 Mounting Hardware for a Four-Post Rack or Cabinet on page 129](#)

## CHAPTER 17

# Overview of Installing the Router into a Rack

- [Overview of Installing the T4000 Router into a Rack on page 137](#)

### Overview of Installing the T4000 Router into a Rack

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1. Read the safety information. To avoid harm to yourself or the router as you lift it into the rack, follow the guidelines and safety procedures for working with routers.  
[See “T4000 Installation Safety Guidelines” on page 120 and “General Safety Guidelines and Warnings” on page 393.](#)

2. Verify that the site has been prepared for the router installation.  
[See “Overview of Preparing the Site for the T4000 Router” on page 87.](#)

3. Because of the T4000 router's size and weight—up to 663.6 lb (301.0 kg) fully configured—we strongly recommend that you lift the router into the rack using a mechanical lift. See [“Overview of Installing a T4000 Router Using a Mechanical Lift” on page 139](#)

However, if a mechanical lift is not available, you can remove components from the chassis to make it easier to install into the rack. With components removed, the chassis weighs approximately 240 lb (109 kg), and four people can lift the chassis into the rack manually. See [“Overview of Installing a T4000 Router Without a Mechanical Lift” on page 147.](#)

#### Related Documentation

- [Overview of Installing the T4000 Router on page 119](#)



## CHAPTER 18

# Installing the Router into a Rack With a Mechanical Lift

- [Overview of Installing a T4000 Router Using a Mechanical Lift on page 139](#)
- [Tools Required to Install the T4000 Router Using a Mechanical Lift on page 139](#)
- [Installing the T4000 Router Using a Mechanical Lift on page 140](#)

### Overview of Installing a T4000 Router Using a Mechanical Lift

Before installing the router, make sure that you have prepared your site, unpacked the router from the shipping crate, and installed the mounting hardware.

Because of the router's size and weight—up to 663.6 lb (301.0 kg), depending on the configuration—we strongly recommend that you install the router using a mechanical lift.

To install the router:

1. Gather the tools required to install the router.  
[See “Tools Required to Install the T4000 Router Using a Mechanical Lift” on page 139.](#)
2. Install the router into the rack using a mechanical lift.  
[See “Installing the T4000 Router Using a Mechanical Lift” on page 140.](#)

#### **Related Documentation**

- [Overview of Installing the T4000 Router into a Rack on page 137](#)

### Tools Required to Install the T4000 Router Using a Mechanical Lift

To install the T320 chassis using a mechanical lift, you need the following tools:

- Mechanical lift
- Phillips (+) screwdrivers, number 2

- Related Documentation**
- [Overview of Installing a T4000 Router Using a Mechanical Lift on page 139](#)
  - [Installing the T4000 Router Using a Mechanical Lift on page 140](#)

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## Installing the T4000 Router Using a Mechanical Lift

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1. [Removing the T4000 Power Supplies on page 140](#)
2. [Attaching the T4000 Installation Handle on page 141](#)
3. [Installing the T4000 Chassis in a Rack or Cabinet Using a Mechanical Lift on page 141](#)
4. [Removing the T4000 Installation Handle on page 144](#)
5. [Reinstalling the T4000 Power Supplies on page 145](#)

### Removing the T4000 Power Supplies

To remove the power supplies, start with the upper power supply:

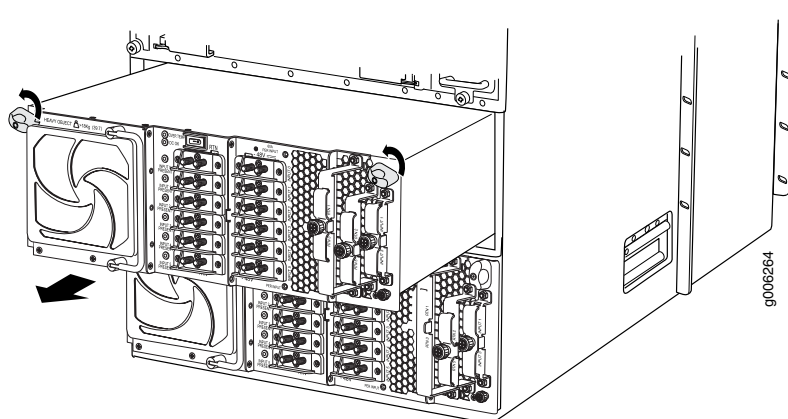
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Loosen the captive screws on the lower corners of the power supply faceplate completely.
3. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.
4. Grasp the handle on the power supply faceplate, and pull firmly to start removing the power supply. Slide it halfway out of the chassis (see [Figure 36 on page 141](#)).



**CAUTION:** Be prepared to support the full weight of the power supply as you remove it from the router.

5. Place one hand underneath the power supply to support it, and slide it completely out of the chassis.
6. Repeat the procedure for the other power supply.

Figure 36: Removing a DC Power Supply

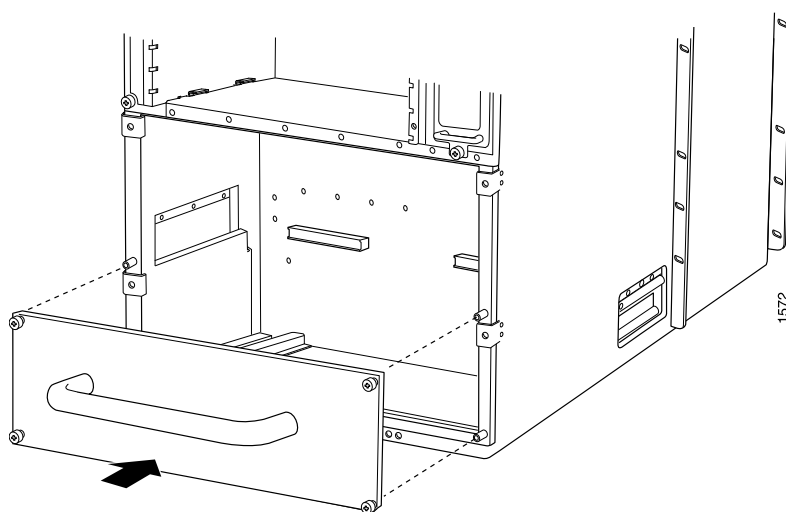


### Attaching the T4000 Installation Handle

To assist you with the installation of the router, attach the installation handle over the power supply slots of the chassis. To attach the installation handle:

1. Place the installation handle over the location of the lower power supply.
2. Tighten the captive screws of the handle into the holes previously occupied by the captive screws of the power supply (see [Figure 37 on page 141](#)).

Figure 37: Attaching the Installation Handle



### Installing the T4000 Chassis in a Rack or Cabinet Using a Mechanical Lift

Because of the router's size and weight—up to 663.6 lb (301.0 kg) depending on configuration—we strongly recommend that you install the router using a lift.

To mount the chassis in the rack or cabinet using a lift (see [Figure 38 on page 143](#)):

1. If you are installing the router in an open-frame rack, ensure that the rack is in its permanent location and is secured to the building. Ensure that the installation site allows adequate clearance for both airflow and maintenance. For details, see [“T4000 Clearance Requirements for Airflow and Hardware Maintenance” on page 91](#).

2. Load the router onto the lift, making sure it rests securely on the lift platform.



**CAUTION:** Do not lift the router using the installation handle or the handles on the sides of the chassis. Use these handles only to help position the router.

3. Using the lift, position the chassis in front of the rack or cabinet, centering it in front of the mounting shelves.
4. Lift the chassis approximately 0.75 in. above the surface of the mounting shelves, and position it as close as possible to the shelves.
5. Carefully slide the chassis onto the mounting shelves so that the bottom of the chassis and the mounting shelves overlap by approximately 2 inches.
6. With one person pulling on the installation handle from the rear of the rack or cabinet while two people push on the front-mounting flanges, slide the chassis onto the mounting shelves until the mounting brackets or front-mounting flanges contact the rack rails or spacer bars (depending on your type of installation). The shelves ensure that the holes in the mounting brackets and the front-mounting flanges of the chassis align with the holes in the rack rails.
7. Move the lift away from the rack.
8. If you are installing the router in a four-post rack or cabinet, install a mounting screw and a cage nut into each of the holes aligned with the threaded holes in the spacer bars. If you are installing the router in an open-frame rack, install a mounting screw into each of the open mounting holes aligned with the rack, starting from the bottom.
9. Visually inspect the alignment of the router. If the router is installed properly in the rack, all the mounting screws on one side of the rack should be aligned with the mounting screws on the opposite side and the router should be level.



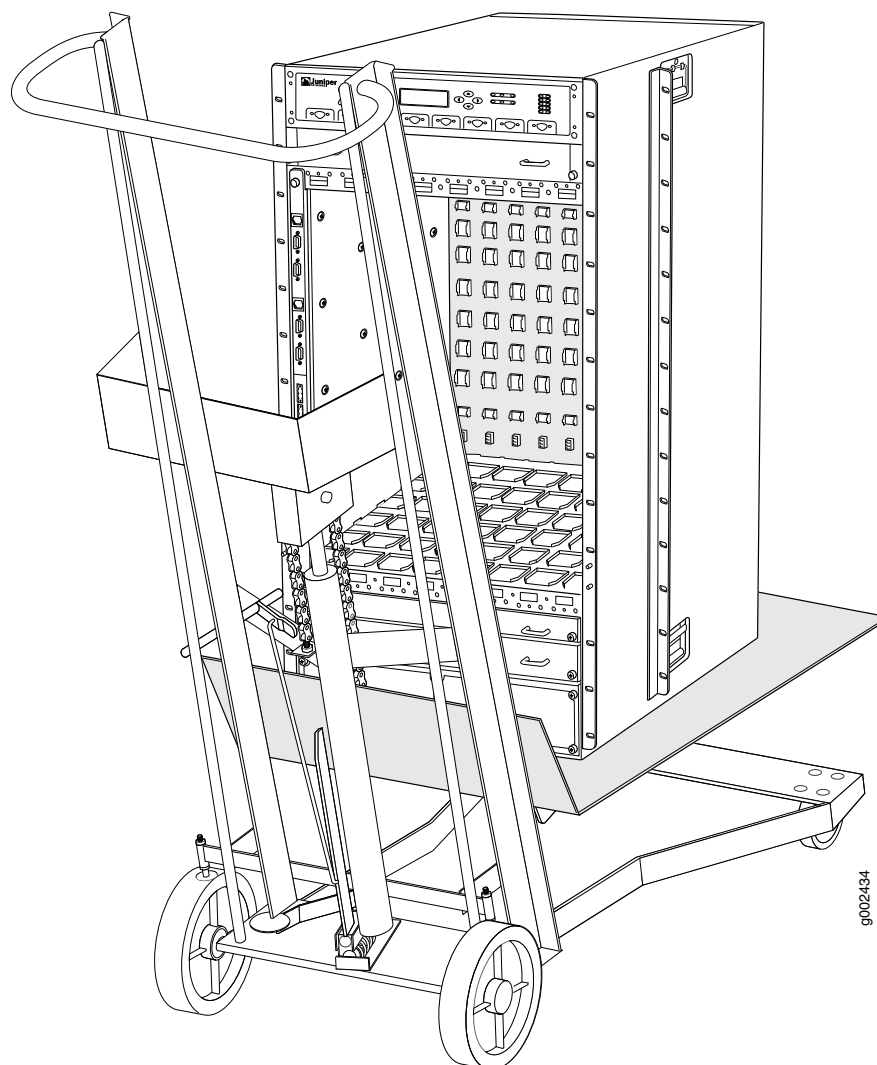
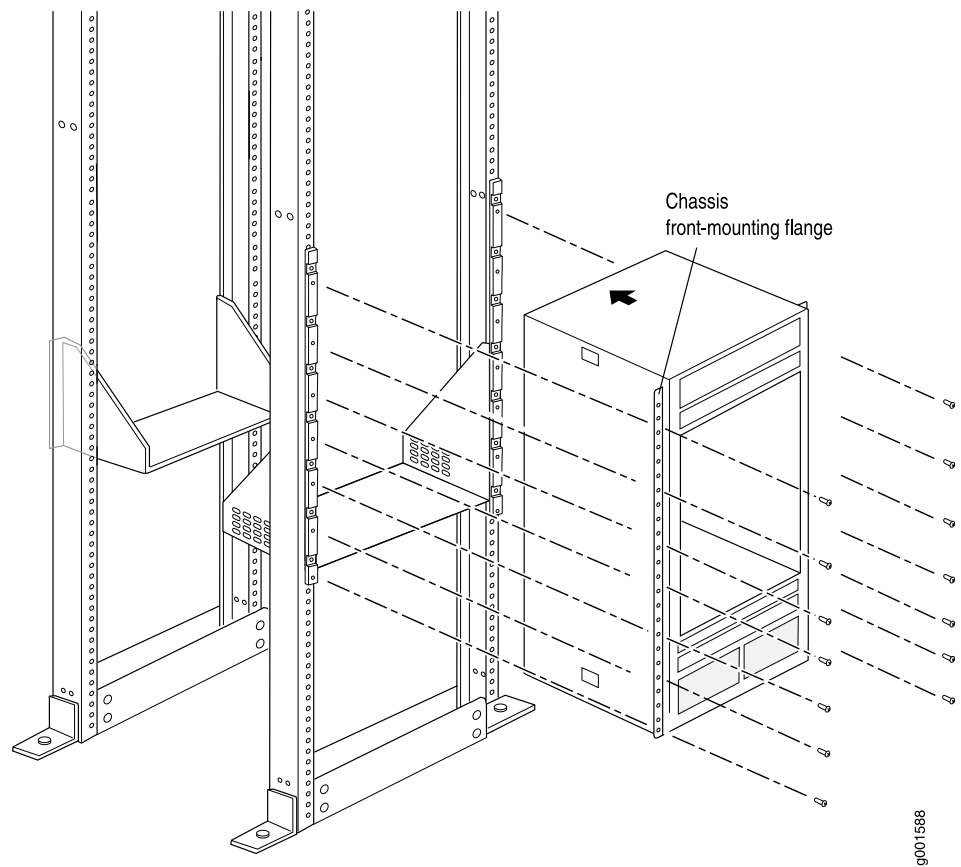
*Figure 38: Lifting the Router*

Figure 39: Installing the Router in a Four-Post Rack



**NOTE:** For an illustration of the mounting hardware required for an open-frame rack, see [“Installing the T4000 Mounting Hardware for an Open-Frame Rack”](#) on page 133.

## Removing the T4000 Installation Handle

After you have installed the router, remove the installation handle:

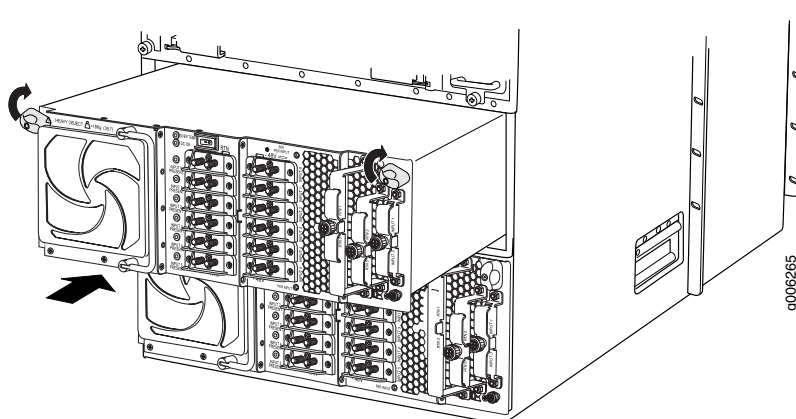
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Loosen the captive screws on the installation handle completely.
3. Remove the handle from the chassis.

## Reinstalling the T4000 Power Supplies

After you have removed the installation handle, reinstall the two power supplies in the chassis, starting with the lower power supply (see [Figure 40 on page 145](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Using both hands, slide the power supply into the chassis until you feel resistance.
3. Twist the ejector handles at the upper corners of the power supply faceplate clockwise until they stop.
4. Tighten the captive screws at the lower corners of the power supply faceplate to secure the power supply in the chassis.
5. Repeat the procedure for the upper power supply.

*Figure 40: Reinstalling the Power Supplies*



### Related Documentation

- [Overview of Installing a T4000 Router Using a Mechanical Lift on page 139](#)
- [Tools Required to Install the T4000 Router Using a Mechanical Lift on page 139](#)



## CHAPTER 19

# Installing the Router into a Rack Without a Mechanical Lift

- [Overview of Installing a T4000 Router Without a Mechanical Lift on page 147](#)
- [Tools Required to Install the T4000 Router Without a Mechanical Lift on page 148](#)
- [Removing T4000 Components from the Chassis on page 148](#)
- [Installing the T4000 Chassis in a Rack or Cabinet Manually on page 160](#)
- [Reinstalling the T4000 Components in the Chassis on page 163](#)

### Overview of Installing a T4000 Router Without a Mechanical Lift

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If you cannot use a mechanical lift to install the T1600 router (the preferred method), you can install it manually. Before installing the router, make sure that you have prepared your site, unpacked the router from the shipping crate, and installed the mounting hardware.

To install the router:

1. Gather the tools required to install the router.  
[See "Tools Required to Install the T4000 Router Without a Mechanical Lift" on page 148.](#)
2. Remove components from the chassis to make it easier to install into the rack.  
[See "Removing T4000 Components from the Chassis" on page 148.](#)
3. Install the router into the rack.  
[See "Installing the T4000 Chassis in a Rack or Cabinet Manually" on page 160.](#)
4. Reinstall the components removed from the chassis.  
[See "Reinstalling the T4000 Components in the Chassis" on page 163.](#)

#### Related Documentation

- [Overview of Installing the T4000 Router into a Rack on page 137](#)

## Tools Required to Install the T4000 Router Without a Mechanical Lift

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To install the router, you need the following tools and parts:

- Phillips (+) screwdrivers, numbers 1 and 2
- Flat-blade (–) screwdriver, number 1
- 7/16-in. (11 mm) socket wrench
- 3/8-in. nut driver
- ESD grounding wrist strap

### **Related Documentation**

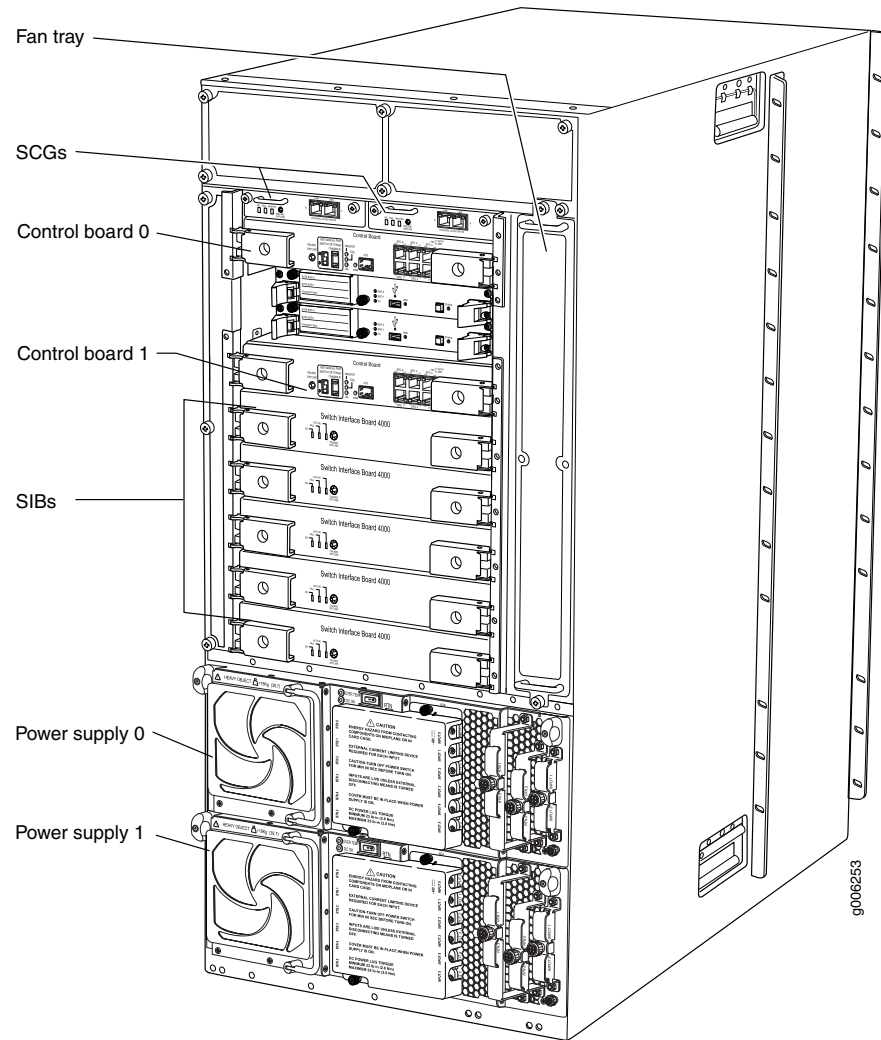
- [Overview of Installing a T4000 Router Without a Mechanical Lift on page 147](#)
- [Removing T4000 Components from the Chassis on page 148](#)
- [Installing the T4000 Chassis in a Rack or Cabinet Manually on page 160](#)
- [Reinstalling the T4000 Components in the Chassis on page 163](#)

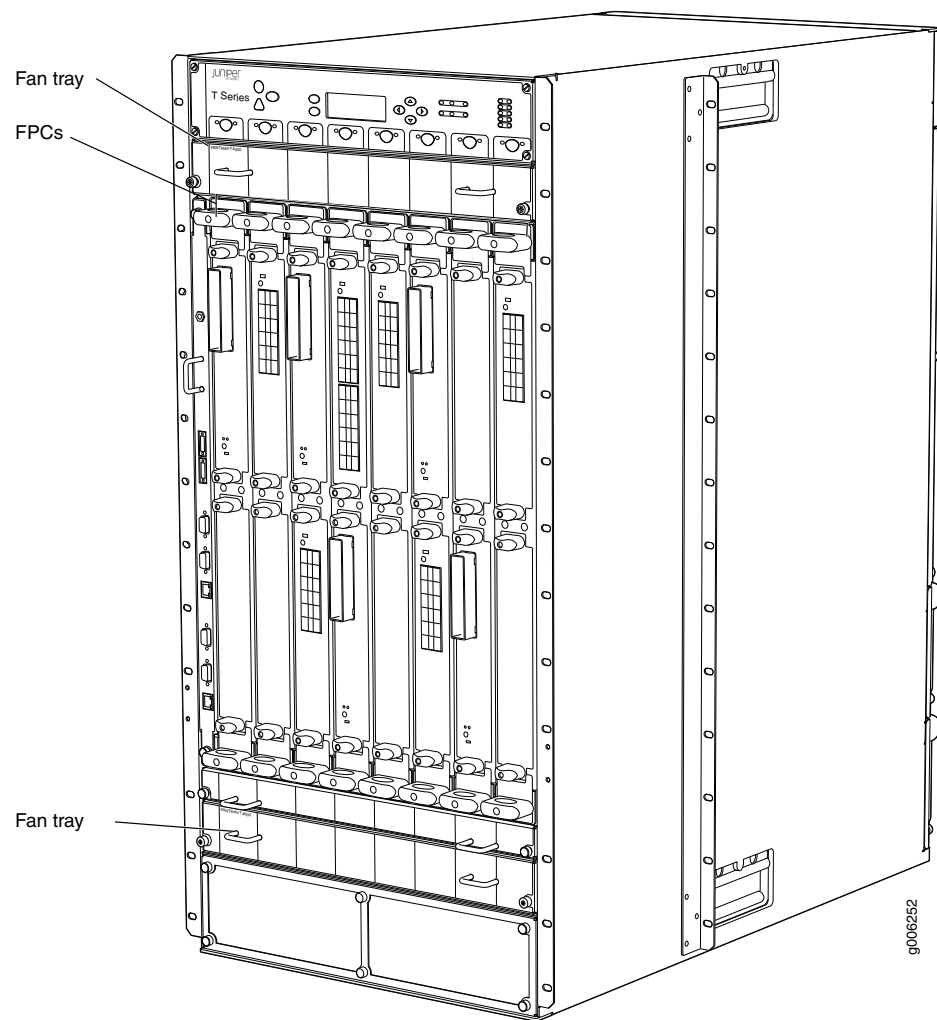
## Removing T4000 Components from the Chassis

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To make the router light enough to install manually, you must first remove most components from the chassis. These removal procedures are for the initial installation only, and assume that you have not connected any cables or power to the router.

Figure 41: Components to Remove from the Rear of the T4000 Router



*Figure 42: Components to Remove from the Front of the T4000 Router*

Remove the components first from the rear of the chassis ([Figure 41 on page 149](#)), and then from the front ([Figure 42 on page 150](#)):

1. [Removing the T4000 DC Power Supplies on page 151](#)
2. [Removing the T4000 SIBs on page 152](#)
3. [Removing the T4000 Control Boards on page 153](#)
4. [Removing the T4000 SCGs on page 154](#)
5. [Removing the T4000 Rear Fan Tray on page 155](#)
6. [Removing the T4000 Front Cable Management System on page 156](#)
7. [Removing the T4000 Front Fan Trays on page 157](#)
8. [Removing the T4000 FPCs on page 159](#)



## Removing the T4000 DC Power Supplies

The power supplies are located at the rear of the chassis below the SIBs. Each six-input DC power supply weighs approximately 39.7 lb (18.0 kg).

To remove the power supplies, starting with the upper power supply:

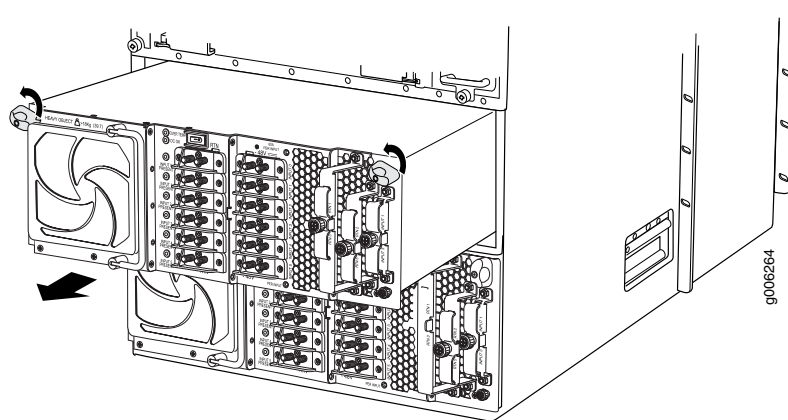
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Loosen the captive screws on the lower corners of the power supply faceplate completely.
3. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.
4. Grasp the handle on the power supply faceplate, and pull firmly to start removing the power supply. Slide it halfway out of the chassis (see [Figure 43 on page 151](#)).
5. Place one hand underneath the power supply to support it, and slide it completely out of the chassis.



**CAUTION:** Be prepared to support the full weight of the power supply as you remove it from the router.

6. Repeat the procedure for the other power supply.

*Figure 43: Removing a Six-Input DC Power Supply Before Installing the Router*



## Removing the T4000 SIBs

Five SIBs are installed in the router. The SIBs are located in the rear of the chassis in the slots marked **SIB0** through **SIB4**. Each SIB weighs approximately 7.1 lb (3.2 kg).

To remove the SIBs (see [Figure 44 on page 153](#)):

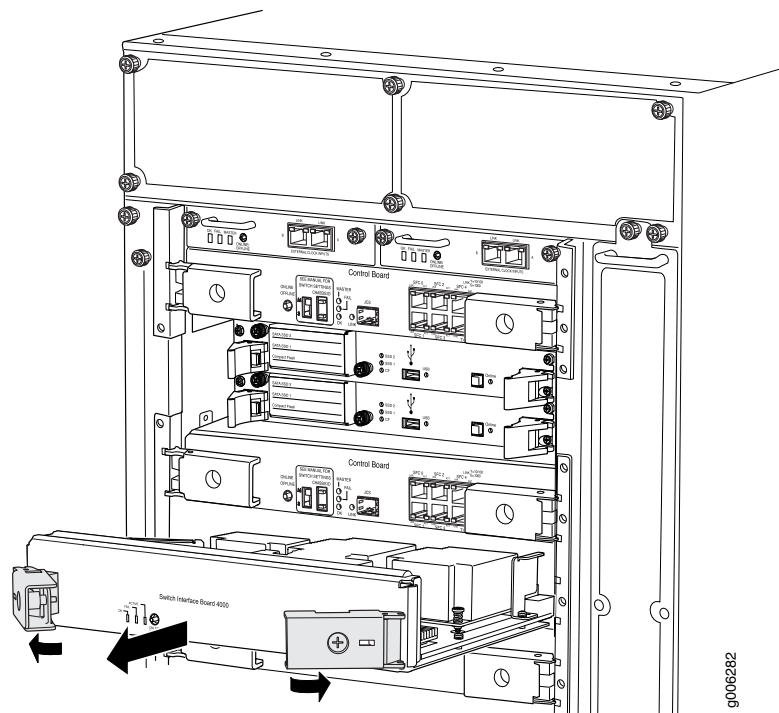
1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
3. Loosen the captive screws (using a Phillips (+) screwdriver, number 2) on the ejector handles on each side of the SIB faceplate.
4. Flip the ejector handles outward to unseat the SIB.
5. Grasp both ejector handles, pull firmly, and slide the SIB about three-quarters of the way out of the chassis.
6. Place one hand underneath the SIB to support it, and slide it completely out of the chassis. Place it on the antistatic mat.



**CAUTION:** Do not stack hardware components on one another after you remove them. Place each component on an antistatic mat resting on a stable, flat surface.

7. Repeat the procedure for each of the remaining SIBs.

Figure 44: Removing a SIB



## Removing the T4000 Control Boards

The router has one or two control boards, located in the upper rear of the chassis in the slots marked **CB0** and **CB1**. Each LCC-CB weighs approximately 5 lb (2.3 kg).

To remove the control boards (see [Figure 45 on page 154](#)):

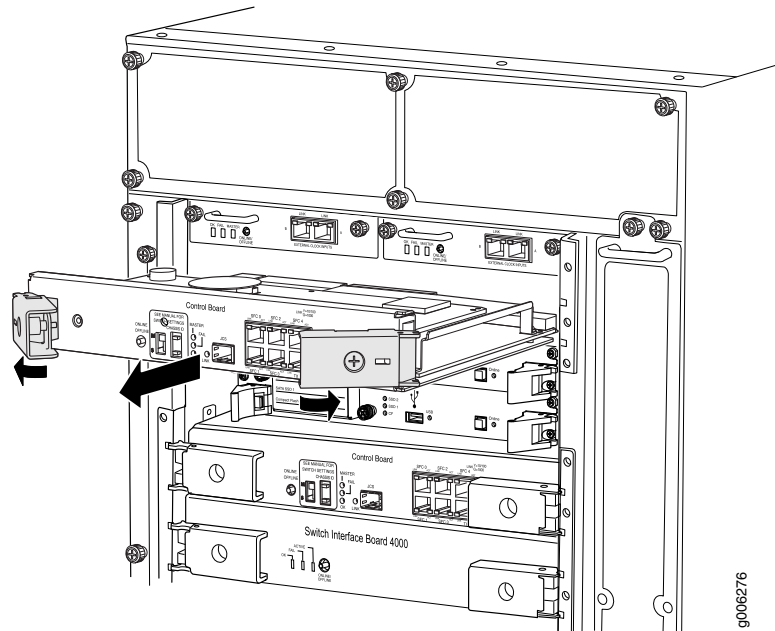
1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
3. Loosen the captive screws on the ejector handles on both sides of the control board faceplate.
4. Flip the ejector handles outward to unseat the control board.
5. Grasp the ejector handles, and slide the control board about halfway out of the chassis.
6. Place one hand underneath the control board to support it, and slide it completely out of the chassis. Place it on the antistatic mat.



**CAUTION:** Do not stack hardware components on one another after you remove them. Place each component on an antistatic mat resting on a stable, flat surface.

7. Repeat the procedure for the second control board.

*Figure 45: Removing a Control Board*



## Removing the T4000 SCGs

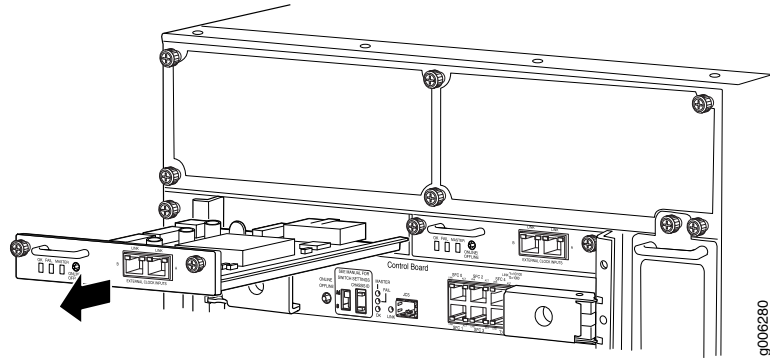
The router has one or two SCGs, located in the upper rear of the chassis, above the control boards and Routing Engines. Each SCG weighs approximately 1.9 lb (0.9 kg).

To remove the SCGs (see [Figure 46 on page 155](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site..
3. Loosen the captive screws on the edges of the SCG faceplate.
4. Grasp the SCG by the handle on the faceplate, and slide it out of the chassis.

5. Place the SCG on the antistatic mat.
6. Repeat the procedure for the second SCG.

*Figure 46: Removing the SCGs*



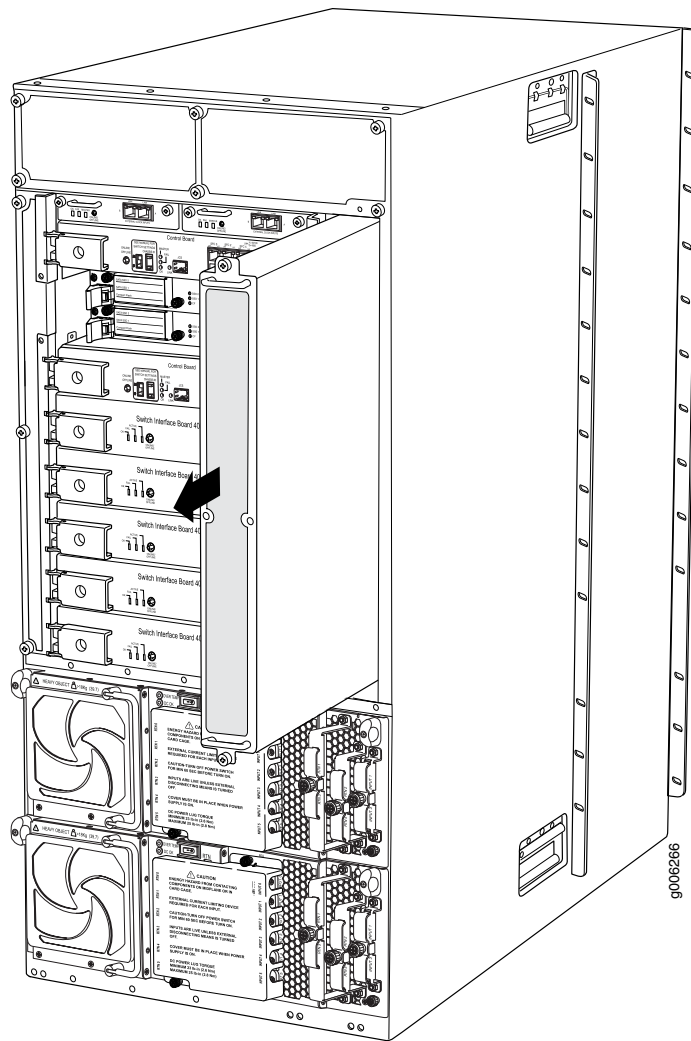
## Removing the T4000 Rear Fan Tray

The rear fan tray is mounted vertically on the right side of the rear of the chassis. The rear fan tray weighs about 10 lb (4.5 kg).

To remove the rear fan tray (see [Figure 47 on page 156](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Loosen the captive screws on the top and bottom of the fan tray faceplate.
3. Grasp the handles, and pull the fan tray halfway out of the chassis.
4. Place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.

Figure 47: Removing the Rear Fan Tray



## Removing the T4000 Front Cable Management System

The front cable management system is located below the FPC card cage. The cable management system weighs approximately 5 lb (2.3 kg).

To remove the front cable management system:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Using a 3/8-in. nut driver, unscrew the nuts on the corners of the cable management system.
3. Grasp the bottom of the cable management system, and pull it straight out from the studs on the front of the chassis.

## Removing the T4000 Front Fan Trays

The upper front fan tray is located above the FPC card cage, and the lower front fan tray is located below the air filter. Each front fan tray weighs about 20.4 lb (9.3 kg)

To remove the front fan trays (see [Figure 48 on page 158](#) and [Figure 49 on page 158](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Loosen the captive screws on the corners of the faceplate of one of the fan trays.
3. Grasp the handles, and pull the fan tray halfway out of the chassis.
4. Place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.
5. Repeat the procedure to remove the remaining front fan tray.

Figure 48: Removing an Upper Front Fan Tray

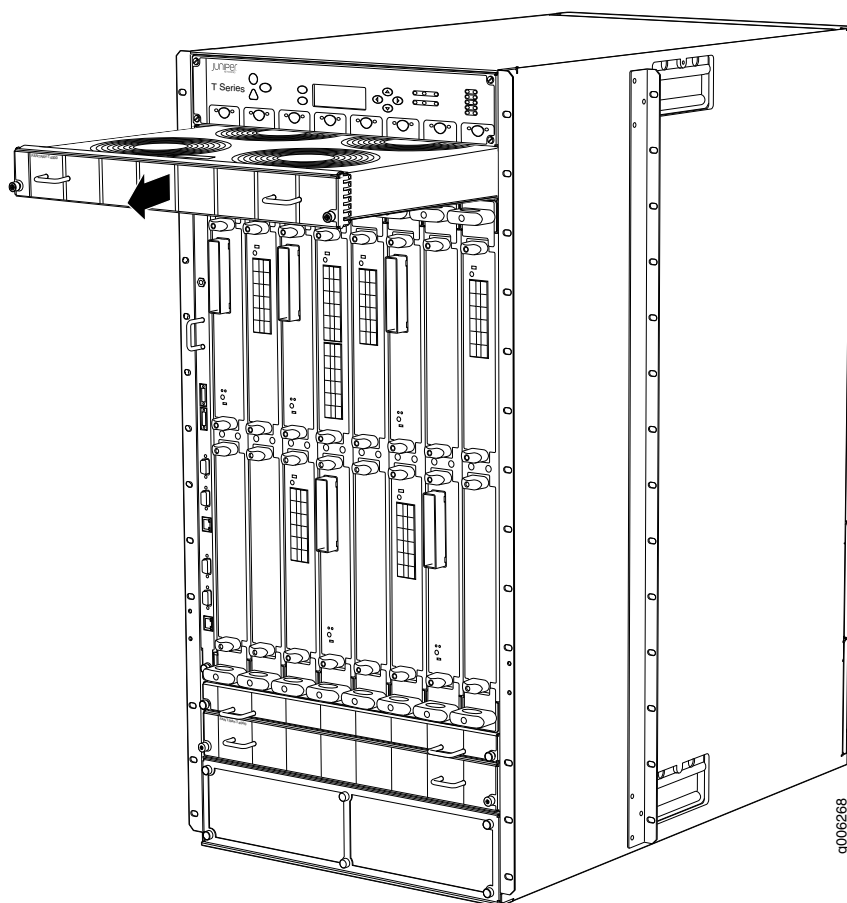
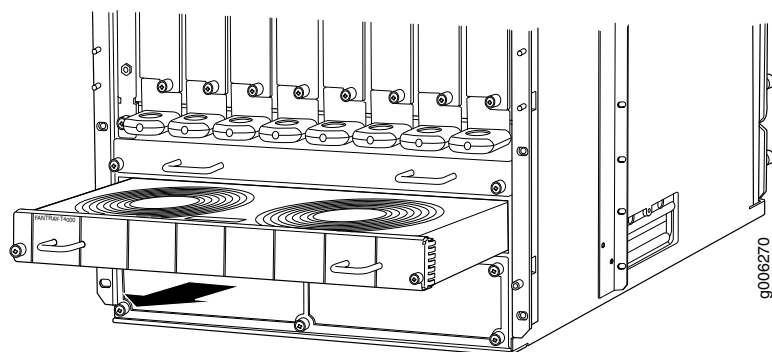


Figure 49: Removing a Lower Front Fan Tray





## Removing the T4000 FPCs

The router holds up to eight FPCs, which are installed vertically in the front of the router. An FPC with PICs installed can weigh up to 33.5 lb (15.1 kg).

Each FPC slot not occupied by an FPC must be covered by an FPC blank panel. An FPC blank panel weighs 9 lb (4.2 kg).

To remove an FPC (see [Figure 50 on page 160](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
3. Before removing the FPCs, record their location in the chassis so that you can reinstall each FPC in the correct slot.
4. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.
5. Grasp the handles, and slide the FPC straight out of the card cage halfway.
6. Place one hand around the front of the FPC (the PIC housing) and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



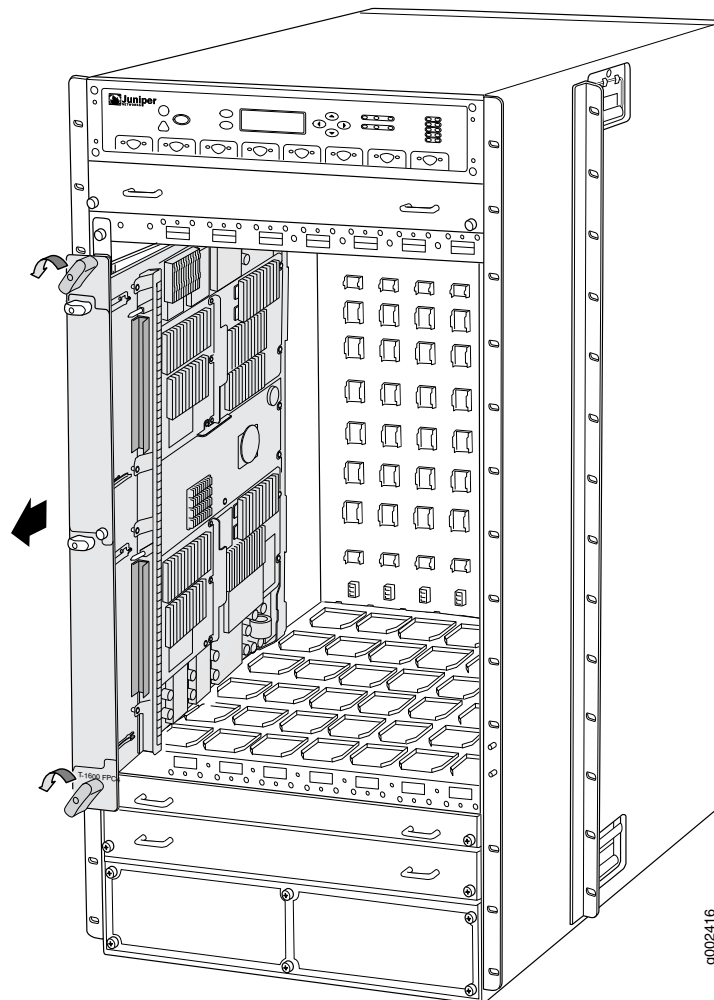
**CAUTION:** The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 33.5 lb (15.1 kg)—as you slide the FPC out of the chassis.

When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

Do not stack FPCs on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

7. Repeat the procedure for each remaining FPC.

Figure 50: Removing an FPC

**Related Documentation**

- [Overview of Installing a T4000 Router Without a Mechanical Lift on page 147](#)
- [Installing the T4000 Chassis in a Rack or Cabinet Manually on page 160](#)
- [Reinstalling the T4000 Components in the Chassis on page 163](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

## Installing the T4000 Chassis in a Rack or Cabinet Manually

To install the router in the rack (see [Figure 52 on page 163](#)):



**CAUTION:** If you are installing two routers in one rack, install the lower one first. Installing a router in the upper position in a rack or cabinet requires a lift.



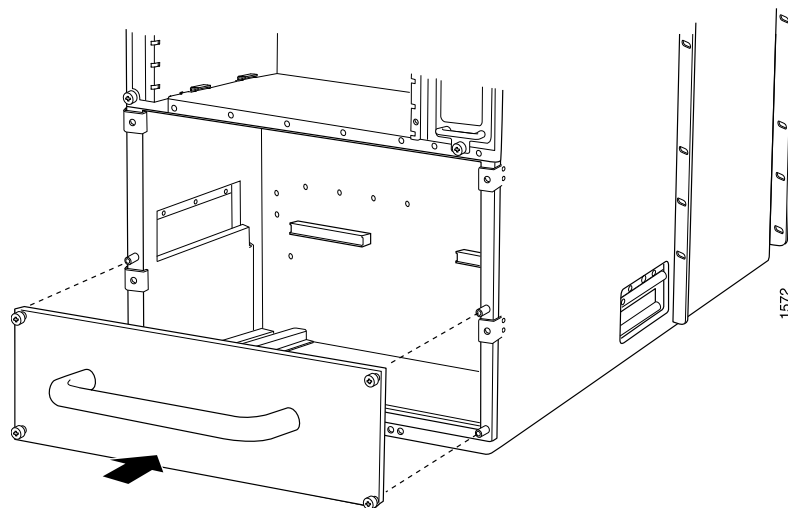
**CAUTION:** Before front-mounting the router in a rack, have a qualified technician verify that the rack is strong enough to support the router's weight and is adequately supported at the installation site.



**CAUTION:** Lifting the chassis and mounting it in a rack requires four people.

1. For open-frame racks, ensure that the rack is in its permanent location and is secured to the building.
2. Ensure that the installation site allows adequate clearance for both airflow and maintenance.
3. Attach the installation handle by tightening the captive screws of the handle into the holes previously occupied by the captive screws of the power supplies (see [Figure 51 on page 161](#)). Tighten the screws, using a Phillips (+) screwdriver, number 2.

*Figure 51: Attaching the Installation Handle*



**CAUTION:** Do not lift the router using the installation handle or the handles on the sides of the chassis. Use these handles only to help position the router.

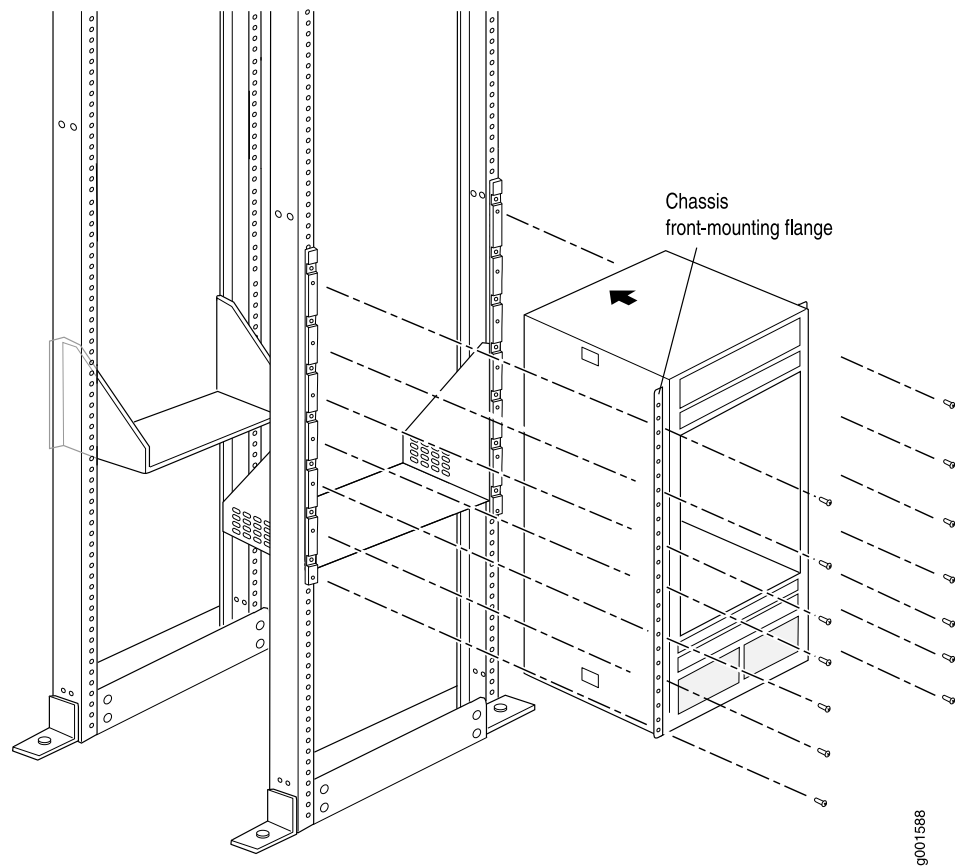
4. Position the router in front of the rack or cabinet, centering it in front of the mounting shelves. Use a pallet jack if one is available.
5. With two people in the front and two people in the back, hold onto the bottom of the chassis, and carefully lift it onto the mounting shelves.



**WARNING:** To prevent injury, keep your back straight and lift with your legs, not your back. Avoid twisting your body as you lift. Balance the load evenly, and be sure that your footing is solid.

6. With one person pulling on the installation handle from the rear of the rack or cabinet while two people push on the front-mounting flanges, slide the router onto the mounting shelves until the mounting brackets or front-mounting flanges contact the rack rails or spacer bars (depending on your type of installation). The shelves ensure that the holes in the mounting brackets and the front-mounting flanges of the chassis align with the holes in the rack rails.
7. If you are installing the router in a four-post rack or cabinet, install a mounting screw and a cage nut into each of the holes aligned with the threaded holes in the spacer bars. If you are installing the router in an open-frame rack, install a mounting screw into each of the open mounting holes aligned with the rack, starting from the bottom.
8. Loosen the captive screws on the installation handle completely, and remove the handle from the chassis.
9. Visually inspect the alignment of the router. If the router is installed properly in the rack, all the mounting screws on one side of the rack should be aligned with the mounting screws on the opposite side and the router should be level.

Figure 52: Installing the Router in the Rack



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**NOTE:** For an illustration of the mounting hardware required for an open-frame rack, see [“Installing the T4000 Mounting Hardware for an Open-Frame Rack”](#) on page 133.

#### Related Documentation

- [T4000 Clearance Requirements for Airflow and Hardware Maintenance](#) on page 91
- [Overview of Installing a T4000 Router Without a Mechanical Lift](#) on page 147
- [Removing T4000 Components from the Chassis](#) on page 148
- [Reinstalling the T4000 Components in the Chassis](#) on page 163
- [Prevention of Electrostatic Discharge Damage](#) on page 423

## Reinstalling the T4000 Components in the Chassis

After the router is installed in the rack, you reinstall the removed components before cabling, booting, and configuring the router.

The procedures describe how to reinstall components in the chassis, first in the rear and then in the front:

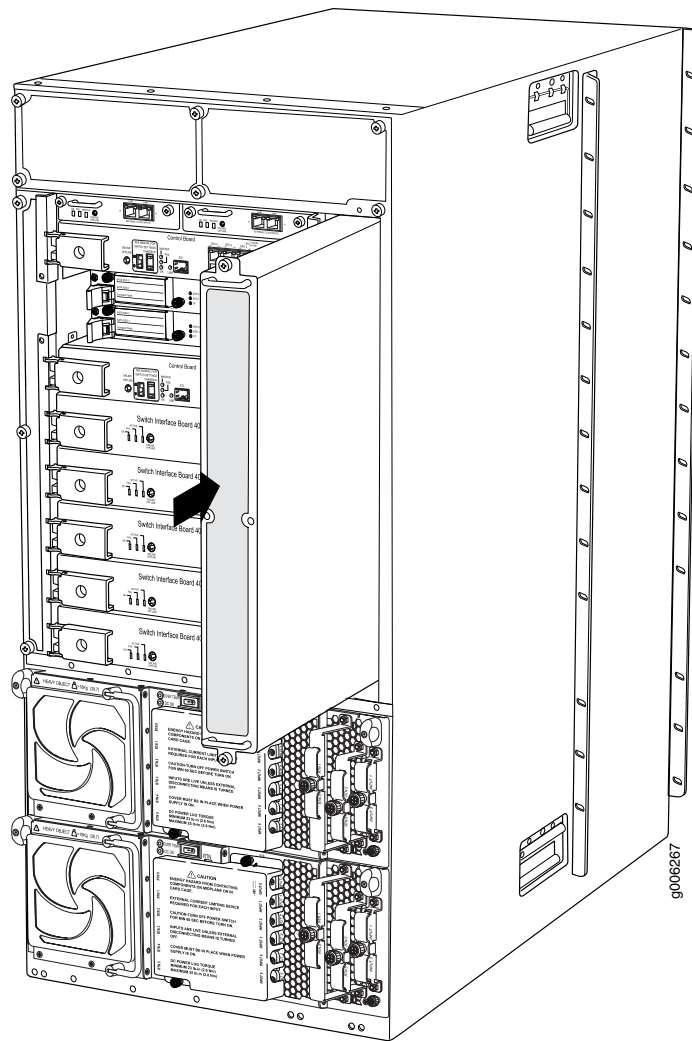
1. [Reinstalling the Rear Fan Tray on page 164](#)
2. [Reinstalling the T4000 SCGs on page 165](#)
3. [Reinstalling the T4000 Control Boards on page 166](#)
4. [Reinstalling the T4000 SIBs on page 167](#)
5. [Reinstalling the Power Supplies on page 168](#)
6. [Reinstalling the FPCs on page 169](#)
7. [Reinstalling T4000 Front Fan Trays on page 170](#)
8. [Reinstalling the T4000 Front Cable Management System on page 171](#)

## Reinstalling the Rear Fan Tray

To install a replacement rear fan tray (see [Figure 53 on page 165](#)):

1. Grasp the fan tray by its handles, and insert it straight into the chassis.
2. Tighten the captive screws on the fan tray faceplate to secure it in the chassis, using a Phillips (+) screwdriver, number 2.

Figure 53: Reinstalling the Rear Fan Tray



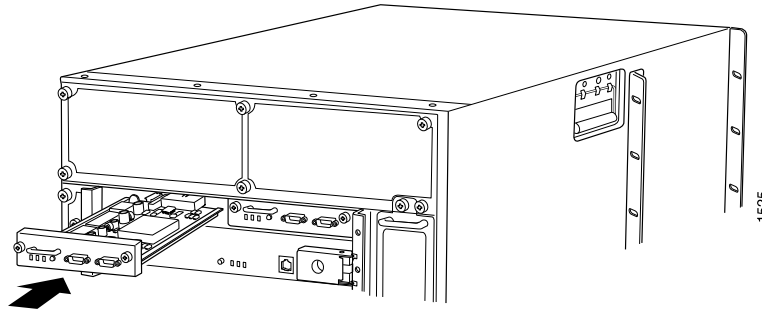
## Reinstalling the T4000 SCGs

To reinstall the SCGs (see [Figure 54 on page 166](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Carefully align the sides of the SCG with the guides in the SCG slot.
3. Grasp the SCG by its handle, and slide it straight into the chassis until it contacts the midplane.

4. Tighten the captive screws on the corners of the SCG faceplate.
5. Repeat the procedure to reinstall the remaining SCG.

*Figure 54: Reinstalling an SCG*

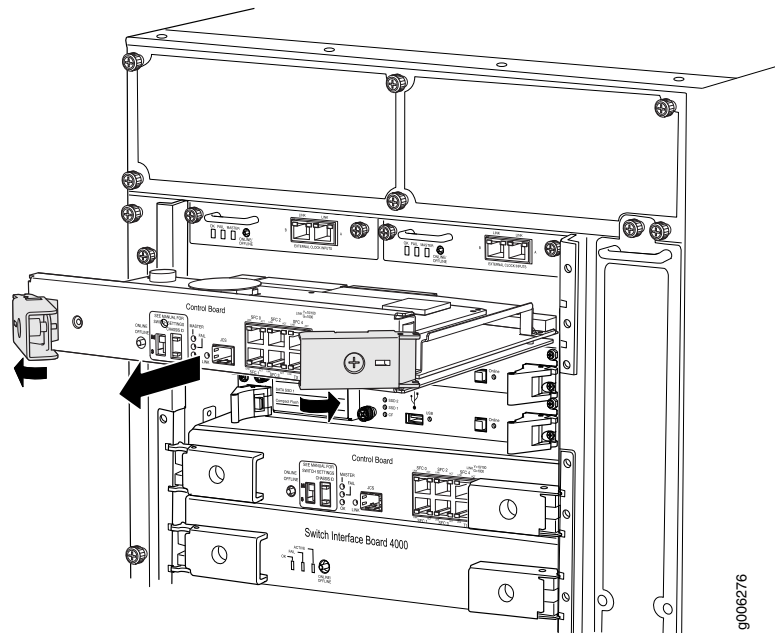


## Reinstalling the T4000 Control Boards

To reinstall the control boards (see [Figure 55 on page 167](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Carefully align the sides of the control boards with the guides inside the chassis.
3. Slide the control boards into the chassis, carefully ensuring that it is correctly aligned.
4. Grasp both ejector handles and press them inward to seat the control board.
5. Tighten the captive screws on the ejector handles, using a Phillips (+) screwdriver, number 2.
6. Repeat the procedure to reinstall the remaining control board.



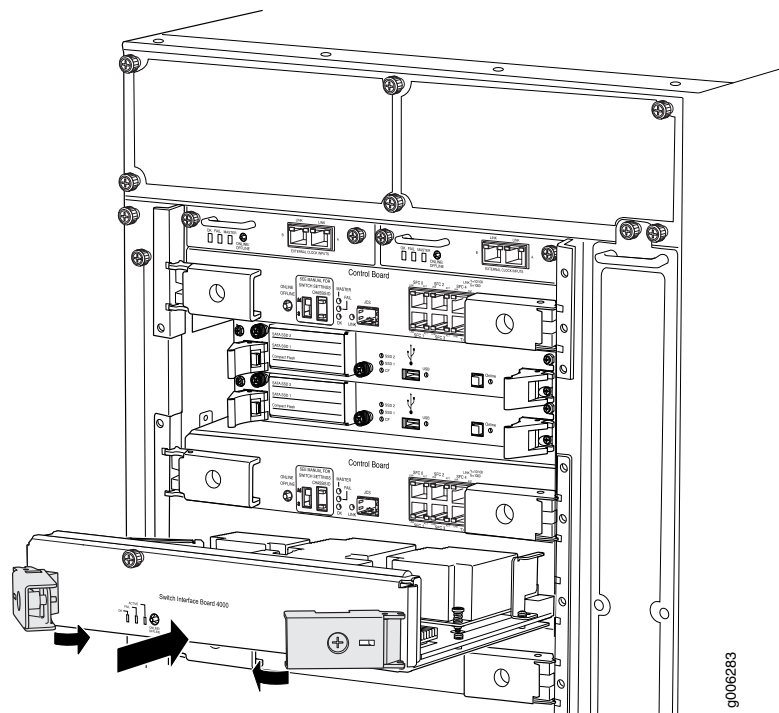
*Figure 55: Reinstalling an LCC-CB*

## Reinstalling the T4000 SIBs

To reinstall the SIBs (see [Figure 56 on page 168](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Place one hand underneath the SIB to support it. With the other hand, hold one of the ejector handles on the SIB faceplate.
3. Carefully align the sides of the SIB with the guides inside the chassis.
4. Slide the SIB into the chassis, carefully ensuring that it is correctly aligned.
5. Grasp both ejector handles and press them inward to seat the SIB.
6. Tighten the captive screws on the ejector handles.
7. Repeat the procedure for each of the remaining SIBs.

Figure 56: Reinstalling a T4000 SIB

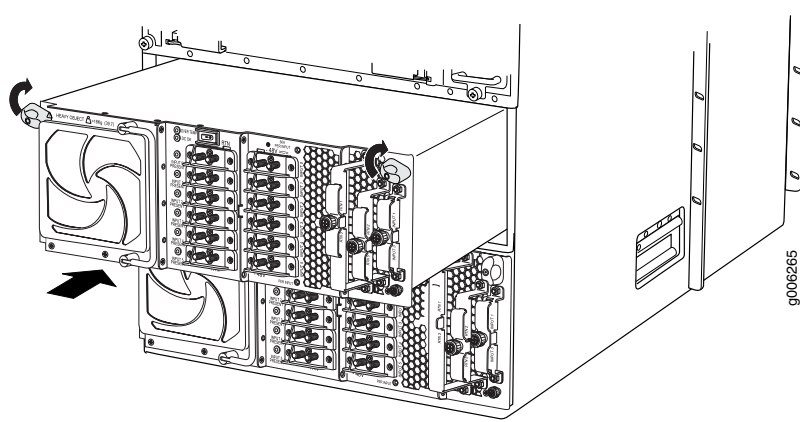


## Reinstalling the Power Supplies

Reinstall the lower power supply first, then the upper power supply. To reinstall the DC power supplies (see [Figure 57 on page 169](#)):

1. Using both hands, slide the power supply into the chassis until you feel resistance.
2. Twist the ejector handles at the upper corners of the power supply faceplate clockwise until they stop.
3. Tighten the captive screws at the lower corners of the power supply faceplate to secure the power supply in the chassis.
4. Repeat the procedure for the upper power supply.

Figure 57: Reinstalling a Six-Input DC Power Supply



## Reinstalling the FPCs

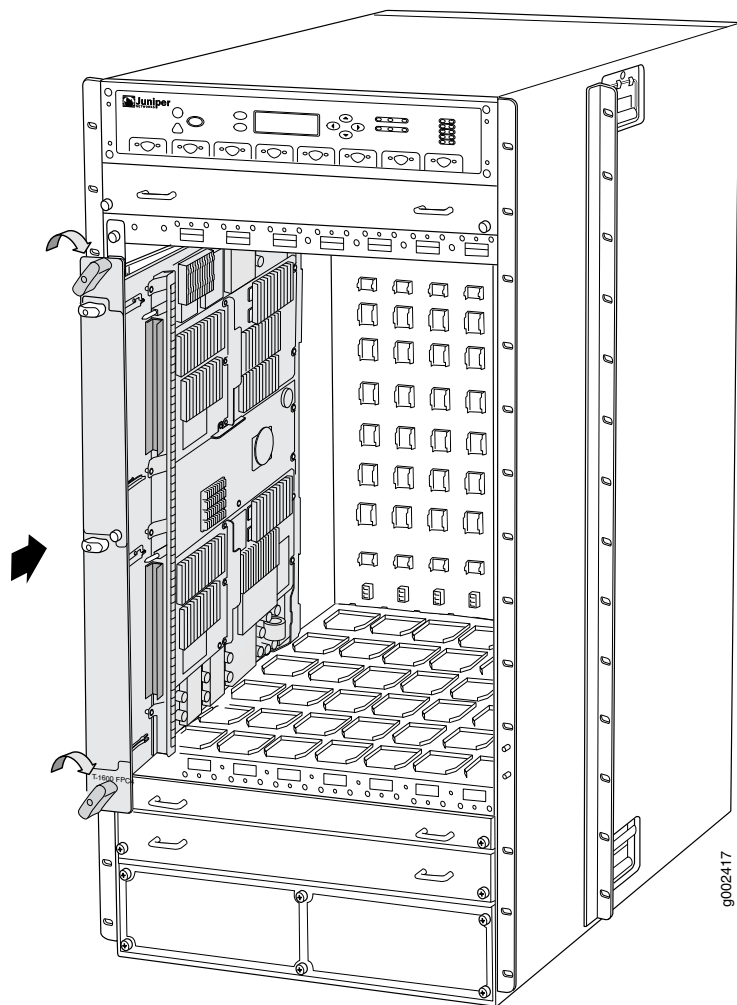
To reinstall FPCs (see [Figure 58 on page 170](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Using the list you created when you removed the FPCs, locate the slot in the FPC card cage in which you plan to install the FPC.
3. Lift the FPC into place and carefully align first the bottom, then the top of the FPC with the guides inside the card cage. Be sure the FPC is right-side up, with the components on the right of the FPC.



**CAUTION:** When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

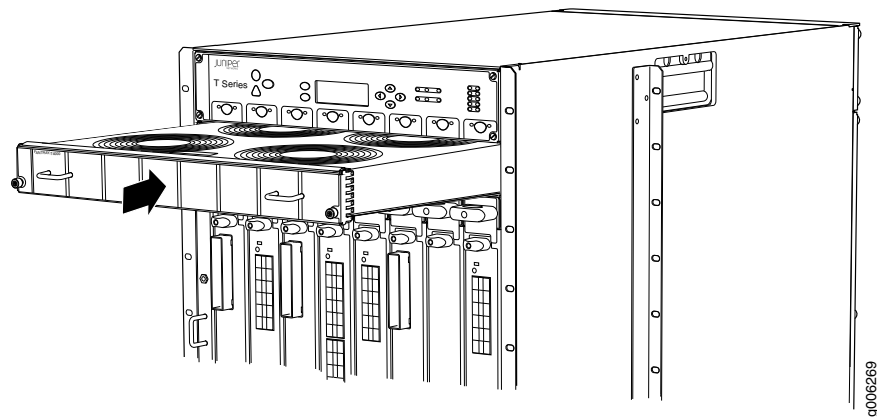
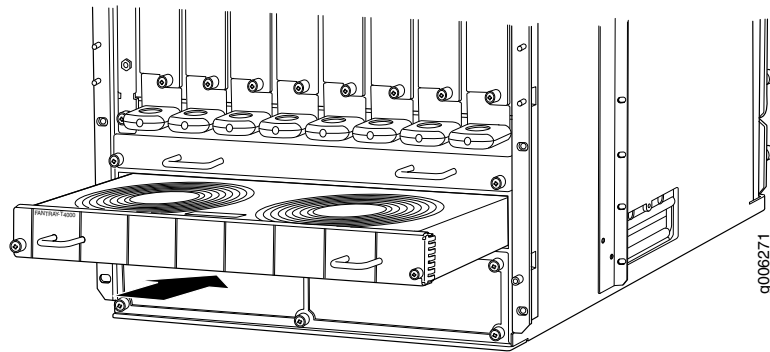
4. Slide the FPC all the way into the card cage until you feel resistance.
5. Starting with the ejector handles on the FPC faceplate nearly horizontal, simultaneously turn both ejector handles clockwise to seat the FPC.
6. Repeat the procedure to reinstall each remaining FPC.

*Figure 58: Reinstalling an FPC*

## Reinstalling T4000 Front Fan Trays

To reinstall the front fan trays (see [Figure 59 on page 171](#) and [Figure 60 on page 171](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Grasp one of the fan trays by its handles, and insert it straight into the chassis.
3. Tighten the captive screw on each side of the fan tray faceplate to secure it in the chassis.
4. Repeat the procedure to reinstall the remaining fan tray.

*Figure 59: Reinstalling an Upper Front Fan Tray**Figure 60: Reinstalling a Lower Front Fan Tray*

## Reinstalling the T4000 Front Cable Management System

To reinstall the front cable management system:

1. Position the front cable management system on the studs on the lower front of the chassis.
2. Insert the nuts through the holes in the cable management system onto the studs on the chassis.
3. Using a 3/8-in. nut driver, tighten the nuts securely.

### Related Documentation

- [Overview of Installing a T4000 Router Without a Mechanical Lift on page 147](#)
- [Removing T4000 Components from the Chassis on page 148](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)



## CHAPTER 20

# Connecting the Router to Ground

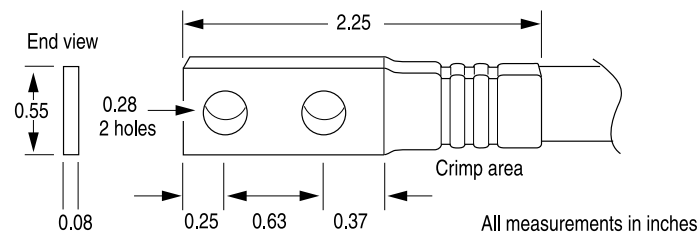
- [Tools and Parts Required to Ground the T4000 Router on page 173](#)
- [Connecting the T4000 Grounding Cable on page 174](#)

### Tools and Parts Required to Ground the T4000 Router

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- Grounding cable (which you must provide)
- Grounding lug (provided with the router)

**Figure 61: Grounding Lug**



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- M6 screws or UNC 1/4-20 screws
- Electrostatic discharge (ESD) grounding wrist strap

#### Related Documentation

- [Overview of Grounding the T4000 Router](#)
- [Connecting the T4000 Grounding Cable on page 174](#)

## Connecting the T4000 Grounding Cable

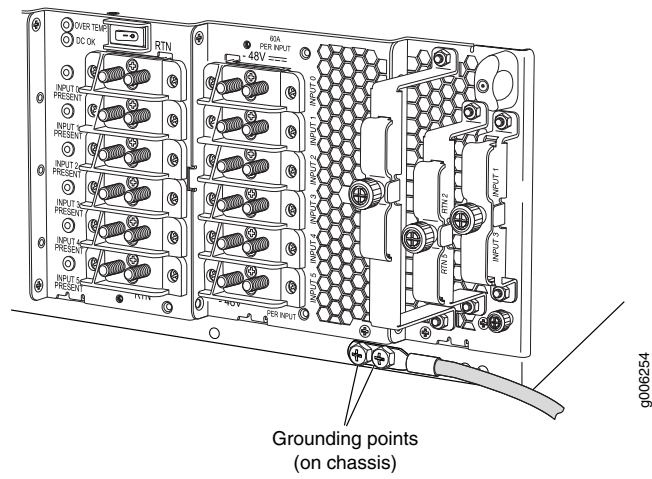
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You ground the router by connecting a grounding cable to earth ground and then attaching it to the chassis grounding points with two screws. You must provide the grounding cable (a cable lug is supplied with the router). To connect the grounding cable (see [Figure 62 on page 175](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Make sure that grounding surfaces are clean and brought to a bright finish before grounding connections are made.
3. Connect the grounding cable to a proper earth ground.
4. Verify that a licensed electrician has attached the cable lug provided with the router to the grounding cable.
5. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
6. Place the grounding cable lug over the grounding points. The left pair is sized for M6 screws, and the right pair is sized for UNC 1/4-20 screws.
7. Secure the grounding cable lug to the grounding points, first with the washers, then with the screws.
8. Verify that the grounding cabling is correct, that the grounding cable does not touch or block access to router components, and that it does not drape where people could trip on it.



Figure 62: Connecting the Grounding Cable



#### Related Documentation

- [Overview of Grounding the T4000 Router](#)
- [Tools and Parts Required to Ground the T4000 Router on page 173](#)
- [T4000 Chassis Grounding Cable and Lug Specifications on page 90](#)



## CHAPTER 21

# Connecting the Router to External Devices

- [Overview of Connecting the T4000 Router to External Devices on page 177](#)
- [Tools and Parts Required to Connect the T4000 Router to External Devices on page 178](#)
- [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)
- [Connecting the T4000 Router to a Management Ethernet Device on page 180](#)
- [Connecting the T4000 Router to an External Alarm-Reporting Device on page 182](#)
- [Connecting PIC Cables to the T4000 Router on page 183](#)

### Overview of Connecting the T4000 Router to External Devices

After you have grounded the T4000 Core Router, you can connect the following external devices:

- An external console or auxiliary device to the **CONSOLE** ports on the Connector Interface Panel (CIP).

See [“Connecting the T4000 Router to a Management Console or Auxiliary Device” on page 178](#).

- A laptop, modem, or other auxiliary device to the **AUXILIARY** ports on the CIP.

See [“Connecting the T4000 Router to a Management Console or Auxiliary Device” on page 178](#).

- A management network to the **ETHERNET** ports on the CIP.

See [“Connecting the T4000 Router to a Management Ethernet Device” on page 180](#).

- An external alarm-reporting device to the alarm relay contacts on the CIP.

See [“Connecting the T4000 Router to an External Alarm-Reporting Device” on page 182](#).

- An external clocking device to the **EXTERNAL CLOCK INPUTS** on the SONET Clock Generator with RJ-48 ports.

See [Connecting the T4000 Router to an External Clocking Device](#).



**NOTE:** The external clock inputs on the SCG with DB-9 ports are not supported.

- A network connection to the ports on the PICs.

See [“Connecting PIC Cables to the T4000 Router” on page 183](#).

**Related  
Documentation**

- [Overview of Installing the T4000 Router on page 119](#)

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## Tools and Parts Required to Connect the T4000 Router to External Devices

To connect the router to external devices, you need the following tools:

- Phillips (+) screwdrivers, numbers 1 and 2
- 2.5-mm flat-blade (-) screwdriver
- Electrostatic discharge (ESD) grounding wrist strap

**Related  
Documentation**

- [Overview of Connecting the T4000 Router to External Devices on page 177](#)
- [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)
- [Connecting the T4000 Router to an External Alarm-Reporting Device on page 182](#)
- [Connecting the T4000 Router to an External Clocking Device](#)
- [Connecting PIC Cables to the T4000 Router on page 183](#)

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## Connecting the T4000 Router to a Management Console or Auxiliary Device

To use a system console to configure and manage the Routing Engine, connect it to the appropriate **CONSOLE** port on the CIP. To use a laptop, modem, or other auxiliary device, connect it to the appropriate **AUXILIARY** port on the CIP. Both ports accept an RS-232 (EIA-232) serial cable with a DB-9 female connector. One DB-9/DB-9 cable is provided with the router. To connect a device to the **CONSOLE** port, and another device to the **AUXILIARY** port, you must supply another cable.

To connect a management console or auxiliary device:

1. Turn off the power to the console or auxiliary device.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Connect one end (shown in [Figure 63 on page 179](#)) of a serial cable with a DB-9 female connector to the appropriate **CONSOLE** or **AUXILIARY** port (see [Figure 64 on page 180](#)). The ports labeled **HOST 0** connect to the Routing Engine in the upper Routing Engine

slot (**RE0**), and the ports labeled **HOST 1** connect to the Routing Engine in the lower Routing Engine slot (**RE1**).



**NOTE:**

For console devices, configure the serial port to the following values:

- Baud rate—9600
- Parity—N
- Data bits—8
- Stop bits—1
- Flow control—none

4. Using a 2.5-mm flat-blade screwdriver, tighten the screws on the connector.
5. Attach the other end of the cable to the console or auxiliary device.

*Figure 63: Console and Auxiliary Serial Port Connector*

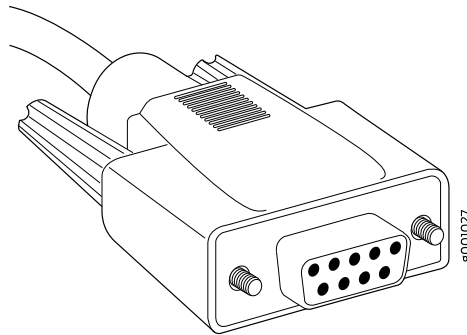
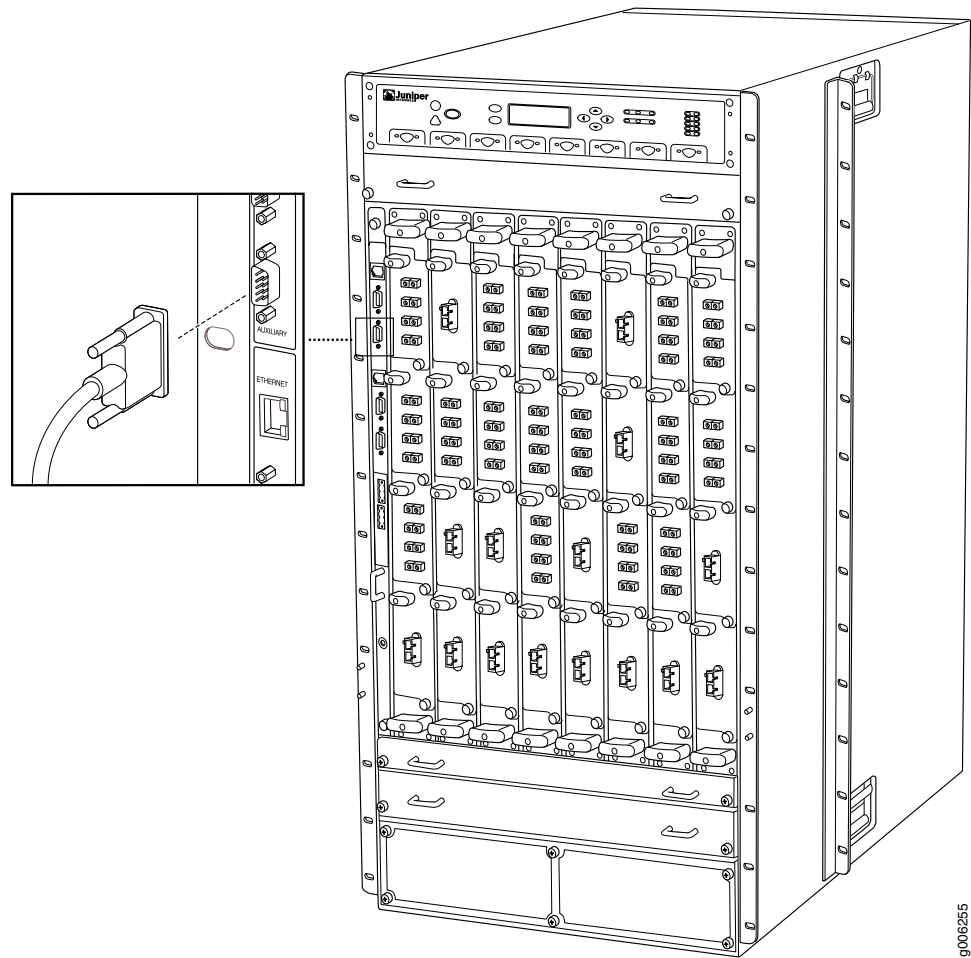


Figure 64: Console and Auxiliary Ports on the CIP



#### Related Documentation

- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [Overview of Connecting the T4000 Router to External Devices on page 177](#)

## Connecting the T4000 Router to a Management Ethernet Device

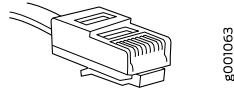
To connect the Routing Engine to a network for out-of-band management, connect an Ethernet with RJ-45 connectors to the **ETHERNET** port on the CIP. One cable is provided with the router.

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Turn off the power to the management device.
3. Plug one end of the Ethernet cable ([Figure 65 on page 181](#) shows the connector) into the appropriate **ETHERNET** port on the CIP (see [Figure 66 on page 181](#)). The ports

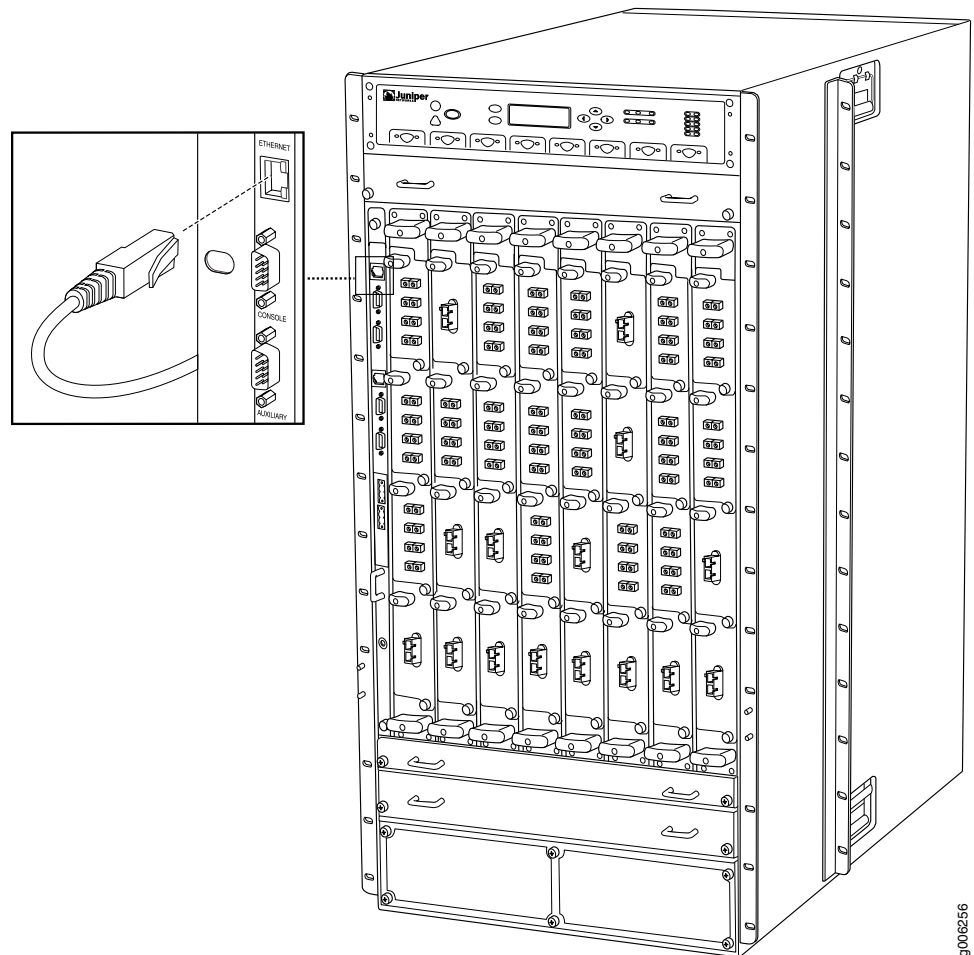
labeled **HOST 0** connect to the Routing Engine in the upper Routing Engine slot (**RE0**), and the ports labeled **HOST 1** connect to the Routing Engine in the lower Routing Engine slot (**RE1**).

4. Plug the other end of the cable into the network device.

*Figure 65: Routing Engine Ethernet Cable Connector*



*Figure 66: ETHERNET Port on the CIP*



**Related Documentation**

- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [Overview of Connecting the T4000 Router to External Devices on page 177](#)

## Connecting the T4000 Router to an External Alarm-Reporting Device

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To connect the router to external alarm-reporting devices, attach wires to the **RED ALARM** and **YELLOW ALARM** relay contacts on the CIP. A system condition that triggers the red or yellow alarm LED on the craft interface also activates the corresponding alarm relay contact.

The terminal blocks that plug into the alarm relay contacts are supplied with the router. They accept wire of any gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>), which is not provided. Use the gauge of wire appropriate for the external device you are connecting.

To connect an external device to an alarm relay contact:

1. Prepare the required length of wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>).
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. While the terminal block is not plugged into the relay contact, use a 2.5-mm flat-blade screwdriver to loosen the small screws on its side. With the small screws on its side facing left, insert wires into the slots in the front of the block based on the wiring for the external device. Tighten the screws to secure the wire.
4. Orient the terminal block according to the labels to the left of the appropriate relay contact (**NC** means “normally closed, **C** means “common,” and (**NO** means “normally open”).
5. Plug the terminal block into the relay contact and use a 2.5-mm flat-blade screwdriver to tighten the screws on the face of the block.
6. Attach the other end of the wires to the external device.

If attaching a reporting device for the other kind of alarm, repeat the procedure.

### Related Documentation

- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [Overview of Connecting the T4000 Router to External Devices on page 177](#)



## Connecting PIC Cables to the T4000 Router

The router supports PICs that use various kinds of network cable, including multimode and single-mode fiber-optic cable.

You connect PICs to the network by plugging in network cable. To connect cable to the PICs (see [Figure 67 on page 184](#), which shows a fiber-optic PIC):

1. Have ready a length of the type of cable used by the PIC. For cable specifications, see *Determining Transceiver Support and Specifications for M Series and T Series Routers* in the *T4000 Core Router Interface Module Reference*.
2. If the PIC cable connector port is covered by a rubber safety plug, remove the plug.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

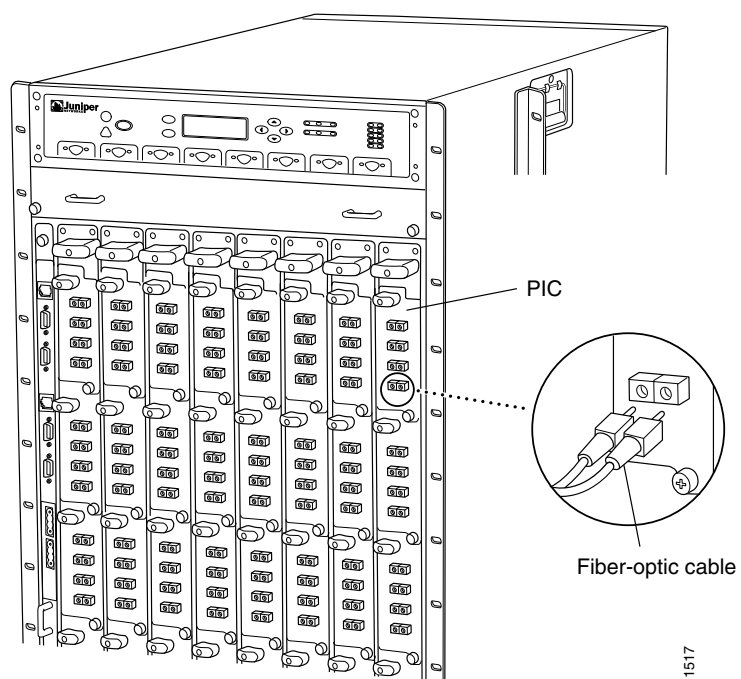
3. Insert the cable connector into the cable connector port on the PIC faceplate.
4. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.



**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

*Figure 67: Attaching a Cable to a PIC*

- Related Documentation**
- [T4000 PIC Description on page 62](#)
  - [Overview of Connecting the T4000 Router to External Devices on page 177](#)

## CHAPTER 22

# Connecting the Router to Power

- [Tools and Parts Required to Provide Power to the T4000 Router on page 185](#)
- [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)

### Tools and Parts Required to Provide Power to the T4000 Router

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To connect the router to power, you need the following tools and parts:

- DC-powered routers: 7/16-in. (11 mm) hexagonal-head external drive nut driver, with a torque range between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm), for tightening nuts to terminal studs on each power supply on a DC-powered router.
- Torque-controlled tool.



**CAUTION:** You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 in-lb (5.0 Nm).

- DC power cables and lugs. See [“T4000 DC Power Cable and Lugs Specifications” on page 105](#).

#### Related Documentation

- [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)

## Connecting DC Power to the T4000 Router (Six 60-A Inputs)

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You connect DC power to the router by attaching power cables from the DC power sources to the terminal studs on the power supply faceplates. You must provide power cables (the cable lugs are supplied with the router).



**CAUTION:** All connected inputs on the DC power supply in slot PEM0 must be powered by dedicated power feeds derived from feed A, and all connected inputs on the DC power supply in slot PEM1 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.



**NOTE:** We recommend that the positive (+) DC source power cables for the RTN (return) terminals be 2.6 in. (6.6 cm) longer than the negative (–) DC source power cables for the –48 V (input) terminals.



**CAUTION:** You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 lb-in. (5.0 Nm).



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.

To connect DC source power cables to the router, follow this procedure for each DC power supply:

1. Verify that a properly rated customer site circuit breaker for each DC power cable has been installed. See the DC power electrical safety guidelines for your router for more information.
2. Switch off the customer site circuit breakers. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.

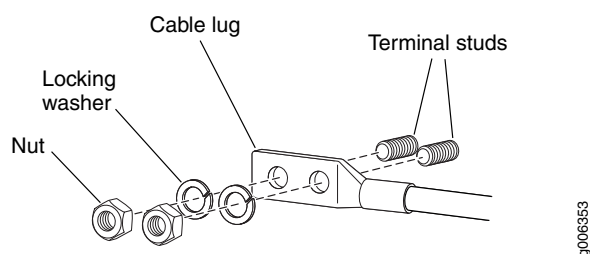
3. Verify that a licensed electrician has attached appropriate cable lugs to the DC power cables. See the DC power cable and lug specifications for your router for more information.
4. Switch the power switch on the power supply faceplate to the standby position.
5. Remove the clear plastic cover protecting the terminal studs on the faceplate.
6. Remove the nut and washer from each power terminal stud to be connected. If no washers and nuts are already installed, they should be in the accessory box.
7. Remove the captive screws on all three cable restraints on the right edge of the power supply faceplate (using a Phillips (+) screwdriver, number 2).
8. Route the negative (–) DC source power cables for **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4** over the smallest cable restraint on the far right. The cable restraint is marked as follows top to bottom: **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4**.



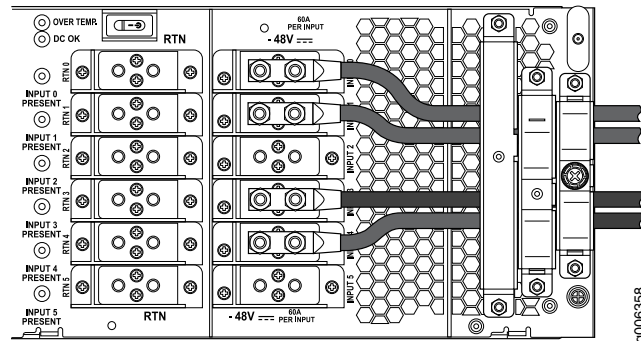
**NOTE:** You must route the cables in the locations as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the negative (–) DC source power cable lugs **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4** to the –48 V (input) terminals on the right. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

*Figure 68: Connecting DC Power Cables*



**Figure 69: Connecting Negative (–) DC Power Cables to INPUT 0, INPUT 1, INPUT 3, and INPUT 4**



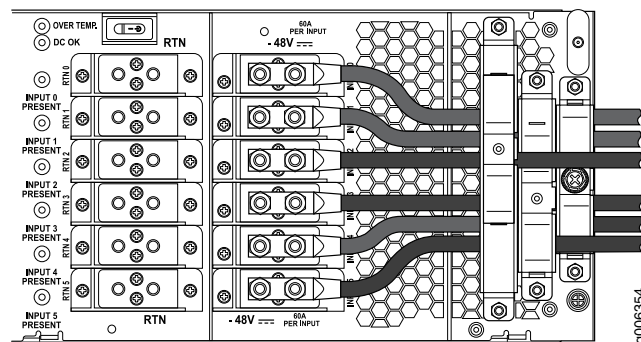
9. Replace the smallest cable restraint on the far right, and tighten the captive screw to hold the power cables for **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4** in place.
10. Route the negative (–) DC source power cables for **INPUT 2** and **INPUT 5** through the middle cable restraint. The middle cable restraint is marked as follows from top to bottom: **INPUT 2**, **RTN 2**, **RTN 5**, and **INPUT 5**.



**NOTE:** You must route the cables in the locations as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the negative (–) DC source power cable lugs to the –48 V (input) terminals on the right. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

**Figure 70: Connecting Negative (–) DC Power Cables to INPUT 2 and INPUT 5**



11. Route the positive (+) DC source power cables for **RTN 2** and **RTN 5** over the middle cable restraint. The middle cable restraint is marked as follows from top to bottom: **INPUT 2**, **RTN 2**, **RTN 5**, and **INPUT 5**.



**NOTE:** You must route the cables as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the positive (+) DC source power cable lugs **RTN 2** and **RTN 5** to the RTN (return) terminals on the left. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

12. Replace the middle cable restraint, and tighten the captive screw to hold the power cables for **INPUT 2**, **INPUT 5**, **RTN 2**, and **RTN 5** in place.
13. Route the positive (+) DC source power cables for **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4** over the largest cable restraint on the left. The left cable restraint is marked as follows from top to bottom: **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4**.

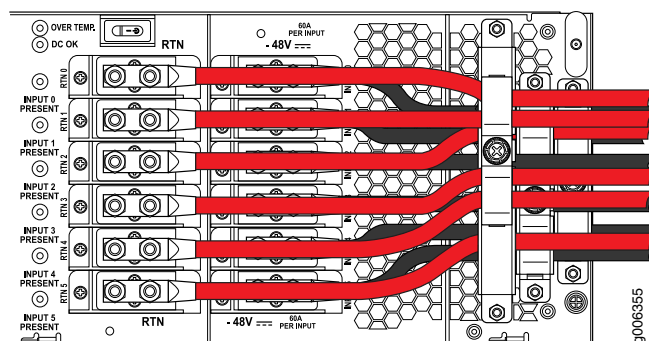


**NOTE:** You must route the cables as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the positive (+) DC source power cable lugs to the **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4** terminals on the left. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

14. Replace the left cable restraint, and tighten the captive screw to hold the power cables for **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4** in place.

**Figure 71: Connecting Positive (+) DC Power Cables to RTN 2, RTN 5, RTN 0, RTN 1, RTN 3, and RTN 4**



15. Verify that the power cabling is correct, that the power cables are not touching or blocking access to router components, and that they do not drape where people could trip on them.
16. Replace the clear plastic cover over the terminal studs on the faceplate.

**Related Documentation**

- [Tools and Parts Required to Provide Power to the T4000 Router on page 185](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- [Powering On the T4000 Router on page 207](#)
- [Configuring DC Power on a T4000 Router on page 213](#)
- [Troubleshooting the T4000 Power System on page 363](#)
- [T4000 DC Power Electrical Safety Guidelines on page 424](#)
- [T4000 DC Power Cable and Lugs Specifications on page 105](#)

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## Connecting DC Power to the T4000 Router (Five 60-A Inputs)

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You connect DC power to the router by attaching power cables from the DC power sources to the terminal studs on the power supply faceplates. You must provide power cables (the cable lugs are supplied with the router).



**CAUTION:** Do not use a terminal jumper for 60-A DC power cables. Using a terminal jumper is not supported for this procedure. Doing so will cause a short across the inputs and trip your external circuit breaker.



**CAUTION:** All connected inputs on the DC power supply in slot PEM0 must be powered by dedicated power feeds derived from feed A, and all connected inputs on the DC power supply in slot PEM1 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.



**CAUTION:** You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 lb-in. (5.0 Nm).



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.





**NOTE:** We recommend that the positive (+) DC source power cables to be connected to the RTN (return) terminals be 2.6 in. (6.6 cm) longer than the negative (–) DC source power cables to be connected to the –48 V (input) terminals.

To connect five 60-A DC source power cables to the router, follow this procedure for each DC power supply:

1. Verify that a properly rated customer site circuit breaker for each DC power cable has been installed. See the DC power electrical safety guidelines for your router for more information.
2. Switch off the customer site circuit breakers. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.
3. Verify that a licensed electrician has attached appropriate cable lugs to the DC power cables. See the DC power cable and lug specifications for your router for more information.
4. Switch the power switch on the power supply faceplate to the standby position.
5. Remove the clear plastic cover protecting the terminal studs on the faceplate.
6. Remove the nut and washer from each power terminal stud to be connected. If no washers and nuts are already installed, they should be in the accessory box.
7. Remove the captive screws on all three cable restraints on the right edge of the power supply faceplate (using a Phillips (+) screwdriver, number 2).
8. Route the negative (–) DC source power cables for **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4**, over the smallest cable restraint on the far right. The cable restraint is marked as follows top to bottom: **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4**,



**NOTE:** You must route the cables in the locations as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the negative (–) DC source power cable lugs to the –48V (input) terminals on the right: **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4**. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

Figure 72: Connecting DC Power Cables

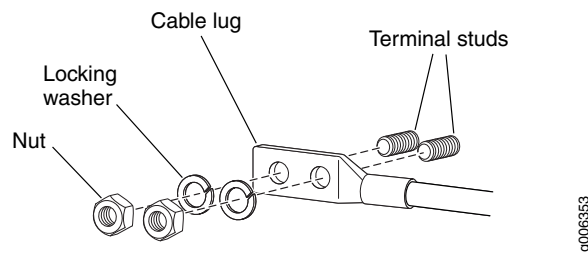
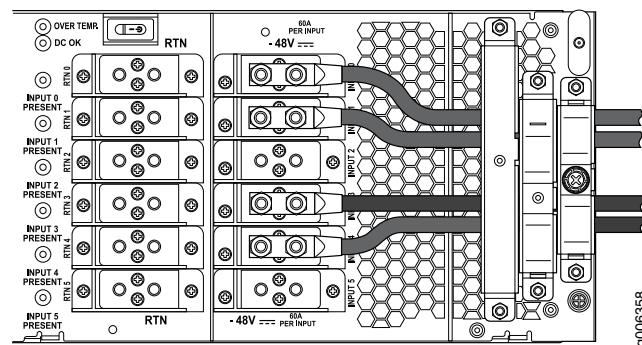


Figure 73: Connecting Negative (–) DC Power Cables to INPUT 0, INPUT 1, INPUT 3, and INPUT 4



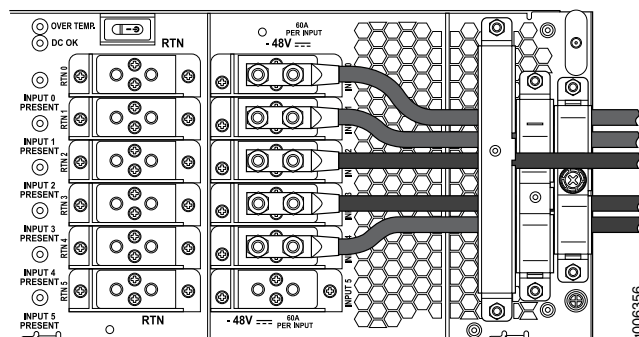
9. Replace the smallest cable restraint on the far right, and tighten the captive screw to hold the power cables for **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4** in place.
10. Route the negative (–) DC source power cables for **INPUT 2**, through the middle cable restraint. The middle cable restraint is marked as follows from top to bottom: **INPUT 2**, **RTN 2**, **RTN 5**, and **INPUT 5**.



**NOTE:** You must route the cable in the location as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the negative (–) DC source power cable lugs to the **INPUT 2** –48 V (input) terminal on the right. Secure the cable lug to the terminal studs, first with the washer, then with the nut. Using a 7/16-in. (11 mm) nut driver, tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

Figure 74: Connecting Negative (–) DC Power Cable to INPUT 2



11. Route the positive (+) DC source power cables for **RTN 2** over the middle cable restraint. The middle cable restraint is marked as follows from top to bottom: **INPUT 2**, **RTN 2**, **RTN 5**, and **INPUT 5**,



**NOTE:** You must route the cables as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the positive (+) DC source power cable lug to the **RTN 2** (return) terminal on the left. Secure the cable lug to the terminal stud, first with the washer, then with the nut. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to the nut.

12. Replace the middle cable restraint, and tighten the captive screw to hold the power cables for **INPUT 2** and **RTN 2** in place.
13. Route the positive (+) DC source power cables for **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4** over the largest cable restraint on the left. The left cable restraint is marked as follows from top to bottom **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4**,

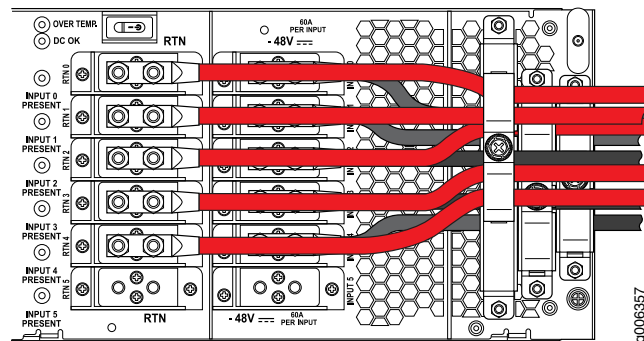


**NOTE:** You must route the cables as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the positive (+) DC source power cable lugs to the RTN terminals on the left: **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4**. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

14. Replace the left cable restraint, and tighten the captive screw to hold the power cables for **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4** in place.

Figure 75: Connecting Positive (+) DC Power Cable to RTN 2, RTN 0, RTN 1, RTN 3, RTN 4



15. Verify that the power cabling is correct, that the power cables are not touching or blocking access to router components, and that they do not drape where people could trip on them.
16. Replace the clear plastic cover over the terminal studs on the faceplate.

#### Related Documentation

- [Tools and Parts Required to Provide Power to the T4000 Router on page 185](#)
- [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- [Powering On the T4000 Router on page 207](#)
- [Configuring DC Power on a T4000 Router on page 213](#)
- [T4000 DC Power Electrical Safety Guidelines on page 424](#)
- [T4000 DC Power Cable and Lugs Specifications on page 105](#)

## Connecting DC Power to the T4000 Router (Four 60-A Inputs)

You connect DC power to the router by attaching power cables from the DC power sources to the terminal studs on the power supply faceplates. You must provide power cables (the cable lugs are supplied with the router).



**CAUTION:** Do not use a terminal jumper for 60-A DC power cables. Using a terminal jumper is not supported for this procedure. Doing so will cause a short across the inputs and trip your external circuit breaker.



**CAUTION:** All connected inputs on the DC power supply in slot PEM0 must be powered by dedicated power feeds derived from feed A, and all connected

inputs on the DC power supply in slot PEM1 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.



**CAUTION:** You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 lb-in. (5.0 Nm).



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.



**NOTE:** We recommend that the positive (+) DC source power cables to be connected to the RTN (return) terminals be 2.6 in. (6.6 cm) longer than the negative (–) DC source power cables to be connected to the –48 V (input) terminals.

To connect four 60-A DC source power cables to the router, follow this procedure for each DC power supply:

1. Check your planned hardware configuration and verify that four 60-A DC source power cables will provide sufficient power. See the DC power requirements for your router for more information.
2. Verify that a properly rated customer site circuit breaker for each DC power cable has been installed. See the DC power electrical safety guidelines for your router for more information.
3. Switch off the customer site circuit breakers. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.
4. Verify that a licensed electrician has attached appropriate cable lugs to the DC power cables. See the DC power cable and lug specifications for your router for more information.
5. Switch the power switch on the power supply faceplate to the standby position.

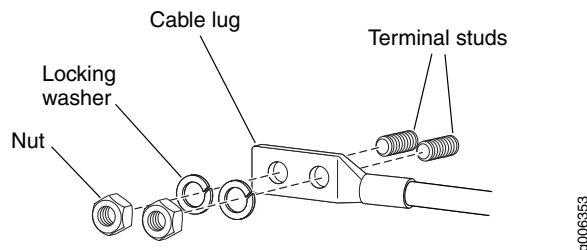
6. Remove the clear plastic cover protecting the terminal studs on the faceplate.
7. Remove the nut and washer from each power terminal stud to be connected (**INPUT 0**, **INPUT 1**, **INPUT 3**, **INPUT 4**, and **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4**). If no washers and nuts are already installed, they should be in the accessory box.
8. Remove the captive screws on the smallest cable restraint on the right edge of the power supply faceplate, and the largest cable restraint to the left (using a Phillips (+) screwdriver, number 2).
9. Route the negative (–) DC source power cables for **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4**, over the smallest cable restraint on the far right. The cable restraint is marked as follows top to bottom: **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4**.



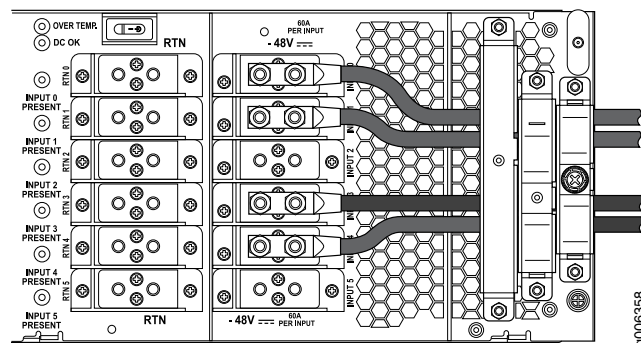
**NOTE:** You must route the cables in the locations as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the negative (–) DC source power cable lugs to the –48V (input) terminals on the right: **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4**. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

**Figure 76: Connecting DC Power Cables**



**Figure 77: Connecting Negative (–) DC Power Cables to INPUT 0, INPUT 1, INPUT 3, and INPUT 4**



10. Replace the smallest cable restraint on the far right, and tighten the captive screw to hold the power cables for **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4** in place.
11. Route the positive (+) DC source power cables for **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4** over the largest cable restraint on the left. The left cable restraint is marked as follows from top to bottom: **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4**,

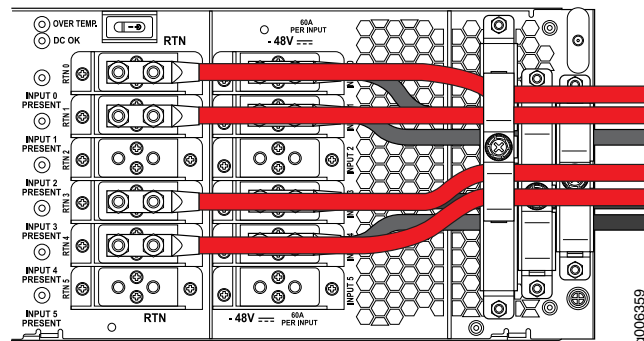


**NOTE:** You must route the cables as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the negative (–) DC source power cable lugs to the RTN terminals on the left: **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4**. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

12. Replace the left cable restraint, and tighten the captive screw to hold the power cables for **RTN 0**, **RTN 1**, **RTN 3**, and **RTN 4** in place.

**Figure 78: Connecting Positive (+) DC Power Cables to RTN 0, RTN 1, RTN 3, and RTN 4**



13. Verify that the power cabling is correct, that the power cables are not touching or blocking access to router components, and that they do not drape where people could trip on them.
14. Replace the clear plastic cover over the terminal studs on the faceplate.

#### Related Documentation

- [Tools and Parts Required to Provide Power to the T4000 Router on page 185](#)
- [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- [Powering On the T4000 Router on page 207](#)
- [Configuring DC Power on a T4000 Router on page 213](#)

- [T4000 DC Power Requirements on page 97](#)
- [T4000 Power Management \(Four 60-A Cables on a Six-Input DC Power Supply\) on page 103](#)
- [T4000 Power Management \(Three 80-A Cables on a Six-Input DC Power Supply\) on page 103](#)
- [Troubleshooting the T4000 Power System on page 363](#)
- [T4000 DC Power Electrical Safety Guidelines on page 424](#)
- [T4000 DC Power Cable and Lugs Specifications on page 105](#)

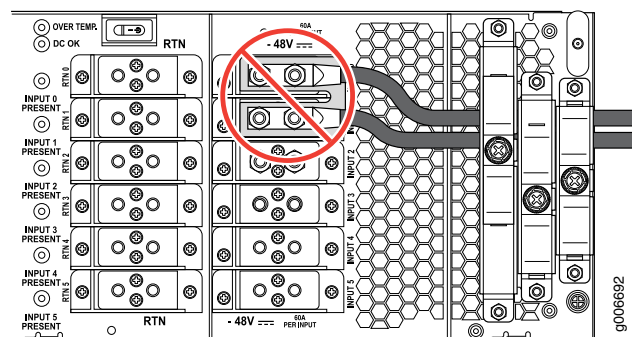
## Connecting DC Power to the T4000 Router (Three 80-A DC Power Cables to Six 60-A Inputs)

You connect DC power to the router by using a terminal jumper to attach one DC power cable from the DC power source to two terminal studs on the power supply faceplate. Use the terminal jumper kit (model number PWR-T-BUS-BAR-S) to perform this procedure (terminal jumpers might also be referred to as bus bars). The terminal jumper kit contains the terminal jumpers and the new clear plastic cover required to accommodate the terminal jumpers. Six terminal jumpers are required for each power supply. You must provide power cables (the cable lugs are supplied with the router).



**CAUTION:** When using a terminal jumper for this procedure, terminate only a single DC power cable to the two input terminals using the terminal jumper as shown in [Figure 82 on page 202](#) and [Figure 83 on page 203](#). Do not connect two DC power cables using a terminal jumper to two inputs as shown in [Figure 79 on page 198](#). Connecting two DC power cables using a terminal jumper to two inputs will cause a short across the inputs and trip your external circuit breaker.

*Figure 79: Incorrect Cable Connection to INPUT 1*



**CAUTION:** All connected inputs on the DC power supply in slot PEM0 must be powered by dedicated power feeds derived from feed A, and all connected



inputs on the DC power supply in slot PEM1 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.



**CAUTION:** You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 lb-in. (5.0 Nm).



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.



**NOTE:** We recommend that the positive (+) DC source power cables to be connected to the RTN (return) terminals be 2.6 in. (6.6 cm) longer than the negative (–) DC source power cables to be connected to the –48 V (input) terminals.

To connect 80-A DC source power cables to six inputs using a terminal jumper, follow this procedure for each DC power supply:

1. Check your planned hardware configuration, and verify that three 80-A DC source power cables will provide sufficient power. See the DC power requirements for your router for more information.
2. Verify that a properly rated customer site circuit breaker for each DC power cable has been installed. See the DC power electrical safety guidelines for your router for more information.
3. Switch off the customer site circuit breakers. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.
4. Verify that a licensed electrician has attached appropriate cable lugs to the DC power cables. See the DC power cable and lug specifications for your router for more information.
5. Switch the power switch on the power supply faceplate to the standby position.

6. Remove the clear plastic cover protecting the terminal studs on the faceplate.



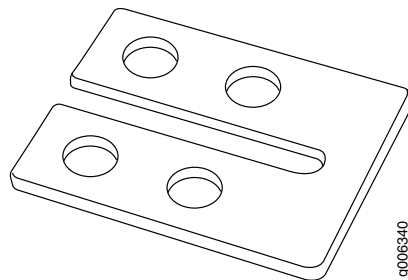
**NOTE:** You will replace this cover with the new cover provided in the terminal jumper kit (model number PWR-T-BUS-BAR-S). The new cover is labeled 2 in [Figure 85 on page 205](#).

7. Remove the nut and washer from each power terminal stud to be connected. If no washers and nuts are already installed, they should be in the accessory box.
8. Remove the captive screws on all three cable restraints on the right edge of the power supply faceplate (using a Phillips (+) screwdriver, number 2).
9. Place one terminal jumper over the negative (–) DC **INPUT 0** and **INPUT 1** terminals on the right.



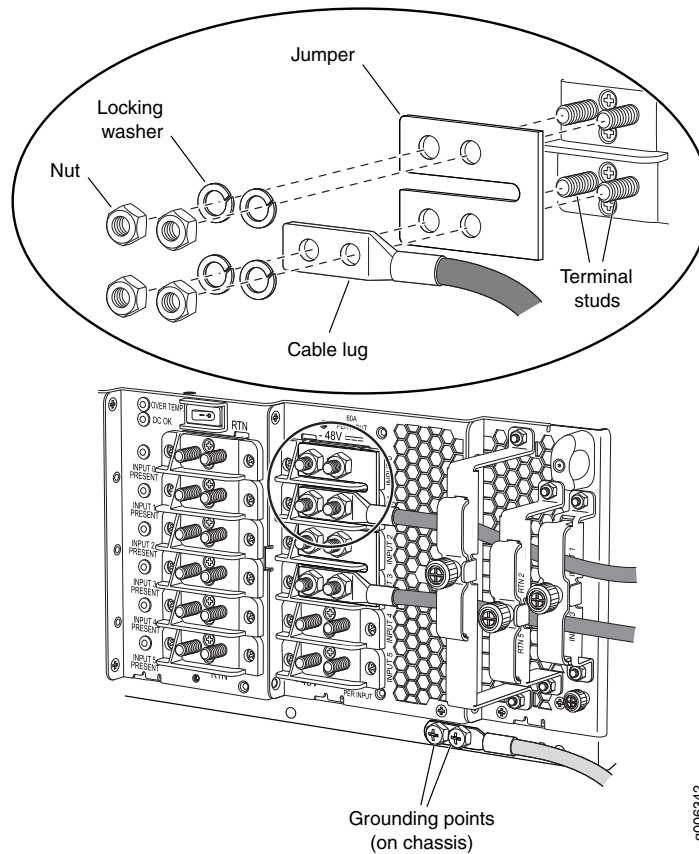
**NOTE:** The terminal jumpers are located in the terminal jumper kit (model number PWR-T-BUS-BAR-S).

*Figure 80: Terminal Jumper*



10. Place a washer, and then a nut on the negative (–) DC **INPUT 0** terminal.  
Using a 7/16-in. (11 mm) nut driver, tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

Figure 81: Connecting DC Power Cables



11. Route the negative (–) DC source power cable for **INPUT 1** over the smallest cable restraint on the far right.



**NOTE:** The smallest cable restraint is marked as follows from top to bottom: **INPUT 0**, **INPUT 1**, **INPUT 3**, and **INPUT 4**. You must route the cables in the locations as marked to be able to install the new clear plastic cover over the terminal studs.

Attach the negative (–) DC source power cable lug to the –48 V (input) **INPUT 1** terminal on the right. Secure the cable lug to the terminal stud, first with the washer, then with the nut.

12. Place one terminal jumper over the negative (–) DC **INPUT 2** and **INPUT 3** input terminals on the right.
13. Place a washer, and then a nut on the negative (–) DC **INPUT 2** terminal.

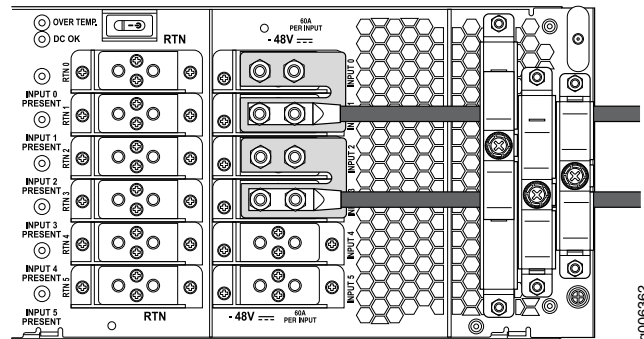
Using a 7/16-in. (11 mm) nut driver, tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to the nut.

14. Route the negative (–) DC source power cable for **INPUT 3** over the smallest cable restraint on the far right.

Attach the negative (–) DC source power cable lug to the –48 V (input) **INPUT 3** terminal on the right. Secure the cable lug to the terminal stud, first with the washer, then with the nut.

Using a 7/16-in. (11 mm) nut driver, tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to the nut.

*Figure 82: Negative (–) DC Power Cables Connected to INPUT 1 and INPUT 3*



15. Replace the smallest cable restraint on the far right, and tighten the captive screw to hold the power cables for **INPUT 1** and **INPUT 3** in place.
16. Place one terminal jumper over the negative (–) DC **INPUT 4** and **INPUT 5** input terminals on the right.
17. Place a washer, and then a nut on the negative (–) DC **INPUT 4** terminal.  
Using a 7/16-in. (11 mm) nut driver, tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to the nut.
18. Route the negative (–) DC source power cable for **INPUT 5** through the middle cable restraint.

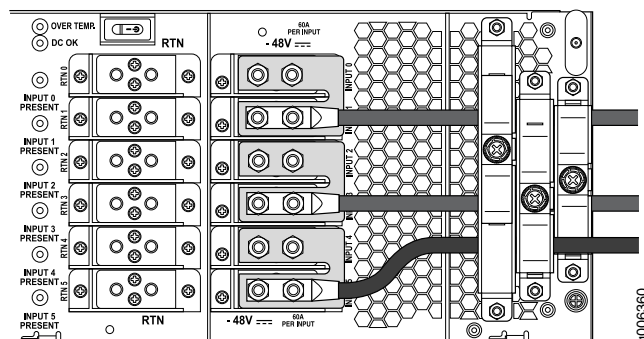


**NOTE:** The middle cable restraint is marked as follows from top to bottom: **INPUT 2**, **RTN 2**, **RTN 5**, and **INPUT 5**. You must route the cable in the location as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the negative (–) DC source power cable lug to the –48 V (input) **INPUT 5** terminal on the right. Secure the cable lug to the terminal studs, first with the washers, then with the nuts.

Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

Figure 83: Connecting Negative (–) DC Power Cable to INPUT 5



19. Place one terminal jumper over the positive (+) DC **RTN 4** and **RTN 5** input terminals on the left
20. Place a washer, and then a nut on **RTN 4**.  
Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.
21. Route the positive (+) DC source power cable for the **RTN 5** input terminal through the middle cable restraint.



**NOTE:** The middle cable restraint is marked as follows from top to bottom: **INPUT 2**, **RTN 2**, **RTN 5**, and **INPUT 5**. You must route the cables as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the positive (+) DC source power cable lug to the **RTN 5** RTN (return) terminal on the left. Secure the cable lug to the terminal stud, first with the washer, then with the nut.

Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

22. Replace the middle cable restraint, and tighten the captive screw to hold the power cables for **INPUT 5** and **RTN 5** in place.
23. Place one terminal jumper over **RTN 0** and **RTN 1**.
24. Place a washer, and then a nut on **RTN 0**.  
Using a 7/16-in. (11 mm) nut driver, tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.
25. Route the positive (+) DC source power cable for **RTN 1** over the largest cable restraint on the left.



**NOTE:** The large left cable restraint is marked as follows from top to bottom: RTN 0, RTN 1, RTN 3, and RTN 4. You must route the cables as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the positive (+) DC source power cable lugs to the **RTN 1** terminal on the left. Secure the cable lugs to the terminal stud, first with the washer, then with the nut.

Using a 7/16-in. (11 mm) nut driver, tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

26. Place terminal jumper over **RTN 2** and **RTN 3**.

27. Place a washer, and then a nut on **RTN 2**.

Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

28. Route the positive (+) DC source power cable for **RTN 3** over the largest cable restraint on the left.



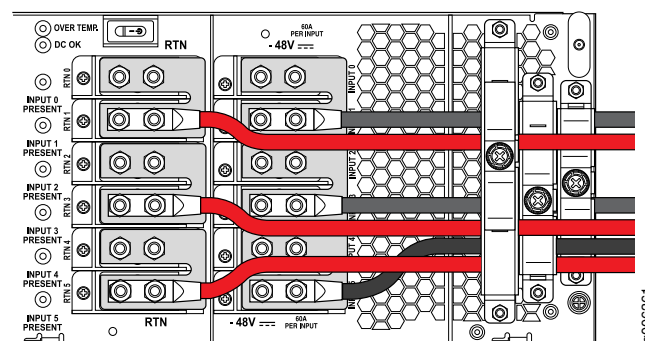
**NOTE:** The large left cable restraint is marked as follows from top to bottom: RTN 0, RTN 1, RTN 3, and RTN 4. You must route the cables as marked to be able to replace the clear plastic cover over the terminal studs.

Attach the positive (+) DC source power cable lug to the **RTN 3** terminal on the left. Secure the cable lug to the terminal stud, first with the washer, then with the nut.

Using a 7/16-in. (11 mm) nut driver, tighten the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

29. Replace the large left cable restraint, and tighten the captive screw to hold the power cables for **RTN 1** and **RTN 3** in place.

**Figure 84: Positive (+) DC Power Cables Connected to RTN 1, RTN 3, and RTN 5**

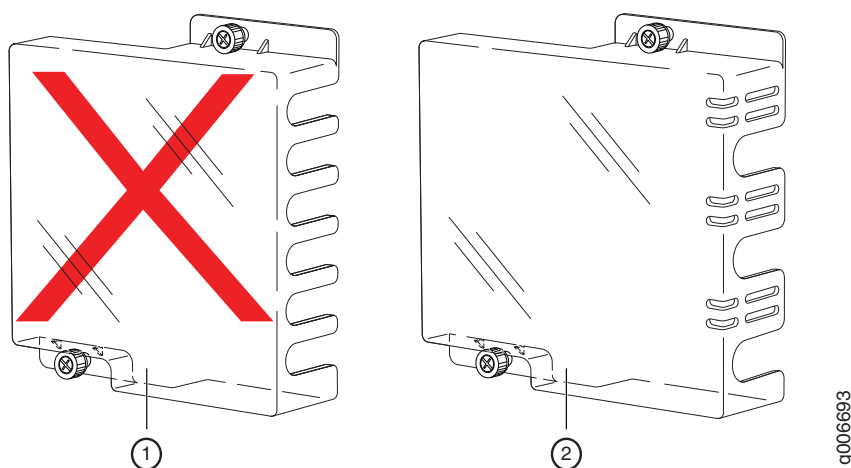


30. Verify that the power cabling is correct, that the power cables are not touching or blocking access to router components, and that they do not drape where people could trip on them.
31. Install the clear plastic terminal jumper cover (labeled 2 in [Figure 85 on page 205](#)) located in the terminal jumper kit (model number PWR-T-BUS-BAR-S) to protect the terminal studs on the faceplate.



**NOTE:** You must use the terminal jumper cover provided in the terminal jumper kit (model number PWR-T-BUS-BAR-S) to ensure there is no access to the terminal jumpers and for proper cable alignment. The terminal jumper cover (labeled 2 in [Figure 85 on page 205](#)) has three cable openings and is longer than the original clear plastic cover (labeled 1 in [Figure 85 on page 205](#)) that has six cable openings.

*Figure 85: Power Supply Covers*



#### Related Documentation

- [Tools and Parts Required to Provide Power to the T4000 Router on page 185](#)
- [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Powering On the T4000 Router on page 207](#)
- [Configuring DC Power on a T4000 Router on page 213](#)
- [Troubleshooting the T4000 Power System on page 363](#)
- [T4000 DC Power Requirements on page 97](#)
- [T4000 Power Management \(Four 60-A Cables on a Six-Input DC Power Supply\) on page 103](#)

- [T4000 Power Management \(Three 80-A Cables on a Six-Input DC Power Supply\) on page 103](#)
- [T4000 DC Power Electrical Safety Guidelines on page 424](#)
- [T4000 DC Power Cable and Lugs Specifications on page 105](#)



# Powering On the Router

- [Powering On the T4000 Router on page 207](#)

## Powering On the T4000 Router

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To power on the DC-powered T4000 router:

1. Verify that the power supplies are fully inserted in the chassis and that the captive screws on their faceplates are tightened.
2. Verify that the source power cables are connected to the appropriate terminal: the positive (+) source cable to the return terminal (labeled **RTN**) and the negative (–) source cable to the input terminal (labeled **–48V**).
3. Verify that an external management device is connected to one of the Routing Engine ports on the CIP (**AUXILIARY**, **CONSOLE**, or **ETHERNET**).



**NOTE:** If you are powering on the router for the first time, the **AUXILIARY** and **ETHERNET** ports do not function until after the initial configuration procedure.

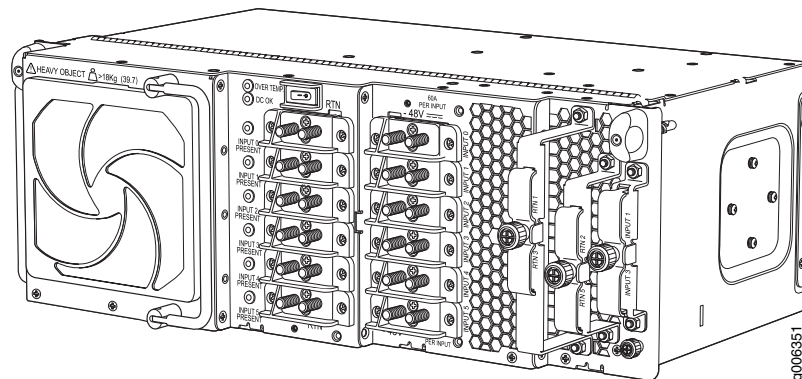
4. Turn on the power to the external management device.
5. Switch on the dedicated customer site circuit breakers to provide power to the DC power cables. Follow your site's procedures.
6. Verify that the **INPUT PRESENT** LED for each input on the DC power supply faceplate is lit steadily green, indicating that the inputs are receiving power.
7. Switch the power switch on the power supply to the **ON** position (—). The **DC OK** LED blinks momentarily, then lights steadily.



**NOTE:** After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the LEDs on the power supply, the command output displays, and messages on the LED display on the craft interface—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

8. Verify that the **DC OK** LED on the DC power supply faceplate is lit steadily, indicating that power supply is correctly installed and functioning properly.
9. On the external management device connected to the Routing Engine, monitor the startup process to verify that the router has booted properly.
10. Repeat the procedure for the other power supply.

*Figure 86: Six-Input DC Power Supply*



#### Related Documentation

- [Connecting DC Power to the T4000 Router \(Six 60-A Inputs\) on page 186](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- [Powering Off the T4000 Router on page 341](#)

# Configuring the JUNOS Software

- [Initially Configuring the T4000 Router on page 209](#)
- [Configuring DC Power on a T4000 Router on page 213](#)

## Initially Configuring the T4000 Router

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These procedures connect a router to the network but do not enable it to forward traffic. For complete information about enabling the router to forward traffic, including examples, see the Junos OS configuration guides.

You configure the router by issuing Junos OS command-line interface (CLI) commands, either on a console device attached to the **CONSOLE** port, or over a telnet connection to a network connected to the **ETHERNET** port.



**NOTE:** These procedures enable you to use the **ETHERNET** management port. For the initial configuration, use a device attached to the **CONSOLE** port.

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1. [Preparing to Configure the Router on page 209](#)
2. [Entering Configuration Mode on page 210](#)
3. [Configuring User Accounts and Passwords on page 210](#)
4. [Configuring System Attributes on page 210](#)
5. [Committing the Configuration on page 212](#)

## Preparing to Configure the Router

Gather the following information before configuring the router:

- Name the router will use on the network
- Domain name the router will use
- IP address and prefix length information for the Ethernet interface
- IP address of a default router
- IP address of a DNS server
- Password for the root user

## Entering Configuration Mode

1. Verify that the network device is powered on.
2. Log in as the root user. There is no password.

```
Amnesiac <ttyd0>  
login: root
```

3. Start the CLI.

```
root@% cli  
root>
```

4. Enter configuration mode.

```
root> configure  
Entering configuration mode.  
[edit]  
root#
```

## Configuring User Accounts and Passwords

For information about using an encrypted password or an SSH public key string (DSA or RSA), see *Configuring the Root Password and authentication (Login)*.

1. Add a password to the root administration user account. Enter a cleartext password.

```
[edit]  
root@host# set system root-authentication plain-text-password  
New password: password  
Retype new password: password
```

2. Create a management console user account.

```
[edit]  
root@host# set system login user user-name authentication plain-text-password  
New Password: password  
Retype new password: password
```

3. Set the user account class to **super-user**.

```
[edit]  
root@host# set system login user user-name class super-user
```

## Configuring System Attributes

For more information on configuring the backup routing and static routes, see the *Junos OS Administration Library*.

1. Configure the name of the router. If the name includes spaces, enclose the name in quotation marks (" ").

```
[edit]
root@host# set system host-name host-name
```



**NOTE:** The DNS server does not use the hostname to resolve to the correct IP address. This hostname is used only to display the name of the routing engine in the CLI. For example, this hostname shows on the command-line prompt when the user is logged on to the CLI:

```
[edit]
user-name@host-name>
```

2. Configure the IP address of the DNS server.

```
[edit]
root# set system name-server address
```

3. Configure the router's domain name.

```
[edit]
root# set system domain-name domain-name
```

4. Configure the IP address and prefix length for the router's management Ethernet interface.



**NOTE:** The RE-C1800 Routing Engine (RE-DUO-1800) does not support the fxp0 management Ethernet interface or the fxp1 and fxp2 internal Ethernet interfaces. Use the em0 interface for the RE-C1800 Routing Engine.

```
[edit]
root# set interfaces em0 unit 0 family inet address address/prefix-length
```

5. Configure the IP address of a backup routing engine. The backup routing engine is used while the local router is booting and if the routing process fails to start. After the routing process starts, the backup routing engine address is removed from the local routing and forwarding tables.

```
[edit]
root# set system backup-router address
```

6. (Optional) Configure the static routes to remote subnets with access to the management port. Access to the management port is limited to the local subnet. To access the management port from a remote subnet, you must add a static route to that subnet within the routing table.

```
[edit]
root# set routing-options static route remote-subnet next-hop destination-IP retain
no-readvertise
```

7. Configure the telnet service at the **[edit system services]** hierarchy level.

```
[edit]
set system services telnet
```

## Committing the Configuration

1. Display the configuration to verify that it is correct.

```
[edit]
root# show
system {
  host-name host-name;
  domain-name domain-name;
  backup-router address;
  root-authentication {
    authentication-method (password | public-key);
  }
  name-server {
    address;
  }
}
interfaces {
  fxp0 {
    unit 0 {
      family inet {
        address address/prefix-length;
      }
    }
  }
}
```

2. Commit the configuration to activate it on the router.

```
[edit]
root# commit
```

3. Optionally, configure additional properties by adding the necessary configuration statements. Then commit the changes to activate them on the router.

```
[edit]
root# commit
```

4. When you have finished configuring the router, exit configuration mode.

```
[edit]
root# exit
```

- Related Documentation**
- [Powering On the T4000 Router on page 207](#)
  - [T4000 Router Description on page 3](#)

## Configuring DC Power on a T4000 Router

After you have connected the DC power and initially configured the router, you must configure the number of input feeds if you connected fewer than six cables to the six-input DC power supply. You must also configure the input current for the DC power supply if you connected three 80-A cables to the six-input DC power supply.

For more information about configuring the DC power supply and the commands used in the procedures, see the *T4000 Power Management Overview* in the *Junos OS Administration Library*.

- [Configuring DC Power on a T4000 Router \(Five 60-A Cables on a Six-Input DC Power Supply\)](#) on page 213
- [Configuring DC Power on a T4000 \(Four 60-A Cables on a Six-Input DC Power Supply\)](#) on page 214
- [Configuring DC Power on a T4000 \(Three 80-A Cables on a Six-Input DC Power Supply\)](#) on page 215

### Configuring DC Power on a T4000 Router (Five 60-A Cables on a Six-Input DC Power Supply)

When you connect five cables on a six-input DC power supply, you must specify the number of input feeds connected in the software. If the number of physical input feeds receiving power does not match the number of configured input feeds, the router displays an alarm message.

1. Configure the number of input feeds to indicate that five DC power cables are connected.

```
[edit]
user@host# set chassis pem feeds 5
```



**NOTE:** The default number of input feeds is 6.

2. (Optional) Use the **show** statement to display the configuration to verify that it is correct.

```
[edit]
user@host# show
pem {
  feeds 5;
}
```

3. Commit the configuration to activate it on the router, and exit configuration mode.

```
[edit]
user@host# commit
user@host# exit
user@host>
```

## See Also

### Configuring DC Power on a T4000 (Four 60-A Cables on a Six-Input DC Power Supply)

When you connect four cables on a six-input DC power supply, you must specify the number of input feeds connected in the software. If the number of physical input feeds receiving power does not match the number of configured input feeds, the router displays an alarm message.

1. Configure the number of input feeds to indicate that four DC power cables are connected.

```
[edit]
user@host# set chassis pem feeds 4
```



**NOTE:** The default number of input feeds is 6.

2. (Optional) If the power has been underprovisioned for your configuration, some FPCs might not be brought online if the available power capacity is exceeded. When you reboot the router, FPCs are brought online based on the default setting of the **fru-poweron-sequence** command. You can use the **fru-poweron-sequence** command to change the default order in which FPCs are brought online when the router is rebooted. The default sequence is the numerical order of the FPC slots (0 through 7).

```
[edit]
user@host# set chassis fru-poweron-sequence fru-poweron-sequence
```

3. (Optional) Use the **show** statement to display the configuration to verify that it is correct.

```
[edit]
user@host# show
pem {
  feeds 4;
}
```

4. Commit the configuration to activate it on the router, and exit configuration mode.

```
[edit]
user@host# commit
user@host# exit
user@host>
```



## Configuring DC Power on a T4000 (Three 80-A Cables on a Six-Input DC Power Supply)

When you connect three 80-A DC power cables to six inputs using terminal jumpers to each power supply, you must specify the input current in the software. In addition, you must also indicate that six input feeds are used. If the number of physical input feeds receiving power does not match the number of configured inputs, the router displays an alarm message.

1. Configure the number of input feeds to indicate that six feeds are used to connect the three 80-A DC power cables by means of terminal jumpers.

```
[edit]
user@host# set chassis pem feeds 6
```



**NOTE:** The default number of input feeds is 6.

2. Configure the input current to indicate that 40-A is used to provide input current. Each 80-A DC power cable connects to two inputs by means of a terminal jumper, with each input receiving approximately 40 amps.

```
[edit]
user@host# set chassis pem input-current 40
```



**NOTE:** The default input current is 60-A.

3. (Optional) If the power has been underprovisioned for your configuration, some FPCs might not be brought online if the available power capacity is exceeded. When you reboot the router, FPCs are brought online based on the default setting of the **fru-poweron-sequence** command. You can use the **fru-poweron-sequence** command to change the default order in which FPCs are brought online when the router is rebooted.

```
[edit]
user@host# set chassis fru-poweron-sequence fru-poweron-sequence
```



**NOTE:** The default is the numerical order of the FPC slots (0 through 7).

4. (Optional) Use the **show** statement to display the configuration to verify that it is correct.

```
[edit]
user@host# show
pem {
  feeds 6;
  input-current 40;
}
```

5. Commit the configuration to activate it on the router and exit configuration mode.

```
[edit]
user@host# commit
user@host# exit
user@host>
```

**Related  
Documentation**

- [T4000 Power System Description on page 75](#)
- [Connecting DC Power to the T4000 Router \(Five 60-A Inputs\) on page 190](#)
- [Connecting DC Power to the T4000 Router \(Four 60-A Inputs\) on page 194](#)
- [Connecting DC Power to the T4000 Router \(Three 80-A DC Power Cables to Six 60-A Inputs\) on page 198](#)
- [Troubleshooting the T4000 Power System on page 363](#)
- [T4000 DC Power Requirements on page 97](#)
- [T4000 Power Management \(Four 60-A Cables on a Six-Input DC Power Supply\) on page 103](#)
- [T4000 Power Management \(Three 80-A Cables on a Six-Input DC Power Supply\) on page 103](#)
- [T4000 Power Management Overview](#)

## CHAPTER 25

# Upgrading to a T4000 Router From a T640 or T1600 Router

- [Overview of Preparing to Upgrade to a T4000 Router on page 217](#)
- [Checking the Hardware Version of T640 or T1600 Components on page 218](#)
- [T4000 Upgrade Kit on page 227](#)
- [Overview of Upgrading to a T4000 Router on page 227](#)
- [Upgrading Hardware Components on the T640 or T1600 Router on page 228](#)
- [Upgrading to T4000 SIBs with Junos OS Release 12.1 on page 232](#)
- [Upgrading to T4000 SIBs Online with Junos OS Release 12.2 and Later on page 233](#)
- [Installing the T4000 FPCs After an Upgrade from a T640 or T1600 Router on page 235](#)
- [Registering Your T4000 Upgrade on page 236](#)

## Overview of Preparing to Upgrade to a T4000 Router

---

To prepare to upgrade to a T4000 router:

1. Prepare the installation site for the T4000 router.  
[See “Overview of Preparing the Site for the T4000 Router” on page 87.](#)
2. Determine which model numbers of the following components are already installed.  
[See “Checking the Hardware Version of T640 or T1600 Components” on page 218.](#)
  - Routing Engines: RE-DUO-C1800-8G or RE-DUO-C1800-16G (supported on T640 or T1600 router)
  - Control boards: CB-LCC (supported on T640 or T1600 router)
  - Rear fan tray: FAN-REAR-TXP-LCC (supported on T1600 router only)
  - Power supplies: PWR-T-6-60-DC (supported on T640 or T1600 router)
3. Order the required hardware.

The hardware upgrade kit includes two LCC-CBs, two RE-DUO-C1800-8G Routing Engines, five SIB-I-T4000 SIBs, one FAN-REAR-TXP-LCC rear fan trays, two FANTRAY-T4000 front fan trays, and two PWR-T-6-60-DC power supplies. If the

required control boards, Routing Engines, rear fan tray, or power supplies are already installed in the T640 or T1600 router, you can also order the other hardware components separately.

See the [“T4000 Upgrade Kit” on page 227](#).

4. Review all safety guidelines and warnings for both the T4000 router and T1600 router or T640 Router.



**WARNING:** To avoid harm to yourself or the router as you install and maintain it, you must follow the safety procedures for working with Internet routers, as well as the guidelines and warnings for working with and near electrical equipment. However, providing an exhaustive set of guidelines for working with electrical equipment is beyond the scope of this documentation.

See [“General Safety Guidelines and Warnings” on page 393](#) and *General Safety Warnings for Juniper Networks Devices*.

5. Upgrade the software on the T1600 router or T640 router to Junos OS Release 12.1 or later. Support of some hardware or software features require Junos OS Release 12.1R2 or later. For information about upgrading the software, see the *Installation and Upgrade Guide*.

6. Delete unsupported configurations from the T640 or T1600 router.

For example, the following CoS configuration is not supported for T4000 routers:

```
Hierarchy Level [edit class-of-service schedulers scheduler-name] drop-profile-map  
  loss-priority (any | low | medium-low | medium-high | high) protocol (any| non-tcp |  
  tcp) drop-profile profile-name.
```

For the T4000 router, **any** is the only protocol option supported for the following statement. The **non-tcp** and **tcp** options are not supported,

```
Hierarchy Level [edit class-of-service schedulers scheduler-name] drop-profile-map  
  loss-priority (any | low | medium-low | medium-high | high) protocol any  
  drop-profile profile-name.
```

**Related  
Documentation**

- [T4000 Router Description on page 3](#)
- [T4000 Hardware Component Overview on page 5](#)

---

## Checking the Hardware Version of T640 or T1600 Components

1. [Checking the Hardware Version of the Control Boards on page 219](#)
2. [Checking the Hardware Version of the Routing Engines on page 221](#)

3. [Checking the Hardware Version of the Rear Fan Tray on page 223](#)
4. [Checking the Hardware Version of the FPCs on page 224](#)

## Checking the Hardware Version of the Control Boards

The control board model number LCC-CB is required for the T4000 router.

The following control boards are not supported for the T4000 router:

- CB-L-T
- CB-T

To determine which model numbers of control boards are installed:

1. Issue the **show chassis hardware models** command:

In this example, the output shows that two **CB-L-T** control boards are installed.

```
user@host> show chassis hardware models
```

Hardware inventory:

Item	Version	Part number	FRU model number
Midplane	REV 04	710-002726	CHAS-BP-T640-S
FPM Display	REV 02	710-002897	CRAFT-T640-S
CIP	REV 05	710-002895	CIP-L-T640-S
PEM 0	Rev 01	740-002595	PWR-T-DC-S
SCG 0	REV 04	710-003423	SCG-T-S
SCG 1	REV 04	710-003423	SCG-T-S
Routing Engine 0	REV 01	740-005022	RE-600-2048-S
Routing Engine 1	REV 07	740-005022	RE-600-2048-S
CB 0	REV 06	710-002726	CB-L-T-S
CB 1	REV 06	710-002728	CB-L-T-S
FPC 5	REV 05	710-007527	T640-FPC2
PIC 0	REV 05	750-002510	PB-2GE-SX
PIC 1	REV 05	750-001901	PB-40C12-SON-SMIR
FPC 6	REV 03	710-001721	T640-FPC3
PIC 1	REV 01	750-009553	PC-40C48-SON-SFP
SIB 4	REV 02	750-005486	SIB-I-T640-S
Fan Tray 0			FANTRAY-T-S
Fan Tray 1			FANTRAY-T-S
Fan Tray 2			FAN-REAR-TX-T640-S

In this example, the output shows that two **CB-T** control boards are installed.

```
user@host> show chassis hardware models
```

Hardware inventory:

Item	Version	Part number	FRU model number
Midplane	REV 03	710-005608	CHAS-BP-T640-S
FPM Display	REV 05	710-002897	CRAFT-T640-S
CIP	REV 06	710-002895	CIP-L-T640-S
PEM 0	Rev 07	740-017906	PWR-T1600-3-80-DC-S
PEM 1	Rev 18	740-002595	PWR-T-DC-S
SCG 0	REV 15	710-003423	SCG-T-S
Routing Engine 0	REV 08	740-014082	RE-A-2000-4096-S
Routing Engine 1	REV 07	740-014082	RE-A-2000-4096-S
CB 0	REV 05	710-007655	CB-T-S
CB 1	REV 03	710-017707	CB-T-S

FPC 0	REV 07	710-013558	T640-FPC2-E2
PIC 0	REV 01	750-010618	PB-4GE-SFP
PIC 1	REV 06	750-001900	PB-10C48-SON-SMSR
PIC 2	REV 14	750-001901	PB-40C12-SON-SMIR
PIC 3	REV 07	750-001900	PB-10C48-SON-SMSR
FPC 1	REV 06	710-013553	T640-FPC1-E2
PIC 0	REV 08	750-001072	P-1GE-SX
PIC 1	REV 10	750-012266	PB-4GE-TYPE1-SFP-IQ2
PIC 2	REV 22	750-005634	PB-1CHOC12SMIR-QPP
FPC 2			
PIC 0	REV 16	750-007141	PC-10GE-SFP
PIC 1	REV 06	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 2	REV 05	750-004695	PC-TUNNEL
PIC 3	REV 17	750-009553	PC-40C48-SON-SFP
FPC 3	REV 01	710-010154	T640-FPC3-E
PIC 0	REV 07	750-012793	PC-1XGE-TYPE3-XFP-IQ2
PIC 1	REV 25	750-007141	PC-10GE-SFP
PIC 2	REV 17	750-009553	PC-40C48-SON-SFP
PIC 3	REV 32	750-003700	PC-10C192-SON-VSR
FPC 4	REV 16	710-013037	T1600-FPC4-ES
PIC 1	REV 06	750-034781	PD-1CE-CFP
FPC 5	REV 02	710-013037	T1600-FPC4-ES
PIC 0	REV 16	750-012518	PD-40C192-SON-XFP
PIC 1	REV 01	750-010850	PD-10C768-SON-SR
FPC 6	REV 14	710-013037	T1600-FPC4-ES
PIC 0	REV 11	750-017405	PD-4XGE-XFP
PIC 1	REV 13	750-017405	PD-4XGE-XFP
FPC 7	REV 09	710-007529	T640-FPC3
PIC 0	REV 10	750-012793	PC-1XGE-TYPE3-XFP-IQ2
PIC 1	REV 01	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 2	REV 01	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 3	REV 15	750-009450	PC-10C192-SON-SR2
SIB 0	REV 07	710-013074	SIB-I-T1600-S
SIB 1	REV 07	710-013074	SIB-I-T1600-S
SIB 2	REV 07	710-013074	SIB-I-T1600-S
SIB 3	REV 07	710-013074	SIB-I-T1600-S
SIB 4	REV 07	710-013074	SIB-I-T1600-S
Fan Tray 0			FANTRAY-T-S
Fan Tray 1			FANTRAY-T-S
Fan Tray 2			FAN-REAR-TX-T640-S

In this example, the output shows that **LCC-CB** control boards are installed.

Fans	Top Left Front fan	OK	Spinning at normal speed
	Top Left Middle fan	OK	Spinning at normal speed
	Top Left Rear fan	OK	Spinning at normal speed
	Top Right Front fan	OK	Spinning at normal speed
	Top Right Middle fan	OK	Spinning at normal speed
	Top Right Rear fan	OK	Spinning at normal speed
	Bottom Left Front fan	OK	Spinning at normal speed
	Bottom Left Middle fan	OK	Spinning at normal speed
	Bottom Left Rear fan	OK	Spinning at normal speed
	Bottom Right Front fan	OK	Spinning at normal speed
	Bottom Right Middle fan	OK	Spinning at normal speed

Bottom Right Rear fan	OK	Spinning at normal speed
Rear Tray Top fan	OK	Spinning at normal speed
Rear Tray Second fan	OK	Spinning at normal speed
Rear Tray Third fan	OK	Spinning at normal speed
Rear Tray Fourth fan	OK	Spinning at normal speed
Rear Tray Fifth fan	OK	Spinning at normal speed
Rear Tray Sixth fan	OK	Spinning at normal speed
Rear Tray Seventh fan	OK	Spinning at normal speed
Rear Tray Bottom fan	OK	Spinning at normal speed

2. If two LCC-CB control boards are not installed, order and install LCC-CB control boards.

## Checking the Hardware Version of the Routing Engines

The Routing Engine model number RE-DUO-C1800-8G or RE-DUO-C1800-16G is required for the T4000 router. The following Routing Engines are not supported on the T4000 router:

- RE-600-2048
- RE-1600-2048
- RE-A-2000-4096

To determine which model numbers of Routing Engines are installed:

1. Issue the **show chassis hardware models** command:

In this example, the output shows that two **RE-600-2048** Routing Engines are installed.

```

user@host> show chassis hardware models
user@host> show chassis hardware models

Hardware inventory:
Item                Version  Part number  FRU model number
Midplane            REV 04    710-002726   CHAS-BP-T640-S
FPM Display         REV 02    710-002897   CRAFT-T640-S
CIP                 REV 05    710-002895   CIP-L-T640-S
PEM 0              Rev 01    740-002595   PWR-T-DC-S
SCG 0              REV 04    710-003423   SCG-T-S
SCG 1              REV 04    710-003423   SCG-T-S
Routing Engine 0    REV 01    740-005022   RE-600-2048-S
Routing Engine 1    REV 07    740-005022   RE-600-2048-S
CB 0               REV 06    710-002726   CB-L-T-S
CB 1               REV 06    710-002728   CB-L-T-S
FPC 5              REV 05    710-007527   T640-FPC2
  PIC 0            REV 05    750-002510   PB-2GE-SX
  PIC 1            REV 05    750-001901   PB-40C12-S0N-SMIR
FPC 6              REV 03    710-001721   T640-FPC3
  PIC 1            REV 01    750-009553   PC-40C48-S0N-SFP
SIB 4              REV 02    750-005486   SIB-I-T640-S
Fan Tray 0         FANTRAY-T-S
Fan Tray 1         FANTRAY-T-S
Fan Tray 2         FAN-REAR-TX-T640-S

```

In this example, the output shows that two **RE-A-2000-4096** Routing Engines are installed.

```
user@host> show chassis hardware models
```

Hardware inventory:

Item	Version	Part number	FRU model number
Midplane	REV 03	710-005608	CHAS-BP-T640-S
FPM Display	REV 05	710-002897	CRAFT-T640-S
CIP	REV 06	710-002895	CIP-L-T640-S
PEM 0	Rev 07	740-017906	PWR-T1600-3-80-DC-S
PEM 1	Rev 18	740-002595	PWR-T-DC-S
SCG 0	REV 15	710-003423	SCG-T-S
Routing Engine 0	REV 08	740-014082	RE-A-2000-4096-S
Routing Engine 1	REV 07	740-014082	RE-A-2000-4096-S
CB 0	REV 05	710-007655	CB-T-S
CB 1	REV 03	710-017707	CB-T-S
FPC 0	REV 07	710-013558	T640-FPC2-E2
PIC 0	REV 01	750-010618	PB-4GE-SFP
PIC 1	REV 06	750-001900	PB-10C48-SON-SMSR
PIC 2	REV 14	750-001901	PB-40C12-SON-SMIR
PIC 3	REV 07	750-001900	PB-10C48-SON-SMSR
FPC 1	REV 06	710-013553	T640-FPC1-E2
PIC 0	REV 08	750-001072	P-1GE-SX
PIC 1	REV 10	750-012266	PB-4GE-TYPE1-SFP-IQ2
PIC 2	REV 22	750-005634	PB-1CHOC12SMIR-QPP
FPC 2			
PIC 0	REV 16	750-007141	PC-10GE-SFP
PIC 1	REV 06	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 2	REV 05	750-004695	PC-TUNNEL
PIC 3	REV 17	750-009553	PC-40C48-SON-SFP
FPC 3	REV 01	710-010154	T640-FPC3-E
PIC 0	REV 07	750-012793	PC-1XGE-TYPE3-XFP-IQ2
PIC 1	REV 25	750-007141	PC-10GE-SFP
PIC 2	REV 17	750-009553	PC-40C48-SON-SFP
PIC 3	REV 32	750-003700	PC-10C192-SON-VSR
FPC 4	REV 16	710-013037	T1600-FPC4-ES
PIC 1	REV 06	750-034781	PD-1CE-CFP
FPC 5	REV 02	710-013037	T1600-FPC4-ES
PIC 0	REV 16	750-012518	PD-40C192-SON-XFP
PIC 1	REV 01	750-010850	PD-10C768-SON-SR
FPC 6	REV 14	710-013037	T1600-FPC4-ES
PIC 0	REV 11	750-017405	PD-4XGE-XFP
PIC 1	REV 13	750-017405	PD-4XGE-XFP
FPC 7	REV 09	710-007529	T640-FPC3
PIC 0	REV 10	750-012793	PC-1XGE-TYPE3-XFP-IQ2
PIC 1	REV 01	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 2	REV 01	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 3	REV 15	750-009450	PC-10C192-SON-SR2
SIB 0	REV 07	710-013074	SIB-I-T1600-S
SIB 1	REV 07	710-013074	SIB-I-T1600-S
SIB 2	REV 07	710-013074	SIB-I-T1600-S
SIB 3	REV 07	710-013074	SIB-I-T1600-S
SIB 4	REV 07	710-013074	SIB-I-T1600-S
Fan Tray 0			FANTRAY-T-S
Fan Tray 1			FANTRAY-T-S
Fan Tray 2			FAN-REAR-TX-T640-S



2. If two RE-DUO-C1800-8G Routing Engines are not installed, order and install RE-DUO-C1800-8G Routing Engines.

## Checking the Hardware Version of the Rear Fan Tray

The rear fan tray model number FAN-REAR-TXP-LCC has eight fans and is required to support the additional thermal power generation of the T4000 router.

The following fan trays do not provide sufficient cooling for the T4000 router:

- RHTREARTRAY-T
- FAN-REAR-TX-T640
- FAN-R
- FAN-REAR-T

To determine which version of the rear fan tray is installed:

1. Issue the **show chassis environment** command:

In this example, the output shows that the rear fan tray has five blowers, indicating that the RHTREARTRAY-T rear fan tray is installed. The last five lines of the output for the fans each include **Blower** in the description.

```
user@host> show chassis environment
Fans  Top Left Front fan      OK      Spinning at normal speed
      Top Left Middle fan   OK      Spinning at normal speed
      Top Left Rear fan     OK      Spinning at normal speed
      Top Right Front fan   OK      Spinning at normal speed
      Top Right Middle fan  OK      Spinning at normal speed
      Top Right Rear fan    OK      Spinning at normal speed
      Bottom Left Front fan OK      Spinning at normal speed
      Bottom Left Middle fan OK      Spinning at normal speed
      Bottom Left Rear fan  OK      Spinning at normal speed
      Bottom Right Front fan OK      Spinning at normal speed
      Bottom Right Middle fan OK      Spinning at normal speed
      Bottom Right Rear fan OK      Spinning at normal speed
      Fourth Blower from top OK      Spinning at normal speed
      Bottom Blower        OK      Spinning at normal speed
      Middle Blower        OK      Spinning at normal speed
      Top Blower           OK      Spinning at normal speed
      Second Blower from top OK      Spinning at normal speed
```

In this example, the output shows that the rear fan tray has eight fans, indicating that FAN-REAR-TX-T640-S rear fan tray is installed. The last eight lines of the output for the fans each begin with **Rear Tray** and include **fan** in the description.

```
Fans  Top Left Front fan      OK      Spinning at normal speed
      Top Left Middle fan   OK      Spinning at normal speed
      Top Left Rear fan     OK      Spinning at normal speed
      Top Right Front fan   OK      Spinning at normal speed
      Top Right Middle fan  OK      Spinning at normal speed
      Top Right Rear fan    OK      Spinning at normal speed
      Bottom Left Front fan OK      Spinning at normal speed
      Bottom Left Middle fan OK      Spinning at normal speed
      Bottom Left Rear fan  OK      Spinning at normal speed
```

Bottom Right Front fan	OK	Spinning at normal speed
Bottom Right Middle fan	OK	Spinning at normal speed
Bottom Right Rear fan	OK	Spinning at normal speed
Rear Tray Top fan	OK	Spinning at normal speed
Rear Tray Second fan	OK	Spinning at normal speed
Rear Tray Third fan	OK	Spinning at normal speed
Rear Tray Fourth fan	OK	Spinning at normal speed
Rear Tray Fifth fan	OK	Spinning at normal speed
Rear Tray Sixth fan	OK	Spinning at normal speed
Rear Tray Seventh fan	OK	Spinning at normal speed
Rear Tray Bottom fan	OK	Spinning at normal speed

2. Issue the **show chassis hardware models** command.

In this example, the output shows that FAN-REAR-TX-T640 is installed.

```

user@host> show chassis hardware models
user@host> show chassis hardware models

Hardware inventory:
Item                Version  Part number  FRU model number
Midplane            REV 04    710-002726   CHAS-BP-T640-S
FPM Display         REV 02    710-002897   CRAFT-T640-S
CIP                 REV 05    710-002895   CIP-L-T640-S
PEM 0               Rev 01    740-002595   PWR-T-DC-S
SCG 0               REV 04    710-003423   SCG-T-S
SCG 1               REV 04    710-003423   SCG-T-S
Routing Engine 0    REV 01    740-005022   RE-600-2048-S
Routing Engine 1    REV 07    740-005022   RE-600-2048-S
CB 0                REV 06    710-002726   CB-L-T-S
CB 1                REV 06    710-002728   CB-L-T-S
FPC 5               REV 05    710-007527   T640-FPC2
  PIC 0             REV 05    750-002510   PB-2GE-SX
  PIC 1             REV 05    750-001901   PB-40C12-SON-SMIR
FPC 6               REV 03    710-001721   T640-FPC3
  PIC 1             REV 01    750-009553   PC-40C48-SON-SFP
SIB 4               REV 02    750-005486   SIB-I-T640-S
Fan Tray 0          FANTRAY-T-S
Fan Tray 1          FANTRAY-T-S
Fan Tray 2          FAN-REAR-TX-T640-S

```

3. If the FAN-REAR-TXP-LCC rear fan tray is not installed, order and install the FAN-REAR-TXP-LCC rear fan tray.

## Checking the Hardware Version of the FPCs

The FPCs supported for the T4000 router are listed in [“T4000 FPCs Supported” on page 61](#). We recommend that you remove unsupported FPCs before installing the T4000 SIBs.

To determine which model numbers of FPCs are installed:

1. Issue the **show chassis hardware models** command:

In this example, the output shows that the **T640-FPC2** and **T640-FPC3** FPCs are installed.

```

user@host> show chassis hardware models

```

```
user@host> show chassis hardware models
```

```
Hardware inventory:
```

Item	Version	Part number	FRU model number
Midplane	REV 04	710-002726	CHAS-BP-T640-S
FPM Display	REV 02	710-002897	CRAFT-T640-S
CIP	REV 05	710-002895	CIP-L-T640-S
PEM 0	Rev 01	740-002595	PWR-T-DC-S
SCG 0	REV 04	710-003423	SCG-T-S
SCG 1	REV 04	710-003423	SCG-T-S
Routing Engine 0	REV 01	740-005022	RE-600-2048-S
Routing Engine 1	REV 07	740-005022	RE-600-2048-S
CB 0	REV 06	710-002726	CB-L-T-S
CB 1	REV 06	710-002728	CB-L-T-S
FPC 5	REV 05	710-007527	T640-FPC2
PIC 0	REV 05	750-002510	PB-2GE-SX
PIC 1	REV 05	750-001901	PB-40C12-SON-SMIR
FPC 6	REV 03	710-001721	T640-FPC3
PIC 1	REV 01	750-009553	PC-40C48-SON-SFP
SIB 4	REV 02	750-005486	SIB-I-T640-S
Fan Tray 0			FANTRAY-T-S
Fan Tray 1			FANTRAY-T-S
Fan Tray 2			FAN-REAR-TX-T640-S

In this example, the output shows that **T640-FPC2-E2**, **T640-FPC1-E2**, **T640-FPC3-E**, and **T1600-FPC4-ES** FPCs are installed. The **T1600-FPC4-ES** FPCs are supported for the T4000 router. All other FPCs in this example are currently unsupported for the T4000 router.

```
user@host> show chassis hardware models
```

```
Hardware inventory:
```

Item	Version	Part number	FRU model number
Midplane	REV 03	710-005608	CHAS-BP-T640-S
FPM Display	REV 05	710-002897	CRAFT-T640-S
CIP	REV 06	710-002895	CIP-L-T640-S
PEM 0	Rev 07	740-017906	PWR-T1600-3-80-DC-S
PEM 1	Rev 18	740-002595	PWR-T-DC-S
SCG 0	REV 15	710-003423	SCG-T-S
Routing Engine 0	REV 08	740-014082	RE-A-2000-4096-S
Routing Engine 1	REV 07	740-014082	RE-A-2000-4096-S
CB 0	REV 05	710-007655	CB-T-S
CB 1	REV 03	710-017707	CB-T-S
FPC 0	REV 07	710-013558	T640-FPC2-E2
PIC 0	REV 01	750-010618	PB-4GE-SFP
PIC 1	REV 06	750-001900	PB-10C48-SON-SMSR
PIC 2	REV 14	750-001901	PB-40C12-SON-SMIR
PIC 3	REV 07	750-001900	PB-10C48-SON-SMSR
FPC 1	REV 06	710-013553	T640-FPC1-E2
PIC 0	REV 08	750-001072	P-1GE-SX
PIC 1	REV 10	750-012266	PB-4GE-TYPE1-SFP-IQ2
PIC 2	REV 22	750-005634	PB-1CHOC12SMIR-QPP
FPC 2			
PIC 0	REV 16	750-007141	PC-10GE-SFP
PIC 1	REV 06	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 2	REV 05	750-004695	PC-TUNNEL
PIC 3	REV 17	750-009553	PC-40C48-SON-SFP
FPC 3	REV 01	710-010154	T640-FPC3-E

PIC 0	REV 07	750-012793	PC-1XGE-TYPE3-XFP-IQ2
PIC 1	REV 25	750-007141	PC-10GE-SFP
PIC 2	REV 17	750-009553	PC-40C48-SON-SFP
PIC 3	REV 32	750-003700	PC-10C192-SON-VSR
FPC 4	REV 16	710-013037	T1600-FPC4-ES
PIC 1	REV 06	750-034781	PD-1CE-CFP
FPC 5	REV 02	710-013037	T1600-FPC4-ES
PIC 0	REV 16	750-012518	PD-40C192-SON-XFP
PIC 1	REV 01	750-010850	PD-10C768-SON-SR
FPC 6	REV 14	710-013037	T1600-FPC4-ES
PIC 0	REV 11	750-017405	PD-4XGE-XFP
PIC 1	REV 13	750-017405	PD-4XGE-XFP
FPC 7	REV 09	710-007529	T640-FPC3
PIC 0	REV 10	750-012793	PC-1XGE-TYPE3-XFP-IQ2
PIC 1	REV 01	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 2	REV 01	750-015217	PC-8GE-TYPE3-SFP-IQ2
PIC 3	REV 15	750-009450	PC-10C192-SON-SR2
SIB 0	REV 07	710-013074	SIB-I-T1600-S
SIB 1	REV 07	710-013074	SIB-I-T1600-S
SIB 2	REV 07	710-013074	SIB-I-T1600-S
SIB 3	REV 07	710-013074	SIB-I-T1600-S
SIB 4	REV 07	710-013074	SIB-I-T1600-S
Fan Tray 0			FANTRAY-T-S
Fan Tray 1			FANTRAY-T-S
Fan Tray 2			FAN-REAR-TX-T640-S

2. Remove all unsupported FPCs. To minimize downtime, you can upgrade FPCs that are supported on both the T640 router or T1600 router and the T4000 router before the upgrade to a T4000 router.



**NOTE:** The following FPCs cannot be installed until all other hardware components for the T4000 router have been installed.

- T1600-FPC4-ES FPCs cannot be installed on T640 routers that have not been upgraded. The T1600-FPC4-ES FPC is not supported on T640 routers.
- T4000-FPC5-3D FPCs cannot be installed on T640 or T1600 routers that have not been upgraded.

#### Related Documentation

- [Overview of Upgrading to a T4000 Router on page 227](#)
- [T4000 Upgrade Kit on page 227](#)

## T4000 Upgrade Kit

The following hardware components are required for an upgrade from a Juniper Networks T640 Core Router or T1600 Core Router to a T4000 Core Router.

- Two redundant, load-sharing six-input DC power supplies (PWR-T-6-60-DC)
- Five T4000 SIBs (SIB-I-T4000)
- One T Series craft interface panel (CRAFT-T-SERIES)
- Two front fan trays (FANTRAY-T4000)
- One rear fan tray (FAN-REAR-TXP-LCC)
- Two Routing Engines (RE-DUO-C1800-8G)



**NOTE:** RE-DUO-C1800-16G is also supported

- Two control boards (CB-LCC)

You can order these components individually or order a T4000 upgrade kit that contains all the components. You might need additional DC power cables.



**NOTE:** These components must be installed before you can install a T4000 FPC5 in the T4000 router.

### Related Documentation

- [Checking the Hardware Version of T640 or T1600 Components on page 218](#)
- [Overview of Upgrading to a T4000 Router on page 227](#)

## Overview of Upgrading to a T4000 Router

To upgrade to a T4000 Router:

1. Verify that you have prepared the T640 or T1600 router for the upgrade. See [“Overview of Preparing to Upgrade to a T4000 Router” on page 217](#).
2. Verify that you have all the hardware required to upgrade to a T4000 router. See the following documentation:
  - [T4000 Upgrade Kit on page 227](#)
  - [Checking the Hardware Version of T640 or T1600 Components on page 218](#)
3. Upgrade the hardware components on the T640 or T1600 router. See [“Upgrading Hardware Components on the T640 or T1600 Router” on page 228](#).
4. Upgrade the SIBs using one of the following procedures:

- For the Junos OS Release 12.1, see [“Upgrading to T4000 SIBs with Junos OS Release 12.1” on page 232.](#)
  - For the Junos OS Release 12.2 and later, see [“Upgrading to T4000 SIBs Online with Junos OS Release 12.2 and Later” on page 233.](#)
5. For Junos OS Release 12.3 and later, configure power management, if needed. See the following documentation:
    - [Configuring DC Power on a T4000 Router on page 213](#)
    - [T4000 Power Management \(Three 80-A Cables on a Six-Input DC Power Supply\) on page 103](#)
    - [T4000 Power Management \(Four 60-A Cables on a Six-Input DC Power Supply\) on page 103](#)
  6. After the SIBs have been upgraded and power management has been configured, you can install the T4000 FPCs. See [“Installing the T4000 FPCs After an Upgrade from a T640 or T1600 Router” on page 235.](#)
  7. Register your upgrade. See [“Registering Your T4000 Upgrade” on page 236.](#)

**Related  
Documentation**

- [T4000 Router Description on page 3](#)

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## Upgrading Hardware Components on the T640 or T1600 Router

The following components are supported on the T640 and T1600 router, and can be installed without powering off or rebooting the router.

You must proceed through the upgrade process in the following order:

1. [Preparing to Upgrade the T640 or T1600 Components on page 228](#)
2. [Upgrade to the Six-Input DC Power Supplies on page 229](#)
3. [Upgrade the Fan Trays on page 229](#)
4. [Upgrading the Host Subsystem on page 230](#)
5. [Removing Unsupported FPCs and PICs on page 230](#)
6. [Verify That Components Supported by the T4000 Router Are Installed on page 231](#)

### Preparing to Upgrade the T640 or T1600 Components

1. Unpack the upgrade components and verify the parts received.
2. Gather the tools required to upgrade the T4000 router hardware components.

## Upgrade to the Six-Input DC Power Supplies

To upgrade to the six-input DC power supply:



**NOTE:** This procedure does not apply to T640 or T1600 routers with AC power supplies. In that case, both AC power supplies must be powered off and removed before the DC power supplies are installed.

1. Verify that the number of inputs that you plan to connect to the 6-input DC power supply provides sufficient power for your planned configuration for the T4000 router.



**NOTE:** For the Junos OS Release 12.1 and 12.2, a minimum of five inputs for each power supply is required. Connecting only four inputs to each DC power supply in a T4000 router is not currently supported.

2. Remove one of the existing power supplies. For information about removing T640 or T1600 components, see the *T640 Core Router Hardware Guide* or *T1600 Core Router Hardware Guide*.
3. Install one six-input DC power supply.
4. Connect the DC power cables to the six-input DC power supply.
5. Repeat the procedure for the other power supply.

## Upgrade the Fan Trays

To upgrade the fan trays:

1. Upgrade the front fan trays.
2. Upgrade the rear fan tray, if needed. FAN-REAR-TXP-LCC rear fan tray is required. Install the FAN-REAR-TXP-LCC rear fan tray, if not already installed.

## Upgrading the Host Subsystem

Upgrade the host subsystem, if needed. For information about upgrading the host subsystem, see the hardware guide for the T640 or T1600 router:

- *T640 Core Router Hardware Guide*
- *T1600 Core Router Hardware Guide*



**NOTE:** Upgrading a Routing Engine or Control board requires that the host subsystem be taken offline. Upgrade the backup Routing Engine and control board first, bring them online, then upgrade the other Routing Engine and control board.

1. Take the host subsystem offline.
2. Upgrade the backup Routing Engine.
3. Upgrade the backup control board.
4. Verify that the two configuration switches on the faceplate of the LCC-CB are set correctly for a standalone T4000 router:
  - The **M/S** configuration switch must be set to **S**.
  - The **CHASSIS ID** configuration switch must be set to **0**.
5. Take the other host subsystem offline.
6. Repeat the procedure for the other Routing Engine and control board.

## Removing Unsupported FPCs and PICs



**NOTE:** Although you can choose to leave unsupported FPCs and PICs in the T640 or T1600 router, the FPCs and PICs installed in those FPCs will not come online in the T4000 router, and will not function.

To remove unsupported PICs and FPCs from the T640 or T1600 router:

1. Determine the FPCs supported by the T4000 router for your Junos OS Release. For a list of the FPCs supported by the T4000 router, see [“T4000 FPCs Supported” on page 61](#).
2. Remove FPCs not supported by the T4000 router. . Install blanks in the FPC slots.



3. Determine the PICs supported by the T4000 router for your Junos OS Release. For a list of PICs supported by the T4000 router, see the *T4000 Core Router Interface Module Reference*.
4. Remove PICs not supported by the T4000 router.

## Verify That Components Supported by the T4000 Router Are Installed

To verify that the hardware components supported by the T4000 router are installed on the T640 or T1600 router:

1. Issue the **show chassis hardware models** command:

```
user@host> show chassis hardware models
```

Hardware inventory:

Item	Version	Part number	Serial number	FRU model number
Midplane	REV 01	710-027486	RC9244	CHAS-BP-T1600-S
FPM Display	REV 03	710-021387	BBAF4338	CRAFT-T1600-S
CIP	REV 06	710-002895	BBAF2353	CIP-L-T640-S
PEM 0	REV 02	740-036442	VG00017	PWR-T-6-60-DC-S
PEM 1	REV 02	740-036442	VG00017	PWR-T-6-60-DC-S
SCG 0	REV 18	710-003423	BBAE4908	SCG-T-S
SCG 1	REV 18	710-003423	BBAB2590	SCG-T-S
Routing Engine 0	REV 06	740-026941	P737F-002693	RE-DUO-C1800-8G-S
Routing Engine 1	REV 06	740-026941	P737F-002587	RE-DUO-C1800-8G-S
CB 0	REV 09	710-022597	EF6057	CB-LCC-S
CB 1	REV 09	710-022597	EF9180	CB-LCC-S
FPC 5	REV 03	710-033871	IPUCAMBCTD	T1600-FPC4-ES
PIC 1	REV 03	750-034781	IPUIBKLMMA	PD-1CE-CFP-FPC4
SIB 0	REV 02	750-005486		SIB-I-T640-S
SIB 1	REV 02	750-005486		SIB-I-T640-S
SIB 2	REV 02	750-005486		SIB-I-T640-S
SIB 3	REV 02	750-005486		SIB-I-T640-S
SIB 4	REV 02	750-005486		SIB-I-T640-S
Fan Tray 0				FANTRAY-T4000-S
Fan Tray 1				FANTRAY-T4000-S
Fan Tray 2				FAN-REAR-TXP-LCC-S

2. Verify that the following hardware components have been installed:
  - Two **PWR-T-6-60-DC**
  - Two **RE-DUO-C1800-8G** or two **RE-DUO-C1800-16G**
  - Two **CB-LCC**
  - Two **FANTRAY-T4000**
  - One **FAN-REAR-TXP-LCC**
3. Verify that unsupported PICs and FPCs have been removed. See the following documentation:
  - For a list of the FPCs supported by the T4000 router, see [“T4000 FPCs Supported” on page 61](#).

- For a list of PICs supported by the T4000 router, see the *T4000 Core Router Interface Module Reference*.

## Upgrading to T4000 SIBs with Junos OS Release 12.1

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**NOTE:** You must use this procedure for Junos OS Release 12.1.

---

You must proceed through the upgrade process in the following order:

1. Unpack the T4000 SIBs and verify the parts received.
2. Gather the tools required to upgrade the T4000 SIBs.
3. Include the **fabric upgrade-mode** statement in the configuration of the T640 or T1600 router at the **[edit chassis]** hierarchy level.

```
[edit]
user@host# set chassis fabric upgrade-mode
```

4. Commit the configuration on both the master and the backup Routing Engines.

```
[edit]
user@host# commit synchronize
```

5. On the T640 router or the T1600 router, verify that upgrade mode has been set.

```
[edit]
user@host# show chassis fabric upgrade-mode
```

6. Install the SIB-I-T4000 SIBs. Replace one SIB at a time.

After each SIB is replaced, bring the newly installed SIB online, and check for crc errors and link status with the following commands before adding another SIB:

- Use the **show chassis sib** command to check the SIB state. The **state** should be **Online**, indicating that the SIB is operational and running.
  - Use the **show chassis fabric fpc** to check the switch fabric links between the Flexible PIC Concentrators (FPCs) and the switch interface boards (SIBs). The **Fabric management FPC state** should be **Links ok**. The **Link error** state indicates that the link between the SIB and FPC has CRC errors. However, the link is still eligible to carry traffic.
  - Use the **show chassis fabric sib** to check the switch fabric links between the SIBs and FPCs. The **Fabric management SIB state** should be **Links ok**. The **Link error** state indicates that the link between the SIB and the FPC is not operational.
7. Delete the **fabric upgrade-mode** statement in the configuration of the T4000 router at the **[edit chassis]** hierarchy level.

```
[edit]
user@host#delete chassis fabric upgrade-mode
```

8. Commit the configuration on both the master and the backup Routing Engines.

```
[edit]
user@host# commit synchronize
```

9. Power off the T1600 router or T640 router.

See the *T640 Core Router Hardware Guide* or *T1600 Core Router Hardware Guide*.

10. Power on the T4000 router.

See “Powering On the T4000 Router” on page 207.

11. Issue the **show chassis hardware models** command:

```
user@host> show chassis hardware models
```

Hardware inventory:

Item	Version	Part number	Serial number	FRU model number
Midplane	REV 01	710-027486	RC9244	CHAS-BP-T1600-S
FPM Display	REV 03	710-021387	BBAF4338	CRAFT-T1600-S
CIP	REV 06	710-002895	BBAF2353	CIP-L-T640-S
PEM 0	REV 02	740-036442	VG00017	PWR-T-6-60-DC-S
PEM 1	REV 02	740-036442	VG00017	PWR-T-6-60-DC-S
SCG 0	REV 18	710-003423	BBAE4908	SCG-T-S
SCG 1	REV 18	710-003423	BBAB2590	SCG-T-S
Routing Engine 0	REV 06	740-026941	P737F-002693	RE-DUO-C1800-8G-S
Routing Engine 1	REV 06	740-026941	P737F-002587	RE-DUO-C1800-8G-S
CB 0	REV 09	710-022597	EF6057	CB-LCC-S
CB 1	REV 09	710-022597	EF9180	CB-LCC-S
SIB 0	REV 02	711-036340	EE6290	
SIB 1	REV 02	711-036340	EE6290	
SIB 2	REV 02	711-036340	EE6290	
SIB 3	REV 02	711-036340	EE6290	
SIB 4	REV 02	711-036340	EE6290	
Fan Tray 0				FANTRAY-T4000-S
Fan Tray 1				FANTRAY-T4000-S
Fan Tray 2				FAN-REAR-TXP-LCC-S

- Related Documentation**
- [T4000 Upgrade Kit on page 227](#)
  - [Checking the Hardware Version of T640 or T1600 Components on page 218](#)

## Upgrading to T4000 SIBs Online with Junos OS Release 12.2 and Later



**NOTE:** This procedure requires 64-bit Junos OS Release 12.2 and later.

You must proceed through the upgrade process in the following order:

1. Unpack the T4000 SIBs and verify the parts received.
2. Gather the tools required to upgrade the T4000 SIBs.
3. Verify that both Routing Engines in the T640 or T1600 router are running a 64-bit Junos Release 12.2 and later.

```
user@host> show version
Hostname: host
Hostname: quietriot1
Model: t1600
JUNOS Base OS boot [12.2R1.1]
JUNOS Base OS Software Suite [12.2R1.1]
JUNOS 64-bit Kernel Software Suite [12.2R1.1]
...
```

4. Include the **fabric upgrade-mode** statement in the configuration of the T640 or T1600 router at the **[edit chassis]** hierarchy level.

```
[edit]
user@host# set chassis fabric upgrade-mode T4000
```

5. Commit the configuration on both the master and the backup Routing Engines.

```
[edit]
user@host# commit synchronize
```

6. On the T640 router or the T1600 router, verify that upgrade mode has been set.

```
[edit]
user@host# show chassis fabric upgrade-mode
```

7. Install the SIB-I-T4000 SIBs. Replace one SIB at a time.

After each SIB is replaced, bring the newly installed SIB online, and check for crc errors and link status with the following commands before adding another SIB:

- Use the **show chassis sib** to check the SIB state. The **state** should be **Online**, indicating that the SIB is operational and running.
- Use the **show chassis fabric fpc** to check the switch fabric links between the Flexible PIC Concentrators (FPCs) and the switch interface boards (SIBs). The **Fabric management FPC state** should be **Links ok**. The **Link error** state indicates that the link between the SIB and FPC has CRC errors. However, the link is still eligible to carry traffic.
- Use the **show chassis fabric sib** to check the switch fabric links between the SIBs and FPCs. The **Fabric management SIB state** should be **Links ok**. The **Link error** state indicates that the link between the SIB and the FPC is not operational.

8. Delete the **fabric upgrade-mode T4000** statement in the configuration of the T4000 router at the **[edit chassis]** hierarchy level.

```
[edit]
user@host# delete chassis fabric upgrade-mode T4000
```

9. Commit the configuration on both the master and the backup Routing Engines.

```
[edit]
user@host# commit synchronize
```

10. Issue the **show chassis hardware models** command:

```
user@host> show chassis hardware models
```

Hardware inventory:

Item	Version	Part number	Serial number	FRU model number
Midplane	REV 01	710-027486	RC9244	CHAS-BP-T1600-S
FPM Display	REV 03	710-021387	BBAF4338	CRAFT-T1600-S
CIP	REV 06	710-002895	BBAF2353	CIP-L-T640-S
PEM 0	REV 02	740-036442	VG00017	PWR-T-6-60-DC-S
PEM 1	REV 02	740-036442	VG00017	PWR-T-6-60-DC-S
SCG 0	REV 18	710-003423	BBAE4908	SCG-T-S
SCG 1	REV 18	710-003423	BBAB2590	SCG-T-S
Routing Engine 0	REV 06	740-026941	P737F-002693	RE-DUO-C1800-8G-S
Routing Engine 1	REV 06	740-026941	P737F-002587	RE-DUO-C1800-8G-S
CB 0	REV 09	710-022597	EF6057	CB-LCC-S
CB 1	REV 09	710-022597	EF9180	CB-LCC-S
SIB 0	REV 02	711-036340	EE6290	
SIB 1	REV 02	711-036340	EE6290	
SIB 2	REV 02	711-036340	EE6290	
SIB 3	REV 02	711-036340	EE6290	
SIB 4	REV 02	711-036340	EE6290	
Fan Tray 0				FANTRAY-T4000-S
Fan Tray 1				FANTRAY-T4000-S
Fan Tray 2				FAN-REAR-TXP-LCC-S

- Related Documentation**
- [T4000 Upgrade Kit on page 227](#)
  - [Checking the Hardware Version of T640 or T1600 Components on page 218](#)

## Installing the T4000 FPCs After an Upgrade from a T640 or T1600 Router

After the SIBs have been upgraded, you can install Type 5 FPCs and PICs.

1. Install the Type 5 FPCs (T4000 FPC5).  
See [“Installing a T4000 FPC” on page 298](#)
2. Install Type 5 PICs.  
See [“Installing a T4000 PIC” on page 303](#).

- Related Documentation**
- [T4000 FPC Description on page 57](#)
  - [T4000 PIC Description on page 62](#)
  - [Overview of Upgrading to a T4000 Router on page 227](#)

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## Registering Your T4000 Upgrade

You must register the upgrade with Juniper Networks upon completion of the upgrade. To register your upgrade:

1. Log on to the Juniper Networks Customer Support Center at <https://www.juniper.net/customers/support/>.
2. Click on **Update Install Base**.
3. Follow the instructions provided in this link.

After your upgrade is registered, allow up to 45 days for restocking of the new hardware configuration to support any Next Day or Same Day contracts. Juniper Networks will provide Best Effort support until restocking of the upgraded product is complete.

- Related Documentation**
- [Overview of Upgrading to a T4000 Router on page 227](#)

## PART 4

# Installing and Replacing Components

- [Overview of Installing and Replacing Components on page 239](#)
- [Replacing Chassis Components on page 245](#)
- [Replacing Cooling System Components on page 259](#)
- [Replacing Host Subsystem Components on page 273](#)
- [Replacing Line Card Components on page 295](#)
- [Replacing Power System Components on page 307](#)
- [Replacing Switch Fabric Components on page 319](#)





# Overview of Installing and Replacing Components

- T4000 Field-Replaceable Units on page 239
- Tools and Parts Required for Replacing T4000 Hardware Components on page 241

## T4000 Field-Replaceable Units

Field-replaceable units (FRUs) are router components that can be replaced at the customer site. Replacing most FRUs requires minimal router downtime.

- Hot-removable and hot-insertable FRUs—You can remove and replace these components without powering off the router or disrupting the routing functions.
- Hot-pluggable FRUs—You can remove and replace these components without powering down the router, but the routing functions of the system are interrupted when the component is removed.
- Other FRUs require that you power off the router or backup Routing Engine.



**NOTE:** Before you remove a Control Board or Routing Engine, you must take the host subsystem offline.

Table 77 on page 239 lists the replaceable FRUs for the router.

**Table 77: Field-Replaceable Units**

Component	Effect of Replacement	For More Information
Air filters	Hot-removable and hot-insertable	<p>"Replacing a T4000 Front Air Filter" on page 259</p> <p>"Replacing a T4000 Rear Air Filter" on page 261</p> <p>"Replacing a T4000 Six-Input DC Power Supply Front Air Filter" on page 312</p> <p>"Replacing a T4000 Six-Input DC Power Supply Side Air Filter" on page 313</p>

Table 77: Field-Replaceable Units (continued)

Component	Effect of Replacement	For More Information
Connector Interface Panel (CIP)	Hot-pluggable	"Replacing a T4000 CIP" on page 245
Backup Control Board Master Control Board (if nonstop active routing is configured)	Hot-removable and hot-insertable	"Taking the T4000 Host Subsystem Offline" on page 273 "Replacing a T4000 LCC-CB" on page 275
Nonredundant Control Boards Master Control Board (if nonstop active routing is not configured)	Hot-pluggable	"Taking the T4000 Host Subsystem Offline" on page 273 "Replacing a T4000 LCC-CB" on page 275
Craft Interface	Hot-removable and hot-insertable	"Replacing a T4000 Craft Interface" on page 249
Front and rear fan trays	Hot-removable and hot-insertable	"Replacing a T4000 Lower Front Fan Tray" on page 265 "Replacing a T4000 Upper Front Fan Tray" on page 267 "Replacing a T4000 Rear Fan Tray" on page 269
Flexible PIC Concentrators (FPCs)	Hot-removable and hot-insertable	"Replacing a T4000 FPC" on page 295
PICs	Hot-removable and hot-insertable	"Replacing a T4000 PIC" on page 301
Redundant power supplies	Hot-removable and hot-insertable	"Replacing a T4000 Six-Input DC Power Supply" on page 307 "Replacing a T4000 DC Power Supply Cable" on page 315
Nonredundant power supplies	The router must be powered off before replacement.	"Replacing a T4000 Six-Input DC Power Supply" on page 307 "Replacing a T4000 DC Power Supply Cable" on page 315
Nonredundant Routing Engine Master Routing Engine (if nonstop active routing is not configured)	Hot-pluggable	"Taking the T4000 Host Subsystem Offline" on page 273 "Replacing a T4000 Routing Engine" on page 280
Backup Routing Engine Master Routing Engine (if nonstop active routing is configured)	Hot-removable and Hot-insertable	"Taking the T4000 Host Subsystem Offline" on page 273 "Replacing a T4000 Routing Engine" on page 280

*Table 77: Field-Replaceable Units (continued)*

Component	Effect of Replacement	For More Information
DIMM Module in a Routing Engine	The Routing Engine is removed.	<a href="#">“Replacing a DIMM Module in a T4000 RE-C1800 Routing Engine” on page 289</a>
CompactFlash card and SSD in a Routing Engine	Power off the Routing Engine.	<a href="#">“Replacing a CompactFlash Card in a T4000 RE-C1800 Routing Engine” on page 286</a> <a href="#">“Replacing a Solid-State Disk in a T4000 RE-C1800 Routing Engine” on page 290</a>
Backup SONET Clock Generator (SCG)	Hot-removable and hot-insertable	<a href="#">“Replacing a T4000 SCG” on page 256</a>
Master SONET Clock Generator (SCG) Nonredundant SONET Clock Generator (SCG)	Hot-pluggable	<a href="#">“Replacing a T4000 SCG” on page 256</a>
Switch Interface Boards (SIBs)	Hot-removable and hot-insertable	<a href="#">“Replacing a T4000-SIB” on page 319</a> <a href="#">“Replacing a T4000 TXP-LCC-3D SIB” on page 322</a>

- Related Documentation**
- [T4000 Hardware Component Overview on page 5](#)
  - [T4000 Component Redundancy on page 7](#)
  - [Tools and Parts Required for Replacing T4000 Hardware Components on page 241](#)

## Tools and Parts Required for Replacing T4000 Hardware Components

To replace hardware components, you need the tools and parts listed in [Table 78 on page 241](#).

*Table 78: Tools and Parts Required for Component Replacement*

Components	Tool or part
All	Electrostatic discharge (ESD) grounding wrist strap
Air filter (front or rear)	Phillips (+) screwdrivers, numbers 1 and 2
CIP	Phillips (+) screwdrivers, numbers 1 and 2
Craft interface	Phillips (+) screwdrivers, numbers 1 and 2
Control board	Phillips (+) screwdrivers, numbers 1 and 2 Electrostatic bag or antistatic mat Blank panel (if component is not reinstalled)

Table 78: Tools and Parts Required for Component Replacement (continued)

Components	Tool or part
DC power supply	Phillips (+) screwdrivers, numbers 1 and 2 7/16-in. (11 mm) nut driver <b>CAUTION:</b> You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 in-lb (5.0 Nm).
DC power supply cable	7/16-in. (11 mm) nut driver <b>CAUTION:</b> You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 in-lb (5.0 Nm).
Fan tray (front or rear)	Phillips (+) screwdrivers, numbers 1 and 2
FPC	Phillips (+) screwdrivers, numbers 1 and 2 Blank panel (if component is not reinstalled) Electrostatic bag or antistatic mat
PIC	Phillips (+) screwdrivers, numbers 1 and 2 Rubber safety cap for fiber-optic PICs or fiber-optic PIC cables Flat-blade (–) screwdriver for Type 1 PICs Electrostatic bag or antistatic mat Blank panel (if component is not reinstalled)
Routing Engine	Phillips (+) screwdrivers, numbers 1 and 2 Electrostatic bag or antistatic mat Blank panel (if component is not reinstalled)
Serial cable to <b>AUXILIARY</b> or <b>CONSOLE</b> Routing Engine port	Flat-blade (–) screwdriver
SIB	Phillips (+) screwdrivers, numbers 1 and 2 Electrostatic bag or antistatic mat Blank panel (if component is not reinstalled)
SCG	Phillips (+) screwdrivers, numbers 1 and 2

- Related Documentation**
- [Returning a Hardware Component to Juniper Networks, Inc. on page 387](#)
  - [Tools and Parts Required to Remove Components from a T4000 Router on page 388](#)



# Replacing Chassis Components

- [Replacing a T4000 CIP on page 245](#)
- [Replacing a T4000 Craft Interface on page 249](#)
- [Replacing a T4000 Console or Auxiliary Cable on page 250](#)
- [Replacing a T4000 Management Ethernet Cable on page 253](#)
- [Replacing the T4000 Alarm Relay Wires on page 255](#)
- [Replacing a T4000 SCG on page 256](#)

## Replacing a T4000 CIP

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The CIP is located to the left side of the FPC card cage. It houses the Routing Engine interface ports, which accept connections to external management and alarm-reporting devices.

The CIP is hot-pluggable. It weighs approximately 8 lb (3.6 kg). When the CIP is removed, you cannot control or communicate with the router using an external device.

1. [Removing a T4000 CIP on page 245](#)
2. [Installing a T4000 CIP on page 246](#)

## Removing a T4000 CIP

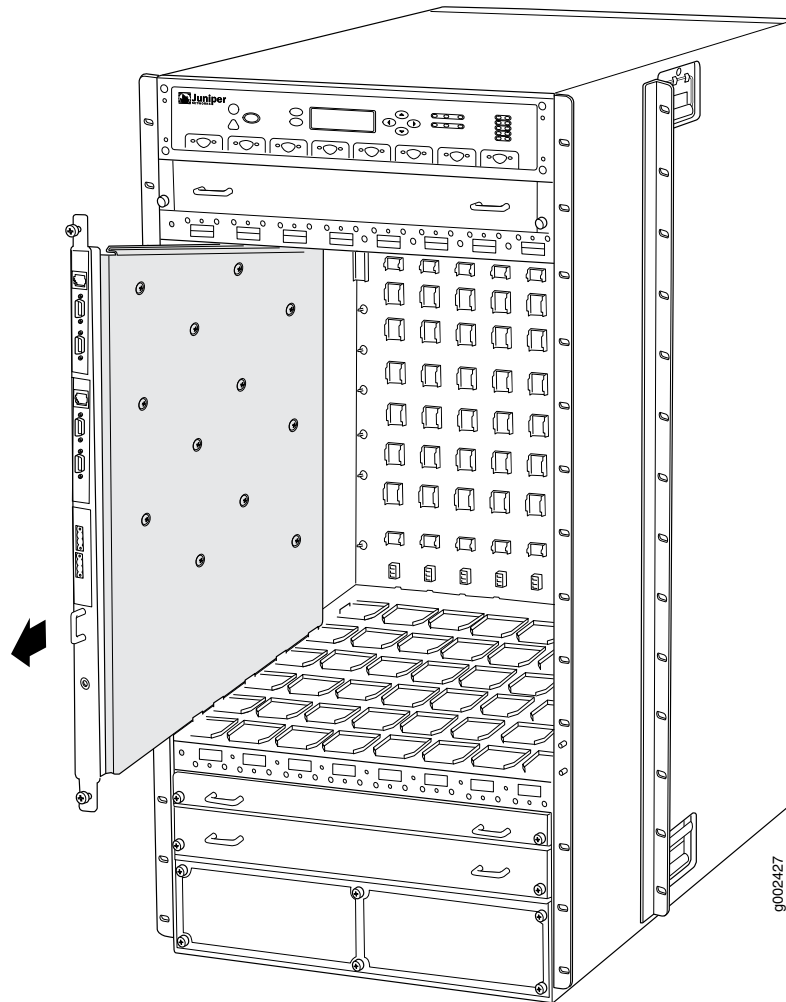
To remove the CIP (see [Figure 87 on page 246](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the site ESD points on the chassis.
2. Disconnect any external devices connected to the CIP.
3. Loosen the captive screws at the top and bottom of the CIP faceplate.
4. Grasp the handle on the CIP faceplate and carefully pull the CIP straight out of the chassis.



**CAUTION:** Be sure to slide the CIP straight within the slot to avoid damaging the connector pins on the front of the midplane.

*Figure 87: Removing the CIP*



## Installing a T4000 CIP

To install the CIP (see [Figure 88 on page 248](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Grasp the CIP handle with one hand and hold the bottom edge of the CIP with the other hand to support its weight.





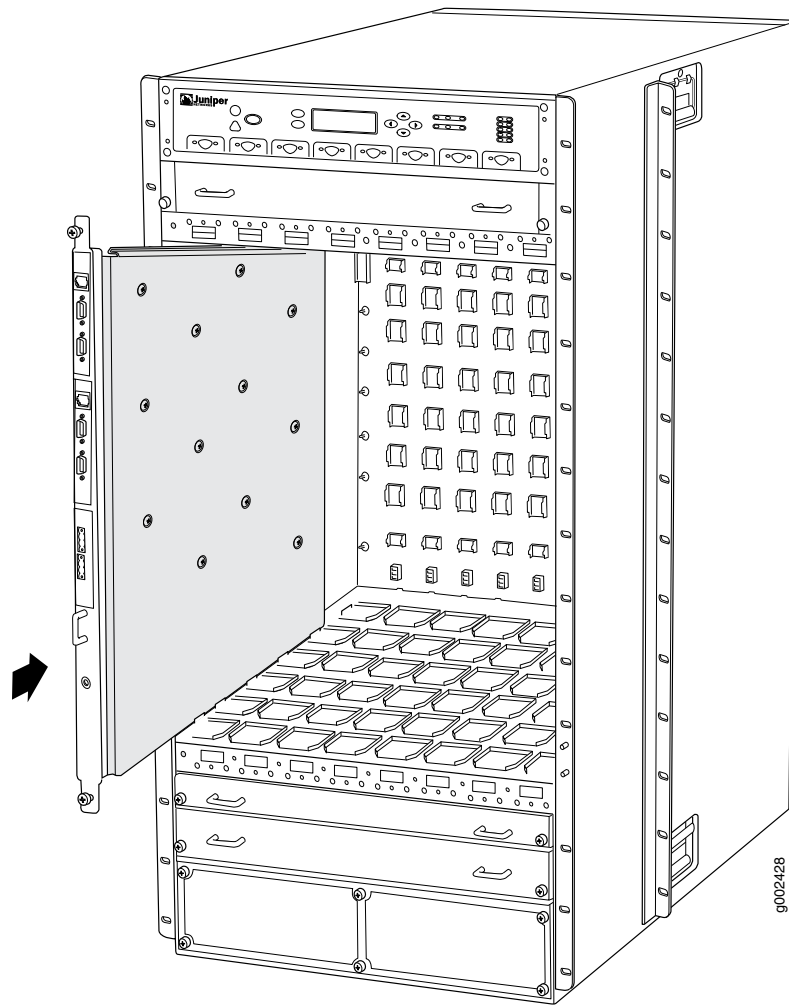
**NOTE:** The components on the CIP are on the left side of the board, unlike the components of an FPC, which are on the right side. Verify that the components are on the left before inserting the CIP.

3. Insert the CIP into the leftmost slot of the FPC card cage, carefully aligning the top and bottom of the CIP with the guides in the card cage.
4. Carefully push the CIP straight into the chassis until it contacts the midplane.
5. Tighten the screws at the top and bottom of the CIP faceplate.
6. Reattach any external devices connected to the CIP.



**CAUTION:** Be sure to slide the CIP straight within the slot to avoid damaging the connector pins on the front of the midplane.

7. To verify that the CIP is installed correctly, plug an Ethernet cable into the Ethernet port on the CIP. If the host module is operational, the **ACTIVE** LED blinks to indicate Ethernet activity. If you can run the CLI, the CIP is installed correctly.

*Figure 88: Installing the CIP***See Also**

- 
- 
- 

**Related Documentation**

- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [Replacing the T4000 Alarm Relay Wires on page 255](#)
- [Replacing a T4000 Console or Auxiliary Cable on page 250](#)
- [Replacing a T4000 Management Ethernet Cable on page 253](#)

## Replacing a T4000 Craft Interface

1. [Removing the T4000 Craft Interface on page 249](#)
2. [Installing the T4000 Craft Interface on page 250](#)

### Removing the T4000 Craft Interface

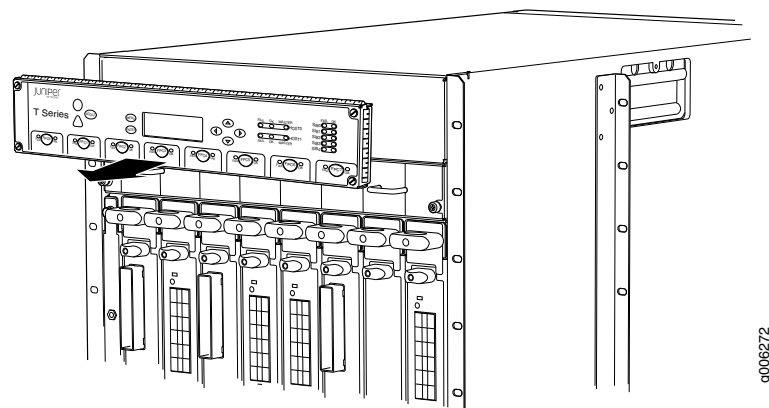


**CAUTION:** Before you remove the craft interface, remove the upper front fan tray. See [“Replacing a T4000 Upper Front Fan Tray” on page 267](#).

To remove the craft interface, see [Figure 89 on page 249](#).

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Completely loosen the screws at the four corners of the craft interface.
3. Insert the blade of a flat-blade screwdriver into the slot on one side of the craft interface, then gently pry that side out from the chassis.
4. Insert the blade of a flat-blade screwdriver into the slot on the other side of the craft interface, then gently pry that side out from the chassis.
5. Grasp the craft interface by the top and bottom edges and carefully pull it straight out of the chassis.

**Figure 89: Removing the Craft Interface**



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## Installing the T4000 Craft Interface

To install the craft interface (see [Figure 90 on page 250](#)):

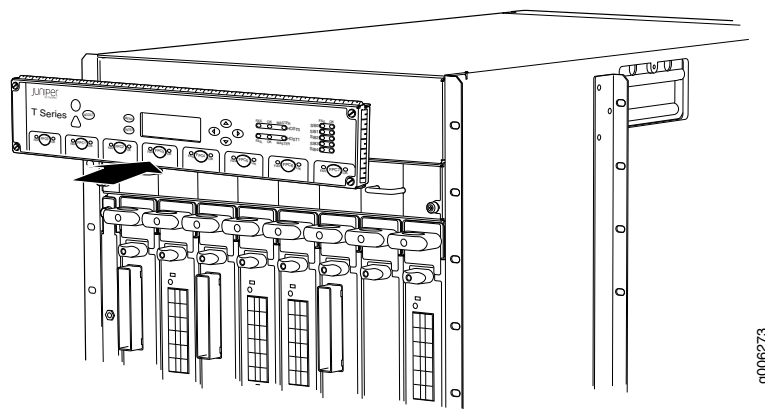
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Grasping the craft interface by the top and bottom edges, press it into place.
3. Tighten the screws at the corners of the craft interface.



**NOTE:** When you install the craft interface in an operating router, allow several minutes for the LEDs on the craft interface to reflect the current state of the router.

After you install the replacement craft interface, immediately reinstall the upper front fan tray. See [“Replacing a T4000 Upper Front Fan Tray” on page 267](#).

*Figure 90: Installing a Replacement Craft Interface*



- Related Documentation**
- [T4000 Craft Interface Description on page 16](#)
  - [Troubleshooting the T4000 Craft Interface on page 349](#)

## Replacing a T4000 Console or Auxiliary Cable

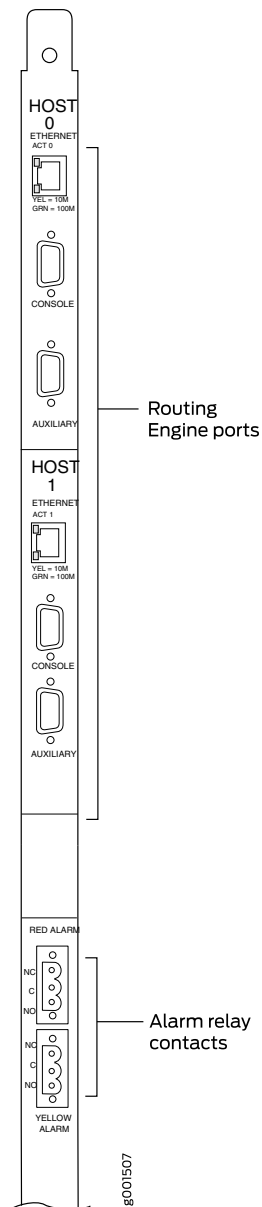
1. [Removing a T4000 Console or Auxiliary Cable on page 251](#)
2. [Installing a T4000 Console or Auxiliary Cable on page 253](#)

## Removing a T4000 Console or Auxiliary Cable

To remove a serial cable connected to a management console or auxiliary device (see [Figure 91 on page 252](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the site ESD points on the chassis.
2. Turn off the power to the console or auxiliary device.
3. Unscrew the screws that secure the cable connector to the port, using a 2.5-mm flat-blade screwdriver if necessary.
4. Pull the cable connector straight out of the port.
5. Disconnect the cable from the console or auxiliary device.

Figure 91: DB-9 Port on the CIP



- See Also**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)
  - [T4000 Routing Engine Interface Cable Specifications on page 113](#)
  - [DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports on page 114](#)

## Installing a T4000 Console or Auxiliary Cable

The **AUXILIARY** port and **CONSOLE** port on the CIP both accept an RS-232 (EIA-232C) serial cable with DB-9 connectors.

To connect a management console or auxiliary device:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the site ESD points on the chassis.
2. Connect one end of the replacement cable into the appropriate **CONSOLE** or **AUXILIARY** port. The ports labeled **HOST 0** connect to the Routing Engine in the upper Routing Engine slot (**RE0**), and the ports labeled **HOST 1** connect to the Routing Engine in the lower Routing Engine slot (**RE1**).
3. Using a 2.5-mm flat-blade screwdriver, tighten the screws on the connector.
4. Plug the other end of the cable into the device's serial port.

- See Also**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)
  - [T4000 Routing Engine Interface Cable Specifications on page 113](#)
  - [DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports on page 114](#)

- Related Documentation**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [Connecting the T4000 Router to a Management Console or Auxiliary Device on page 178](#)
  - [T4000 Routing Engine Interface Cable Specifications on page 113](#)
  - [DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports on page 114](#)

## Replacing a T4000 Management Ethernet Cable

1. [Removing a T4000 Management Ethernet Cable on page 253](#)
2. [Installing a T4000 Management Ethernet Cable on page 255](#)

### Removing a T4000 Management Ethernet Cable

1. Press the tab on the connector, and pull the connector straight out of the **ETHERNET** port. [Figure 92 on page 254](#) shows the connector.
2. Disconnect the cable from the network device.

Figure 92: Ethernet Cable Connectors

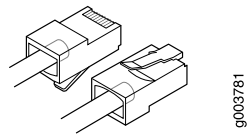
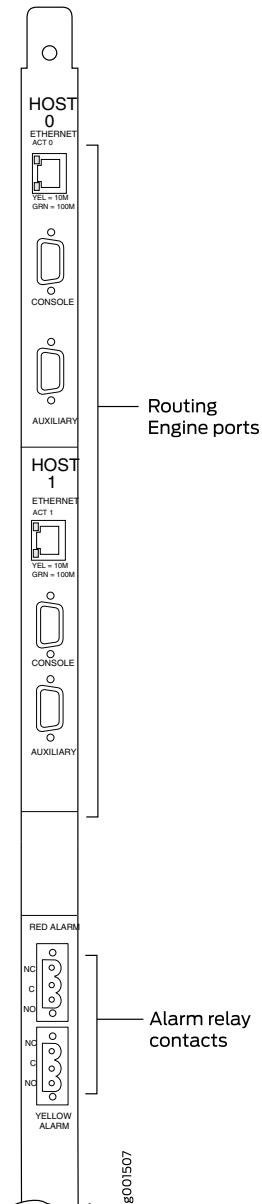


Figure 93: Ethernet Port on CIP



- See Also**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [Connecting the T4000 Router to a Management Ethernet Device on page 180](#)



- [T4000 Routing Engine Interface Cable Specifications on page 113](#)
- [RJ-45 Connector Pinouts for the T4000 Management ETHERNET Port on page 115](#)

## Installing a T4000 Management Ethernet Cable

1. Plug one end of the replacement cable into the appropriate **ETHERNET** port. The ports labeled **HOST 0** connect to the Routing Engine in the upper Routing Engine slot (**RE0**), and the ports labeled **HOST 1** connect to the Routing Engine in the lower Routing Engine slot (**RE1**).
2. Plug the other end of the cable into the network device.

- See Also**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [Connecting the T4000 Router to a Management Ethernet Device on page 180](#)
  - [T4000 Routing Engine Interface Cable Specifications on page 113](#)
  - [RJ-45 Connector Pinouts for the T4000 Management ETHERNET Port on page 115](#)

- Related Documentation**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [Connecting the T4000 Router to a Management Ethernet Device on page 180](#)
  - [T4000 Routing Engine Interface Cable Specifications on page 113](#)
  - [RJ-45 Connector Pinouts for the T4000 Management ETHERNET Port on page 115](#)

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## Replacing the T4000 Alarm Relay Wires

1. [Removing the T4000 Alarm Relay Wires on page 255](#)
2. [Installing the T4000 Alarm Relay Wires on page 256](#)

## Removing the T4000 Alarm Relay Wires

To remove the wires connected to an alarm-reporting device:

1. Disconnect the existing wire at the external device.
2. Using a 2.5-mm flat-blade screwdriver, loosen the small screws on the face of the terminal block and remove the block from the relay contact.
3. Using the 2.5-mm flat-blade screwdriver, loosen the small screws on the side of the terminal block. Remove existing wires from the slots in the front of the block, and insert replacement wires. Tighten the screws to secure the wire.

## Installing the T4000 Alarm Relay Wires

To connect replacement wires to an alarm-reporting device:

1. Prepare the required length of replacement wire with a gauge between 28 AWG and 14 AWG (0.08 and 2.08 mm<sup>2</sup>).
2. Plug the terminal block into the relay contact, and use a 2.5-mm flat-blade screwdriver to tighten the screws on the face of the block.
3. Attach the other end of the wires to the external device.

### Related Documentation

- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [Connecting the T4000 Router to an External Alarm-Reporting Device on page 182](#)
- [T4000 Alarm Relay Contact Wire Specifications on page 114](#)

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## Replacing a T4000 SCG

1. [Removing a T4000 SCG on page 256](#)
2. [Installing a T4000 SCG on page 257](#)

### Removing a T4000 SCG

The router can have one or two SCGs installed. The SCGs are located in the upper rear of the chassis, above the control boards and Routing Engines. Each SCG weighs approximately 1.9 lb (0.9 kg).

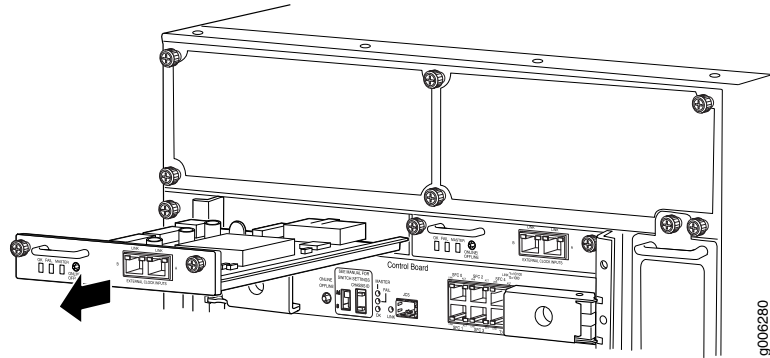
A nonredundant SCG is hot-pluggable. For redundant SCGs, the master SCG is hot-pluggable. The backup SCG is hot-removable and hot-insertable if the master SCG is functioning. Removing the backup SCG does not affect the functioning of the router. Taking the master SCG offline might result in a brief loss of SONET clock lock while the backup SCG becomes the master.

To remove an SCG (see [Figure 94 on page 257](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Press the online/offline button on the SCG faceplate, and hold it down until the LED goes out (about 5 seconds).
4. Loosen the captive screws on the edges of the SCG faceplate.

5. Grasp the SCG by the handle on the faceplate, and slide it out of the chassis.
6. Place the SCG on the antistatic mat.

*Figure 94: Removing an SCG*



## Installing a T4000 SCG

To install a replacement SCG (see [Figure 95 on page 258](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Carefully align the sides of the SCG with the guides in the SCG slot.
3. Grasp the SCG by its handle, and slide it straight into the chassis until it contacts the midplane.
4. Tighten the captive screws on the corners of the SCG faceplate.
5. To bring the SCG online, press the online/offline button until the green **OK** LED lights.
6. To verify that the SCG is installed correctly and is functioning normally, check the LEDs on the SCG faceplate. The green **OK** LED should light steadily. If the SCG is master, the blue **MASTER** LED should also light steadily.

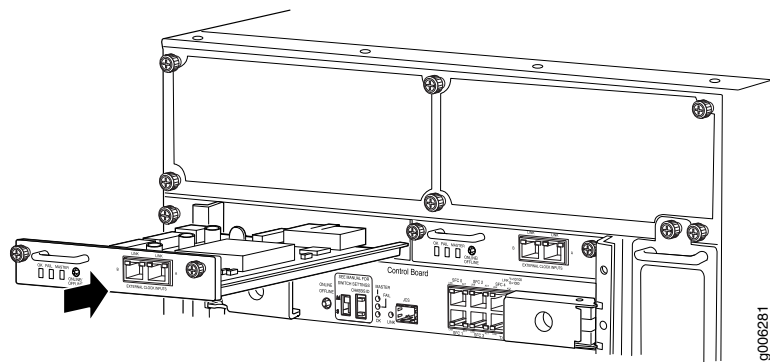
To check the status of the SCGs, use the following CLI command:

```
user@host> show chassis environment scg
```

```
SCG 0 status:
State           Online - Master clock
Temperature      38 degrees C / 100 degrees F
Power
  GROUND         0 mV
  1.8 V bias     1797 mV
  3.3 V          3312 mV
  3.3 V bias     3274 mV
  5.0 V          5047 mV
```

5.0 V bias	4989 mV
5.6 V	5758 mV
8.0 V bias	7560 mV
Bus Revision	40
SCG 1 status:	
State	Online - Standby
Temperature	38 degrees C / 100 degrees F
Power	
GROUND	0 mV
1.8 V bias	1786 mV
3.3 V	3318 mV
3.3 V bias	3286 mV
5.0 V	5037 mV
5.0 V bias	5001 mV
5.6 V	5777 mV
8.0 V bias	7582 mV
Bus Revision	40

*Figure 95: Installing an SCG*



**Related Documentation**

- [T4000 SONET Clock Generators \(SCGs\) Description on page 20](#)
- [T4000 SONET Clock Generators \(SCGs\) LEDs on page 22](#)
- [Maintaining the T4000 SCGs on page 333](#)
- [Troubleshooting the T4000 SCGs on page 349](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

# Replacing Cooling System Components

- [Replacing a T4000 Front Air Filter on page 259](#)
- [Replacing a T4000 Rear Air Filter on page 261](#)
- [Replacing a T4000 Lower Front Fan Tray on page 265](#)
- [Replacing a T4000 Upper Front Fan Tray on page 267](#)
- [Replacing a T4000 Rear Fan Tray on page 269](#)

## Replacing a T4000 Front Air Filter

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1. [Removing the T4000 Front Air Filter on page 259](#)
2. [Installing the T4000 Front Air Filter on page 260](#)

### Removing the T4000 Front Air Filter

The front air filter, located below the FPC card cage in the front of the chassis, installs horizontally. The front air filter weighs approximately 1 lb (0.5 kg). The air filters are hot-insertable and hot-removable.

To remove the front air filter (see [Figure 96 on page 260](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Unwrap any PIC cables from the spools on the cable management system, and remove the cables from the tray. Arrange the cables so that they do not block the front of the cable management system and tray, and secure them with temporary fasteners so that they are not supporting their own weight as they hang from the connector.

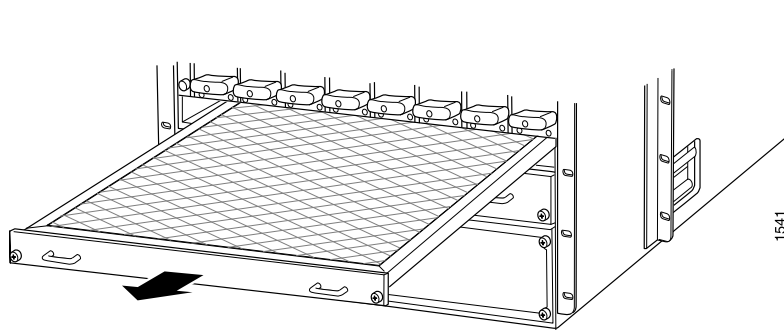


**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

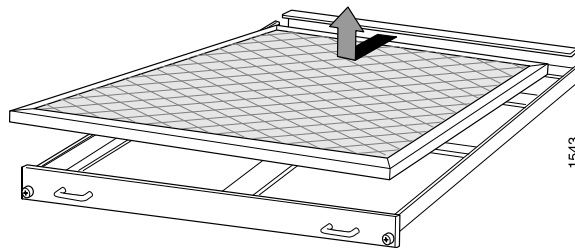
3. Simultaneously pull the two releases on the cable management system. Lift it up and outward to lock it in place to access the air filter.

4. Loosen the captive screws on the corners of the air filter faceplate.
5. Grasp the handles, and pull the air filter straight out of the chassis.
6. Remove the filter element from the air filter frame (see [Figure 97 on page 260](#)).

*Figure 96: Removing the Front Air Filter*



*Figure 97: Replacing the Front Filter Element*

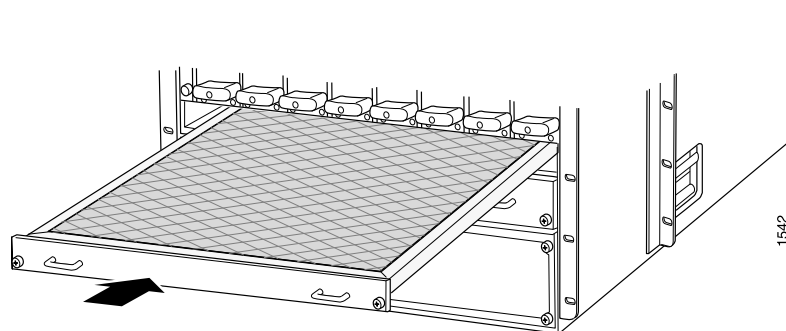


See Also .

## Installing the T4000 Front Air Filter

To install the front air filter (see [Figure 98 on page 261](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Insert the filter element into the air filter frame.
3. Grasp the air filter by the handles on its faceplate, and slide it straight into the chassis.
4. Tighten the captive screws on the corners of the faceplate.
5. Unlock the cable management system, and lower it to the fully lowered position.
6. Rearrange the PIC cables in the cable management system.

*Figure 98: Installing the Front Air Filter*

See Also .

#### Related Documentation

- [Prevention of Electrostatic Discharge Damage on page 423](#)
- [T4000 Cooling System Description on page 25](#)
- [Troubleshooting the T4000 Cooling System on page 351](#)
- [T4000 Clearance Requirements for Airflow and Hardware Maintenance on page 91](#)
- [Maintaining the T4000 Air Filters on page 334](#)

## Replacing a T4000 Rear Air Filter

1. [Removing a Rear T4000 Air Filter on page 261](#)
2. [Installing the T4000 Rear Air Filter on page 263](#)

### Removing a Rear T4000 Air Filter

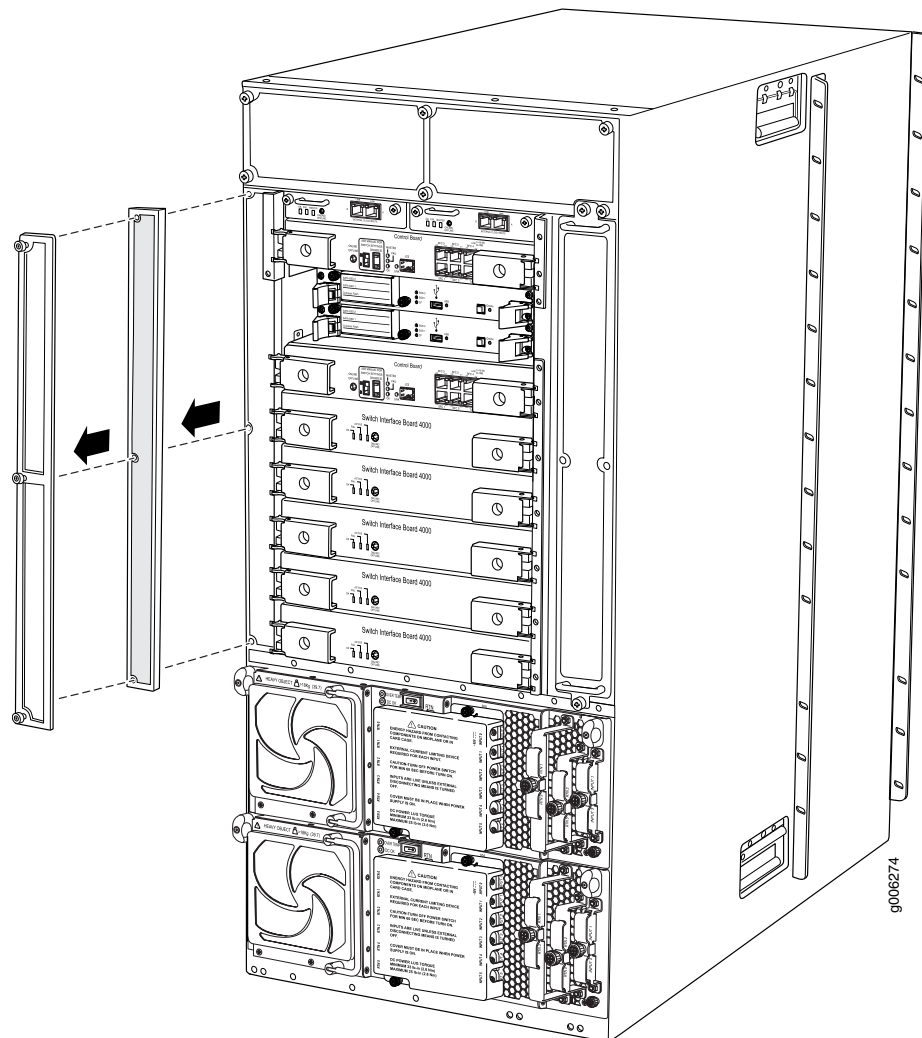
The rear air filter is located at the left rear edge of the chassis. The rear air filter weighs less than 1 lb (0.5 kg).

To remove the rear air filter:

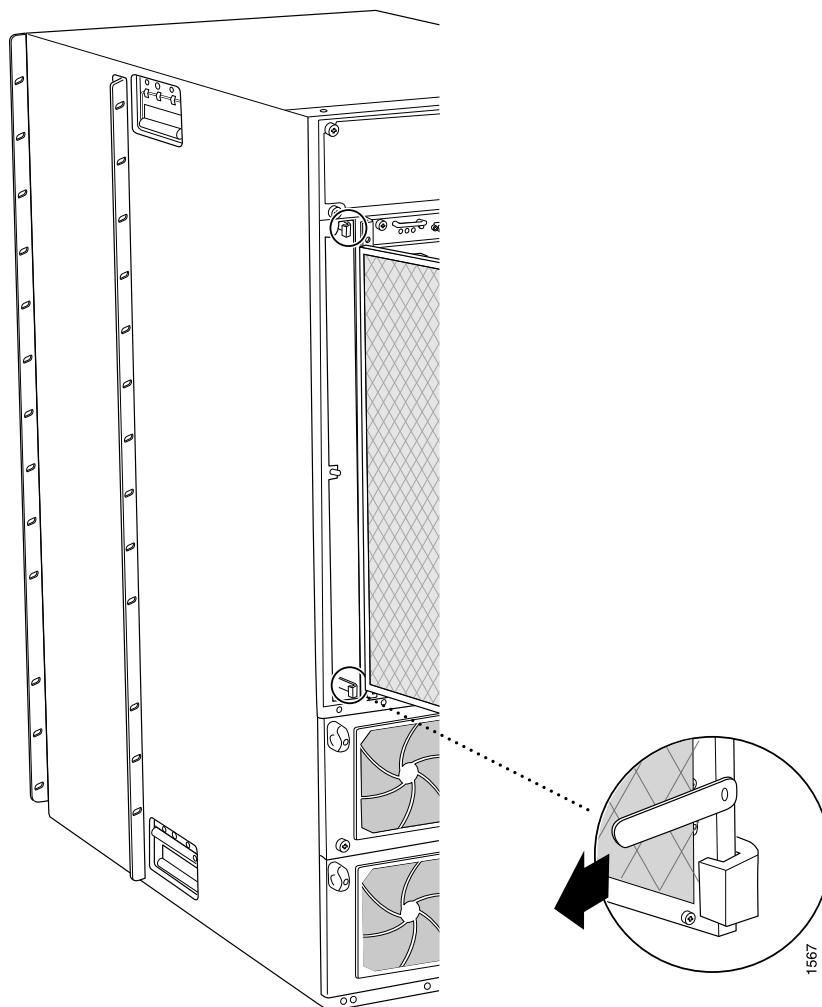
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Loosen the captive screws at the top, center, and bottom of the air filter, using a Phillips (+) screwdriver, number 2.
3. Grasp the air filter cover by the captive screws, and pull firmly to remove the cover and honeycomb assembly from the chassis (see [Figure 99 on page 262](#)).
4. Press the filter element inward until it clears the hooks at the top and bottom of the air filter slot, then push it to the left to unseat it.

5. Move the tabs on the filter element to a horizontal position.
6. Grasp the tabs on the filter element, and carefully pull it straight out from the chassis (see [Figure 100 on page 263](#)).

*Figure 99: Removing the Rear Air Filter*





*Figure 100: Removing the Rear Air Filter Element*

See Also •

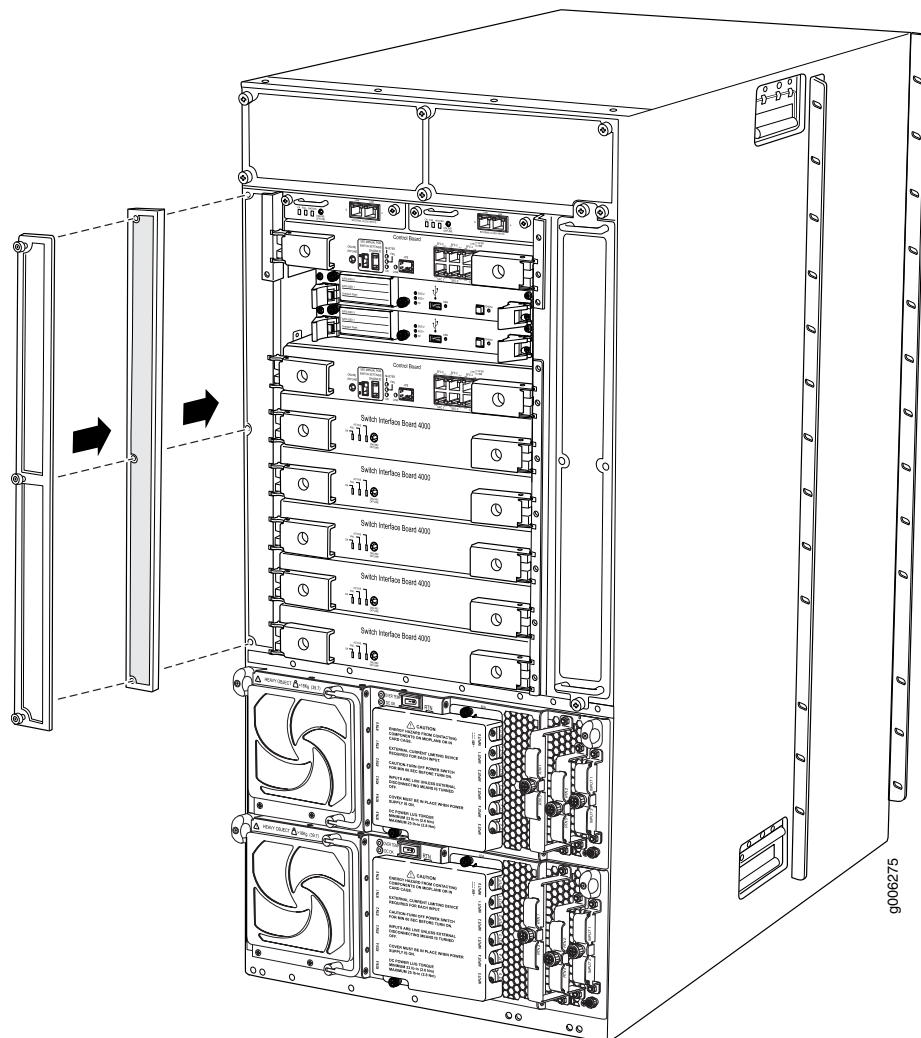
### Installing the T4000 Rear Air Filter

To install the rear air filter (see [Figure 101 on page 264](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Holding the filter by the tabs, carefully push the filter all the way into the air filter slot.
3. Holding the filter all the way in, push it to the right side of the slot until it is held in place behind the hooks.
4. Move the tabs to a vertical position.

5. Place the right edge of the honeycomb against the flange of the air filter slot.
6. Line up the holes at the top, center, and bottom of the honeycomb with the pins in the slot, and press the honeycomb into place.
7. Replace the air filter cover.
8. Firmly tighten the captive screws at the top, center, and bottom of the filter cover to secure it to the chassis, using a Phillips (+) screwdriver, number 2.

*Figure 101: Installing the Rear Air Filter*



See Also .

**Related Documentation**

- [Prevention of Electrostatic Discharge Damage on page 423](#)
- [T4000 Cooling System Description on page 25](#)
- [Troubleshooting the T4000 Cooling System on page 351](#)
- [T4000 Clearance Requirements for Airflow and Hardware Maintenance on page 91](#)
- [Maintaining the T4000 Air Filters on page 334](#)

## Replacing a T4000 Lower Front Fan Tray

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The lower front fan tray is located below the front air filter. Each front fan tray weighs about 20.4 lb (9.3 kg). The fan trays are hot-insertable and hot-removable. The upper and lower fan trays are interchangeable with each other.



**NOTE:** Ensure that at any given time only one front fan tray is replaced. Do NOT replace both the front lower and upper fans simultaneously.

1. [Removing the T4000 Lower Front Fan Tray on page 265](#)
2. [Installing the T4000 Lower Front Fan Tray on page 266](#)

## Removing the T4000 Lower Front Fan Tray

1. Attach an electrostatic discharge (ESD) grounding strap to your wrist, and connect the strap to one of the ESD points on the chassis.
2. Unwrap any PIC cables from the spools on the front cable management system and remove the cables from the tray. Arrange the cables so that they do not block the front cable management system and tray, and secure them with temporary fasteners so that they are not supporting their own weight as they hang from the connector.



**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

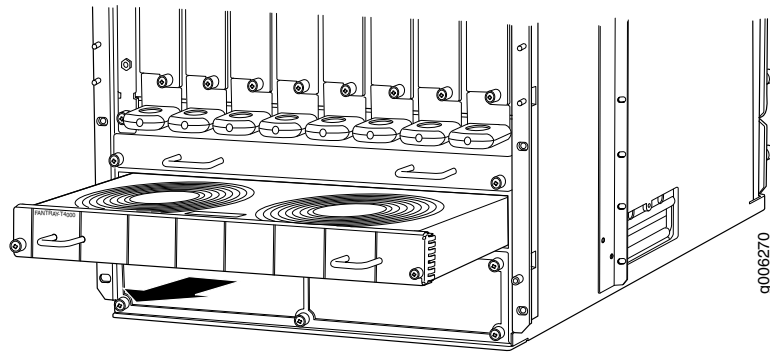
3. Simultaneously pull the two releases on the front cable management system. Lift it up and outward to lock it in place to access the lower fan tray.
4. Rearrange the PIC cables in the front cable management system. For more information about proper cable arrangement, see ["Maintaining T4000 PICs" on page 338](#).
5. Loosen the captive screws on the corners of the fan tray faceplate.
6. Grasp the handles, and pull the fan tray halfway out of the chassis.



**WARNING:** To avoid injury, keep tools and your fingers away from the fans as you slide the fan tray out of the chassis. The fans might still be spinning.

7. When the fans stop spinning, place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.

*Figure 102: Removing the T4000 Lower Front Fan Tray*



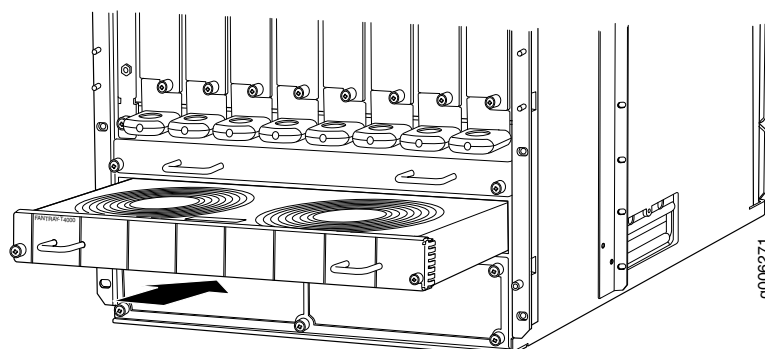
See Also .

## Installing the T4000 Lower Front Fan Tray

To install a lower front fan tray:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Grasp the fan tray by its handles, and insert it straight into the chassis.
3. Tighten the captive screws on each side of the fan tray faceplate to secure it in the chassis.
4. Unlock the front cable management system and lower it to the fully lowered position.
5. Rearrange the PIC cables in the front cable management system. For more information about proper cable arrangement, see [“Maintaining T4000 PICs” on page 338](#).

Figure 103: Installing the T4000 Lower Front Fan Tray



See Also •

#### Related Documentation

- [T4000 Cooling System Description on page 25](#)
- [Troubleshooting the T4000 Cooling System on page 351](#)
- [T4000 Clearance Requirements for Airflow and Hardware Maintenance on page 91](#)
- [Maintaining the T4000 Fan Trays on page 335](#)

## Replacing a T4000 Upper Front Fan Tray

The upper front fan tray is located above the FPC card cage. Each front fan tray weighs about 20.4 lb (9.3 kg). The fan trays are hot-insertable and hot-removable. The upper and lower fan trays are interchangeable with each other.



**NOTE:** Ensure that at any given time only one front fan tray is replaced. Do NOT replace both the front lower and upper fans simultaneously.

1. [Removing the T4000 Upper Front Fan Tray on page 267](#)
2. [Installing the T4000 Upper Front Fan Tray on page 269](#)

## Removing the T4000 Upper Front Fan Tray

To remove an upper front fan tray (see [Figure 104 on page 268](#)):

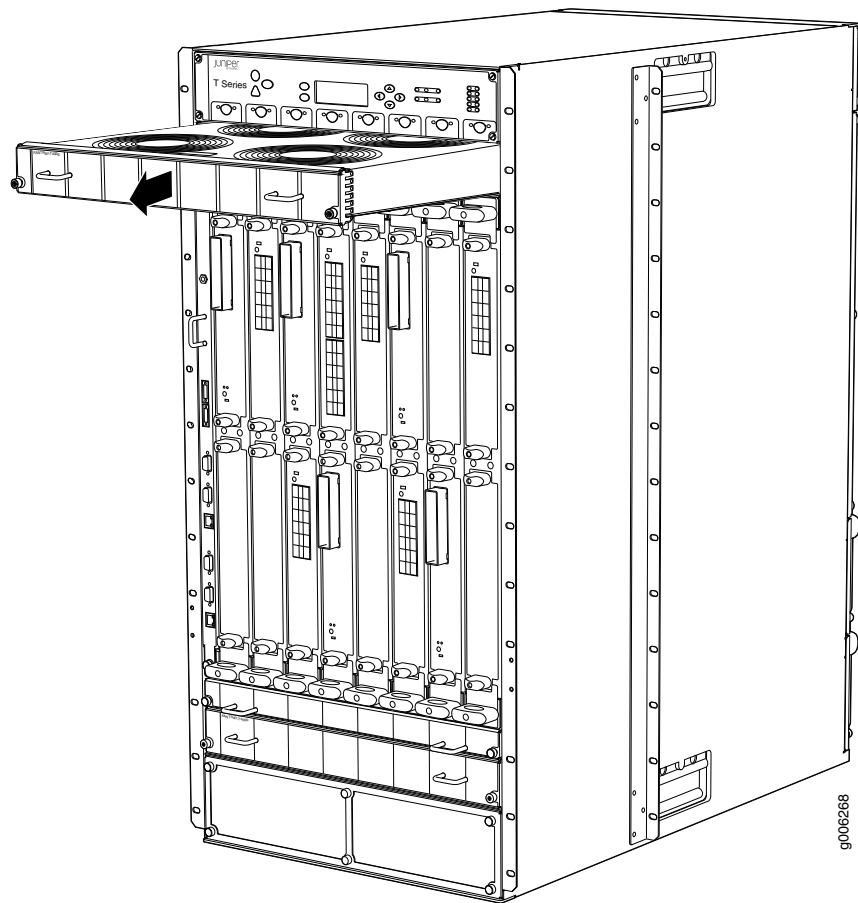
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Loosen the captive screws on the corners of the fan tray faceplate.
3. Grasp the handles, and pull the fan tray halfway out of the chassis.



**WARNING:** To avoid injury, keep tools and your fingers away from the fans as you slide the fan tray out of the chassis. The fans might still be spinning.

4. When the fans stop spinning, place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.

*Figure 104: Removing an Upper Front Fan Tray*



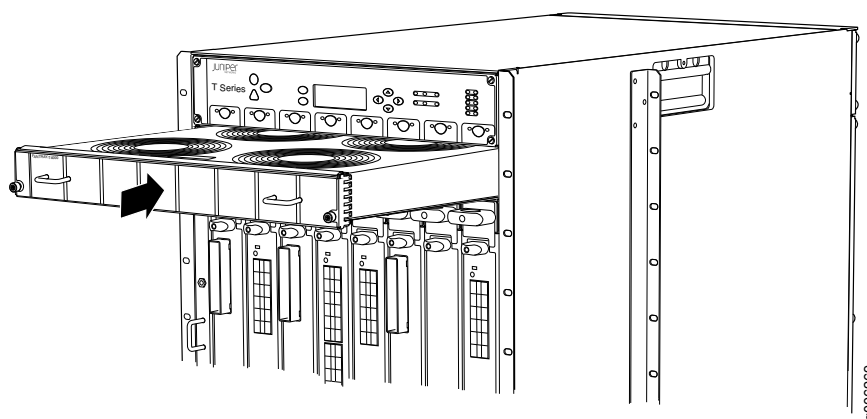
See Also •

## Installing the T4000 Upper Front Fan Tray

To install an upper front fan tray (see [Figure 105 on page 269](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Grasp the fan tray by its handles, and insert it straight into the chassis.
3. Tighten the captive screws on each side of the fan tray faceplate to secure it in the chassis.

*Figure 105: Installing an Upper Front Fan Tray*



See Also •

- Related Documentation**
- [T4000 Cooling System Description on page 25](#)
  - [Troubleshooting the T4000 Cooling System on page 351](#)
  - [T4000 Clearance Requirements for Airflow and Hardware Maintenance on page 91](#)
  - [Maintaining the T4000 Fan Trays on page 335](#)

## Replacing a T4000 Rear Fan Tray

The rear fan tray is mounted vertically on the right side of the rear of the chassis. The rear fan tray contains eight fans, and is not interchangeable with the front fan trays. The rear fan tray must be used in conjunction with the front fan trays. The rear fan tray weighs about 10 lb (4.5 kg).



**CAUTION:** To maintain proper cooling, do not operate the routing node with the rear fan tray removed for more than one minute.

1. [Removing the T4000 Rear Fan Tray on page 270](#)
2. [Installing the T4000 Rear Fan Tray on page 271](#)

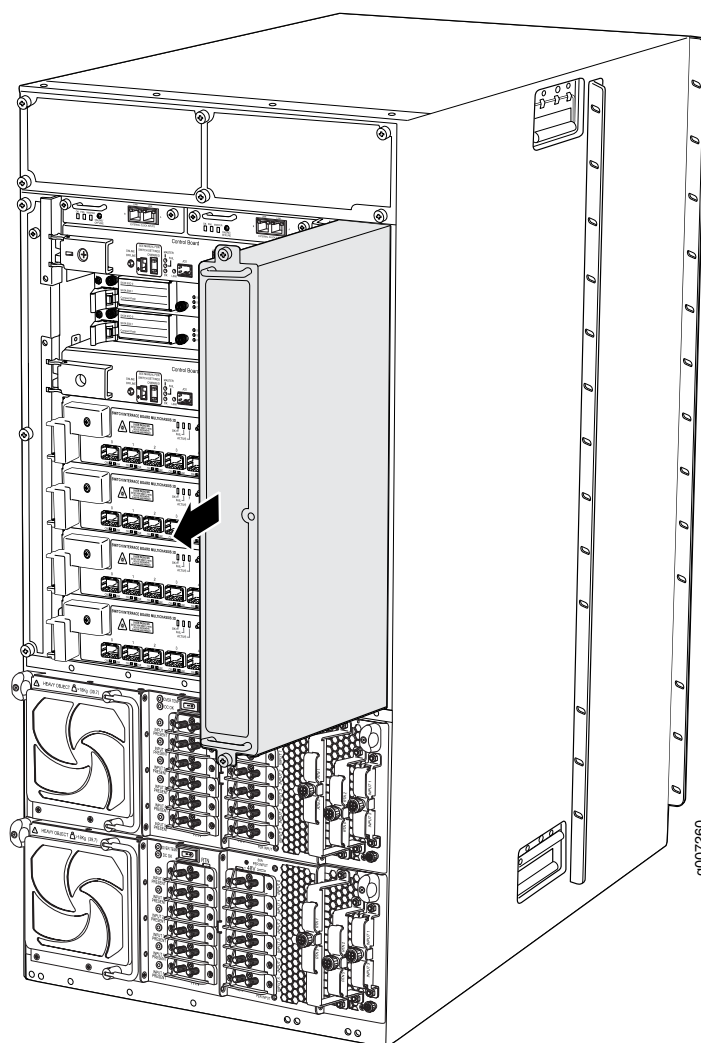
## Removing the T4000 Rear Fan Tray

To remove the rear fan tray (see [Figure 106 on page 271](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point.
2. Loosen the captive screws on the top and bottom of the fan tray faceplate.
3. Grasp the handles, and pull the fan tray halfway out of the chassis.
4. Wait for the fans to stop spinning.
5. After the fans stop spinning, place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.



Figure 106: Removing the FAN-R-TXP-3D-LCC Rear Fan Tray

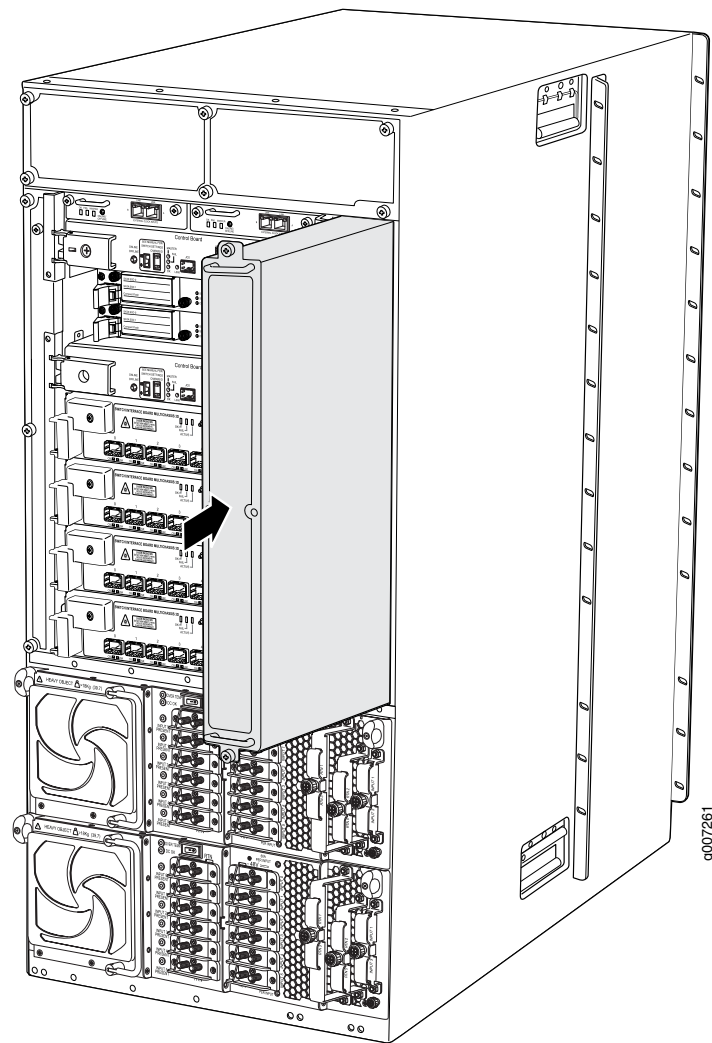


See Also .

### Installing the T4000 Rear Fan Tray

To install a replacement rear fan tray (see [Figure 107 on page 272](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Grasp the fan tray by its handles, and insert it straight into the chassis.
3. Tighten the captive screws on the fan tray faceplate to secure it in the chassis, using a Phillips (+) screwdriver, number 2.

*Figure 107: Installing the Rear Fan Tray*

See Also .

**Related  
Documentation**

- [T4000 Cooling System Description on page 25](#)
- [T4000 Clearance Requirements for Airflow and Hardware Maintenance on page 91](#)
- [Maintaining the T4000 Fan Trays on page 335](#)
- [Troubleshooting the T4000 Cooling System on page 351](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

# Replacing Host Subsystem Components

- [Replacing T4000 Host Subsystem Components on page 273](#)
- [Replacing a T4000 LCC-CB on page 275](#)
- [Replacing a T4000 Routing Engine on page 280](#)
- [Replacing a CompactFlash Card in a T4000 RE-C1800 Routing Engine on page 286](#)
- [Replacing a DIMM Module in a T4000 RE-C1800 Routing Engine on page 289](#)
- [Replacing a Solid-State Disk in a T4000 RE-C1800 Routing Engine on page 290](#)

## Replacing T4000 Host Subsystem Components

---

1. [Taking the T4000 Host Subsystem Offline on page 273](#)
2. [Replacing a Control Board or Routing Engine Component on page 275](#)

### Taking the T4000 Host Subsystem Offline

Before you replace a control board or Routing Engine, you must take the host subsystem offline. The host subsystem is taken offline and brought online as a unit. Normally, if two host subsystems are installed in the router, **RE0** functions as the master and **RE1** functions as the backup.



NOTE: Router performance might change if the backup Routing Engine's configuration differs from the former master's configuration. For the most predictable performance, configure the two Routing Engines identically, except for parameters unique to each Routing Engine.



NOTE: For information about high availability features, configuring graceful switchover and nonstop active routing, see the *Junos OS High Availability Library for Routing Devices*.

Table 79 on page 274 explains the effect of taking the host subsystem offline.

*Table 79: Effect of Taking the Host Subsystem Offline*

Type of Host Subsystem	Effect of taking the Host Subsystem Offline
Nonredundant host subsystem	The router shuts down.
Backup host subsystem	The functioning of the router is not interrupted. The backup host subsystem is hot-removable and hot-insertable.
Master host subsystem	<p>The backup host subsystem becomes the master. The backup Routing Engine assumes Routing Engine functions. The master host subsystem is hot-pluggable. Removal or failure of the master Routing Engine affects forwarding and routing based on the high availability configuration:</p> <ul style="list-style-type: none"> <li>Dual Routing Engines without any high availability features enabled—Traffic is interrupted while the Packet Forwarding Engine is reinitialized. All kernel and forwarding processes are restarted. When the switchover to the new master Routing Engine is complete, routing convergence takes place and traffic is resumed.</li> <li>Graceful Routing Engine switchover (GRES) is enabled—Graceful Routing Engine switchover preserves interface and kernel information. Traffic is not interrupted. However, graceful Routing Engine switchover does not preserve the control plane. Neighboring routers detect that the router has restarted and react to the event in a manner prescribed by individual routing protocol specifications. To preserve routing without interruption during a switchover, graceful Routing Engine switchover must be combined with nonstop active routing.</li> </ul> <p><b>NOTE:</b> Graceful Routing Engine switchover (GRES) is supported on Junos OS Release 12.1R2 and later for T4000 routers.</p> <ul style="list-style-type: none"> <li>Nonstop active routing is enabled (graceful Routing Engine switchover must be configured for nonstop active routing to be enabled)—Nonstop active routing supports Routing Engine switchover without alerting peer nodes that a change has occurred. Nonstop active routing uses the same infrastructure as graceful Routing Engine switchover to preserve interface and kernel information. However, nonstop active routing also preserves routing information and protocol sessions by running the routing protocol process (rpd) on both Routing Engines. In addition, nonstop active routing preserves TCP connections maintained in the kernel.</li> </ul> <p>Nonstop active routing is supported on Junos OS Release 12.1R2 and later for T4000 routers,</p> <ul style="list-style-type: none"> <li>Graceful restart is configured—Graceful restart provides extensions to routing protocols so that neighboring helper routers restore routing information to a restarting router. These extensions signal neighboring routers about the graceful restart and prevent the neighbors from reacting to the router restart and from propagating the change in state to the network during the graceful restart period. Neighbors provide the routing information that enables the restarting router to stop and restart routing protocols without causing network reconvergence. Neighbors are required to support graceful restart. The routing protocol process (rpd) restarts. A graceful restart interval is required. For certain protocols, a significant change in the network can cause graceful restart to stop.</li> </ul>

## Replacing a Control Board or Routing Engine Component



**NOTE:** To replace a solid-state disk or CompactFlash card, you must power off the Routing Engine.

After you take the host subsystem offline, you can replace the following host subsystem components:

- [Replacing a T4000 LCC-CB on page 275](#)
- [Replacing a T4000 Routing Engine on page 280](#)
- [Replacing a CompactFlash Card in a T4000 RE-C1800 Routing Engine on page 286](#)
- [Replacing a Solid-State Disk in a T4000 RE-C1800 Routing Engine on page 290](#)
- [Replacing a DIMM Module in a T4000 RE-C1800 Routing Engine on page 289](#)

See Also •

### Related Documentation

- [T4000 Host Subsystem Description on page 29](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)
- [\*request system halt\*](#)

## Replacing a T4000 LCC-CB

The router can have up to two LCC-CBs. They are located in the upper rear of the chassis in the slots marked **CB0** and **CB1**. Each LCC-CB weighs approximately 5 lb (2.3 kg).



**CAUTION:** Before you replace a control board, you must take the host subsystem offline. The backup control board is hot-removable and hot-insertable. If the control board to be replaced is associated with the Routing Engine currently functioning as the master Routing Engine, switch the master to the backup before removing the control board. If there is only one host subsystem, taking the host subsystem offline shuts down the router.

1. [Taking the Host Subsystem Offline on page 276](#)
2. [Removing a T4000 LCC-CB on page 277](#)
3. [Installing a T4000 LCC-CB on page 278](#)

## Taking the Host Subsystem Offline

To take a host subsystem offline:

1. Determine whether the host subsystem is functioning as the master or as the backup, using one of the two following methods:
  - Check the Routing Engine LEDs on the craft interface. If the green **MASTER** LED is lit, the corresponding host subsystem is functioning as the master.
  - Use the **show chassis routing-engine** command to determine which Routing Engine is the master. In this example, the master Routing Engine in **Slot 0** is designated **Master** in the **Current state** field:

```
user@host> show chassis routing-engine
```

Routing Engine status:

```
Slot 0:
  Current state           Master
  Election priority       Master (default)
  Temperature             38 degrees C / 100 degrees F
  CPU temperature         56 degrees C / 132 degrees F
  DRAM                   8960 MB
  Memory utilization      20 percent
  CPU utilization:
    User                  0 percent
    Background            0 percent
    Kernel                4 percent
    Interrupt             1 percent
    Idle                  95 percent
  Model                  RE-DUO-1800
  Serial ID              P737F-002693
  Start time             2011-12-08 21:04:20 PST
  Uptime                 1 day, 13 hours, 22 minutes, 57 seconds
  Last reboot reason     Router rebooted after a normal shutdown.

  Load averages:         1 minute   5 minute   15 minute
                        0.04        0.05        0.01
```

Routing Engine status:

```
Slot 1:
  Current state           Backup
  Election priority       Backup (default)
  Temperature             38 degrees C / 100 degrees F
  CPU temperature         53 degrees C / 127 degrees F
  DRAM                   8960 MB
  Memory utilization      17 percent
  CPU utilization:
    User                  0 percent
    Background            0 percent
    Kernel                1 percent
    Interrupt             1 percent
    Idle                  98 percent
  Model                  RE-DUO-1800
  Serial ID              P737F-002587
  Start time             2011-12-08 20:57:51 PST
  Uptime                 1 day, 13 hours, 29 minutes, 11 seconds
  Last reboot reason     Router rebooted after a normal shutdown.
```

2. If the host subsystem is functioning as the master, switch it to backup using the CLI

command:

```
user@host> request chassis routing-engine master switch
```

3. To halt the router:

```
user@host> request system halt
```

If two Routing Engines are installed, also issue the command on the backup Routing Engine. Wait until a message appears on the console confirming that the operating system has halted.

The command shuts down the Routing Engine cleanly, so its state information is preserved.



**NOTE:** The SIBs might continue forwarding traffic for approximately 5 minutes after the `request system halt` command has been issued.

4. To take the control board offline, issue the following command.

```
user@host> request chassis cb offline slot n
```

*n* is 0 or 1 for the slot number of the host subsystem being taken offline.

5. Verify that the control board is offline:

```
user@host> show chassis environment cb 0
```

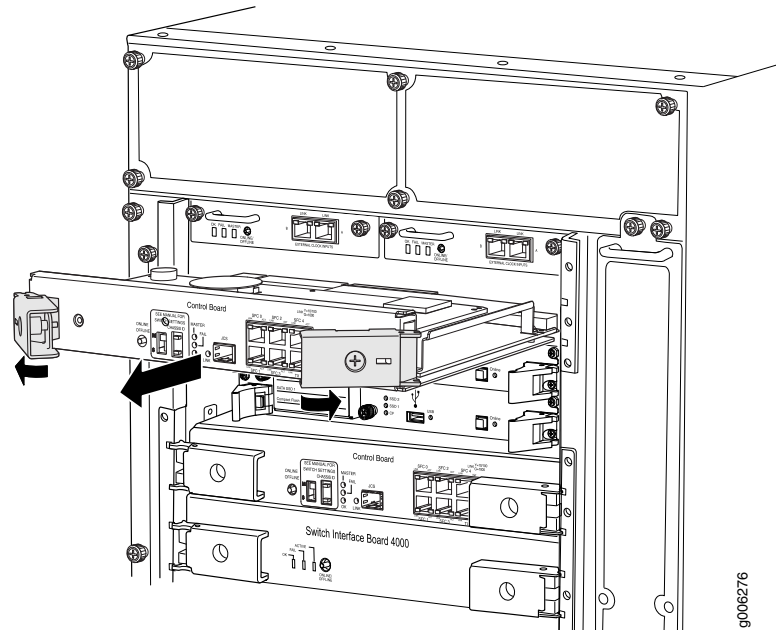
## Removing a T4000 LCC-CB

To remove an LCC-CB (see [Figure 108 on page 278](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Loosen the captive screws (using a Phillips (+) screwdriver, number 2) on the ejector handles on both sides of the LCC-CB faceplate.
4. Flip the ejector handles outward to unseat the LCC-CB.
5. Grasp the ejector handles, and slide the LCC-CB about halfway out of the chassis.
6. Place one hand underneath the LCC-CB to support it, and slide it completely out of the chassis.

7. Place the LCC-CB on the antistatic mat.
8. If you are not replacing the LCC-CB now, install a blank panel over the empty slot.

*Figure 108: Removing an LCC-CB*



## Installing a T4000 LCC-CB

To install an LCC-CB (see [Figure 109 on page 280](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Verify that the **CHASSIS ID** and **M/S** switches on the LCC-CB faceplate are set correctly for your configuration. If you are installing the LCC-CB in a standalone router, the **M/S** switch must be set to **S** and the **CHASSIS ID** configuration switch must be set to **0**.



**NOTE:** See *Setting the Chassis ID and M/S Switch on the LCC-CB* in the *TX Matrix Plus Router Hardware Guide* for instructions to set the switches when installing the LCC-CB in a T4000 that is part of a routing matrix.

3. Carefully align the sides of the LCC-CB with the guides inside the chassis.
4. Slide the LCC-CB into the chassis, carefully ensuring that it is correctly aligned.
5. Grasp both ejector handles, and press them inward to seat the LCC-CB.



6. Tighten the captive screws on the ejector handles, using a Phillips (+) screwdriver, number 2.
7. Verify that the LCC-CB is functioning normally:
  - Check the LEDs on the LCC-CB faceplate. The green **OK** LED should light steadily a few minutes after the LCC-CB is installed. If power is applied to the Routing Engine and its corresponding LCC-CB is functioning normally, the LCC-CB comes online automatically.

If the **FAIL** LED is lit steadily, remove and install the LCC-CB again. If the **FAIL** LED still lights steadily, the LCC-CB is not functioning properly. Contact your customer support representative.

  - Use the **show chassis environment cb** command to check the status of the LCC-CB.

**show chassis environment cb**

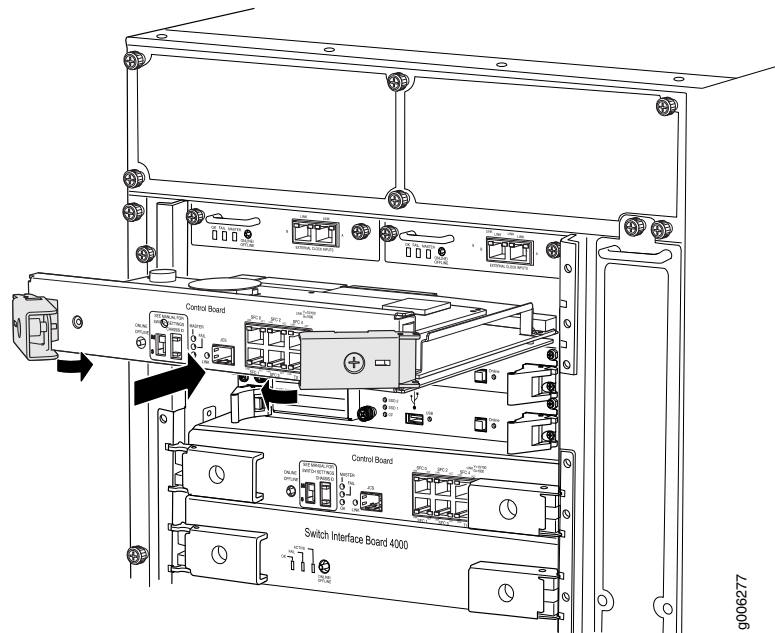
```

CB 0 status:
  State                Online Master
  Temperature          38 degrees C / 100 degrees F
  Power 1
    1.8 V              1800 mV
    2.5 V              2501 mV
    3.3 V              3288 mV
    3.3 V bias         3296 mV
    4.6 V              4682 mV
    5.0 V              4923 mV
    8.0 V bias         7755 mV
    12.0 V             11887 mV
  Power 2
    1.0 V              989 mV
    1.2 V              1186 mV
    3.3 V RE           3321 mV
  Bus Revision         51
  FPGA Revision        5

CB 1 status:
  State                Online Standby
  Temperature          40 degrees C / 104 degrees F
  Power 1
    1.8 V              1802 mV
    2.5 V              2518 mV
    3.3 V              3297 mV
    3.3 V bias         3274 mV
    4.6 V              4693 mV
    5.0 V              4959 mV
    8.0 V bias         7746 mV
    12.0 V             11897 mV
  Power 2
    1.0 V              991 mV
    1.2 V              1200 mV
    3.3 V RE           3315 mV
  Bus Revision         51
  FPGA Revision        5

```

Figure 109: Installing an LCC-CB



## See Also

- 
- 
- 

## Related Documentation

- [T4000 Control Board Description on page 30](#)
- [T4000 LCC-CB on page 30](#)
- [T4000 LCC-CB Control Board LEDs on page 31](#)
- [Replacing T4000 Host Subsystem Components on page 273](#)

## Replacing a T4000 Routing Engine

The router can have one or two Routing Engines. They are located in the upper rear of the chassis in the slots marked **RE0** and **RE1**. Each Routing Engine can weigh up to 2.4 lb (1.1 kg). The backup Routing Engine is hot-removable and hot-insertable.



**CAUTION:** Before you replace a Routing Engine, you must take the host subsystem offline. If there is only one host subsystem, taking the host subsystem offline shuts down the router. If the Routing Engine to be replaced

is currently functioning as the master Routing Engine, switch it to be the backup before removing it.

1. [Taking the Host Subsystem Offline on page 281](#)
2. [Removing a T4000 Routing Engine on page 282](#)
3. [Installing a T4000 Routing Engine on page 284](#)

## Taking the Host Subsystem Offline

To take a host subsystem offline:

1. Determine whether the host subsystem is functioning as the master or as the backup, using one of the two following methods:
  - Check the Routing Engine LEDs on the craft interface. If the green **MASTER** LED is lit, the corresponding host subsystem is functioning as the master.
  - Use the **show chassis routing-engine** command to determine which Routing Engine is the master. In this example, the master Routing Engine in **Slot 0** is designated **Master** in the **Current state** field:

```
user@host> show chassis routing-engine
```

Routing Engine status:

Slot 0:

Current state	Master
Election priority	Master (default)
Temperature	38 degrees C / 100 degrees F
CPU temperature	56 degrees C / 132 degrees F
DRAM	8960 MB
Memory utilization	20 percent
CPU utilization:	
User	0 percent
Background	0 percent
Kernel	4 percent
Interrupt	1 percent
Idle	95 percent
Model	RE-DUO-1800
Serial ID	P737F-002693
Start time	2011-12-08 21:04:20 PST
Uptime	1 day, 13 hours, 22 minutes, 57 seconds
Last reboot reason	Router rebooted after a normal shutdown.

Load averages:	1 minute	5 minute	15 minute
	0.04	0.05	0.01

Routing Engine status:

Slot 1:

Current state	Backup
Election priority	Backup (default)
Temperature	38 degrees C / 100 degrees F
CPU temperature	53 degrees C / 127 degrees F
DRAM	8960 MB
Memory utilization	17 percent
CPU utilization:	
User	0 percent
Background	0 percent

```

Kernel                1 percent
Interrupt             1 percent
Idle                  98 percent
Model                 RE-DUO-1800
Serial ID             P737F-002587
Start time            2011-12-08 20:57:51 PST
Uptime                1 day, 13 hours, 29 minutes, 11 seconds
Last reboot reason    Router rebooted after a normal shutdown.

```

2. If the host subsystem is functioning as the master, switch it to backup using the CLI command:

```
user@host> request chassis routing-engine master switch
```

3. To halt the router:

```
user@host> request system halt
```

If two Routing Engines are installed, also issue the command on the backup Routing Engine. Wait until a message appears on the console confirming that the operating system has halted.

The command shuts down the Routing Engine cleanly, so its state information is preserved.



**NOTE:** The SIBs might continue forwarding traffic for approximately 5 minutes after the `request system halt` command has been issued.

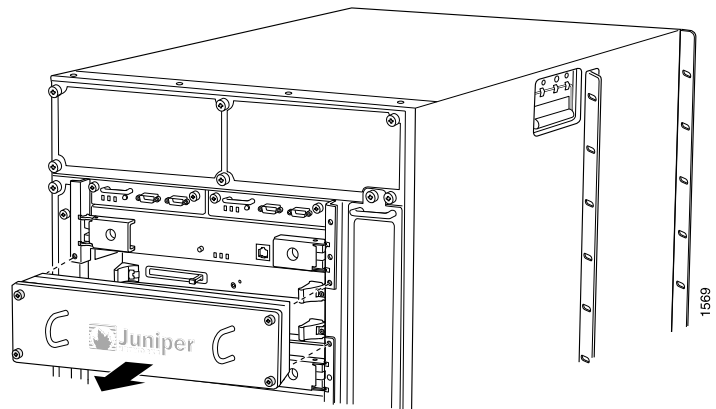
## Removing a T4000 Routing Engine

To remove a Routing Engine (see [Figure 111 on page 283](#)):

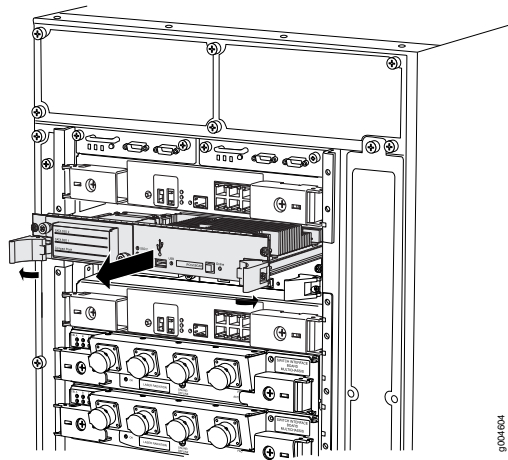
1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Loosen the captive screws on the corners of the Routing Engine cover.
4. Grasp the Routing Engine cover by its edges, and pull it free from the chassis (see [Figure 110 on page 283](#)).
5. If applicable, loosen the screws on the extractor handles at either end of the Routing Engine faceplate, using a Phillips screwdriver.
6. Press the red tabs on the ejector handles on both sides of the Routing Engine faceplate.
7. Flip the ejector handles outward to unseat the Routing Engine.

8. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.
9. Place one of your hands underneath the Routing Engine to support it, and slide it completely out of the chassis.
10. Place the Routing Engine on the antistatic mat.
11. If you are not replacing the Routing Engine now, reinstall the Routing Engine cover, and tighten the screws on the corners of the cover to secure it to the chassis.

*Figure 110: Removing the Routing Engine Cover*



*Figure 111: Removing a T4000 C1800 Routing Engine*

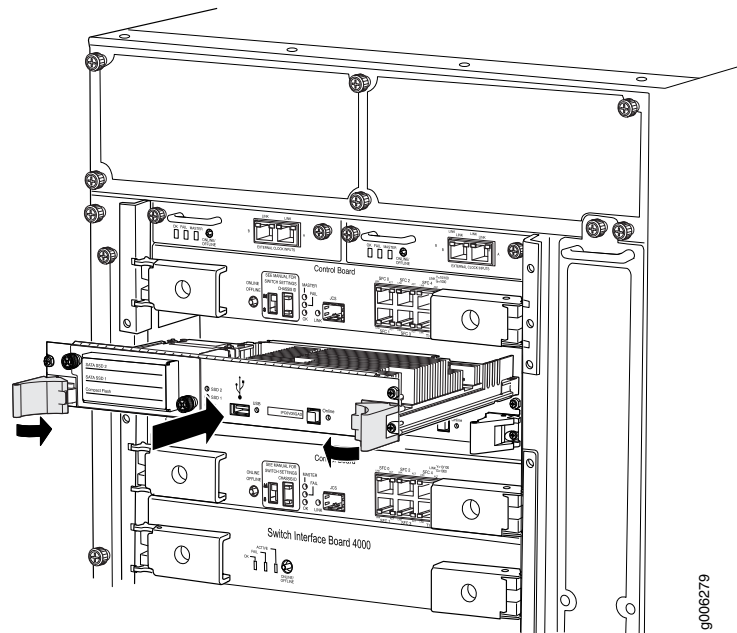


## Installing a T4000 Routing Engine

To install a Routing Engine (see [Figure 112 on page 285](#)):

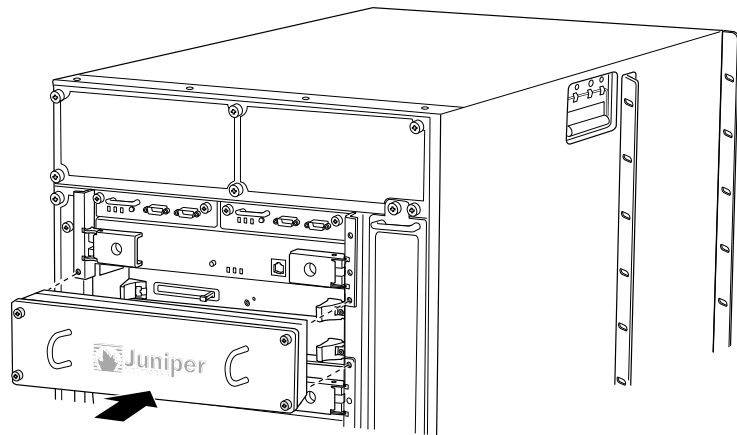
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Ensure that the ejector handles are not in the locked position. If necessary, press the red tabs and flip the ejector handles outward.
3. Place one hand underneath the Routing Engine to support it. With the other hand, grasp one of the ejector handles on the faceplate.
4. Carefully align the sides of the Routing Engine with the guides inside the chassis.
5. Slide the Routing Engine into the chassis until you feel resistance, then press the Routing Engine's faceplate until it engages the midplane connectors.
6. Press both the ejector handles inward to seat the Routing Engine.  
The Routing Engine might require several minutes to boot.
7. If applicable, tighten the screws on the extractor handles, by using a Phillips screwdriver. Be sure to tighten the screws enough to seat the Routing Engine properly.
8. Press the Routing Engine cover into place, then tighten the captive screws on the corners of the cover to secure it to the chassis (see [Figure 113 on page 285](#)).

Figure 112: Installing a Routing Engine



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Figure 113: Reinstalling the Routing Engine Cover



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#### Related Documentation

- [T4000 Host Subsystem Description on page 29](#)
- [T4000 Routing Engine Description on page 33](#)
- [T4000 RE-C1800 Routing Engine Description on page 34](#)
- [T4000 RE-C1800 LEDs on page 35](#)
- [Maintaining the T4000 Routing Engines on page 336](#)
- [Troubleshooting the T4000 Routing Engines on page 355](#)
- [Replacing T4000 Host Subsystem Components on page 273](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

## Replacing a CompactFlash Card in a T4000 RE-C1800 Routing Engine

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1. [Preparing to Replace a CompactFlash Card in a T4000 RE-C1800 Routing Engine on page 286](#)
2. [Removing a CompactFlash Card from a T4000 RE-C1800 Routing Engine on page 286](#)
3. [Installing a CompactFlash Card into a T4000 RE-C1800 Routing Engine on page 287](#)
4. [Copying Junos OS to the CompactFlash Card in a T1600 RE-C1800 Routing Engine on page 288](#)

### Preparing to Replace a CompactFlash Card in a T4000 RE-C1800 Routing Engine

The CompactFlash card is located in the slot labeled **CF** on the Routing Engine faceplate. To prepare to replace the CompactFlash card:

1. Determine whether the host subsystem is functioning as the master or as the backup, using one of these methods:
  - Check the Host Subsystem LEDs on the craft interface. If the green **MASTER** LED is lit, the corresponding host subsystem is functioning as the master.
  - Check the **MASTER** LED on the control board. If the blue **MASTER** LED is lit, the host subsystem is functioning as the master.
  - Issue the **show chassis routing-engine** command:

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state           Master
  ...
```

In these examples, the Routing Engine in slot 0 is designated **Master** in the **Current state** field

2. If the host subsystem is functioning as the master, switch it to backup. Issue the **request chassis routing-engine master switch** command.
3. From the master Routing Engine, power down the backup Routing Engine. Issue the **request system power-off other-routing-engine** command.

### Removing a CompactFlash Card from a T4000 RE-C1800 Routing Engine

The CompactFlash card is located in the slot labeled **CF** on the Routing Engine faceplate. To remove the CompactFlash card (see [Figure 114 on page 287](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Verify that the **Online**, **DISK1**, and **CF** LEDs on the backup Routing Engine faceplate are off.



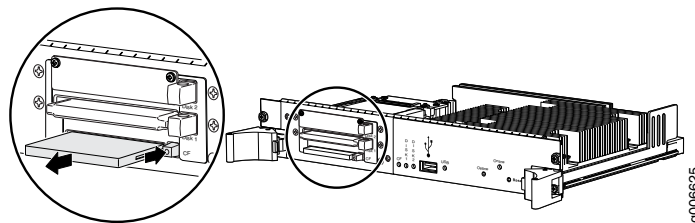
3. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
4. Using a Phillips (+) screwdriver, number 2, loosen the captive screws on the corners of the cover over the Routing Engine slots.
5. Remove the cover from the Routing Engine slots.



**CAUTION:** Do not remove the cover if any of the LEDs are lit.

6. Press the eject button on the right side of the CompactFlash card slot to release the CompactFlash card.
7. The CompactFlash card pops partially out of the slot. Grasp the card and pull it completely out of the slot.
8. Place the CompactFlash card on the antistatic mat.

*Figure 114: Removing a CompactFlash Card*



### Installing a CompactFlash Card into a T4000 RE-C1800 Routing Engine

To install a CompactFlash card (see [Figure 115 on page 288](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Insert the CompactFlash card into the CompactFlash card slot on the Routing Engine, with the logo facing up.



**CAUTION:** Be sure to insert the CompactFlash card with the label facing up. Inserting the CompactFlash card incorrectly might damage the Routing Engine.

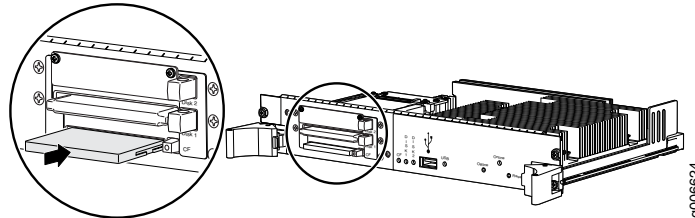
3. Press the card firmly all the way into the slot.

4. Reinstall the Routing Engine cover. Using a Phillips (+) screwdriver, number 2, tighten the screws on the corners of the cover to secure it to the Routing Engine.
5. From the master Routing Engine, power on the Routing Engine. Issue the **request system power-on other-routing-engine** command.



**NOTE:** After you replace a CompactFlash card, the Routing Engine boots from the solid-state disk (SSD). You may get an error message and be prompted for a keystroke. After you press the keystroke, it might take up to 10 minutes for the Routing Engine to reset and for the router to boot from the SSD.

*Figure 115: Installing a CompactFlash Card*



## Copying Junos OS to the CompactFlash Card in a T1600 RE-C1800 Routing Engine

After installing the CompactFlash card for the first time, you must copy the software from the Routing Engine's solid-state disk (SSD) to the CompactFlash card.

To copy software to the CompactFlash card:

1. On the console or other management device connected to the Routing Engine, enter CLI operational mode and copy the currently running and active file system partitions on the router to standby partitions on the CompactFlash card. Issue the **request system snapshot partition** command.
2. Wait until a message appears on the console confirming that the snapshot partition procedure is complete.
3. Issue the **request system reboot** command to reboot the router's software.
4. Issue the **show system boot-messages** command to verify that the CompactFlash card is listed as the primary boot device. The output lists the devices mounted. The CompactFlash card is located at **ad0**.

### Related Documentation

- [T4000 Routing Engine Description on page 33](#)
- [T4000 RE-C1800 Routing Engine Description on page 34](#)
- [T4000 RE-C1800 LEDs on page 35](#)

- [T4000 Craft Interface LEDs](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

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## Replacing a DIMM Module in a T4000 RE-C1800 Routing Engine

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1. [Removing a DIMM Module from a T4000 RE-C1800 Routing Engine on page 289](#)
2. [Installing a DIMM Module into a T4000 RE-C1800 Routing Engine on page 289](#)

### Removing a DIMM Module from a T4000 RE-C1800 Routing Engine

To remove a DIMM module:

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Remove the Routing Engine. See [“Replacing a T4000 Routing Engine” on page 280](#).
4. Eject the DIMM module by pressing the plastic ejectors on both sides of the DIMM module.
5. Grasp the DIMM module, being careful not to touch any electrical components on the module, and firmly pull it out of the slot on the Routing Engine.
6. Place the DIMM module on the antistatic mat or in the electrostatic bag.
7. Push the plastic ejectors to close the empty DIMM module slot.

### Installing a DIMM Module into a T4000 RE-C1800 Routing Engine

To insert a DIMM module into the Routing Engine:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Remove the DIMM module from its electrostatic bag.
3. To open the empty DIMM slot, press the plastic ejectors open.
4. Grasp the DIMM module by the edges, being careful not to touch any electrical components.
5. Press firmly on both ends, and push the module into the slot until the ejectors return completely to the closed position.
6. Install the Routing Engine. See [“Replacing a T4000 Routing Engine” on page 280](#).
7. You can view the SDRAM configuration and verify that the DIMM was installed correctly by issuing the **show chassis routing-engine** command.

#### Related Documentation

- [T4000 Routing Engine Description on page 33](#)
- [T4000 RE-C1800 Routing Engine Description on page 34](#)

- [T4000 RE-C1800 LEDs on page 35](#)
- [T4000 Craft Interface LEDs](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

## Replacing a Solid-State Disk in a T4000 RE-C1800 Routing Engine

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1. [Preparing to Replace a Solid-State Disk from a T4000 RE-C1800 Routing Engine on page 290](#)
2. [Removing a Solid-State Disk from a T4000 RE-C1800 Routing Engine on page 291](#)
3. [Installing a Solid-State Disk From a T4000 RE-C1800 Routing Engine on page 292](#)
4. [Copying Junos OS to the Solid-State Disk in a T4000 RE-C1800 Routing Engine on page 292](#)

### Preparing to Replace a Solid-State Disk from a T4000 RE-C1800 Routing Engine

To prepare to replace an SSD:

1. Determine whether the host subsystem is functioning as the master or as the backup, using one of these methods:
  - Check the Host Subsystem LEDs on the craft interface. If the green **MASTER** LED is lit, the corresponding host subsystem is functioning as the master.
  - Check the **MASTER** LED on the control board. If the blue **MASTER** LED is lit, the host subsystem is functioning as the master.
  - Issue the **show chassis routing-engine.** command.

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state           Master
  ...
```
2. If the host subsystem is functioning as the master, switch it to backup. Issue the **request chassis routing-engine master switch** command.
3. From the master Routing Engine, power down the backup Routing Engine. Issue the **request system power-off other-routing-engine** command.

## Removing a Solid-State Disk from a T4000 RE-C1800 Routing Engine

The solid-state disk (SSD) is located in the slot labeled **DISK1** on the Routing Engine faceplate.



**NOTE:** The **DISK2** slot is not currently supported.

To remove an SSD from a Routing Engine (see [Figure 116 on page 291](#)):

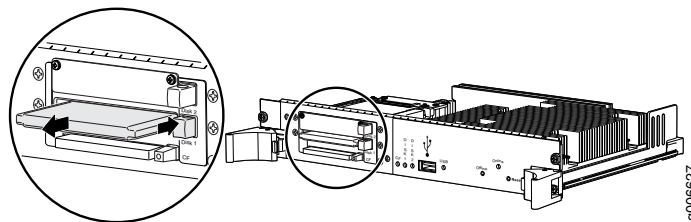
1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Verify that the **Online**, **DISK1**, and **CF** LEDs on the backup Routing Engine faceplate are off.
3. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
4. Using a Phillips (+) screwdriver, number 2, loosen the captive screws on the corners of the cover.
5. Remove the cover from the Routing Engine slots.



**CAUTION:** Do not remove the cover if any of the LEDs on the Routing Engine faceplate are lit.

6. Press the eject button on the right side of the **DISK1** slot to release the SSD.
7. The SSD pops partially out of the slot. Grasp the SSD and carefully slide it completely out of the slot.
8. Place the SSD on the antistatic mat.

*Figure 116: Removing an SSD*



## Installing a Solid-State Disk From a T4000 RE-C1800 Routing Engine

To install an SSD in a Routing Engine (see [Figure 117 on page 292](#)):

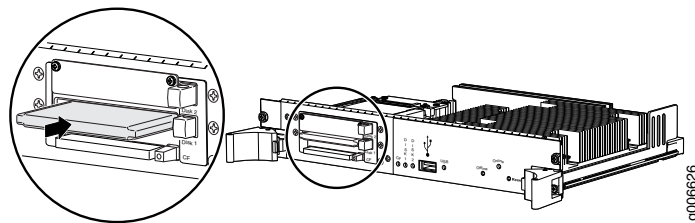
1. Insert the SSD into the **DISK1** slot on the Routing Engine, with the logo facing down.



**CAUTION:** Be sure to insert the SSD with the label facing down. Inserting the SSD incorrectly might damage the Routing Engine.

2. Slide the SSD into the slot until you feel resistance, carefully ensuring that it is correctly aligned.
3. Reinstall the Routing Engine cover. Using a Phillips (+) screwdriver, number 2, tighten the screws on the corners of the cover to secure it to the Routing Engine .
4. From the master Routing Engine, power on the Routing Engine. Issue the **request system power-on other-routing-engine** command.

*Figure 117: Installing an SSD*



## Copying Junos OS to the Solid-State Disk in a T4000 RE-C1800 Routing Engine

After installing a solid-state disk (SSD) for the first time, you must copy the software from the Routing Engine's CompactFlash card to the SSD.

To copy software to the SSD:

1. On the console or other management device connected to the Routing Engine, enter CLI operational mode.
2. Partition the SSD. Issue the **request system partition hard-disk** command.
3. Wait until a message appears on the console confirming that the partition procedure is complete.
4. Reboot the router's software. Issue the **request system reboot** command.

5. Back up the currently running and active file system partitions on the router to standby partitions that are not running. Issue the **request system snapshot** command.
6. Wait until a message appears on the console confirming that the snapshot procedure is complete.
7. Reboot the router's software again. Issue the **request system reboot** command.
8. Verify that the SSD is listed as the secondary boot device. The output lists the devices mounted. The SSD is located at **ad1**. Issue the **show system boot-messages** command.

**Related  
Documentation**

- [T4000 Routing Engine Description on page 33](#)
- [T4000 RE-C1800 Routing Engine Description on page 34](#)
- [T4000 RE-C1800 LEDs on page 35](#)
- [T4000 Craft Interface LEDs](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)





# Replacing Line Card Components

- [Replacing a T4000 FPC on page 295](#)
- [Replacing a T4000 PIC on page 301](#)

## Replacing a T4000 FPC

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The FPCs are hot-insertable and hot-removable. When you remove an FPC, the router continues to function, although the PIC interfaces installed on the FPC being removed no longer function.

The router holds up to eight FPCs, which are installed vertically in the front of the router. An empty FPC weighs approximately 25 lb (11.3 kg), and an FPC with PICs installed can weigh up to 33.5 lb (15.1 kg).

Each FPC slot not occupied by an FPC must be covered by an FPC blank panel. An FPC blank panel weighs 9 lb (4.2 kg).

1. [Removing a T4000 FPC on page 295](#)
2. [Installing a T4000 FPC on page 298](#)

## Removing a T4000 FPC

To remove an FPC (see [Figure 118 on page 297](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Before removing an FPC, record its location in the chassis so that you can reinstall each FPC in the correct slot.
4. Use one of the following methods to take the FPC offline:
  - Press and hold the FPC online/offline button. The green **OK** LED next to the button begins to blink. Hold the button down until the LED goes out. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
  - Issue the following CLI command:

`user@host>request chassis fpc slot slot-number offline`

5. Disconnect the cables from the PICs installed in the FPC. If a PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap. Arrange the disconnected cables in the cable management system, to prevent the cables from developing stress points.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. If necessary, remove each installed PIC from the FPC.
7. After you remove each PIC, immediately place it on an antistatic mat or in an electrostatic bag.  
  
Do not stack components on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.
8. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.
9. Grasp the handles, and slide the FPC straight out of the card cage halfway.
10. Place one hand around the front of the FPC (the PIC housing) and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



**CAUTION:** The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 33.5 lb (15.1 kg)—as you slide the FPC out of the chassis.

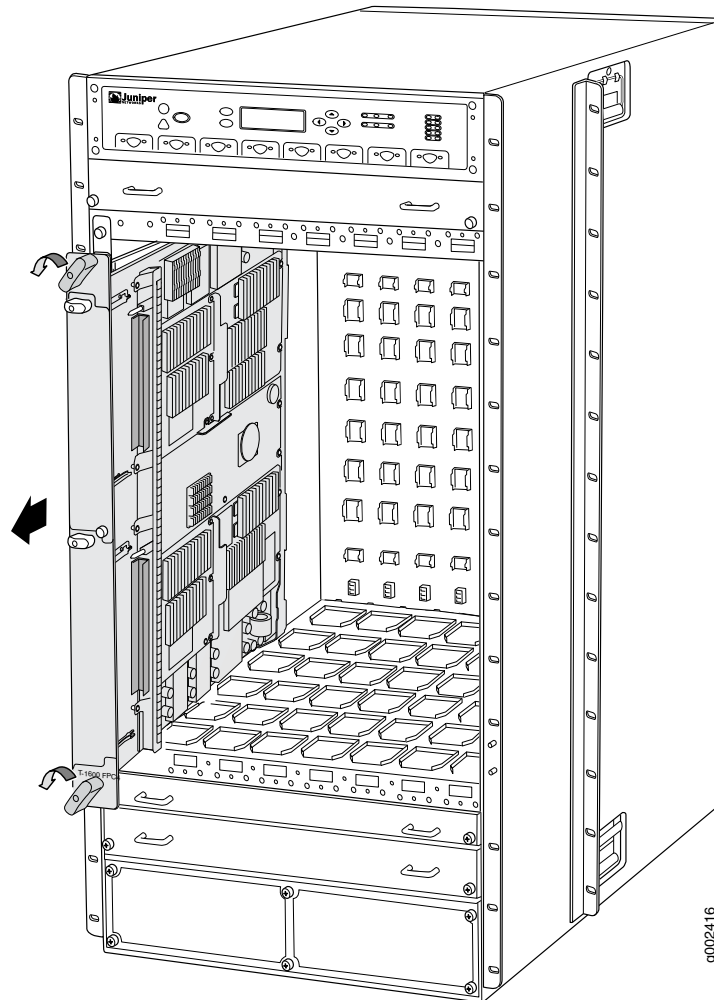
When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

11. If you are not reinstalling an FPC into the emptied FPC slot within a short time, install a blank FPC panel over the slot to maintain proper airflow in the FPC card cage.



**CAUTION:** After removing an FPC from the chassis, wait at least 30 seconds before reinserting it, removing an FPC from a different slot, or inserting an FPC into a different slot.

Figure 118: Removing an FPC



See Also • [T4000 FPC Description on page 57](#)

- [T4000 Craft Interface LEDs](#)
- [Maintaining T4000 FPCs on page 337](#)
- [Troubleshooting the T4000 FPCs on page 358](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

## Installing a T4000 FPC



**CAUTION:** The FPC power connector is located in the corner where the bottom and the connector edges meet. If a power connector prong becomes bent, it no longer aligns with the female connector on the midplane, and the FPC no longer functions.

To install an FPC (see [Figure 119 on page 299](#)):

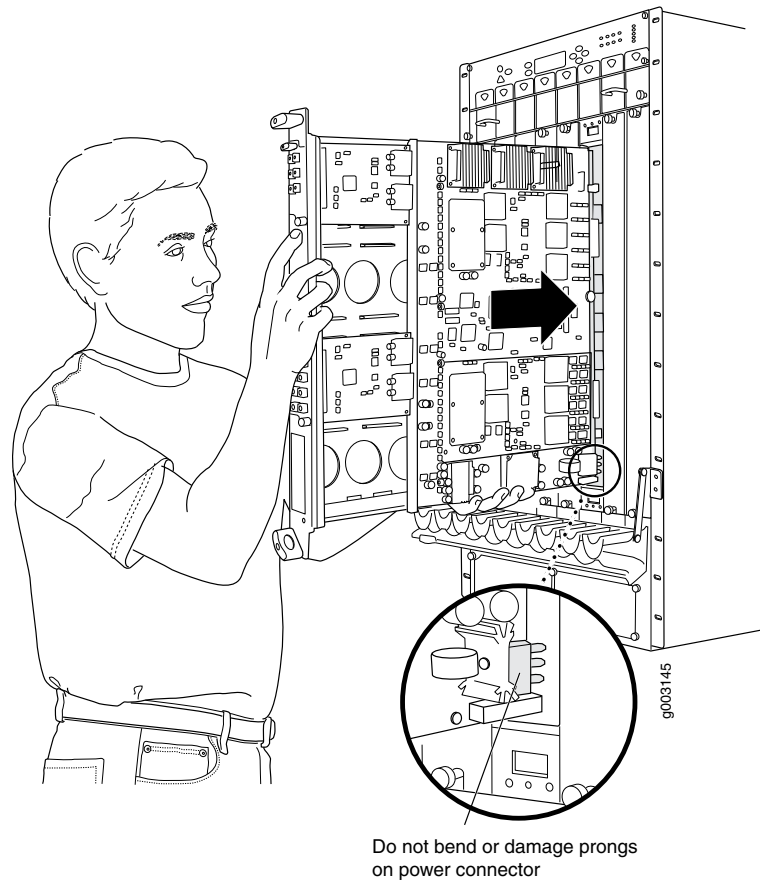
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Place the FPC on an antistatic mat.
3. Take each PIC to be installed in the replacement FPC out of its electrostatic bag and identify the slot on the FPC where it will be connected.
4. Verify that each fiber-optic PIC has a rubber safety cap covering the PIC transceiver. If it does not, cover the transceiver with a safety cap.
5. Install each PIC into the appropriate slot on the FPC. For information about installing a PIC, see [“Installing a T4000 PIC” on page 303](#).
6. Locate the slot in the FPC card cage in which you plan to install the FPC.
7. Inspect the slot in the FPC card cage to verify that there are no missing or bent pins on the midplane.
8. Inspect the FPC to verify that the connectors are not misaligned or damaged.
9. Orient the FPC vertically with the component side facing to the right. Be sure the FPC is right-side up, with the components on the right of the FPC.



**CAUTION:** When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

10. Carefully align the connector edge of the FPC with the appropriate empty slot in the chassis.
11. Lift the FPC into place, and carefully align the bottom and top of the FPC with the guides inside the card cage.

*Figure 119: Installing an FPC*



12. Gently rest the bottom edge of the FPC on the bottom edge of the slot opening, making contact a short distance forward of the power connector.



**CAUTION:** Take care not to bend or otherwise damage the power connector prongs.

13. Slowly slide the FPC into the slot until you feel resistance.
14. Align the ejector handles on the FPC faceplate in a position close to horizontal.

15. Simultaneously turn both ejector handles clockwise until you cannot turn them farther.
16. If any of the PICs on the FPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.

17. Insert the appropriate cable into the cable connector ports on each PIC on the FPC. Secure the cables so that they are not supporting their own weight. Place excess cable out of the way in a neatly coiled loop, using the cable management system. Placing fasteners on a loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

18. Use one of the following methods to bring the FPC online:
  - Press and hold the FPC online/offline button until the green **OK** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```



**CAUTION:** After the OK LED lights steadily, wait at least 30 seconds before removing the FPC again, removing an FPC from a different slot, or inserting an FPC in a different slot.

You can also verify correct FPC and PIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands.

- See Also**
- [T4000 FPC Description on page 57](#)
  - [T4000 Craft Interface LEDs](#)

- [Maintaining T4000 FPCs on page 337](#)
- [Troubleshooting the T4000 FPCs on page 358](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

## Replacing a T4000 PIC

1. [Removing a T4000 PIC on page 301](#)
2. [Installing a T4000 PIC on page 303](#)

### Removing a T4000 PIC

PICs are hot-insertable and hot-removable. When you remove a PIC, the router continues to function, although the PIC interfaces being removed no longer function.

The PICs are located in the FPCs installed in the front of the router. A PIC weighs approximately 2 lb (0.9 kg).

To remove a PIC (see [Figure 120 on page 303](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the PIC. If the PIC connects to fiber-optic cable, have ready a rubber safety cap for each transceiver and cable.
2. Attach an electrostatic discharge ESD grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Use one of the following methods to take the PIC offline:
  - Issue the following CLI command:
 

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot offline
```
  - Press and hold the online/offline button until the status LED on the PIC goes out (about 5 seconds). The label for the status LED varies for each PIC. See the *T4000 Core Router Interface Module Reference* for more information about the PIC LEDs.  
For a Type 4 or Type 5 PIC, use a narrow-ended tool that fits inside the opening that leads to the button.
4. Label the cables connected to the PIC so that you can later reconnect each cable to the correct PIC.
5. Disconnect the cables from the PIC. If the PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

6. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop in the cable management system. Placing fasteners on the loop helps to maintain its shape.

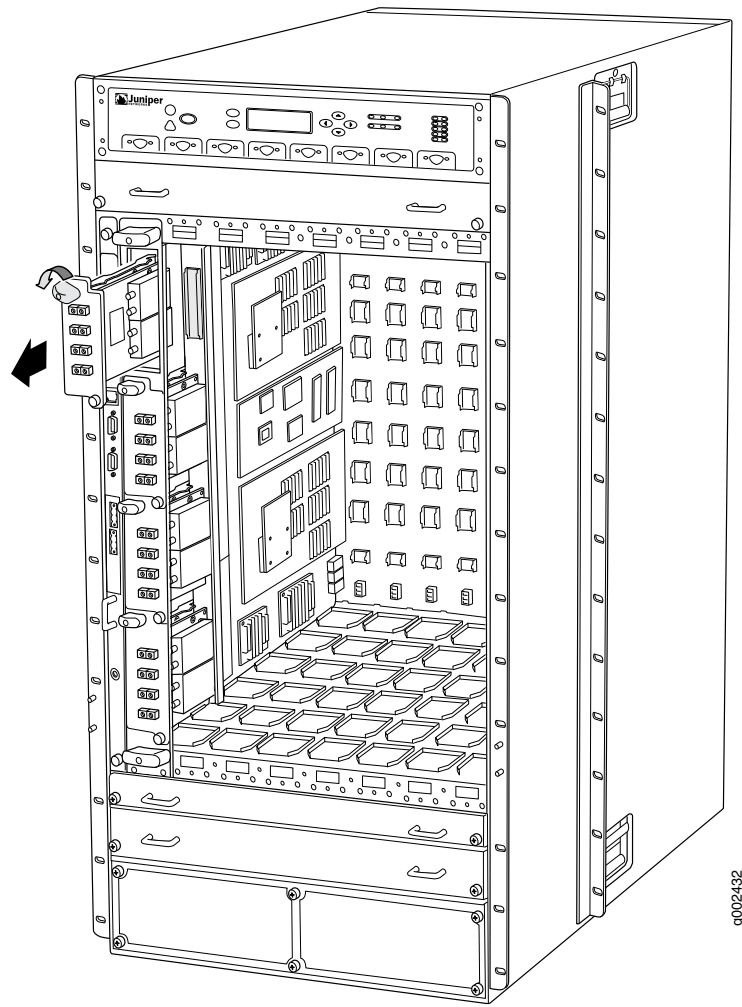


**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

7. Type 4 or Type 5 PIC—To unseat the PIC, twist the ejector handle at the bottom of the PIC faceplate, then twist the ejector handle at the top of the faceplate counterclockwise to unseat the PIC.
8. Slide the PIC out of the FPC card carrier, and place it in the electrostatic bag or on the antistatic mat.
9. If you are not reinstalling a PIC into the emptied PIC slot within a short time, install a blank PIC panel over the slot to maintain proper airflow in the FPC card cage.



Figure 120: Removing a PIC



- See Also**
- [T4000 PIC Description on page 62](#)
  - [Maintaining T4000 PICs on page 338](#)
  - [Troubleshooting the T4000 PICs on page 363](#)
  - [Prevention of Electrostatic Discharge Damage on page 423](#)

## Installing a T4000 PIC

To install a PIC (see [Figure 121 on page 305](#)).

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. If the PIC uses fiber-optic cable, verify that there is a rubber safety cap over each transceiver on the faceplate. Install a cap if necessary.

3. Align the notches in the connector at the rear of the PIC with the notches in the PIC slot in the FPC, and then slide the PIC in until it lodges firmly in the FPC.



**CAUTION:** Slide the PIC straight into the slot to avoid damaging the components on the bottom of the PIC.

4. Type 4 or Type 5 PICs—To secure the PIC to the FPC faceplate, twist the ejector handle at the bottom of the PIC faceplate, then twist the ejector handle at the top of the faceplate counterclockwise to unseat the PIC.

5. If the PIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

6. Insert the appropriate cables into the cable connectors on the PIC.
7. Arrange each cable in the cable management system to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop in the cable management system. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

8. Use one of the following methods to bring the PIC online:

- Press the PIC offline/online button until the status LED on the PIC lights green. For a Type 4 or Type 5 PIC, use a narrow-ended tool that fits inside the opening that leads to the button.

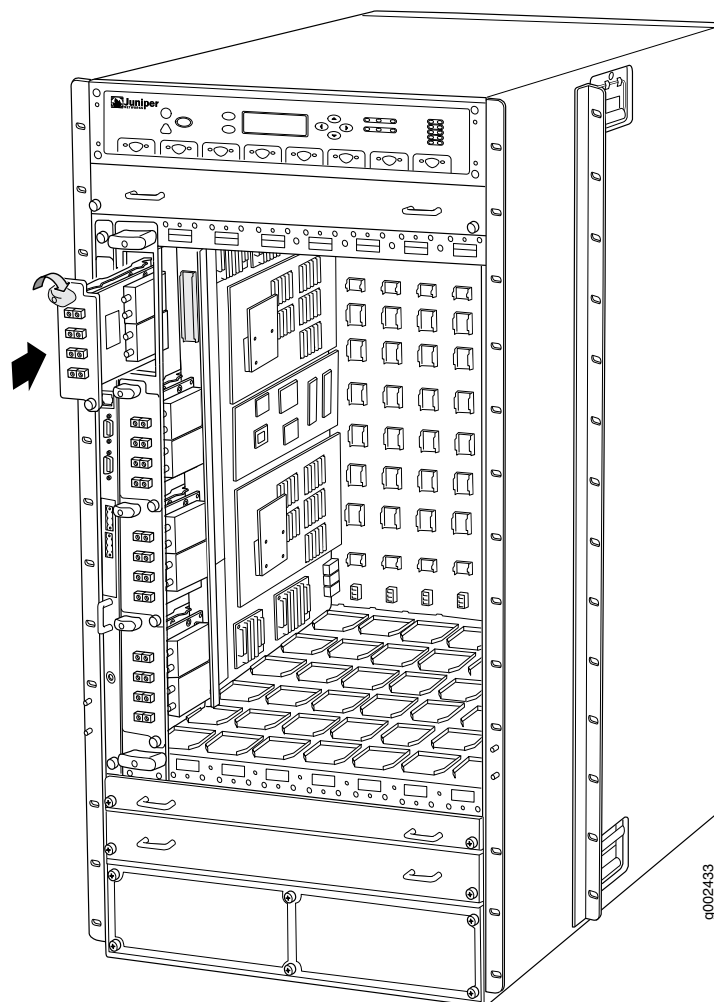
For more information about the PIC LEDs, see the *T4000 Core Router Interface Module Reference*.

- Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

The normal functioning status LED confirms that the PIC is online. You can also verify correct PIC functioning by issuing the **show chassis fpc pic-status** command.

*Figure 121: Installing a PIC*



- See Also**
- [T4000 PIC Description on page 62](#)
  - [Maintaining T4000 PICs on page 338](#)

- [Troubleshooting the T4000 PICs on page 363](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

## CHAPTER 31

# Replacing Power System Components

- [Replacing a T4000 Six-Input DC Power Supply on page 307](#)
- [Replacing a T4000 Six-Input DC Power Supply Front Air Filter on page 312](#)
- [Replacing a T4000 Six-Input DC Power Supply Side Air Filter on page 313](#)
- [Replacing a T4000 DC Power Supply Cable on page 315](#)

## Replacing a T4000 Six-Input DC Power Supply

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1. [Removing a T4000 Six-Input DC Power Supply on page 307](#)
2. [Installing a T4000 Six-Input DC Power Supply on page 310](#)

## Removing a T4000 Six-Input DC Power Supply

To remove a six-input DC power supply:

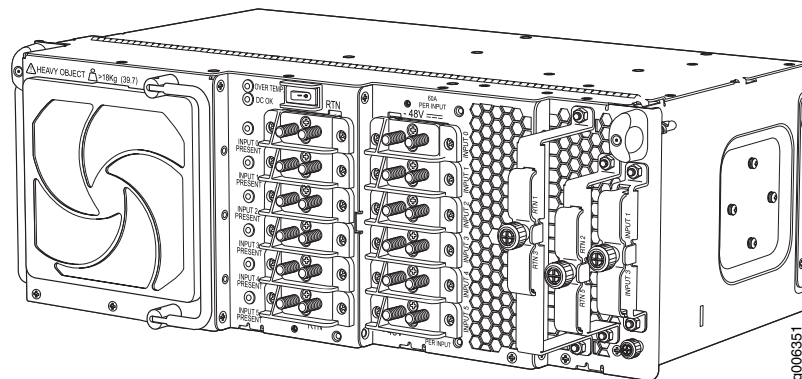
1. Switch off the customer site circuit breakers to the power supply being removed. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during the removal process.



**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on.

2. Remove the clear plastic cover protecting the terminal studs on the faceplate.

Figure 122: DC Power Supply

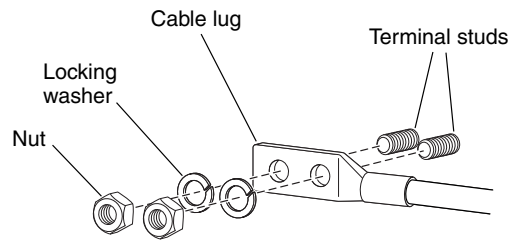


3. Using a 7/16-in. (11 mm) nut driver, remove the nuts and washers from the terminal studs (see Figure 123 on page 308).



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.

Figure 123: Disconnecting Power Cables from the DC Power Supply



4. Remove the cable lugs from the terminal studs.
5. Loosen the captive screws on the cable restraints on the right edge of the power supply faceplate.
6. Carefully move the power cables out of the way.
7. Loosen the captive screws on the lower corners of the power supply faceplate completely.

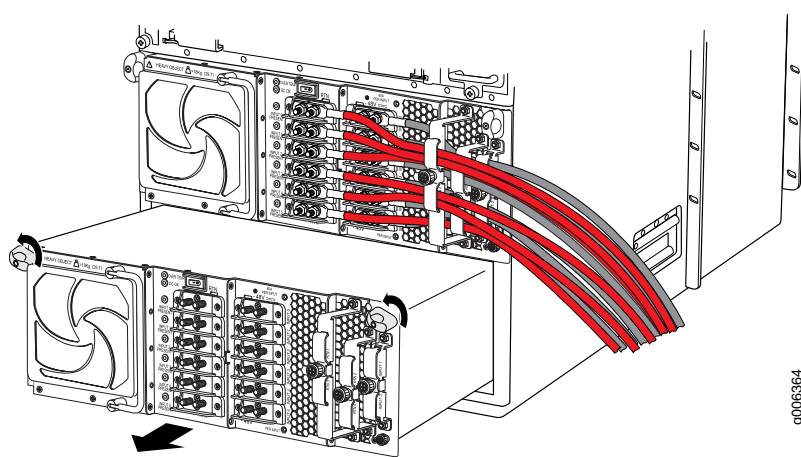
8. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.
9. Grasp the handle on the power supply faceplate, and pull firmly. Slide it halfway out of the chassis (see [Figure 124 on page 309](#)).



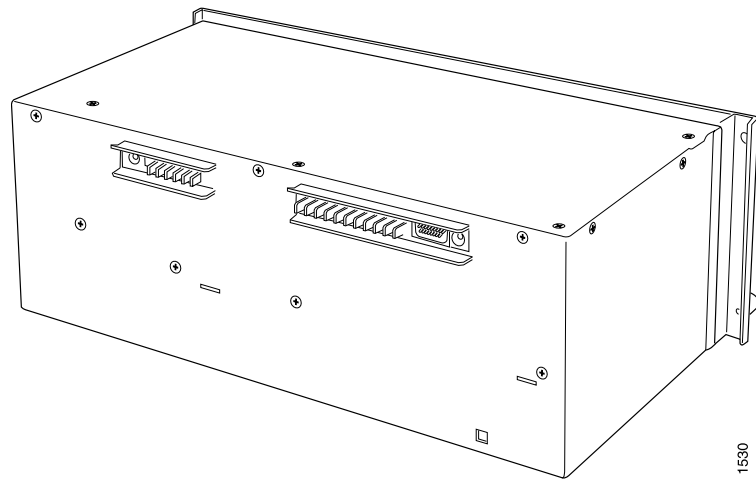
**CAUTION:** Each DC power supply weighs approximately 39.7 lb (18.0 kg). Be prepared to support the full weight of the power supply as you remove it from the router.

10. Place one hand underneath the power supply to support it, and slide it completely out of the chassis.

*Figure 124: Removing a DC Power Supply*



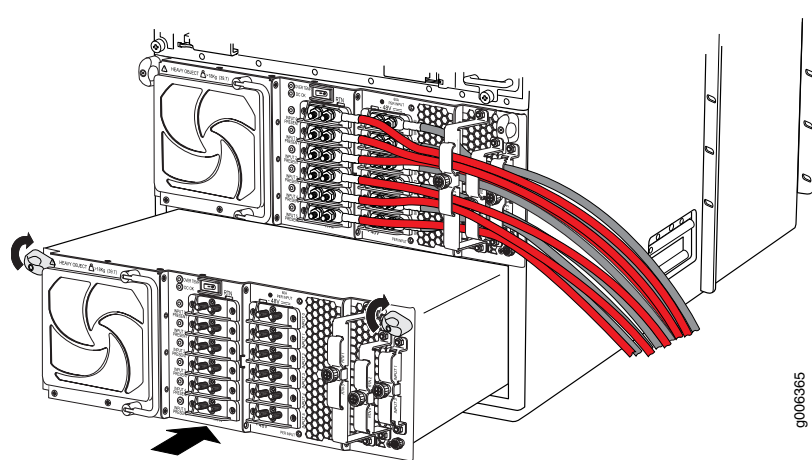
**WARNING:** Do not touch the power connectors on the rear of the power supply (see [Figure 125 on page 310](#)). They can contain dangerous voltages.

*Figure 125: Rear of the Power Supply Showing Midplane Connectors*

### Installing a T4000 Six-Input DC Power Supply

Each DC power supply weighs approximately 39.7 lb (18.0 kg). To install a six-input DC power supply:

1. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during installation.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Using both hands, slide the power supply into the chassis until you feel resistance (see [Figure 126 on page 310](#)).

*Figure 126: Inserting the DC Power Supply into the Chassis*

4. Twist the ejector handles at the upper corners of the power supply faceplate clockwise until they stop.



5. Tighten the captive screws at the lower corners of the power supply faceplate to secure the power supply in the chassis.
6. Verify that a licensed electrician has attached cable lugs to the power cables that you supply.
7. Remove the clear plastic cover protecting the terminal studs on the faceplate.
8. Remove the nut and washer from each power terminal stud.



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.

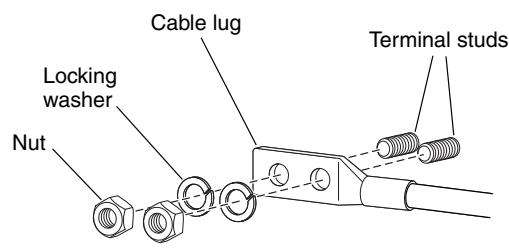
9. Attach the lugs on the DC source power cables to the terminal studs.
  - a. Attach the negative (–) DC source power cable lug to the **–48V** (input) terminal.
  - b. Attach the positive (+) DC source power cable lug to the **RTN** (return) terminal.

Secure the cable lugs to the terminal studs, first with a washer, then with a nut (see [Figure 127 on page 311](#)). Use a 7/16-in. (11 mm) nut driver to tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.



**CAUTION:** You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 lb-in. (5.0 Nm).

*Figure 127: Attaching the DC Power Cable*



10. Loosen the captive screws on the cable restraint on the right edge of the power supply faceplate.

11. Route the DC power cables through the cable restraint.
12. Tighten the cable restraint captive screws to hold the power cables in place.
13. Verify that the power cabling is correct, that the power cables do not touch or block access to other hardware components, and that they do not drape where people could trip on them.
14. Replace the clear plastic cover over the terminal studs on the faceplate.
15. Switch on the customer site circuit breakers to provide voltage to the DC power source cables.
16. Verify that the **INPUT PRESENT** LEDs on the power supply faceplate are lit steadily, indicating that the inputs are receiving power.
17. Switch the power switch on the power supply to the **ON** position (I). The **DC OK** LED blinks momentarily, then lights steadily.



**NOTE:** After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the LEDs on the power supply, the command output displays, and messages on the LED display on the craft interface—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

18. Verify that the **DC OK** LED on the power supply faceplate is lit steadily, indicating that the power supply is correctly installed and is functioning properly.

**Related  
Documentation**

- [T4000 Power System Description on page 75](#)
- [T4000 Six-Input DC Power Supply LEDs on page 77](#)
- [Maintaining the T4000 Power System on page 338](#)
- [Troubleshooting the T4000 Power System on page 363](#)

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## Replacing a T4000 Six-Input DC Power Supply Front Air Filter

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1. [Removing a T4000 Six-Input DC Power Supply Front Air Filter on page 313](#)
2. [Installing a T4000 Six-Input DC Power Supply Front Air Filter on page 313](#)

## Removing a T4000 Six-Input DC Power Supply Front Air Filter

To remove a six-input DC power supply :

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Grasp the filter cover on the power supply faceplate, and pull it straight off the power supply.
3. Remove the air filter.

## Installing a T4000 Six-Input DC Power Supply Front Air Filter

To install a six-input DC power supply front filter element:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Install a new filter element.
3. Press the filter cover straight onto the power supply faceplate until all four sides click into place.

- See Also**
- [T4000 Cooling System Description on page 25](#)
  - [Routine Maintenance Procedures for the T4000 Router on page 331](#)
  - [Maintaining the T4000 Air Filters on page 334](#)
  - [Replacing a T4000 Six-Input DC Power Supply Side Air Filter on page 313](#)
  - [Prevention of Electrostatic Discharge Damage on page 423](#)

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## Replacing a T4000 Six-Input DC Power Supply Side Air Filter

1. [Removing a T4000 Six-Input DC Power Supply Side Air Filter on page 313](#)
2. [Installing a T4000 Six-Input DC Power Supply Side Air Filter on page 314](#)

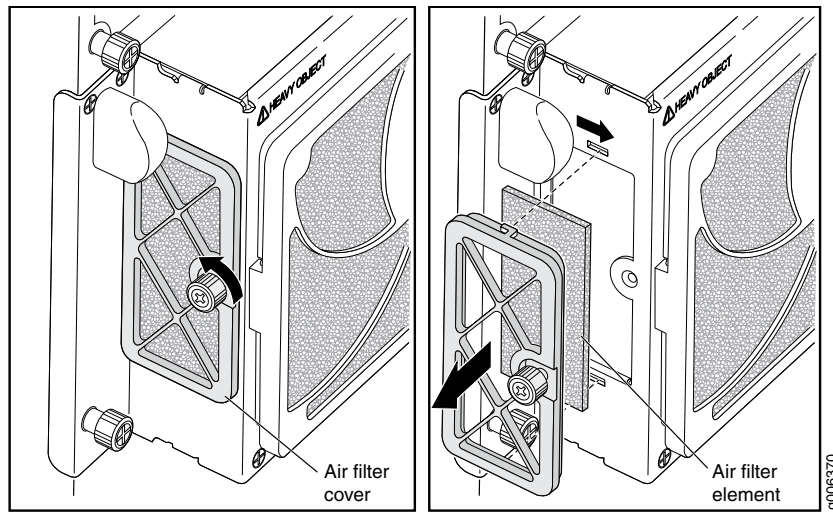
## Removing a T4000 Six-Input DC Power Supply Side Air Filter

To remove a six-input DC power supply side air filter element:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Loosen the captive screw.

3. Slide the air filter cover until the two lances leave the sheet metal.
4. Remove the air filter cover hooks from the rectangle holes in the sheet metal.
5. Remove the side air filter element from the air filter cover.

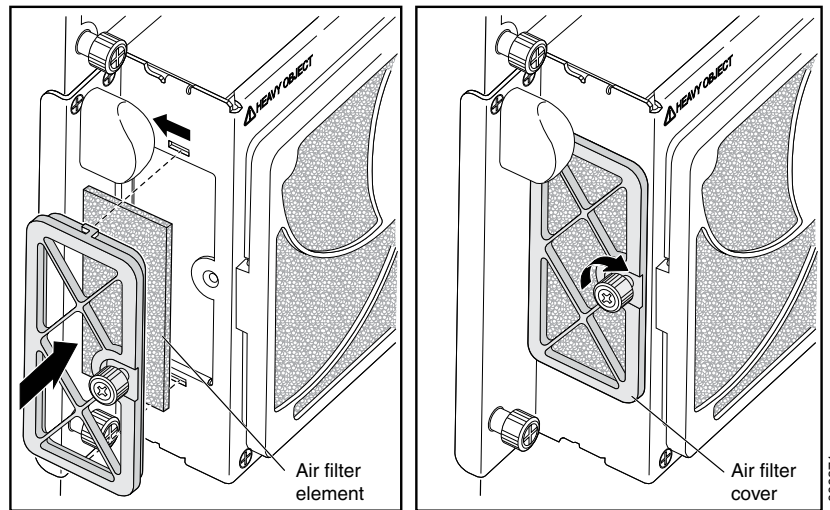
*Figure 128: Removing the Power Supply Side Air Filter*



### Installing a T4000 Six-Input DC Power Supply Side Air Filter

To install a six-input DC power supply side air filter element:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Install a new side filter element into the side air filter cover.
3. Insert the side air filter cover hooks into the rectangle holes in the sheet metal.
4. Slide the side air filter cover back into the power supply faceplate. The two lances insert into the sheet metal.
5. Tighten the captive screw.

*Figure 129: Installing the Power Supply Side Air Filter*

- See Also**
- [T4000 Cooling System Description on page 25](#)
  - [Routine Maintenance Procedures for the T4000 Router on page 331](#)
  - [Maintaining the T4000 Air Filters on page 334](#)
  - [Replacing a T4000 Six-Input DC Power Supply Front Air Filter on page 312](#)
  - [Prevention of Electrostatic Discharge Damage on page 423](#)

## Replacing a T4000 DC Power Supply Cable

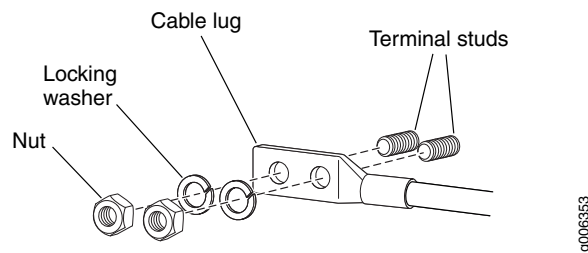
1. [Removing a T4000 DC Power Supply Cable on page 315](#)
2. [Installing a T4000 DC Power Supply Cable on page 316](#)

### Removing a T4000 DC Power Supply Cable

To remove a DC power supply cable from a six-input DC power supply:

1. Switch off the customer site circuit breakers for all the cables attached to the power supply. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during the removal process.
2. Remove the power cable from the external DC power source.
3. Remove the clear plastic cover protecting the terminal studs on the faceplate.
4. Remove the nut and washer from the terminal stud on the power supply (see [Figure 130 on page 316](#)). Use a 7/16-in. (11 mm) nut driver.

Figure 130: Disconnecting the DC Power Cable



5. Remove the cable lug from the terminal stud on the power supply.
6. Loosen the captive screw or screws on the cable restraint on the right edge of the power supply faceplate.
7. Carefully move the power cable out of the way.

## Installing a T4000 DC Power Supply Cable

To install a DC power supply cable on a six-input DC power supply:

1. Locate a DC power cable that meets the specifications for the power supply.



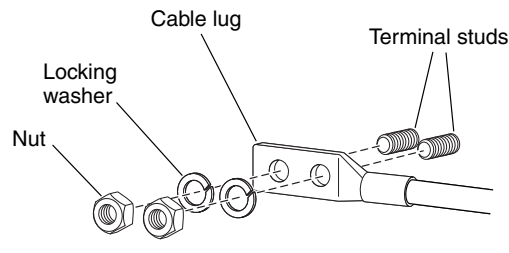
**CAUTION:** A licensed electrician must attach a cable lug to the power cable that you supply. A cable with an incorrectly attached lug can damage the router.

2. Route the power cable through the appropriate cable restraint.
3. Attach the lug on the DC source power cable to the terminal stud.
  - a. Attach a negative (–) DC source power cable lug to the **–48V** (input) terminals.
  - b. Attach a positive (+) DC source power cable lug to the **RET** (return) terminals.

Secure the cable lug to the terminal stud, first with a washer, then with a nut (see [Figure 131 on page 317](#)). Use a 7/16-in. (11-mm) nut driver to tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.



**CAUTION:** You must use an appropriate torque-controlled tool to tighten the nuts. Applying excessive torque damages the terminal studs and the power supply. The absolute maximum torque that may be applied to this nut is 45 lb-in. (5.0 Nm).

**Figure 131: Connecting the DC Power Cable**

g006353

4. Tighten the cable restraint captive screw or screws to hold the power cable in place.
5. Replace the clear plastic cover over the terminal studs on the faceplate.
6. Verify that the DC source power cabling is correct, that the power cable is not touching or blocking access to router components, and that it does not drape where people could trip on it.
7. Attach the other end of the power cable to the external DC power source.
8. Switch on the customer site circuit breakers.
9. Verify that the **INPUT PRESENT** LEDs on the power supply faceplate are lit steadily, indicating that the inputs are receiving voltage.
10. Switch the power switch on the power supply to the **ON** position (I). The **DC OK** LED blinks momentarily, then lights steadily.



**NOTE:** After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the LEDs on the power supply, the command output displays, and messages on the LED display on the craft interface—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

11. Verify that the **DC OK** LED on the power supply faceplate is lit steadily, indicating that the power supply is correctly installed and is functioning properly.

#### Related Documentation

- [T4000 Power System Description on page 75](#)
- [T4000 Six-Input DC Power Supply LEDs on page 77](#)
- [Maintaining the T4000 Power System on page 338](#)
- [Troubleshooting the T4000 Power System on page 363](#)





# Replacing Switch Fabric Components

- [Replacing a T4000-SIB on page 319](#)
- [Replacing a T4000 TXP-LCC-3D SIB on page 322](#)

## Replacing a T4000-SIB

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Five SIBs are installed in the router. The SIBs are located in the rear of the chassis in the slots marked **SIB0** through **SIB4**. Each T4000 SIB weighs approximately 6.5 lb (3.0 kg).

1. [Removing a T4000-SIB on page 319](#)
2. [Installing a T4000-SIB on page 320](#)

## Removing a T4000-SIB

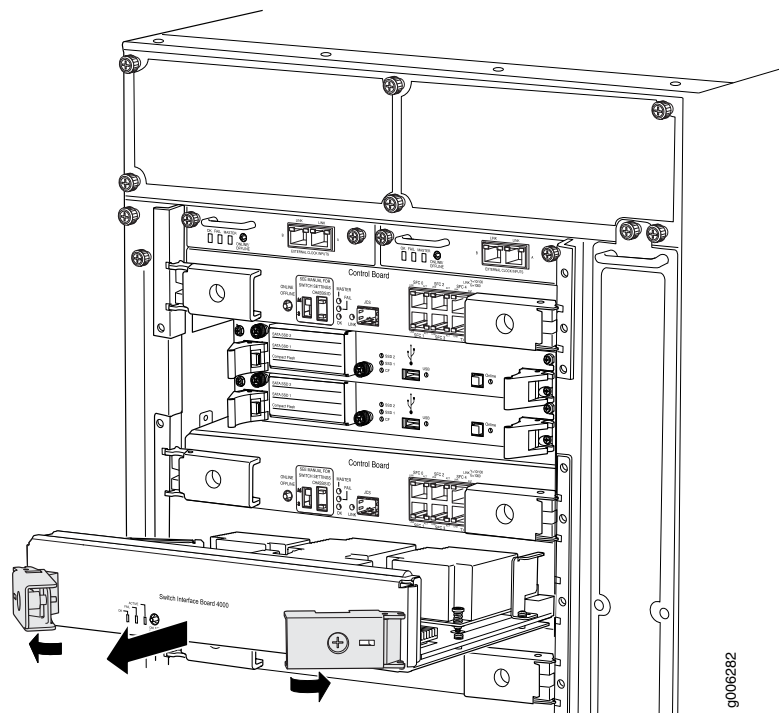
To remove a SIB (see [Figure 132 on page 320](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Loosen the captive screws (using a Phillips (+) screwdriver, number 2) on the ejector handles on each side of the SIB faceplate.
4. Flip the ejector handles outward to unseat the SIB.
5. Grasp both ejector handles, pull firmly, and slide the SIB about three-quarters of the way out of the chassis.
6. Place one hand underneath the SIB to support it, and slide it completely out of the chassis. Place it on the antistatic mat.



**CAUTION:** Do not stack hardware components on one another after you remove them. Place each component on an antistatic mat resting on a stable, flat surface.

Figure 132: Removing a T4000 SIB



## Installing a T4000-SIB

To install a T4000-SIB (see [Figure 133 on page 321](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Place one hand underneath the SIB to support it. With the other hand, hold one of the ejector handles on the SIB.
3. Carefully align the sides of the SIB with the guides inside the chassis.
4. Slide the SIB into the chassis, carefully ensuring that it is correctly aligned.
5. Grasp both ejector handles, and press them inward to seat the SIB. Ensure that the ejector handle tabs are properly mated inside their corresponding chassis slots. You might have to close and open the handles a few times before the tabs catch the slots.
6. Tighten the captive screws on the ejector handles.
7. Bring the SIB online using one of the following methods:
  - Press and hold the **ONLINE/OFFLINE** button on the SIB faceplate. The green **OK** LED on the faceplate begins to blink. Hold the button down until the LED blinks.

- Issue the following CLI command on the router:

```
user@host> request chassis sib online slot 0
```

8. Check the LEDs on the SIB faceplate.

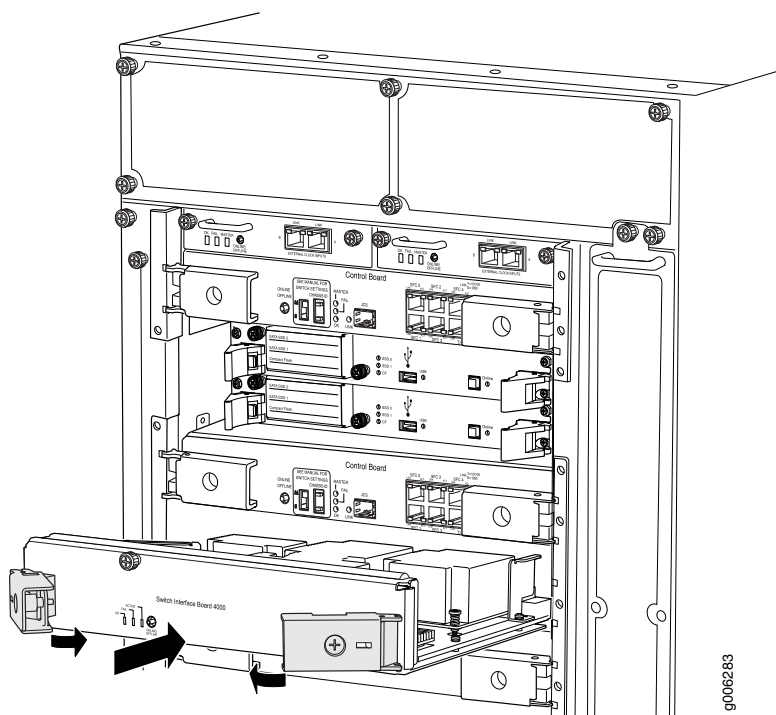
- The green **OK** LED should light steadily a few minutes after the SIB is installed.
- If the **FAIL** LED is lit steadily, remove and install the SIB again. Make sure that the SIB is seated properly. If the **FAIL** LED still lights steadily, the SIB is not functioning properly. Contact your customer support representative.

9. Verify that four SIBs are in the **Online** state and one SIB is in the **Spare** state. Display the status of the SIB by issuing the **show chassis sibs** command:

```
user@host> show chassis sibs
```

Slot	State	Uptime
0	Spare	
1	Online	1 day, 13 hours, 16 minutes, 49 seconds
2	Online	1 day, 13 hours, 16 minutes, 33 seconds
3	Online	1 day, 13 hours, 16 minutes, 16 seconds
4	Online	1 day, 13 hours, 16 minutes

*Figure 133: Installing a T4000 SIB*



See Also •

- Related Documentation**
- [T4000 Switch Interface Board \(SIB\) Description on page 79](#)
  - [T4000-SIB Description on page 80](#)
  - [Maintaining the T4000 SIBs on page 339](#)
  - [Troubleshooting the T4000 SIBs on page 368](#)
  - [Prevention of Electrostatic Discharge Damage on page 423](#)

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## Replacing a T4000 TXP-LCC-3D SIB

Five SIBs are installed in the router. The SIBs are located in the rear of the chassis in the slots marked **SIB0** through **SIB4**.

Each TXP-LCC-3D SIB weighs approximately 9.4 lb (4.2 kg). The TXP-LCC-3D SIBs are connected to the TXP-F13-3D SIBs in a TX Matrix Plus router.

TXP-LCC-3D SIBs in active data switching planes are hot-pluggable. TXP-LCC-3D SIBs in a spare data switching planes are hot-insertable and hot-removable. When you remove a TXP-LCC-3D SIB in a spare switching plane, traffic forwarding continues without any degradation as long as the other four switching planes remain online. However, removing a TXP-LCC-3D SIB in an active switching plane might cause performance degradation in that switching plane. To avoid performance degradation, you can take the switching plane offline before you remove a TXP-LCC-3D SIB. For more information, see the *TX Matrix Plus Router Hardware Guide*.

1. [Removing a T4000 TXP-LCC-3D SIB on page 322](#)
2. [Installing a T4000 TXP-LCC-3D SIB on page 325](#)

## Removing a T4000 TXP-LCC-3D SIB

To remove a TXP-LCC-3D SIB:

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Ensure that the cables connected to the TXP-LCC-3D SIB are labeled so you can reconnect them correctly.
4. Use one of the following methods to take the TXP-LCC-3D SIB offline:
  - Issue the **request chassis sib lcc *number* slot *slot-number* offline** command. For example:

```
user@host> request chassis sib lcc 0 slot 3 offline
Online initiated, use "show chassis sibs" to verify
```

- Press and hold the **SIB ONLINE/OFFLINE** button in the middle of the TXP-LCC-3D SIB faceplate to take the SIB offline. Hold the buttons down until all the LEDs on the faceplate are not lit.
5. Remove each switching plane cable from the SIB.
    - CXP—Disconnect the CXP cables ([Figure 134 on page 324](#)) from the CXP transceivers. After all the CXP cables have been disconnected from the transceivers, remove the CXP transceivers ([Figure 135 on page 324](#)) from the SIB.



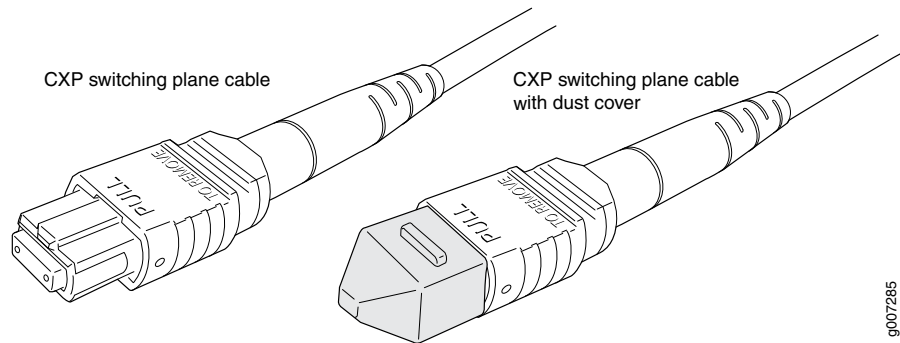
**WARNING:** Do not look directly into a CXP cable connected to a port. The fiber optics emit laser light that can damage your eyes.

- AOC—Remove the AOC transceivers from the SIB ([Figure 136 on page 324](#)).
6. Install dust covers on the cables and transceivers that you removed. Align the dust cover with the cable or transceiver and carefully press them together until they stop. The dust cover and the cable or transceiver are keyed to ensure proper mating.
    - CXP—Install a dust cover on each CXP transceiver and CXP cable.
    - AOC—Install a dust cover on each AOC transceiver.
  7. Move the cables to the side of the SIB so they do not interfere with the removal of the SIB.
  8. Using a Phillips (+) screwdriver, number 2, loosen the captive screws on the ejector handles on each side of the SIB faceplate.
  9. Flip the ejector handles outward to unseat the SIB ([Figure 137 on page 325](#)).
  10. Grasp both ejector handles, pull firmly, and slide the SIB about three-quarters of the way out of the chassis.
  11. Place one hand underneath the SIB to support it, and slide it completely out of the chassis. Place it on the antistatic mat.

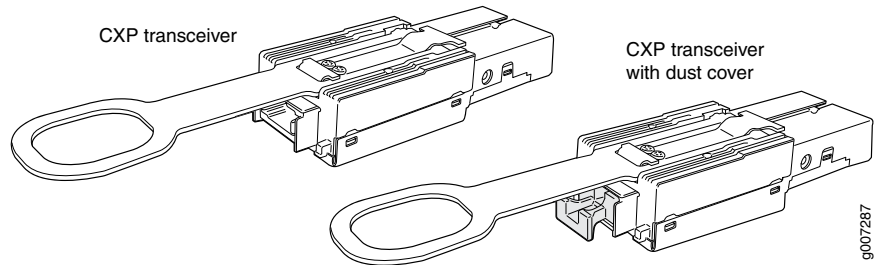


**CAUTION:** Do not stack hardware components on one another after you remove them. Place each component on an antistatic mat resting on a stable, flat surface.

**Figure 134: CXP Cable and Dust Cover**



**Figure 135: CXP Transceiver and Dust Cover**



**Figure 136: AOC Transceiver and Dust Cover**

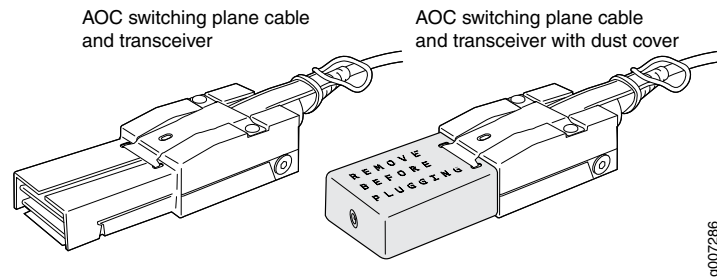
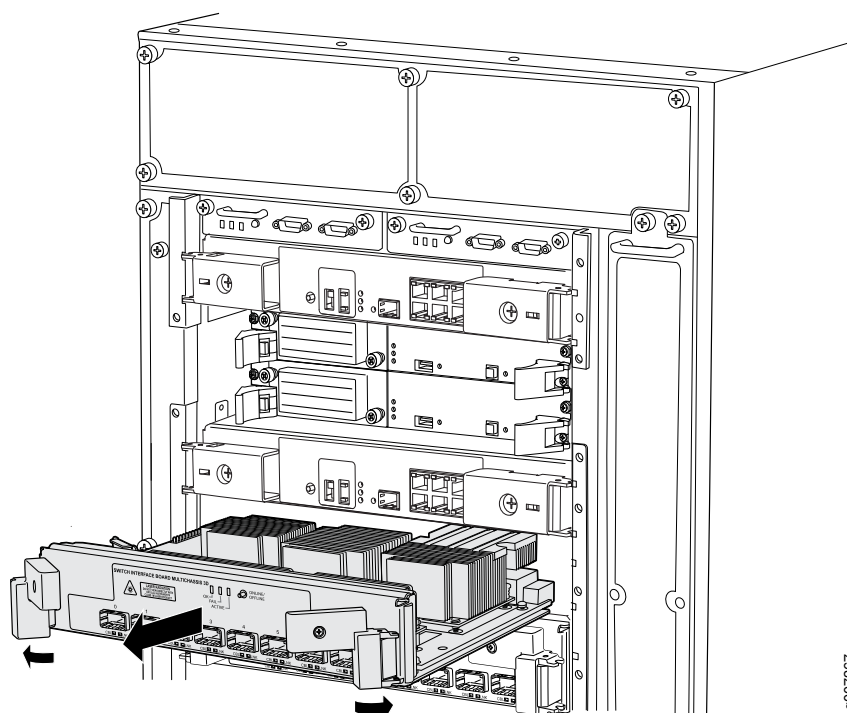


Figure 137: Removing a TXP-LCC-3D SIB



## Installing a T4000 TXP-LCC-3D SIB

To install a TXP-LCC-3D SIB:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Place one hand underneath the SIB to support it. With the other hand, hold one of the ejector handles on the SIB.
3. Carefully align the sides of the SIB with the guides inside the chassis.
4. Slide the SIB into the chassis, carefully ensuring that it is correctly aligned ([Figure 138 on page 327](#)).
5. Grasp both ejector handles, and press them inward to seat the SIB. Ensure that the ejector handle tabs are properly mated inside their corresponding chassis slots. You might have to close and open the handles a few times before the tabs catch the slots.
6. Tighten the captive screws on the ejector handles.
7. Remove the dust covers from the transceivers and cables. Store the dust covers in a dust-free resealable plastic bag.

## 8. Insert the transceiver into the ports.

- **CXP**—Insert the CXP transceivers into the TXP-LCC-3D ports. The CXP transceivers and the port are keyed to ensure proper mating. After all the CXP transceiver have been installed, reconnect each CXP cable ([Figure 139 on page 327](#)) to the CXP transceiver in the TXP-LCC-3D port that corresponds to the label on the cable.

Align the cable with the port and carefully press it into the port until it your hear a click and it stops. The CXP cables and CXP transceivers are keyed to ensure proper mating.

- **AOC**—Using the cable labels, insert each AOC transceiver into its corresponding TXP-F13-3D port ([Figure 140 on page 328](#)).

Align the transceiver with the port and carefully press it into the port until it your hear a click and it stops. The AOC transceivers and the port are keyed to ensure proper mating.

## 9. Bring the TXP-LCC-3D SIB online using one of the following methods:

- Press and hold the **ONLINE/OFFLINE** button on the TXP-LCC-3D SIB faceplate. The green **OK** LED on the faceplate begins to blink. Hold the button down until the LED blinks.
- Issue the following CLI command on the router:

```
user@host> request chassis sib online slot 0
```

## 10. Check the LEDs on the TXP-LCC-3D SIB faceplate.

- The green **OK** LED should light steadily a few minutes after the SIB is installed.
- If the **FAIL** LED is lit steadily, remove and install the TXP-LCC-3D SIB again. Make sure that the SIB is seated properly. If the **FAIL** LED still lights steadily, the SIB is not functioning properly. Contact your customer support representative.

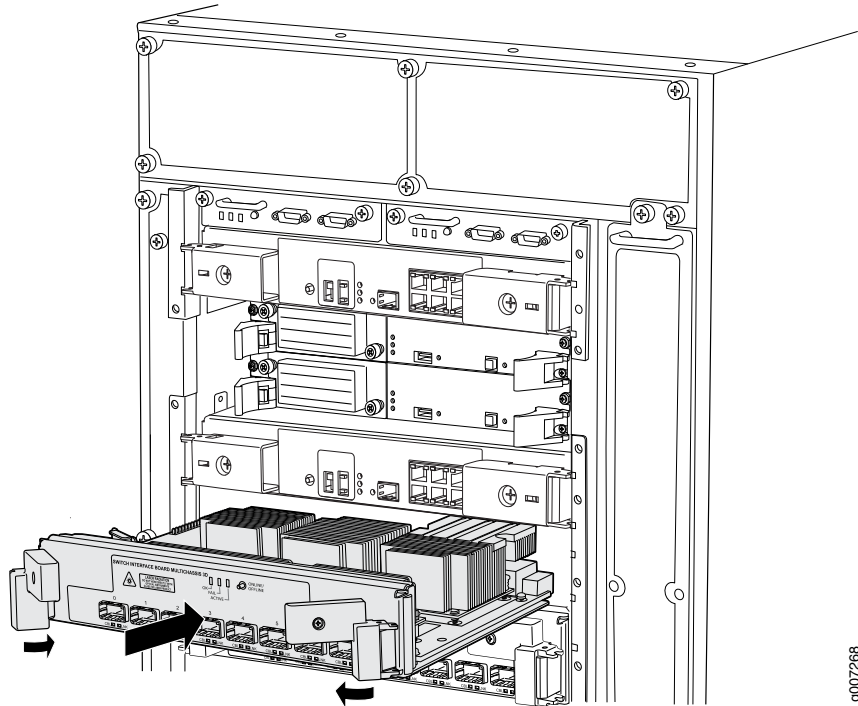
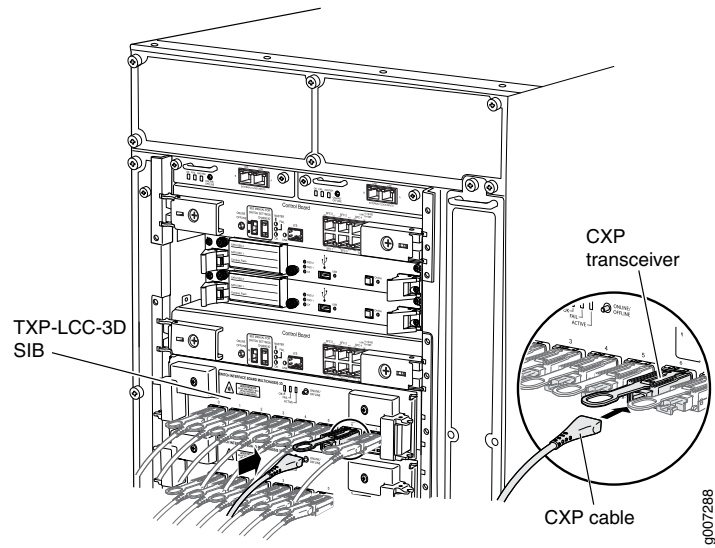
11. Verify that four SIBs are in the **Online** state and one SIB is in the **Spare** state. Display the status of the SIB by issuing the **show chassis sibs** command:

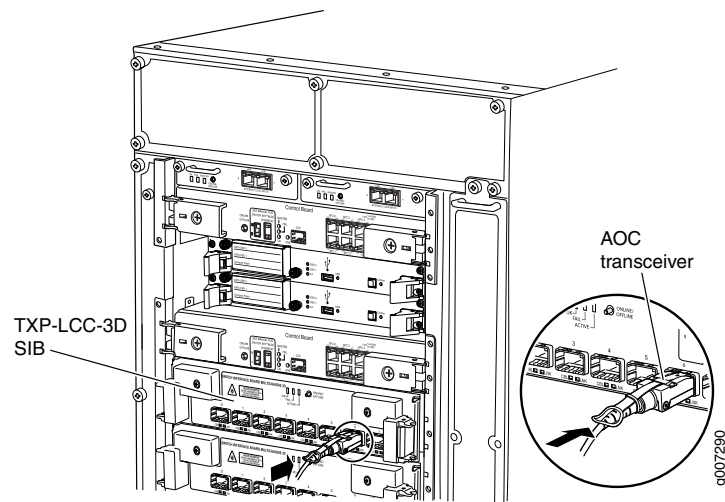
```
user@host> show chassis sibs
```

Slot	State	Uptime
0	Spare	
1	Online	1 day, 13 hours, 16 minutes, 49 seconds
2	Online	1 day, 13 hours, 16 minutes, 33 seconds
3	Online	1 day, 13 hours, 16 minutes, 16 seconds
4	Online	1 day, 13 hours, 16 minutes

If a SIB is not online, issue the **request chassis sib online operational mode** command.



*Figure 138: Installing a TXP-LCC-3D SIB**Figure 139: Connecting a CXP Cable to a CXP Transceiver*

*Figure 140: Installing an AOC Transceiver***Related Documentation**

- [T4000 Switch Interface Board \(SIB\) Description on page 79](#)
- [T4000 TXP-LCC-3D SIB Description on page 80](#)
- [Maintaining the T4000 SIBs on page 339](#)
- [Troubleshooting the T4000 SIBs on page 368](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

## PART 5

# Maintaining the Chassis and Components

- [Routine Maintenance Procedures on page 331](#)
- [Maintaining Components on page 333](#)
- [Powering Off the Router on page 341](#)



## CHAPTER 33

# Routine Maintenance Procedures

- [Routine Maintenance Procedures for the T4000 Router on page 331](#)

## Routine Maintenance Procedures for the T4000 Router

---

**Purpose** For optimum router performance, perform preventive maintenance procedures.

**Action** On a regular basis:

- Inspect the installation site for moisture, loose wires or cables, and excessive dust. Make sure that airflow is unobstructed around the router and into the air intake vents.
- Check the status-reporting devices on the craft interface: system alarms, LEDs, and LCD.
- Inspect the air filters at the bottom front and left rear of the router. Do not run the router for more than a few minutes without the air filters in place.

Check the air filters regularly for dust and debris. As a general guideline, we recommended that you replace the filter elements every 6 months for routers operating in a typical environment. The filter elements degrade over time, and replacement intervals will vary by operating environment.

- Related Documentation**
- [T4000 Cooling System Description on page 25](#)
  - [T4000 Craft Interface Description on page 16](#)
  - [Maintaining the T4000 Air Filters on page 334](#)



## CHAPTER 34

# Maintaining Components

- [Tools and Parts Required to Maintain the T4000 Hardware Components on page 333](#)
- [Maintaining the T4000 SCGs on page 333](#)
- [Maintaining the T4000 Air Filters on page 334](#)
- [Maintaining the T4000 Fan Trays on page 335](#)
- [Maintaining the T4000 Host Subsystem on page 335](#)
- [Maintaining the T4000 Routing Engines on page 336](#)
- [Maintaining the T4000 Control Boards on page 337](#)
- [Maintaining T4000 FPCs on page 337](#)
- [Maintaining T4000 PICs on page 338](#)
- [Maintaining the T4000 Power System on page 338](#)
- [Maintaining the T4000 SIBs on page 339](#)

### Tools and Parts Required to Maintain the T4000 Hardware Components

To maintain the hardware components, you need the following tools and parts:

- ESD grounding wrist strap
- Flat-blade (–) screwdriver
- Phillips (+) screwdriver, number 1
- Phillips (+) screwdriver, number 2

#### **Related Documentation**

- [Routine Maintenance Procedures for the T4000 Router on page 331](#)

### Maintaining the T4000 SCGs

**Purpose** For optimum router performance, verify the condition of the SCGs.

**Action** On a regular basis:

- Check the SCG LEDs. During normal operations:
  - The green **OK** LED on the SCG faceplate is lit.
  - The yellow **FAIL** LED on the SCG faceplate is not lit. If the yellow **FAIL** LED is lit, see [“Troubleshooting the T4000 SCGs” on page 349](#).
- Use the `show chassis environment scg` command to verify the status of the SCGs.

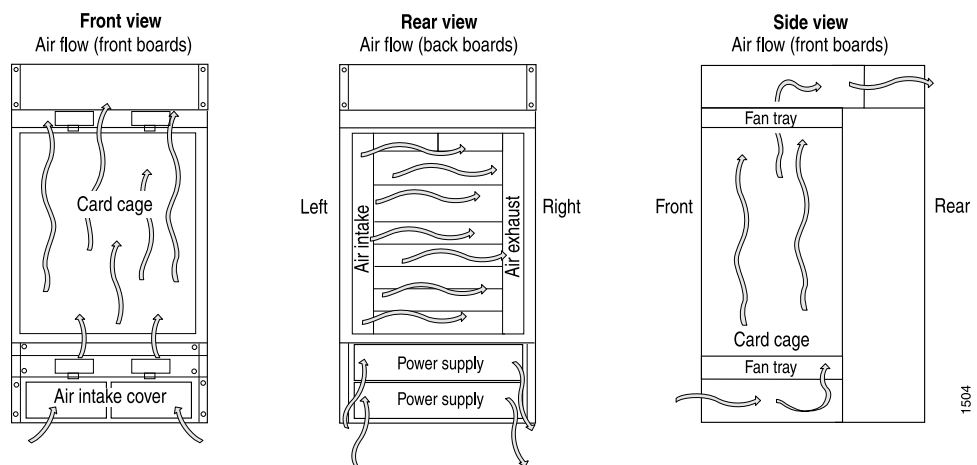
- Related Documentation**
- [T4000 SONET Clock Generators \(SCGs\) Description on page 20](#)
  - [T4000 SONET Clock Generators \(SCGs\) LEDs on page 22](#)

## Maintaining the T4000 Air Filters

**Purpose** For optimum cooling, verify the condition of the air filters.

Air filters for both the front and rear fan trays help keep dust and other particles from entering the cooling system. To function properly, the entire cooling system requires an unobstructed airflow and proper clearance around the site, as described in [“T4000 Clearance Requirements for Airflow and Hardware Maintenance” on page 91](#). See [Figure 141 on page 334](#).

**Figure 141: Airflow Through the Chassis**



**Action** Check the air filters regularly for dust and debris. As a general guideline, we recommended that you replace the filter elements every 6 months for routers operating in a typical environment. The filter elements degrade over time, and replacement intervals will vary by operating environment.



For procedures to replace the air filters, see the following topics:

- [Replacing a T4000 Rear Air Filter on page 261](#)
- [Replacing a T4000 Front Air Filter on page 259](#)
- [Replacing a T4000 Six-Input DC Power Supply Front Air Filter on page 312](#)
- [Replacing a T4000 Six-Input DC Power Supply Side Air Filter on page 313](#)

The shelf life of polyurethane filter varies from two years to five years depending on the storage conditions. Store in a cool, dry, and dark environment. Wrap the media in plastic and store in an environment with relative humidity between 40%– 80% and temperature between 40°F (4° C) to 90°F (32° C). Note that if the material flakes, or becomes brittle when rubbed or deformed, it is no longer usable.



**CAUTION:** Always keep the air filters in place while the router is operating. Because the fans are very powerful, they could pull small bits of wire or other materials into the router through the unfiltered air intake. This could damage the router components.

- Related Documentation**
- [T4000 Cooling System Description on page 25](#)
  - [Maintaining the T4000 Fan Trays on page 335](#)
  - [Troubleshooting the T4000 Cooling System on page 351](#)

## Maintaining the T4000 Fan Trays

**Purpose** For optimum cooling, verify the condition of the fans.

**Action** On a regular basis, monitor the status of the fans. The fan trays each contain multiple fans that work in unison to cool the router components. During normal operation, the status of each fan is **OK**, and the fans in each fan tray function at normal speed. Use the **show chassis environment** and **show chassis fan** commands to verify the status of the fans.

- Related Documentation**
- [T4000 Cooling System Description on page 25](#)
  - [Maintaining the T4000 Air Filters on page 334](#)
  - [Troubleshooting the T4000 Cooling System on page 351](#)

## Maintaining the T4000 Host Subsystem

**Purpose** For optimum router performance, verify the condition of the Routing Engines and the control boards.

**Action** Each host subsystem comprises a Routing Engine and an adjacent control board functioning together. To maintain the host subsystem:

- Check the host subsystem LEDs (**HOST0** and **HOST1**) on the craft interface. During normal operations:
  - The green host subsystem **OK** LED on the craft interface is lit.
  - The red host subsystem **FAIL** LED on the craft interface is not lit.

If the red **HOST0 FAIL** or **HOST1 FAIL** LED is lit, see [“Troubleshooting the T4000 Host Subsystems” on page 354](#)

- Check the LEDs on the control board. See [“Maintaining the T4000 Control Boards” on page 337](#).
- Check the LEDs on the Routing Engine. See [“Maintaining the T4000 Routing Engines” on page 336](#)

**Related Documentation**

- [T4000 Craft Interface LEDs](#)
- [T4000 LCC-CB Control Board LEDs on page 31](#)
- [T4000 RE-C1800 LEDs on page 35](#)

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## Maintaining the T4000 Routing Engines

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**Purpose** For optimum router performance, verify the condition of the Routing Engines.

**Action** On a regular basis:

- Check the host subsystem LEDs (**HOST0** and **HOST1**) on the craft interface. During normal operations:
  - The green host subsystem **OK** LED on the craft interface is lit.
  - The red host subsystem **FAIL** LED on the craft interface is not lit.

If the red **HOST0 FAIL** or **HOST1 FAIL** LED is lit, see [“Troubleshooting the T4000 Host Subsystems” on page 354](#)

- Check the LEDs on the Routing Engine. During normal operation, the **ONLINE** LED on each Routing Engine is lit green, indicating that the Routing Engine is functional.
- Check the LCD on the craft interface to view information about the router temperature and the status of the Routing Engines.
- Use the **show chassis routing-engine** command to check the status of the Routing Engines.

**Related Documentation**

- [T4000 Craft Interface LEDs](#)
- [T4000 RE-C1800 LEDs on page 35](#)

- [Maintaining the T4000 Host Subsystem on page 335](#)
- [Maintaining the T4000 Control Boards on page 337](#)
- [Troubleshooting the T4000 Routing Engines on page 355](#)

## Maintaining the T4000 Control Boards

---

**Purpose** For optimum router performance, verify the condition of the control boards.

**Action** On a regular basis:

- Check the LEDs on the control board faceplate. During normal operations:
  - The green **OK** LED on the control board faceplate is lit.
  - The yellow **FAIL** LED on the control board faceplate is not lit. If the **FAIL** is lit, see [“Troubleshooting the T4000 Host Subsystems” on page 354](#) and [“Troubleshooting the T4000 Control Boards” on page 356](#).
- Check the host subsystem LEDs (**HOST0** and **HOST1**) on the craft interface. During normal operations:
  - The green host subsystem **OK** LED on the craft interface is lit.
  - The red host subsystem **FAIL** LED on the craft interface is not lit.

If the red **HOST0 FAIL** or **HOST1 FAIL** LED is lit, see [“Troubleshooting the T4000 Host Subsystems” on page 354](#) and [“Troubleshooting the T4000 Control Boards” on page 356](#).
- Use the **show chassis environment cb** command to check the status of the control boards. During normal operations, the control board is **online**.

- Related Documentation**
- [T4000 LCC-CB Control Board LEDs on page 31](#)
  - [Maintaining the T4000 Host Subsystem on page 335](#)
  - [Maintaining the T4000 Routing Engines on page 336](#)

## Maintaining T4000 FPCs

---

**Purpose** For optimum router performance, verify the condition of the FPCs. The router can have up to eight FPCs mounted vertically in the FPC card cage at the front of the chassis.

**Action** On a regular basis:

- Check the LEDs on the craft interface directly above each FPC slot. During normal operation:
  - The green **OK** LED above the FPC on the craft interface lights steadily when the FPC is online and functioning normally.
  - The green **OK** LED blinks during startup.
  - The red **FAIL** LED above the FPC on the craft interface is not lit. If the **FAIL** is lit, see [“Troubleshooting the T4000 FPCs” on page 358](#).
- Check the LCD on the craft interface.
- Use the **show chassis fpc** command to verify the status of installed FPCs. The value **Online** in the column labeled **State** indicates that the FPC is functioning normally.

**Related Documentation**

- [T4000 Craft Interface LEDs](#)
- [T4000 FPC Description on page 57](#)

---

## Maintaining T4000 PICs

**Purpose** For optimum router performance, verify the condition of the PICs.

**Action** On a regular basis:

- Check the LEDs on PIC faceplates. A PIC LED lit green indicates the PIC is functioning normally.

The meaning of the LED states differs for various PICs. For more information, see the *T4000 Core Router Interface Module Reference*. If the FPC that houses the PIC detects a PIC failure, the FPC generates an alarm message to be sent to the Routing Engine.
- Use the **show chassis fpc pic-status** command or **show chassis pic** command. The PIC slots in an FPC are numbered from 0 through 1, top to bottom:

**Related Documentation**

- [T4000 PIC Description on page 62](#)
- [Troubleshooting the T4000 PICs on page 363](#)

---

## Maintaining the T4000 Power System

**Purpose** For optimum router performance, verify the condition of the power supplies and grounding.

**Action** On a regular basis:

- Check the red and yellow alarm LEDs and the LCD on the craft interface. Power supply failure or removal triggers an alarm that causes one or both of the LEDs to light and

an error message to appear on the LCD. You can display the associated error messages by issuing the following CLI command:

```
user@host> show chassis alarms
```

For a list of possible alarm messages, see [“Troubleshooting the T4000 Power System” on page 363](#).

- Make sure that the DC power cables are arranged so that they do not obstruct access to other router components.
- The power supplies require an unobstructed airflow at both the front and rear of the chassis. Periodically check the site to ensure that both the air intake at the bottom front of the chassis and the exhaust from the power supply faceplates are unobstructed.
- Periodically inspect the site to ensure that the grounding and power cables connected to the router are securely in place and that no moisture is accumulating near the router. To review grounding and site wiring requirements for the router, see [“T4000 DC Power Cable and Lugs Specifications” on page 105](#) and [“T4000 Chassis Grounding Cable and Lug Specifications” on page 90](#).
- Use the **show chassis environment pem** command to verify the status of the power supplies.
- Routinely check the status LEDs on the power supply faceplates to verify that the power supplies are functioning normally. During normal operation:
  - The blue **DC OK** LEDs light to indicate that the power supplies are functioning normally.
  - Each green **INPUT PRESENT** LED on a DC power supply lights when the input is receiving source DC power.

**Related Documentation**

- [T4000 Power System Description on page 75](#)
- [T4000 Six-Input DC Power Supply LEDs on page 77](#)

## Maintaining the T4000 SIBs

**Purpose** For optimum router performance, verify the condition of the SIBs.

**Action** On a regular basis:

- Check the LEDs on the SIB faceplate and on the craft interface. During normal operations:
  - The green **OK** LED is lit.
  - The red **FAIL** LED is not lit. If the red **FAIL** is lit, see [“Troubleshooting the T4000 SIBs” on page 368](#).
- Use the **show chassis environment sib** command to verify the status of the SIBs.

- Related Documentation**
- [T4000 Switch Interface Board \(SIB\) Description on page 79](#)
  - *T4000 Craft Interface LEDs*
  - [T4000 SIB LEDs on page 81](#)

## CHAPTER 35

# Powering Off the Router

- [Powering Off the T4000 Router on page 341](#)

## Powering Off the T4000 Router

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To power off a T4000 router:

1. On the external management device connected to the Routing Engine, issue the **request system halt** operational mode command. The command shuts down both Routing Engines cleanly, so their state information is preserved. (If the router contains only one Routing Engine, issue the **request system halt** command.)

```
user@host> request system halt both-routing-engines
```

2. Wait until a message appears on the console confirming that the operating system has halted.

```
Halt the system ? [yes,no] (no) yes
```

```
*** FINAL System shutdown message from root@section2 ***
```

```
System going down IMMEDIATELY
```

```
Terminated
```

```
...
```

```
syncing disks... 11 8 done
```

```
The operating system has halted.
```

```
Please press any key to reboot.
```

3. Switch off the external customer site circuit breakers to the power supplies.

### Related Documentation

- [Powering On the T4000 Router on page 207](#)
- *request system halt*





## PART 6

# Troubleshooting Hardware

- [Troubleshooting Components on page 345](#)



## CHAPTER 36

# Troubleshooting Components

- [T4000 Troubleshooting Resources Overview on page 345](#)
- [T4000 LED Overview on page 346](#)
- [T4000 Alarm Messages Overview on page 347](#)
- [Troubleshooting the T4000 Craft Interface on page 349](#)
- [Troubleshooting the T4000 SCGs on page 349](#)
- [Troubleshooting the T4000 Cooling System on page 351](#)
- [Troubleshooting the T4000 Host Subsystems on page 354](#)
- [Troubleshooting the T4000 Routing Engines on page 355](#)
- [Troubleshooting the T4000 Control Boards on page 356](#)
- [Troubleshooting the T4000 FPCs on page 358](#)
- [Troubleshooting the T4000 PICs on page 363](#)
- [Troubleshooting the T4000 Power System on page 363](#)
- [Troubleshooting the T4000 SIBs on page 368](#)

## T4000 Troubleshooting Resources Overview

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To troubleshoot a T4000 router, you use the Junos OS command-line interface (CLI), LCD, alarms, devices connected to the alarm relay contacts, and LEDs on both the components and craft interface.

- **LEDs**—When the Routing Engine detects an alarm condition, it lights the red or yellow alarm LED on the craft interface as appropriate. In addition, you can also use the component-specific LEDs on the craft interface and on the faceplate of a component to troubleshoot the router.
- **LCD**—When a red or yellow alarm occurs, the cause of the alarm messages is displayed on the craft interface LCD. Use the CLI to display more information about the alarm.
- **Alarm devices connected to the alarm relay contact**—When a red or yellow alarm occurs, it trips the corresponding alarm relay contact.
- **CLI**—The CLI is the primary tool for controlling and troubleshooting hardware, Junos OS, routing protocols, and network connectivity. CLI commands display information from routing tables, information specific to routing protocols, and information about network connectivity derived from the ping and traceroute utilities. For information

about using the CLI to troubleshoot Junos OS, see the appropriate Junos OS configuration guide.

- JTAC—If you need assistance during troubleshooting, you can contact the Juniper Networks Technical Assistance Center (JTAC) by using the Web or by telephone. If you encounter software problems, or problems with hardware components not discussed here, contact JTAC.

**Related  
Documentation**

- [T4000 Craft Interface Description on page 16](#)
- [T4000 Craft Interface LEDs](#)
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
- [T4000 LED Overview on page 346](#)
- [T4000 Alarm Messages Overview on page 347](#)
- [Contacting Customer Support on page 375](#)

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## T4000 LED Overview

- [Craft Interface LEDs on page 346](#)
- [Component LEDs on page 346](#)

### Craft Interface LEDs

The craft interface displays system status messages and allows you to troubleshoot the router. See *T4000 Craft Interface LEDs*.

LEDs on the craft interface include:

- Red and yellow alarm LEDs
- FPC LEDs
- Host subsystem LEDs
- SIB LEDs

### Component LEDs

The following LEDs are located on various router components and display the status of those components:

- Control board LEDs  
[See “T4000 LCC-CB Control Board LEDs” on page 31](#)
- Routing Engine LEDs  
[See “T4000 RE-C1800 LEDs” on page 35.](#)
- PIC LEDs  
[See \*T4000 Core Router Interface Module Reference\*.](#)

- Power Supply LEDs  
See [“T4000 Six-Input DC Power Supply LEDs” on page 77.](#)
- SIB LEDs  
See [“T4000 SIB LEDs” on page 81.](#)
- SCG LEDs  
See [“T4000 SONET Clock Generators \(SCGs\) LEDs” on page 22.](#)

**Related  
Documentation**

- [T4000 Hardware Component Overview on page 5](#)
- [T4000 Troubleshooting Resources Overview on page 345](#)
- [T4000 Alarm Messages Overview on page 347](#)

## T4000 Alarm Messages Overview

When the Routing Engine detects an alarm condition, it lights the red or yellow alarm LED on the craft interface as appropriate, trips the corresponding alarm relay contact, and reports the cause of the alarm in the craft interface LCD.

To view a more detailed description of the alarm cause, issue the **show chassis alarms** CLI command:

```
user@host> show chassis alarms
1 alarms currently active
Alarm time           Class  Description
2011-12-08 21:05:15 PST  Minor  PEM 1 Absent
```

There are two classes of alarm messages:

- [Chassis Alarms on page 347](#)
- [Interface Alarms on page 348](#)

## Chassis Alarms

Chassis alarms indicate a problem with a chassis component such as the cooling system or power supplies. For more information about chassis alarms for each component, see the following topics:

- [Troubleshooting the T4000 Cooling System on page 351](#)
- [Troubleshooting the T4000 Craft Interface on page 349](#)
- [Troubleshooting the T4000 Control Boards on page 356](#)
- [Troubleshooting the T4000 FPCs on page 358](#)
- [Troubleshooting the T4000 Host Subsystems on page 354](#)
- [Troubleshooting the T4000 PICs on page 363](#)
- [Troubleshooting the T4000 Power System on page 363](#)

- [Troubleshooting the T4000 Routing Engines on page 355](#)
- [Troubleshooting the T4000 SCGs on page 349](#)
- [Troubleshooting the T4000 SIBs on page 368](#)

## Interface Alarms

Interface alarms indicate a problem with a specific network interface, as described in [Table 80 on page 348](#).

In [Table 80 on page 348](#), the text in the column labeled “LCD Message” appears in the LCD. The text in the column labeled “CLI Message” appears in the output from the **show chassis alarms** command.

*Table 80: SONET/SDH Interface Alarm Messages*

LCD Message	CLI Message
<i>interface-name so-x/x/x BERR-SD</i>	<i>interface-name so-x/x/x - SONET bit error rate defect</i>
<i>interface-name so-x/x/x BERR-SF</i>	<i>interface-name so-x/x/x - SONET bit error rate fault</i>
<i>interface-name so-x/x/x LAIS</i>	<i>interface-name so-x/x/x - SONET line AIS</i>
<i>interface-name so-x/x/x LOF</i>	<i>interface-name so-x/x/x - SONET loss of frame</i>
<i>interface-name so-x/x/x LOL</i>	<i>interface-name so-x/x/x - SONET loss of light</i>
<i>interface-name so-x/x/x LOP</i>	<i>interface-name so-x/x/x - SONET loss of pointer</i>
<i>interface-name so-x/x/x LOS</i>	<i>interface-name so-x/x/x - SONET loss of signal</i>
<i>interface-name so-x/x/x LRDI</i>	<i>interface-name so-x/x/x - SONET line remote defect indicator</i>
<i>interface-name so-x/x/x PAIS</i>	<i>interface-name so-x/x/x - SONET path AIS</i>
<i>interface-name so-x/x/x PLL</i>	<i>interface-name so-x/x/x - SONET PLL lock</i>
<i>interface-name so-x/x/x PMIS</i>	<i>interface-name so-x/x/x - SONET path mismatch</i>
<i>interface-name so-x/x/x PRDI</i>	<i>interface-name so-x/x/x - SONET path remote defect indicator</i>
<i>interface-name so-x/x/x REI</i>	<i>interface-name so-x/x/x - SONET remote error indicator</i>
<i>interface-name so-x/x/x SEF</i>	<i>interface-name so-x/x/x - SONET severely errored frame</i>
<i>interface-name so-x/x/x UNEQ</i>	<i>interface-name so-x/x/x - SONET unequipped</i>

- Related Documentation**
- [T4000 Connector Interface Panel \(CIP\) Description on page 14](#)
  - [T4000 Craft Interface Description on page 16](#)

## Troubleshooting the T4000 Craft Interface

**Problem Description:**

The following alarms, LEDs, and other conditions indicate a problem with the craft interface:

- The router is powered on, but none of the LEDs on the craft interface are lit.
- A yellow alarm indicates that the craft interface has failed.

In [Table 81 on page 349](#), the text in the column labeled "LCD Message" appears in the display of the craft interface. The text in the column labeled "CLI Message" appears in the output from the **show chassis alarms** command.

*Table 81: Chassis Alarm Messages for the Craft Interface*

Alarm Type	LCD Message	CLI Message
Yellow	Craft Failure	Craft Failure

**Solution** To troubleshoot the craft interface:

1. Check the LEDs on the craft interface. If the router is powered on but none of the LEDs are lit, reseal the craft interface to make sure that it is installed properly. See ["Replacing a T4000 Craft Interface" on page 249](#).
2. Use the CLI to check for alarms. Use the **show chassis alarms** command.

- Related Documentation**
- [T4000 Craft Interface Description on page 16](#)
  - [T4000 Craft Interface LEDs](#)

## Troubleshooting the T4000 SCGs

**Problem Description:**

The following alarms and LEDs indicate a problem with an SCG:

- The yellow **FAIL** LED on the SCG faceplate is lit.
- The green **OK** LED on the SCG faceplate is not lit.
- A red alarm indicates that the SCG has failed or has been removed.
- A yellow alarm indicates that the SCG is not online.

In [Table 82 on page 350](#), the text in the column labeled "LCD Message" appears in the display of the craft interface. The text in the column labeled "CLI Message" appears in the output from the **show chassis alarms** command.

**Table 82: Chassis Alarm Messages for the SCGs**

Alarm Type	LCD Message	CLI Message
Red	SCG SCG-number Failure	SCG SCG-number Failure
	SCG SCG-number Removed	SCG SCG-number Removed
Yellow	SCG SCG-number Not Online	SCG SCG-number Not Online

**Solution** To troubleshoot the SCGs:

1. Check the LEDs on the faceplate of each SCG.
2. Check the LEDs on the craft interface.
3. Use the **show chassis environment scg** command.

```
user@host> show chassis environment scg
SCG 0 status:
  State                Online - Master clock
  Temperature          31 degrees C / 87 degrees F
  Power:
    GROUND              0 mV
    3.3 V               3310 mV
    5.0 V               5052 mV
    5.6 V               5689 mV
    1.8 V bias          1782 mV
    3.3 V bias          3306 mV
    5.0 V bias          4989 mV
    8.0 V bias          8336 mV
  GBUS Revision        40
  FPGA Revision        1.6
```

4. Use the CLI to check for alarms—Issue the **show chassis alarms** command to view the alarms.

**Related  
Documentation**

- [T4000 SONET Clock Generators \(SCGs\) Description on page 20](#)
- [T4000 SONET Clock Generators \(SCGs\) LEDs on page 22](#)
- [Maintaining the T4000 SCGs on page 333](#)
- [Replacing a T4000 SCG on page 256](#)



## Troubleshooting the T4000 Cooling System

### Problem Description:

The following alarms, LEDs, and other conditions indicate a problem with the cooling system:

- A red alarm indicates that the temperature of the router exceeds the maximum (“temperature hot”) threshold.
- Automatic shutdown of the power supplies can be caused by the temperature of the router exceeding the maximum (“temperature hot”) threshold. The control board turns off the power supplies because the router temperature exceeds the acceptable maximum.
- A red alarm indicates that a fan failed.
- A yellow alarm indicates that the router temperature exceeds the “temperature warm” threshold.
- A yellow alarm indicates that one of the fan trays was removed.
- One or more fans in a fan tray function at full speed. The control boards constantly monitor the temperatures detected by sensors on the midplane and router components, adjusting the speed of the fans as necessary. If one fan fails, the host subsystem adjusts the speed of the remaining fans to maintain proper cooling.

**Table 83: T4000 Cooling System Fan Tray Alarms**

Alarm Type	LCD Message	CLI Message	Alarm Condition	Solution
Red	<b>Fan Failure</b>	<i>fan-name</i> Failure	A fan has failed.	Replace the fan tray.
	<b>Fans Missing</b>	<b>Too many fans missing or failing</b>	A fan tray is missing or too many fan trays have failed.	Reinstall the fan tray in the chassis.
	<b>&lt;fan-name&gt; Improper</b>	<b>&lt;fan-name&gt; Improper for Platform</b>	A fan tray is unsupported for the T4000 router.	Replace with an appropriate fan tray. For a list of supported fan trays, see “ <a href="#">T4000 Cooling System Description</a> ” on page 25.
		<b>Incompatible rear fan tray or front fan tray detected</b>	An incompatible fan tray is inserted into the chassis.	Replace with an appropriate fan tray.
Yellow	<b>Fan Removed</b>	<i>fan-name</i> Removed	A fan tray has been removed.	Reinstall the fan tray in the chassis.

Table 84: T4000 Temperature Alarms

Alarm Type	Craft Interface LCD Message	CLI Message	Alarm Condition	Solution
Red	Temperature Hot	Temperature Hot	The chassis temperature exceeded the recommend hot temperature threshold. If this condition persists, the router shuts down.	<ul style="list-style-type: none"> <li>Place your hand near the exhaust vents at the rear of the chassis to determine whether the fans are pushing air out of the chassis.</li> <li>Verify that the room temperature is within acceptable limits.</li> <li>Verify that there is sufficient air flow.</li> <li>Verify that the cooling system in the chassis is operating properly.</li> </ul>
	Sensor Failure	Temperature sensor failure	A temperature sensor failed.	Contact JTAC.
Yellow	Temperature Warm	Temperature Warm	The chassis temperature exceeded the recommended warm temperature threshold.	<ul style="list-style-type: none"> <li>Place your hand near the exhaust vents at the rear of the chassis to determine whether the fans are pushing air out of the chassis.</li> <li>Verify that the room temperature is within acceptable limits.</li> <li>Verify that there is sufficient air flow.</li> <li>Verify that the cooling system in the chassis is operating properly.</li> </ul>

**Solution** To troubleshoot the cooling system:

1. Check the red and yellow alarm LEDs on the craft interface.
2. Find the source of the problem by looking at the craft interface display. The number of alarm conditions, as well as the source of each alarm, appears on the screen. If the craft interface display lists only one fan failure and the other fans are functioning normally, the fan is probably faulty and you need to replace the fan tray.
3. Use the **show chassis alarms** command to get information about the source of an alarm condition:

```
user@host> show chassis alarms
```

For information about the alarms, see [Table 83 on page 351](#) and [Table 84 on page 352](#).

4. Use the **show chassis fan** command to verify that the status of each fan is **OK** and that the output display indicates that each of the fans are **Spinning at normal speed**.

```
user@host> show chassis fan
```

Item	Status	RPM	Measurement
Top Left Front fan	OK	3420	Spinning at normal speed

Top Left Middle fan	OK	3420	Spinning at normal speed
Top Left Rear fan	OK	3450	Spinning at normal speed
Top Right Front fan	OK	3420	Spinning at normal speed
Top Right Middle fan	OK	3420	Spinning at normal speed
Top Right Rear fan	OK	3420	Spinning at normal speed
Bottom Left Front fan	OK	3420	Spinning at normal speed
Bottom Left Middle fan	OK	3450	Spinning at normal speed
Bottom Left Rear fan	OK	3360	Spinning at normal speed
Bottom Right Front fan	OK	3420	Spinning at normal speed
Bottom Right Middle fan	OK	3420	Spinning at normal speed
Bottom Right Rear fan	OK	3420	Spinning at normal speed
Rear Tray Top fan	OK	5190	Spinning at normal speed
Rear Tray Second fan	OK	5190	Spinning at normal speed
Rear Tray Third fan	OK	5190	Spinning at normal speed
Rear Tray Fourth fan	OK	5190	Spinning at normal speed
Rear Tray Fifth fan	OK	5190	Spinning at normal speed
Rear Tray Sixth fan	OK	5190	Spinning at normal speed
Rear Tray Seventh fan	OK	5190	Spinning at normal speed
Rear Tray Bottom fan	OK	5190	Spinning at normal speed

The fans in the fan trays are listed as follows:

- Upper front fan tray—**Top Left** and **Top Right**
  - Lower front fan tray—**Bottom Left** and **Bottom Right**
  - Rear fan tray—**Rear**
5. Use the **show chassis environment** command to check the status and speed of the fans.

```

user@host> show chassis environment
Class Item                               Status      Measurement
...
Fans Top Left Front fan                    OK          Spinning at normal speed
      Top Left Middle fan                OK          Spinning at normal speed
      Top Left Rear fan                  OK          Spinning at normal speed
      Top Right Front fan                 OK          Spinning at normal speed
      Top Right Middle fan                OK          Spinning at normal speed
      Top Right Rear fan                  OK          Spinning at normal speed
      Bottom Left Front fan               OK          Spinning at normal speed
      Bottom Left Middle fan              OK          Spinning at normal speed
      Bottom Left Rear fan                OK          Spinning at normal speed
      Bottom Right Front fan              OK          Spinning at normal speed
      Bottom Right Middle fan             OK          Spinning at normal speed
      Bottom Right Rear fan               OK          Spinning at normal speed
      Rear Tray Top fan                   OK          Spinning at normal speed
      Rear Tray Second fan                OK          Spinning at normal speed
      Rear Tray Third fan                  OK          Spinning at normal speed
      Rear Tray Fourth fan                 OK          Spinning at normal speed
      Rear Tray Fifth fan                  OK          Spinning at normal speed
      Rear Tray Sixth fan                  OK          Spinning at normal speed
      Rear Tray Seventh fan                OK          Spinning at normal speed
      Rear Tray Bottom fan                 OK          Spinning at normal speed...
```

**Top Left** and **Top Right** refer to fans in the upper front fan tray. **Bottom Left** and **Bottom Right** refer to fans in the lower front fan tray. **Rear** refers to the fans in the rear fan tray.

- Related Documentation**
- [T4000 Cooling System Description on page 25](#)
  - [Replacing a T4000 Lower Front Fan Tray on page 265](#)
  - [Replacing a T4000 Upper Front Fan Tray on page 267](#)
  - [Replacing a T4000 Rear Fan Tray on page 269](#)
  - [Replacing a T4000 Front Air Filter on page 259](#)
  - [Replacing a T4000 Rear Air Filter on page 261](#)

## Troubleshooting the T4000 Host Subsystems

### Problem Description:

The following alarms and LEDs indicate a problem with a host subsystem control board and Routing Engine:

- The red host subsystem **FAIL** LED on the craft interface is lit.
- The green host subsystem **OK** LED on the craft interface is not lit.
- A red alarm indicates that the host subsystem has been removed.
- A yellow alarm indicates that the host subsystem has failed.

In [Table 85 on page 354](#), the text in the column labeled "LCD Message" appears in the display of the craft interface. The text in the column labeled "CLI Message" appears in the output from the **show chassis alarms** command.

*Table 85: Chassis Alarm Messages for Host Subsystems*

Alarm Type	LCD Message	CLI Message
Red	Host <i>host-number</i> Removed	Host <i>host-number</i> Removed
Yellow	Host <i>host-number</i> Failure	Host <i>host-number</i> Failure

### Solution To troubleshoot the host subsystems:

1. Check the LEDs on the faceplate of each control board and Routing Engine.
2. Check the LEDs on the craft interface.
3. If the red **HOST0 FAIL** or **HOST1 FAIL** LED is lit on the craft interface, look at the LCD
4. Use the **show chassis alarms** command to check for alarms.

- Related Documentation**
- [T4000 Host Subsystem Description on page 29](#)
  - [T4000 Control Board Description on page 30](#)
  - [T4000 LCC-CB on page 30](#)
  - [T4000 LCC-CB Control Board LEDs on page 31](#)
  - [T4000 Routing Engine Description on page 33](#)
  - [T4000 RE-C1800 Routing Engine Description on page 34](#)
  - [T4000 RE-C1800 LEDs on page 35](#)
  - [Maintaining the T4000 Host Subsystem on page 335](#)
  - [Replacing a T4000 LCC-CB on page 275](#)
  - [Replacing a T4000 Routing Engine on page 280](#)

---

## Troubleshooting the T4000 Routing Engines

---

**Problem Description:**

The following alarms, LEDs, and other conditions indicate a problem with a Routing Engine:

- The **show chassis routing-engine** LED on the Routing Engine faceplate is lit steadily red, indicating that the Routing Engine has failed.
- An alarm indicates that a host subsystem has been removed or failed.

**Solution** To troubleshoot the Routing Engines:

1. Use the **show chassis routing-engine** command.

```
user@host> show chassis routing-engine
Routing Engine status:
Slot 0:
Current state           Master
Election priority       Master (default)
Temperature             34 degrees C / 93 degrees F
DRAM                   2048 Mbytes
CPU utilization:
User                   0 percent
Background             0 percent
Kernel                 1 percent
Interrupt              0 percent
Idle                   99 percent
Start time             2002-01-22 05:21:31 UTC
Uptime                 10 days, 16 hours, 4 minutes, 52 seconds
Load averages:         1 minute   5 minute  15 minute
                       0.00       0.00    0.00

Routing Engine status:
Slot 1:
Current state           Empty
```

- Related Documentation**
- [T4000 Host Subsystem Description on page 29](#)
  - [T4000 Control Board Description on page 30](#)
  - [T4000 LCC-CB on page 30](#)
  - [T4000 LCC-CB Control Board LEDs on page 31](#)
  - [T4000 Routing Engine Description on page 33](#)
  - [T4000 RE-C1800 Routing Engine Description on page 34](#)
  - [T4000 RE-C1800 LEDs on page 35](#)
  - [Maintaining the T4000 Host Subsystem on page 335](#)
  - [Replacing a T4000 LCC-CB on page 275](#)
  - [Replacing a T4000 Routing Engine on page 280](#)

---

## Troubleshooting the T4000 Control Boards

---

**Problem Description:**

The following alarms and LEDs indicate a problem with a Control Board:

- The yellow **FAIL** LED on the Control Board faceplate is lit, which indicates that the Ethernet switch in the Control Board has failed.
- The green **OK** LED on the Control Board faceplate is not lit.

- The red host subsystem **FAIL** LED on the craft interface is lit, which indicates that the Control Board has failed or has been removed.
- The green host subsystem **OK** LED on the craft interface is not lit.

In [Table 86 on page 357](#), the text in the LCD Message column appears in the display of the craft interface. The text in the CLI Message column appears in the output of the **show chassis alarms** command.

**Table 86: T4000 Chassis Alarm Messages and Solutions for the Control Boards**

Alarm Type	LCD Message	CLI Message	Alarm Condition	Solution
Red	<b>CB <i>cb-number</i> Removed</b>	<b>CB <i>cb-number</i> Removed</b>	A Control Board has been removed.	Reinstall the Control Board.
	<b>CB <i>cb-number</i> Failure</b>	<b>CB <i>cb-number</i> Failure</b>	A Control Board has failed.	Replace the Control Board.
Yellow	<b>CB <i>cb-number</i> Ethernet Switch Failure</b>	<b>CB <i>cb-number</i> Ethernet Switch Failure</b>	A Control Board's Ethernet switch has failed.	Replace the Control Board.
	<b>CB <i>cb-number</i> Unsupported</b>	<b>CB <i>cb-number</i> Not Supported</b>	An unsupported Control Board is installed.	Install a supported Control Board. See <a href="#">"T4000 Control Board Description"</a> on page 30.



**NOTE:** The **CB *cb-number* Unsupported** alarm can occur even when you are integrating a new line-card chassis (LCC) into an existing TX Matrix Plus router. The alarm occurs when the LCC is booting and is unable to check the connectivity between the LCC and the switch-fabric chassis (SFC), before the cable between the Control Board of the LCC and the connector interface panel (CIP) of the SFC is connected. Connecting the LCC CB to the CIP on the SFC clears the alarm.

**Solution** To troubleshoot the Control Boards:

1. Check the LEDs on the faceplate of each Control Board.
2. Check the LEDs on the craft interface.
3. Use the **show chassis alarms** command to view the alarms.
4. Use the **show chassis environment cb** command to check the status of the Control Boards. Verify that the Control Boards are **Online**.

```
user@host> show chassis environment cb
```

```

CB 0 status:
State
Temperature          Online Master
                     29 degrees C / 84 degrees F
Power:
  1.8 V              1809 mV
  2.5 V              2496 mV
  3.3 V              3295 mV
  4.6 V              4687 mV
  5.0 V              5042 mV
 12.0 V             11985 mV
  3.3 V bias         3277 mV
  8.0 V bias         7472 mV
GBUS Revision        40
FPGA Revision        7

```

- Based on the messages on the LCD and the CLI, follow the instructions given in [Table 86 on page 357](#) to troubleshoot the Control Board.

#### Related Documentation

- [T4000 Host Subsystem Description on page 29](#)
- [T4000 Control Board Description on page 30](#)
- [T4000 LCC-CB on page 30](#)
- [T4000 LCC-CB Control Board LEDs on page 31](#)
- [Maintaining the T4000 Host Subsystem on page 335](#)
- [Replacing a T4000 LCC-CB on page 275](#)

## Troubleshooting the T4000 FPCs

### Problem Description:

The following LEDs indicate a problem with an FPC:

- The red **FAIL** LED above the FPC on the craft interface is lit.
- The green **FAIL** LED above the FPC on the craft interface is lit.

*Table 87: Chassis Alarm Messages for the FPCs*

Alarm Type	LCD Message	CLI Message	Alarm Condition	Solution
Red	<b>FPC fpc-slot misconfig</b>	<b>FPC fpc-slot misconfig</b>	The FPC is not supported, and will not come online.	Remove the unsupported FPC. See <a href="#">"T4000 FPCs Supported" on page 61</a> .



**Solution** To troubleshoot an FPC:

1. Look at the display on the craft interface to check the status of the FPC and the PICs that are plugged into it.
2. Use the **show chassis fpc** command to check the status of an FPC.

```
user@host> show chassis fpc
```

Slot	State	Temp (C)	CPU Utilization (%) Total Interrupt	Memory DRAM (MB)	Utilization (%) Heap Buffer
0	Empty				
1	Empty				
2	Empty				
3	Empty				
4	Online	58	11 0	2816	30 27
5	Empty				
6	Online	52	13 0	2816	29 27
7	Online	60	12 0	2816	29 27

For more detailed output, add the **detail** option.

```
user@host> show chassis fpc detail
```

Slot 4 information:

```
State Online
Temperature 58 degrees C / 136 degrees F
Total CPU DRAM 2816 MB
Total SRAM 1554 MB
Total SDRAM 10752 MB
Start time 2011-12-08 21:10:44 PST
Uptime 1 day, 13 hours, 50 minutes, 14 seconds
```

Slot 6 information:

```
State Online
Temperature 52 degrees C / 125 degrees F
Total CPU DRAM 2816 MB
Total SRAM 1554 MB
Total SDRAM 10752 MB
Start time 2011-12-08 21:10:50 PST
Uptime 1 day, 13 hours, 50 minutes, 8 seconds
```

Slot 7 information:

```
State Online
Temperature 60 degrees C / 140 degrees F
Total CPU DRAM 2816 MB
Total SRAM 1554 MB
Total SDRAM 10752 MB
Start time 2011-12-09 01:33:46 PST
Uptime 1 day, 9 hours, 27 minutes, 12 seconds
```

For detailed output for a specific FPC, specify a slot number (**5**), which is optional:

```
user@host> show chassis fpc detail 5
```

Slot 5 information:

```
State Online
Temperature 53 degrees C / 127 degrees F
Total CPU DRAM 2816 MB
Total SRAM 1554 MB
Total SDRAM 10752 MB
```

Start time                                    2011-10-24 09:54:43 UTC  
Uptime                                      14 days, 19 hours, 58 minutes, 13 seconds

3. Verify that the FPC is properly seated in the midplane. Check that each ejector handle has been turned clockwise and is tight. Use a screwdriver to check that the screws inside the ejector handles are tight.
4. Use the **show chassis fabric fpcs** command to check the status of an FPC.

```
user@host> show chassis fabric fpcs
```

```
Fabric management FPC state:
```

```
FPC #4
```

```
  PFE #0
```

```
    SIB #0
```

```
      Links ok
```

```
    SIB #1
```

```
      Plane enabled
```

```
    SIB #2
```

```
      Plane enabled
```

```
    SIB #3
```

```
      Plane enabled
```

```
    SIB #4
```

```
      Plane enabled
```

```
  PFE #1
```

```
    SIB #0
```

```
      Links ok
```

```
    SIB #1
```

```
      Plane enabled
```

```
    SIB #2
```

```
      Plane enabled
```

```
    SIB #3
```

```
      Plane enabled
```

```
    SIB #4
```

```
      Plane enabled
```

```
FPC #6
```

```
  PFE #0
```

```
    SIB #0
```

```
      Links ok
```

```
    SIB #1
```

```
      Plane enabled
```

```
    SIB #2
```

```
      Plane enabled
```

```
    SIB #3
```

```
      Plane enabled
```

```
    SIB #4
```

```
      Plane enabled
```

```
  PFE #1
```

```
    SIB #0
```

```
      Links ok
```

```
    SIB #1
```

```
      Plane enabled
```

```
    SIB #2
```

```
      Plane enabled
```

```
    SIB #3
```

```
      Plane enabled
```

```
    SIB #4
```

```
      Plane enabled
```

```
FPC #7
```

```

PFE #0
  SIB #0
    Links ok
  SIB #1
    Plane enabled
  SIB #2
    Plane enabled
  SIB #3
    Plane enabled
  SIB #4
    Plane enabled
PFE #1
  SIB #0
    Links ok
  SIB #1
    Plane enabled
  SIB #2
    Plane enabled
  SIB #3
    Plane enabled
  SIB #4
    Plane enabled

```

5. Use the **show chassis fabric reachability** command to check the status of an FPC.

```

user@host> show chassis fabric reachability
Fabric reachability status: Enabled destinations reachable

Fabric reachability detection:
  Unreachable destinations           : Present on 0 FPCs
  Detected on                       : 2011-12-10 11:17:43 PST

```

6. Use the **show chassis environment fpc** command to check the status of an FPC.

```

user@host> show chassis environment fpc
FPC 4 status:
State                               Online
Fan Intake                          34 degrees C / 93 degrees F
Fan Exhaust                         58 degrees C / 136 degrees F
PMB                                 49 degrees C / 120 degrees F
LMB0                               65 degrees C / 149 degrees F
LMB1                               61 degrees C / 141 degrees F
LMB2                               39 degrees C / 102 degrees F
PFE1 LU2                           72 degrees C / 161 degrees F
PFE1 LU0                           44 degrees C / 111 degrees F
PFE0 LU0                           79 degrees C / 174 degrees F
XF1                                58 degrees C / 136 degrees F
XF0                                63 degrees C / 145 degrees F
XM1                                40 degrees C / 104 degrees F
XM0                                75 degrees C / 167 degrees F
PFE0 LU1                           75 degrees C / 167 degrees F
PFE0 LU2                           71 degrees C / 159 degrees F
PFE1 LU1                           40 degrees C / 104 degrees F
Power 1
  1.0 V                             997 mV
  1.2 V bias                        1195 mV
  1.8 V                             1782 mV
  2.5 V                             2494 mV
  3.3 V                             3296 mV
  3.3 V bias                        3286 mV

```

12.0 V A	10446 mV
12.0 V B	10437 mV
Power 2	
0.9 V	901 mV
0.9 V PFE0	919 mV
0.9 V PFE1	904 mV
1.0 V PFE0	991 mV
1.0 V PFE1	970 mV
1.1 V	1096 mV
1.5 V_0	1495 mV
1.5 V_1	1479 mV
Power 3	
1.0 V PFE0	1003 mV
1.0 V PFE1	1004 mV
1.0 V PFE0 *	993 mV
1.0 V PFE1 *	996 mV
1.8 V PFE 0	1794 mV
1.8 V PFE 1	1794 mV
2.5 V	2450 mV
12.0 V	11638 mV
Power 4	
1.0 V PFE0 LU0	1003 mV
1.0 V PFE1 LU0	1001 mV
1.0 V PFE1 LU2	1001 mV
1.0 V PFE0 LU0 *	995 mV
1.0 V PFE1 LU0 *	995 mV
1.0 V PFE1 LU2 *	995 mV
12.0 V	11614 mV
12.0 V C	11658 mV
Power (Base/PMB/MMB)	
LMB0 VDD2V5	2504 mV
LMB0 VDD1V8	1782 mV
LMB0 VDD1V5	1496 mV
LMB0 PFE0 LU0 AVDD1V0	1002 mV
LMB0 PFE0 LU0 VDD1V0	1008 mV
LMB0 VDD12V0	10624 mV
LMB1 VDD2V5	2484 mV
LMB1 VDD1V8	1784 mV
LMB1 VDD1V5	1480 mV
LMB1 PFE0 LU2 AVDD1V0	1000 mV
LMB1 PFE0 LU2 VDD1V0	1006 mV
LMB1 VDD12V0	10704 mV
LMB2 VDD2V5	2492 mV
LMB2 VDD1V8	1794 mV
LMB2 VDD1V5	1492 mV
LMB2 PFE1 LU1 AVDD1V0	998 mV
LMB2 PFE1 LU1 VDD1V0	1006 mV
LMB2 VDD12V0	10576 mV
PMB 1.05v	1049 mV
PMB 1.5v	1500 mV
PMB 2.5v	2500 mV
PMB 3.3v	3300 mV
Bus Revision	80

- Related Documentation**
- *T4000 Craft Interface LEDs*
  - [T4000 FPC Description on page 57](#)
  - [Maintaining T4000 FPCs on page 337](#)

- [Replacing a T4000 FPC on page 295](#)

## Troubleshooting the T4000 PICs

**Problem**    **Description:** A PIC LED lit red indicates a problem with the PIC.

**Solution**    To troubleshoot a PIC:

1. Check the status of each port on a PIC. Look at the LEDs located on the PIC faceplate. For information about the meaning of LED states on different PICs, see the *T4000 Core Router Interface Module Reference*.
2. Check the status of a PIC, issuing the following CLI command. The PIC slots in the FPC are numbered from 0 through 3, top to bottom:

```
user@host> show chassis fpc pic-status
```

```
Slot 0  Online      FPC Type 4-ES
PIC 0   Online      4x 10GE (LAN/WAN) XFP
PIC 1   Online      4x 10GE (LAN/WAN) XFP
Slot 3  Online      FPC Type 5-3D
PIC 0   Online      12x10GE (LAN/WAN) SFPP
PIC 1   Online      12x10GE (LAN/WAN) SFPP
Slot 4  Online      FPC Type 5-3D
PIC 0   Online      12x10GE (LAN/WAN) SFPP
PIC 1   Online      12x10GE (LAN/WAN) SFPP
Slot 5  Online      FPC Type 5-3D
PIC 0   Online      12x10GE (LAN/WAN) SFPP
PIC 1   Online      12x10GE (LAN/WAN) SFPP
Slot 6  Online      FPC Type 5-3D
PIC 0   Online      24x10GE (LAN/WAN) SFPP
PIC 1   Online      24x10GE (LAN/WAN) SFPP
Slot 7  Online      FPC Type 5-3D
PIC 0   Online      12x10GE (LAN/WAN) SFPP
PIC 1   Online      1x100GE
```

- Related Documentation**
- [T4000 PIC Description on page 62](#)
  - [Replacing a T4000 PIC on page 301](#)

## Troubleshooting the T4000 Power System

**Problem**    **Description:**

The following alarms, LEDs, and other conditions indicate a problem with the power system:

- If all power supplies have failed, the system temperature might have exceeded the threshold, causing the system to shut down.

- [Table 88 on page 366](#) lists alarms for the power system, including the solution.
- [Table 89 on page 367](#) lists abnormal LED states for the power supplies, including the solution.

**Solution** 1. Check the display on the craft interface to determine the source of a yellow or red alarm (see [Table 88 on page 366](#)). Junos OS constantly updates the screen with status information for each component.



**NOTE:** On the display and in the CLI, the power supplies are referred to as PEM0 and PEM1, from top to bottom.

If the system temperature exceeds the threshold, Junos OS shuts down all power supplies so that no status is displayed.

Junos OS also can shut down one of the power supplies for other reasons. In that case, the remaining power supply assumes the load, and you can still view the system status through the CLI or display.

2. Issue the **show chassis alarms** command to check for power system alarms. See [Table 88 on page 366](#).
3. Check the LEDs on each six-input DC power supply faceplate. See [Table 89 on page 367](#).
4. Use the **show chassis environment pem** command.

```
user@host> show chassis environment pem
PEM 0 status:
  State           Online
  Temperature     34 degrees C / 93 degrees F
  DC Input:       OK
                   Voltage(V)  Current(A)  Power(W)  Load(%)
INPUT 0           53.500      7.437      397       52
INPUT 1           53.750     10.812     581       77
INPUT 2           53.125      9.562     507       67
INPUT 3           53.625     11.125     596       79
INPUT 4           53.750      9.875     530       70
INPUT 5           53.250      9.500     505       67
DC Output         Voltage(V)  Current(A)  Power(W)  Load(%)
FPC 0             0.000      0.000       0         0
FPC 1             0.000      0.000       0         0
FPC 2             0.000      0.000       0         0
FPC 3             0.000      0.000       0         0
FPC 4            55.375      9.562     529       70
FPC 5             0.062      0.000       0         0
FPC 6            55.062      9.000     495       66
FPC 7            55.437      9.000     498       66
SCG/CB/SIB       55.375     15.375     851       70
FAN              49.000      7.875     385       51
```

5. Verify that the customer site circuit breaker for each input has the proper current rating.



**NOTE:** All inputs on a DC power supply in slot PEM0 must be powered by dedicated power feeds derived from feed A, and all inputs on a DC power supply in slot PEM1 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.

6. Verify that the DC power cables from the power source to the router are not damaged. If the insulation is cracked or broken, immediately replace the DC power cable .
7. Connect the power supply to a different power source with a new DC power cable. If the power supply **DC OK** LED still does not light, the power supply is the source of the problem. Replace the power supply with a spare. If the **DC OK** LED on the installed spare still does not light—The replaced power supply might also be faulty. To return it for replacement, see [“Contacting Customer Support” on page 375](#).
8. If you cannot determine the cause of the problem or need additional assistance, see [“Contacting Customer Support” on page 375](#).

In [Table 88 on page 366](#), the text in the column labeled “LCD Message” appears in the display of the craft interface. The text in the column labeled “CLI Message” appears in the output from the **show chassis alarms** command.

Table 88: Power System Chassis Alarms

Alarm Type	LCD Message	CLI Message	Alarm Condition	Solution
Red	PEM <i>pem-number</i> High Temp	PEM <i>pem-number</i> High Temp	The power supply is not receiving enough airflow to maintain proper temperature.	<p>Check that the power supply fans are running and that the air filters are clean to be sure they are functioning and providing sufficient airflow through the power supply.</p> <p>If there is not sufficient airflow, replace the air filters.</p> <p>Use the <b>show chassis environment pem</b> command to view the temperature.</p>
	PEM <i>pem-number</i> Input Fail	PEM <i>pem-number</i> Input Failure	A feed to the power supply has failed.	Check the input feed connectivity and voltage levels. Voltage range should be between -40 V and -72 V.
	PEM <i>pem-number</i> Not OK	PEM <i>pem-number</i> Not OK	The power supply experienced a failure.	Replace the power supply.
	PEM <i>pem-number</i> Improper	PEM <i>pem-number</i> Improper for Platform	The power supply is not supported.	Install a supported power supply.
Yellow	PEM <i>pem-number</i> Absent	PEM <i>pem-number</i> Absent	A power supply is not installed.	Install a supported power supply in the appropriate slot.
	PEM <i>pem-number</i> Inputs Cfg	PEM <i>pem-number</i> Configuration Mismatch-number of inputs	The number of installed cables does not match the number of cables configured in the <b>set chassis pem feeds</b> command.	<p>Ensure that the number of cables connected to the power supply is correct and that the number of cables connected matches the number of feeds configured on the router with the <b>set chassis pem feeds</b> command. Correct one or both of the following:</p> <ul style="list-style-type: none"> <li>• add or remove cables connected to the power supply</li> <li>• reconfigure the number of feeds and the input current by using the <b>set chassis pem feeds</b> and <b>set chassis pem input-current</b> commands</li> </ul>



Table 89: Troubleshooting PDU LEDs

LED	Color	State	Condition	Solution
INPUT PRESENT	Green	Off	The input is not connected, not receiving voltage or is under -40 V.	<ul style="list-style-type: none"> <li>Verify that the customer site circuit breakers are switched on. If the customer site circuit breakers are off, switch them on.</li> <li>Verify that the input is receiving power within the supported voltage range.</li> </ul> <p>If the customer circuit breakers are switched on but the input is not receiving power, switch off the customer site circuit breakers, and reinstall the DC power source cables.</p>
DC OK	Blue	Off	The power switch on the power supply faceplate is off, the power supply is not functioning normally, or the input voltage is not present or is under -40 V.	<p>Verify that the customer site circuit breakers are switched on, and that the input is receiving power within the supported voltage range.</p> <ul style="list-style-type: none"> <li>If the customer site circuit breakers are off, switch them on.</li> <li>If the customer circuit breakers are switched on but the input is not receiving power, switch off the customer site circuit breakers, and reinstall the DC power source cables.</li> </ul>
		Blinking steadily	The input is okay, but the power supply might not be properly inserted, or there is a fault (such as insufficient airflow or faulty output).	<p>The LED blinks when the power supply is initializing; but if it continues to blink, verify that the power supply is installed properly and that the power supply switch is in the on position.</p> <p>If the LED continues to blink, replace the power supply.</p>
OVER TEMP	Yellow	On	The power supply is shut down because of excessive internal temperature.	<p>Check the power supply fan and air filters to be sure they are functioning and providing sufficient airflow through the power supply and that the power supply is operating within the specified ambient temperature.</p> <p>Wait approximately 30 to 60 minutes and turn on the power supply. If the over temperature condition persists, replace the power supply.</p> <p>Use the <b>show chassis environment pem</b> command to view the temperature.</p>

#### Related Documentation

- [T4000 Power System Description on page 75](#)
- [T4000 Six-Input DC Power Supply LEDs on page 77](#)
- [Maintaining the T4000 Power System on page 338](#)
- [Replacing a T4000 Six-Input DC Power Supply on page 307](#)
- [Replacing a T4000 Six-Input DC Power Supply Front Air Filter on page 312](#)
- [Replacing a T4000 Six-Input DC Power Supply Side Air Filter on page 313](#)

## Troubleshooting the T4000 SIBs

### Problem Description:

The following alarms and LEDs indicate a problem with a SIB:

- A red alarm indicates that the SIB failed or has been removed or that a spare SIB has failed or has been removed.
- The red **FAIL** LED on the SIB faceplate is lit.
- The green **OK** LED on the SIB faceplate is not lit.

In [Table 90 on page 368](#) the text in the column labeled "LCD Message" appears in the display of the craft interface. The text in the column labeled "CLI Message" appears in the output from the **show chassis alarms** command.

*Table 90: T4000 Chassis Alarm Messages for SIBs*

Alarm Type	LCD Message	CLI Message
Red	SIB <i>sib-number</i> Failure	SIB <i>sib-number</i> Fault
	SIB <i>sib-number</i> Removed	SIB <i>sib-number</i> Absent

### Solution To troubleshoot the T4000 SIBs:

1. Check the LEDs on the faceplate of each SIB.
2. Check the LEDs on the craft interface.
3. Use the CLI to check for alarms.
  - Issue the **show chassis alarms** command to view the alarms.
4. Use the **show chassis sibs** command.

```
user@host> show chassis sibs
```

Slot	State	Uptime
0	Spare	
1	Online	1 day, 14 hours, 21 minutes, 52 seconds
2	Online	1 day, 14 hours, 21 minutes, 36 seconds
3	Online	1 day, 14 hours, 21 minutes, 19 seconds
4	Online	1 day, 14 hours, 21 minutes, 3 seconds

5. Use the **show chassis fabric sibs** command.

```
user@host> show chassis fabric sibs
```

Fabric management SIB state:

```

SIB #0
  plane state: S_SPARE
  FPC #4
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #6
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #7
    PFE #0 : Links ok
    PFE #1 : Links ok
SIB #1
  plane state: S_ACTIVE
  FPC #4
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #6
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #7
    PFE #0 : Links ok
    PFE #1 : Links ok
SIB #2
  plane state: S_ACTIVE
  FPC #4
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #6
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #7
    PFE #0 : Links ok
    PFE #1 : Links ok
SIB #3
  plane state: S_ACTIVE
  FPC #4
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #6
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #7
    PFE #0 : Links ok
    PFE #1 : Links ok
SIB #4
  plane state: S_ACTIVE
  FPC #4
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #6
    PFE #0 : Links ok
    PFE #1 : Links ok
  FPC #7
    PFE #0 : Links ok
    PFE #1 : Links ok

```

6. Use the **show chassis environment sib** command.

```
user@host> show chassis environment sib
```

```

SIB 0 status:
State          Online - Standby
Temperature    50 degrees C / 122 degrees F
Power
  8.0 V bias   8232 mV
  3.3 V bias   3280 mV
  0.9 V bias   910 mV
  1.1 V bias   1094 mV
  1.5 V bias   1486 mV
  2.5 V bias   2528 mV
  9.0 V        9012 mV
  3.3 V        3300 mV
  XF0 0.92 V   926 mV
  XF0 1.0 V LDO 994 mV
  PCIE SW 1.0 V 996 mV
  XF0 1.8 V    1792 mV
  XF1 0.92 V   922 mV
  XF2 0.92 V   922 mV
  XF3 1.0 V    1000 mV
  1.2 V        1192 mV
  XF1 1.0 V LDO 996 mV
  XF2 1.0 V LDO 996 mV
  XF3 1.0 V LDO 994 mV
  XF1 1.8 V    1792 mV
  XF2 1.8 V    1796 mV
  XF3 1.8 V    1786 mV
  1.5 V        1486 mV
  SW 3.3 V     3292 mV

SIB 1 status:
State          Online
Temperature    49 degrees C / 120 degrees F
Power
  8.0 V bias   8280 mV
  3.3 V bias   3296 mV
  0.9 V bias   910 mV
  1.1 V bias   1096 mV
  1.5 V bias   1494 mV
  2.5 V bias   2524 mV
  9.0 V        9000 mV
  3.3 V        3296 mV
  XF0 1.0 V    1008 mV
  XF0 1.0 V LDO 998 mV
  PCIE SW 1.0 V 996 mV
  XF0 1.8 V    1804 mV
  XF1 1.0 V    1004 mV
  XF2 1.0 V    1000 mV
  XF3 1.0 V    1002 mV
  1.2 V        1194 mV
  XF1 1.0 V LDO 998 mV
  XF2 1.0 V LDO 996 mV
  XF3 1.0 V LDO 998 mV
  XF1 1.8 V    1808 mV
  XF2 1.8 V    1794 mV
  XF3 1.8 V    1786 mV
  1.5 V        1492 mV
  SW 3.3 V     3304 mV

SIB 2 status:
State          Online
Temperature    49 degrees C / 120 degrees F
Power

```

8.0 V bias	8244 mV
3.3 V bias	3296 mV
0.9 V bias	908 mV
1.1 V bias	1098 mV
1.5 V bias	1490 mV
2.5 V bias	2520 mV
9.0 V	9000 mV
3.3 V	3296 mV
XF0 1.0 V	1004 mV
XF0 1.0 V LDO	998 mV
PCIe SW 1.0 V	994 mV
XF0 1.8 V	1790 mV
XF1 1.0 V	1004 mV
XF2 1.0 V	1002 mV
XF3 1.0 V	1004 mV
1.2 V	1198 mV
XF1 1.0 V LDO	1002 mV
XF2 1.0 V LDO	998 mV
XF3 1.0 V LDO	1000 mV
XF1 1.8 V	1794 mV
XF2 1.8 V	1790 mV
XF3 1.8 V	1800 mV
1.5 V	1478 mV
SW 3.3 V	3308 mV
SIB 3 status:	
State	Online
Temperature	48 degrees C / 118 degrees F
Power	
8.0 V bias	8280 mV
3.3 V bias	3300 mV
0.9 V bias	910 mV
1.1 V bias	1098 mV
1.5 V bias	1506 mV
2.5 V bias	2520 mV
9.0 V	8988 mV
3.3 V	3304 mV
XF0 1.0 V	1004 mV
XF0 1.0 V LDO	1000 mV
PCIe SW 1.0 V	996 mV
XF0 1.8 V	1808 mV
XF1 1.0 V	1000 mV
XF2 1.0 V	1002 mV
XF3 1.0 V	1002 mV
1.2 V	1194 mV
XF1 1.0 V LDO	998 mV
XF2 1.0 V LDO	996 mV
XF3 1.0 V LDO	996 mV
XF1 1.8 V	1794 mV
XF2 1.8 V	1794 mV
XF3 1.8 V	1792 mV
1.5 V	1484 mV
SW 3.3 V	3300 mV
SIB 4 status:	
State	Online
Temperature	50 degrees C / 122 degrees F
Power	
8.0 V bias	8268 mV
3.3 V bias	3296 mV
0.9 V bias	910 mV
1.1 V bias	1098 mV
1.5 V bias	1500 mV

2.5 V bias	2492 mV
9.0 V	9012 mV
3.3 V	3312 mV
XF0 1.0 V	1004 mV
XF0 1.0 V LDO	1002 mV
PCIe SW 1.0 V	996 mV
XF0 1.8 V	1790 mV
XF1 1.0 V	1004 mV
XF2 1.0 V	1006 mV
XF3 1.0 V	1004 mV
1.2 V	1196 mV
XF1 1.0 V LDO	1006 mV
XF2 1.0 V LDO	1002 mV
XF3 1.0 V LDO	1000 mV
XF1 1.8 V	1800 mV
XF2 1.8 V	1800 mV
XF3 1.8 V	1796 mV
1.5 V	1486 mV
SW 3.3 V	3312 mV

- Related Documentation**
- [T4000 Switch Interface Board \(SIB\) Description on page 79](#)
  - [T4000 Craft Interface LEDs](#)
  - [T4000 SIB LEDs on page 81](#)
  - [Replacing a T4000-SIB on page 319](#)

## PART 7

# Contacting Customer Support and Returning the Chassis or Components

- [Contacting Customer Support on page 375](#)
- [Locating Component Serial Numbers on page 377](#)
- [Packing and Returning Components on page 387](#)





# Contacting Customer Support

- [Contacting Customer Support on page 375](#)

## Contacting Customer Support

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You can contact Juniper Networks Technical Assistance Center (JTAC) 24 hours a day, 7 days a week in one of the following ways:

- On the Web, using the Case Manager link at:

<https://www.juniper.net/support/>

- By telephone:

From the US and Canada: 1-888-314-JTAC

From all other locations: 1-408-745-9500

If contacting JTAC by phone, enter your 12-digit case number followed by the # key if this is an existing case, or press the \* key to be routed to the next available support engineer.

When requesting support from JTAC by telephone, be prepared to provide the following information:

- Your existing case number, if you have one
- Details of the failure or problem
- Type of activity being performed on the platform when the problem occurred
- Configuration data using one or more of the show commands



## CHAPTER 38

# Locating Component Serial Numbers

- [Displaying T4000 Component Serial Numbers on page 377](#)
- [T4000 Component Serial Number Locations on page 379](#)

## Displaying T4000 Component Serial Numbers

---

Before contacting Juniper Networks, Inc. to request a Return Materials Authorization (RMA), you must find the serial number on the router or component. To list all of the router components and their serial numbers, enter the following command-line interface (CLI) command:

```
user@host> show chassis hardware
```

Hardware inventory:

Item	Version	Part number	Serial number	Description
Chassis			JN11B7FECAHA	T4000
Midplane	REV 01	710-027486	RC9244	T-series Backplane
FPM GBUS	REV 13	710-002901	BBAF3545	T640 FPM Board
FPM Display	REV 03	710-021387	BBAF4338	T4000 FPM Display
CIP	REV 06	710-002895	BBAF2353	T-series CIP
PEM 0	REV 02	740-036442	VG00017	Power Entry Module 6x60
SCG 0	REV 18	710-003423	BBAE4908	T640 Sonet Clock Gen.
SCG 1	REV 18	710-003423	BBAB2590	T640 Sonet Clock Gen.
Routing Engine 0	REV 06	740-026941	P737F-002693	RE-DUO-1800
Routing Engine 1	REV 06	740-026941	P737F-002587	RE-DUO-1800
CB 0	REV 09	710-022597	EF6057	LCC Control Board
CB 1	REV 09	710-022597	EF9180	LCC Control Board
FPC 4	REV 05	750-010153	EE9812	FPC Type 5-3D
CPU	REV 06	711-030686	EE8534	SNG PMB
PIC 0	REV 07	750-034624	EF6805	12x10GE (LAN/WAN) SFPP
Xcvr 1	REV 01	740-031980	123363A01143	SFP+-10G-SR
PIC 1	REV 02	750-034624	EE3717	12x10GE (LAN/WAN) SFPP
Xcvr 1	REV 01	740-031980	123363A01301	SFP+-10G-SR
Xcvr 4	REV 01	740-031981	UHP016G	SFP+-10G-LR
Xcvr 6	REV 01	740-031980	B10M03384	SFP+-10G-SR
Xcvr 7	REV 01	740-031980	AJJ032B	SFP+-10G-SR
Xcvr 9	REV 01	740-031980	AJJ03C5	SFP+-10G-SR
Xcvr 10	REV 01	740-031980	AJJ037Y	SFP+-10G-SR
Xcvr 11	REV 01	740-031980	AJJ01LW	SFP+-10G-SR
LMB 0 Board	REV 04	711-034381	EE8796	Galaxy FPC LU Mezzanine
LMB 1 Board	REV 03	711-035774	EE8818	Type-1 LU Mezzanine Board
LMB 2 Board	REV 04	711-034381	EE8795	Galaxy FPC LU Mezzanine

FPC 6	REV 26	750-032819	EH3173	FPC Type 5-3D
CPU	REV 10	711-030686	EG7759	SNG PMB
PIC 0	REV 08	50-035293	EG2430	1x100GE
Xcvr 0	REV 01	740-032210	C22CTQB	CFP-100G-LR4
PIC 1	REV 03	750-035293	EF3655	1x100GE
Xcvr 0	REV 01	740-032210	C22CQXC	CFP-100G-LR4
LMB 0	REV 05	711-034381	EG6370	Galaxy FPC LU Mezzanine
Board				
LMB 1	REV 04	711-035774	EG6503	Type-1 LU Mezzanine Board
LMB 2	REV 05	711-034381	EG6374	Galaxy FPC LU Mezzanine
Board				
FPC 7	REV 24	750-032819	EG9191	FPC Type 5-3D
CPU	REV 10	711-030686	EG7776	SNG PMB
PIC 0	REV 07	750-034624	EF6808	12x10GE (LAN/WAN) SFPP
Xcvr 0	REV 01	740-031980	B10M01418	SFP+-10G-SR
Xcvr 1	REV 01	740-031981	UK60DPC	SFP+-10G-LR
Xcvr 2	REV 01	740-031980	AJJ01QE	SFP+-10G-SR
Xcvr 3	REV 01	740-031980	B10M03379	SFP+-10G-SR
Xcvr 4	REV 01	740-031980	B10M01541	SFP+-10G-SR
Xcvr 5	REV 01	740-031980	B10M03333	SFP+-10G-SR
Xcvr 6	REV 01	740-031980	B10M03344	SFP+-10G-SR
Xcvr 7	REV 01	740-031980	AJJ0399	SFP+-10G-SR
Xcvr 8	REV 01	740-031980	AJJ0339	SFP+-10G-SR
Xcvr 9	REV 01	740-031980	B10M00112	SFP+-10G-SR
Xcvr 10	REV 01	740-031981	UHP0168	SFP+-10G-LR
Xcvr 11	REV 01	740-031980	B10M00452	SFP+-10G-SR
PIC 1	REV 01	750-035293	EE2286	1x100GE
Xcvr 0	REV 01	740-032210	C22CR7E	CFP-100G-LR4
LMB 0	REV 03	711-034381	ED8127	Galaxy FPC LU Mezzanine
Board				
LMB 1	REV 02	711-035774	EE2480	Type-1 LU Mezzanine Board
LMB 2	REV 03	711-034381	EE3034	Galaxy FPC LU Mezzanine
Board				
SPMB 0	REV 05	710-023321	EF9671	LCC Switch CPU
SPMB 1	REV 05	710-023321	EF6092	LCC Switch CPU
SIB 0	REV 07	711-036340	EG2276	SIB-HC-3D
SIB 1	REV 07	711-036340	EG2299	SIB-HC-3D
SIB 2	REV 07	711-036340	EG2302	SIB-HC-3D
SIB 3	REV 02	711-036340	EE6290	SIB-HC-3D
SIB 4	REV 02	711-036340	EF1319	SIB-HC-3D
Fan Tray 0				Front Top Fan Tray --
Rev 2				
Fan Tray 1				Front Bottom Fan Tray
Rev 2				
Fan Tray 2				Rear Fan Tray -- Rev 3

#### Related Documentation

- [Contacting Customer Support on page 375](#)
- [T4000 Component Serial Number Locations on page 379](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 387](#)

## T4000 Component Serial Number Locations

Most components have a small serial number ID label attached to the component body. For example, many components have a rectangular serial number label as shown in [Figure 142 on page 379](#).

*Figure 142: Serial Number ID Label*

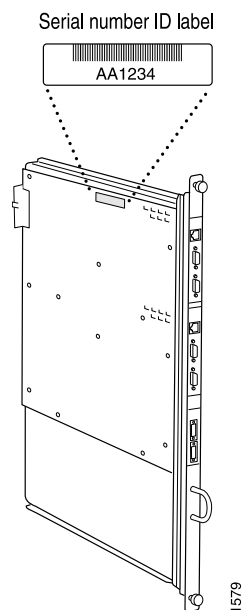


- [CIP Serial Number Label on page 379](#)
- [Control Board Serial Number Label on page 380](#)
- [Craft Interface Serial Number Label on page 380](#)
- [FPC Serial Number Label on page 380](#)
- [PIC Serial Number Label on page 382](#)
- [Power Supply Serial Number Label on page 383](#)
- [Routing Engine Serial Number Label on page 383](#)
- [SCG Serial Number Label on page 384](#)
- [SIB Serial Number Label on page 384](#)

### CIP Serial Number Label

The serial number label is located at the top of the left side of the CIP (see [Figure 143 on page 379](#)).

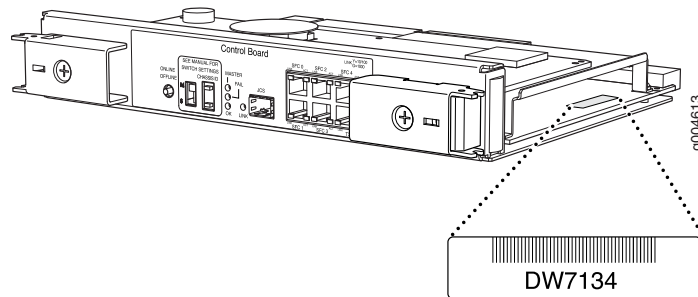
*Figure 143: CIP Serial Number Label*



## Control Board Serial Number Label

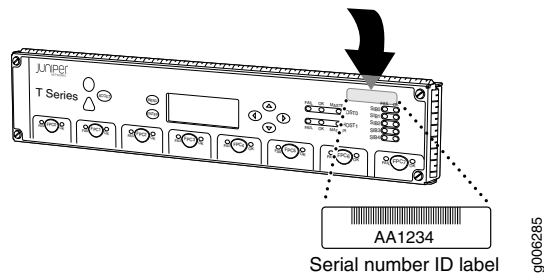
The LCC-CB serial number is located on the lower right side of the control board (see [Figure 144 on page 380](#)).

*Figure 144: LCC-CB Serial Number Label*



## Craft Interface Serial Number Label

*Figure 145: Craft Interface Serial Number ID Label*



## FPC Serial Number Label

The location of the serial number label varies depending on the FPC:

- T1600 Type 4 FPCs: located on the lower right side
- T4000 Type 5 FPCs: located on the upper middle.

[Figure 146 on page 381](#) shows the serial number location for a T1600 Type 4 FPC.

Figure 146: Serial Number Label on a T1600 Type 4 FPC

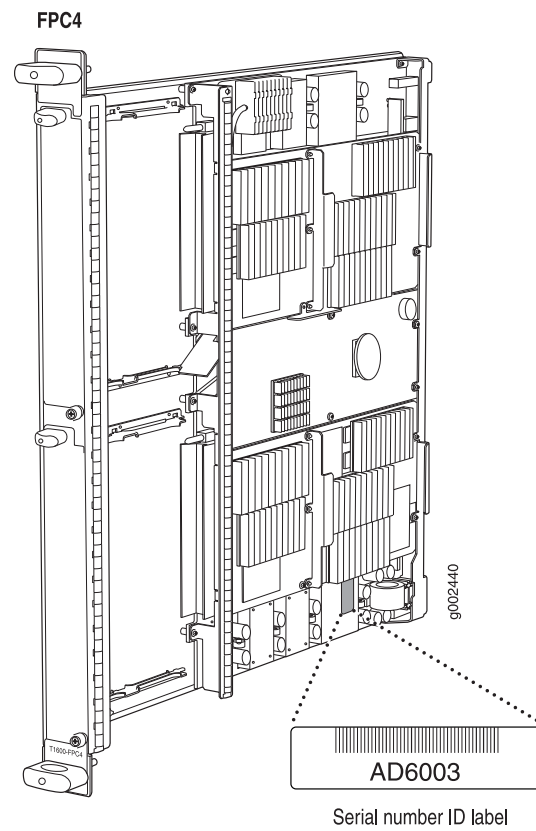
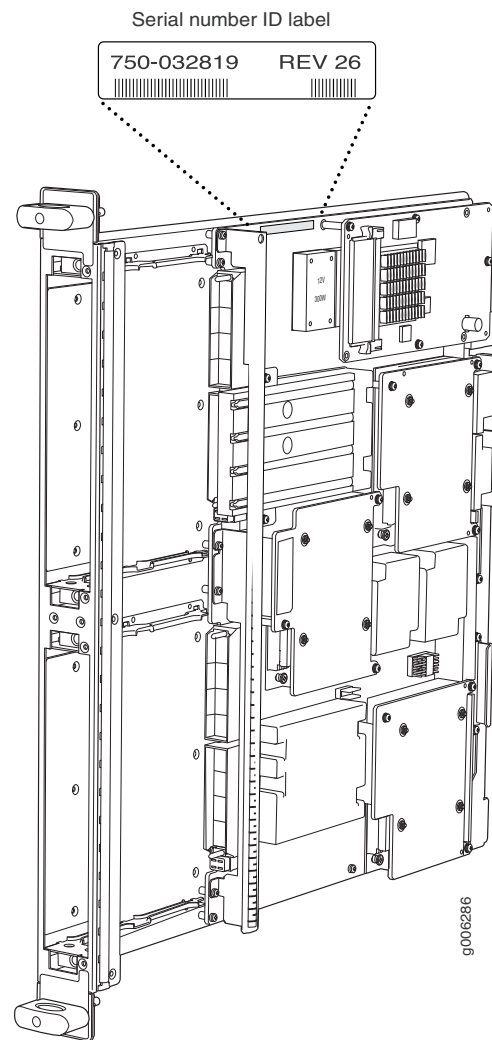


Figure 147 on page 382 shows the serial number location for a T4000 Type 5 FPC.

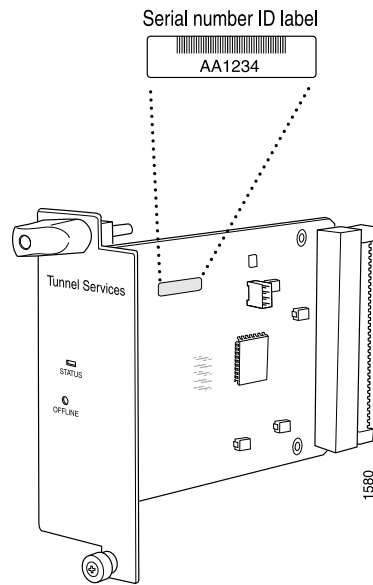
*Figure 147: Type 5 FPC Serial Number ID Label*

## PIC Serial Number Label

The exact location serial number label is different on different PICs, depending on the placement of components on the PIC board. In this example, the serial number label is located on the right side of the PIC (see [Figure 148 on page 383](#)), when the PIC is vertically oriented (as it would be installed in the router).



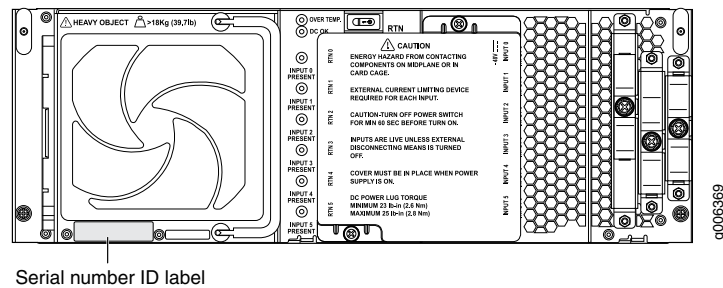
Figure 148: PIC Serial Number Label



## Power Supply Serial Number Label

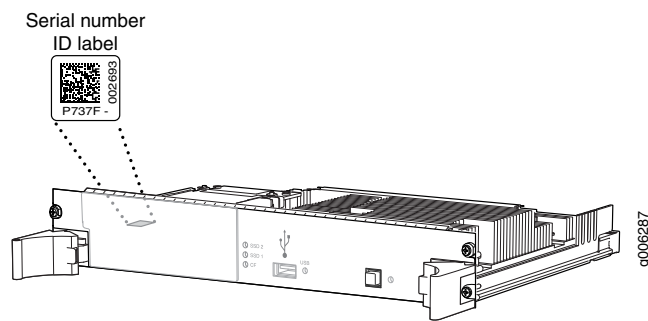
For the DC power supply, the serial number label is located on the lower left side of the faceplate. (see [Figure 149 on page 383](#)).

Figure 149: DC Power Supply Serial Number Label



## Routing Engine Serial Number Label

The serial number label is located on the left side (see [Figure 150 on page 384](#)).

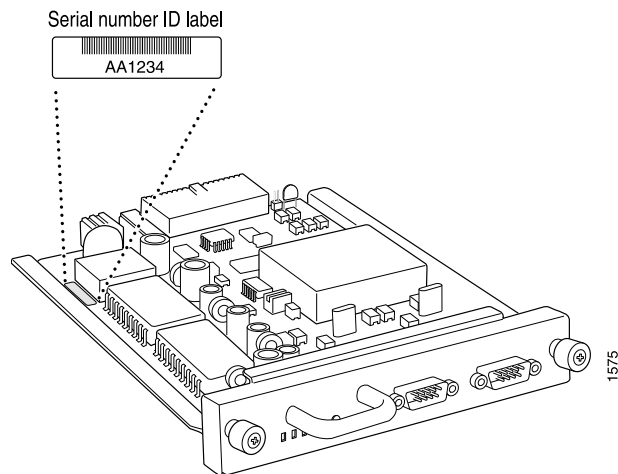
*Figure 150: Routing Engine*

### SCG Serial Number Label

The serial number is located on the top of the SCG, close to the midplane connector (see [Figure 151 on page 384](#)).



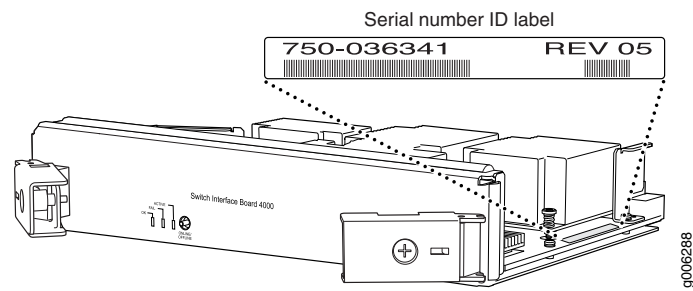
**NOTE:** Although the illustration shows the SCG with DB-9 ports, the serial number location is the same for the SCG with RJ-48 ports.

*Figure 151: SCG Serial Number Label*

### SIB Serial Number Label

The serial number is located on the right side behind the faceplate (see [Figure 152 on page 385](#)).

Figure 152: SIB Serial Number ID Label



**Related Documentation**

- [Displaying T4000 Component Serial Numbers on page 377](#)



# Packing and Returning Components

- [Returning a Hardware Component to Juniper Networks, Inc. on page 387](#)
- [Tools and Parts Required to Remove Components from a T4000 Router on page 388](#)
- [Packing the T4000 Router for Shipment on page 388](#)
- [Packing the T4000 Router Components for Shipment on page 389](#)

## Returning a Hardware Component to Juniper Networks, Inc.

---

In the event of a hardware failure, please contact Juniper Networks, Inc. to obtain a Return Material Authorization (RMA) number. This number is used to track the returned material at the factory and to return repaired or new components to the customer as needed.



**NOTE:** Do not return any component to Juniper Networks, Inc. unless you have first obtained an RMA number. Juniper Networks, Inc. reserves the right to refuse shipments that do not have an RMA. Refused shipments are returned to the customer by collect freight.

For more information about return and repair policies, see the customer support Web page at <https://www.juniper.net/support/guidelines.html>.

For product problems or technical support issues, contact the Juniper Networks Technical Assistance Center (JTAC) by using the Case Manager link at <https://www.juniper.net/support/> or at 1-888-314-JTAC (within the United States) or 1-408-745-9500 (from outside the United States).

To return a defective hardware component:

1. Determine the part number and serial number of the defective component.
2. Obtain an RMA number from the Juniper Networks Technical Assistance Center (JTAC). You can send e-mail or telephone as described above.
3. Provide the following information in your e-mail message or during the telephone call:
  - Part number and serial number of component
  - Your name, organization name, telephone number, and fax number

- Description of the failure
- 4. The support representative validates your request and issues an RMA number for return of the component.
- 5. Pack the component for shipment.

---

## Tools and Parts Required to Remove Components from a T4000 Router

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To remove components from the router or the router from a rack, you need the following tools and parts:

- 2.5-mm flat-blade (–) screwdriver, for detaching alarm relay terminal block
- 7/16-in. (11 mm) nut driver
- Blank panels to cover empty slots
- Electrostatic bag or antistatic mat, for each component
- Electrostatic discharge (ESD) grounding wrist strap
- Flat-blade (–) screwdriver
- Mechanical lift, if available
- Phillips (+) screwdrivers, numbers 1 and 2
- Rubber safety caps for fiber-optic transceivers and cable

### Related Documentation

- [Tools and Parts Required for Replacing T4000 Hardware Components on page 241](#)
- [Packing the T4000 Router Components for Shipment on page 389](#)
- [Packing the T4000 Router for Shipment on page 388](#)

---

## Packing the T4000 Router for Shipment

---

To pack the router for shipment:

1. Retrieve the shipping crate and packing materials in which the router was originally shipped. If you do not have these materials, contact your Juniper Networks representative about approved packaging materials.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. On the console or other management device connected to the master Routing Engine, enter CLI operational mode. To power off the router, see [“Powering Off the T4000 Router” on page 341](#).
4. Disconnect power from the router. .

5. Remove the cables that connect to all external devices. For instructions, see [“Removing a T4000 Management Ethernet Cable” on page 253](#), [“Removing a T4000 Console or Auxiliary Cable” on page 251](#), and [“Replacing the T4000 Alarm Relay Wires” on page 255](#).
6. Remove all field replaceable units (FRUs) from the router.
7. Remove the router from the rack:
  - If you are using a mechanical lift, place the lift platform under the router, unscrew and remove the mounting screws from the rack, and move the router to the shipping crate.
  - If you are not using a mechanical lift:
    - If the router weight is fully supported by a shelf or another router, unscrew and remove the mounting screws from the rack. Four people can then lift the router and move it to the shipping crate.
    - If the router weight is not fully supported by a shelf or another router, four people should grasp the router while another person unscrews and removes the mounting screws from the rack. The lifters can then move the router to the shipping crate.
8. Place the router into the shipping crate or onto the pallet. If on a pallet, bolt the router to the pallet.
9. Cover the router with an ESD bag, and place packing foam on top of and around the router.
10. Replace the accessory box on top of the packing foam.
11. Securely tape the box closed or place the crate cover over the router.
12. Write the Return Materials Authorization (RMA) number on the exterior of the box to ensure proper tracking.

**Related  
Documentation**

- [Contacting Customer Support on page 375](#)
- [Prevention of Electrostatic Discharge Damage on page 423](#)

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## Packing the T4000 Router Components for Shipment

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To pack and ship individual components:

- When you return components, make sure they are adequately protected with packing materials and packed so that the pieces are prevented from moving around inside the carton.
- Use the original shipping materials if they are available.

- Place individual boards in electrostatic bags.
- Write the Return Materials Authorization (RMA) number on the exterior of the box to ensure proper tracking.



CAUTION: Do not stack any of the router components.

**Related  
Documentation**

- [Contacting Customer Support on page 375](#)
- [Displaying T4000 Component Serial Numbers on page 377](#)
- [T4000 Component Serial Number Locations on page 379](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 387](#)



## PART 8

# Safety and Compliance Information

- [General Safety Guidelines and Warnings on page 393](#)
- [Fire Safety Requirements on page 399](#)
- [Installation Safety Guidelines and Warnings on page 401](#)
- [Radiation and Laser Safety Guidelines and Warnings on page 411](#)
- [Maintenance and Operational Safety Warnings on page 415](#)
- [Electrical Safety Guidelines and Warnings on page 421](#)
- [Agency Approvals and Compliance Statements on page 435](#)



## CHAPTER 40

# General Safety Guidelines and Warnings

- [General Safety Guidelines and Warnings on page 393](#)
- [Definitions of Safety Warning Levels on page 394](#)
- [Qualified Personnel Warning on page 396](#)
- [Warning Statement for Norway and Sweden on page 397](#)

### General Safety Guidelines and Warnings

---

The following guidelines help ensure your safety and protect the device from damage. The list of guidelines might not address all potentially hazardous situations in your working environment, so be alert and exercise good judgment at all times.

- Perform only the procedures explicitly described in the hardware documentation for this device. Make sure that only authorized service personnel perform other system services.
- Keep the area around the device clear and free from dust before, during, and after installation.
- Keep tools away from areas where people could trip over them while walking.
- Do not wear loose clothing or jewelry, such as rings, bracelets, or chains, which could become caught in the device.
- Wear safety glasses if you are working under any conditions that could be hazardous to your eyes.
- Do not perform any actions that create a potential hazard to people or make the equipment unsafe.
- Never attempt to lift an object that is too heavy for one person to handle.
- Never install or manipulate wiring during electrical storms.
- Never install electrical jacks in wet locations unless the jacks are specifically designed for wet environments.
- Operate the device only when it is properly grounded.
- Ensure that the separate protective earthing terminal provided on this device is permanently connected to earth.
- Replace fuses only with fuses of the same type and rating.

- Do not open or remove chassis covers or sheet-metal parts unless instructions are provided in the hardware documentation for this device. Such an action could cause severe electrical shock.
- Do not push or force any objects through any opening in the chassis frame. Such an action could result in electrical shock or fire.
- Avoid spilling liquid onto the chassis or onto any device component. Such an action could cause electrical shock or damage the device.
- Avoid touching uninsulated electrical wires or terminals that have not been disconnected from their power source. Such an action could cause electrical shock.
- Some parts of the chassis might become hot. The following label provides the warning of



the hot surfaces on the chassis:

- Always ensure that all modules, power supplies, and cover panels are fully inserted and that the installation screws are fully tightened.

#### Related Documentation

- [AC Power Electrical Safety Guidelines](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- [Maintenance and Operational Safety Guidelines and Warnings on page 415](#)
- [Installation Instructions Warning on page 401](#)
- [Grounded Equipment Warning on page 408](#)

## Definitions of Safety Warning Levels

The documentation uses the following levels of safety warnings (there are two *Warning* formats):



**NOTE:** You might find this information helpful in a particular situation, or you might overlook this important information if it was not highlighted in a Note.



**CAUTION:** You need to observe the specified guidelines to prevent minor injury or discomfort to you or severe damage to the device.



**WARNING:** This symbol alerts you to the risk of personal injury from a laser.



**WARNING:** This symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards

involved with electrical circuitry and be familiar with standard practices for preventing accidents.

**Waarschuwing** Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen.

**Varoitus** Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista.

**Attention** Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents.

**Warnung** Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt.

**Avvertenza** Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti.

**Advarsel** Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du være oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker.

**Aviso** Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes.

**¡Atención!** Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes.

**Varning!** Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning

måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador.

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**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- [Installation Instructions Warning on page 401](#)
- [Maintenance and Operational Safety Guidelines and Warnings on page 415](#)
- [Grounded Equipment Warning on page 408](#)
- [Laser and LED Safety Guidelines and Warnings on page 412](#)
- [Laser and LED Safety Guidelines and Warnings for the ACX5000 Router](#)
- [Laser and LED Safety Guidelines and Warnings for the QFX Series](#)
- [Laser and LED Safety Guidelines and Warnings for the PTX10008 and PTX10016](#)
- [Warning Statement for Norway and Sweden on page 397](#)

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## Qualified Personnel Warning

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**WARNING:** Only trained and qualified personnel should install or replace the device.

**Waarschuwing** Installatie en reparaties mogen uitsluitend door getraind en bevoegd personeel uitgevoerd worden.

**Varoitus** Ainoastaan koulutettu ja pätevä henkilökunta saa asentaa tai vaihtaa tämän laitteen.

**Attention** Tout installation ou remplacement de l'appareil doit être réalisé par du personnel qualifié et compétent.

**Warnung** Gerät nur von geschultem, qualifiziertem Personal installieren oder auswechseln lassen.

**Avvertenza** Solo personale addestrato e qualificato deve essere autorizzato ad installare o sostituire questo apparecchio.

**Advarsel** Kun kvalifisert personell med riktig opplæring bør montere eller bytte ut dette utstyret.

**Aviso** Este equipamento deverá ser instalado ou substituído apenas por pessoal devidamente treinado e qualificado.

**¡Atención!** Estos equipos deben ser instalados y reemplazados exclusivamente por personal técnico adecuadamente preparado y capacitado.

**Varning!** Denna utrustning ska endast installeras och bytas ut av utbildad och kvalificerad personal.

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- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [General Electrical Safety Guidelines and Warnings on page 421](#)
  - *AC Power Electrical Safety Guidelines*
  - *PTX5000 AC Power Electrical Safety Guidelines*
  - *PTX5000 AC Power Electrical Safety Warnings*
  - *DC Power Electrical Safety Guidelines*
  - *PTX1000 DC Power Electrical Safety Guidelines*
  - *PTX3000 DC Power Electrical Safety Guidelines*
  - *PTX5000 DC Power Electrical Safety Guidelines*

## Warning Statement for Norway and Sweden

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**WARNING:** The equipment must be connected to an earthed mains socket-outlet.

**Advarsel** Apparatet skal kobles til en jordet stikkontakt.

**Varning!** Apparaten skall anslutas till jordat nätuttag.

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- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)





## CHAPTER 41

# Fire Safety Requirements

- [Fire Safety Requirements on page 399](#)

## Fire Safety Requirements

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In the event of a fire emergency, the safety of people is the primary concern. You should establish procedures for protecting people in the event of a fire emergency, provide safety training, and properly provision fire-control equipment and fire extinguishers.

In addition, you should establish procedures to protect your equipment in the event of a fire emergency. Juniper Networks products should be installed in an environment suitable for electronic equipment. We recommend that fire suppression equipment be available in the event of a fire in the vicinity of the equipment and that all local fire, safety, and electrical codes and ordinances be observed when you install and operate your equipment.

## Fire Suppression

In the event of an electrical hazard or an electrical fire, you should first turn power off to the equipment at the source. Then use a Type C fire extinguisher, which uses noncorrosive fire retardants, to extinguish the fire.

## Fire Suppression Equipment

Type C fire extinguishers, which use noncorrosive fire retardants such as carbon dioxide and Halotron™, are most effective for suppressing electrical fires. Type C fire extinguishers displace oxygen from the point of combustion to eliminate the fire. For extinguishing fire on or around equipment that draws air from the environment for cooling, you should use this type of inert oxygen displacement extinguisher instead of an extinguisher that leaves residues on equipment.

Do not use multipurpose Type ABC chemical fire extinguishers (dry chemical fire extinguishers). The primary ingredient in these fire extinguishers is monoammonium phosphate, which is very sticky and difficult to clean. In addition, in the presence of minute amounts of moisture, monoammonium phosphate can become highly corrosive and corrodes most metals.

Any equipment in a room in which a chemical fire extinguisher has been discharged is subject to premature failure and unreliable operation. The equipment is considered to be irreparably damaged.



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**NOTE:** To keep warranties effective, do not use a dry chemical fire extinguisher to control a fire at or near a Juniper Networks device. If a dry chemical fire extinguisher is used, the unit is no longer eligible for coverage under a service agreement.

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We recommend that you dispose of any irreparably damaged equipment in an environmentally responsible manner.

**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- [Action to Take After an Electrical Accident on page 422](#)

## CHAPTER 42

# Installation Safety Guidelines and Warnings

- [Installation Instructions Warning on page 401](#)
- [Chassis and Component Lifting Guidelines on page 402](#)
- [Restricted Access Warning on page 402](#)
- [Ramp Warning on page 404](#)
- [Rack-Mounting and Cabinet-Mounting Warnings on page 404](#)
- [Grounded Equipment Warning on page 408](#)

## Installation Instructions Warning

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**WARNING:** Read the installation instructions before you connect the device to a power source.

**Waarschuwing** Raadpleeg de installatie-aanwijzingen voordat u het systeem met de voeding verbindt.

**Varoit** Lue asennusohjeet ennen järjestelmän yhdistämistä virtälähteeseen.

**Attention** Avant de brancher le système sur la source d'alimentation, consulter les directives d'installation.

**Warnung** Lesen Sie die Installationsanweisungen, bevor Sie das System an die Stromquelle anschließen.

**Avvertenza** Consultare le istruzioni di installazione prima di collegare il sistema all'alimentatore.

**Advarsel** Les installasjonsinstruksjonene før systemet kobles til strømkilden.

**Aviso** Leia as instruções de instalação antes de ligar o sistema à sua fonte de energia.

**¡Atención!** Ver las instrucciones de instalación antes de conectar el sistema a la red de alimentación.

**Varning!** Läs installationsanvisningarna innan du kopplar systemet till dess strömförsörjningsenhet.

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- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [Laser and LED Safety Guidelines and Warnings on page 412](#)
  - *Laser and LED Safety Guidelines and Warnings for the ACX5000 Router*
  - [Grounded Equipment Warning on page 408](#)

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## Chassis and Component Lifting Guidelines

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- Before moving the device to a site, ensure that the site meets the power, environmental, and clearance requirements.
- Before lifting or moving the device, disconnect all external cables and wires.
- As when lifting any heavy object, ensure that most of the weight is borne by your legs rather than your back. Keep your knees bent and your back relatively straight. Do not twist your body as you lift. Balance the load evenly and be sure that your footing is firm.
- Use the following lifting guidelines to lift devices and components:
  - Up to 39.7 lb (18 kg): One person.
  - 39.7 lb (18 kg) to 70.5 lb (32 kg): Two or more people.
  - 70.5 lb (32 kg) to 121.2 lb (55 kg): Three or more people.
  - Above 121.2 lbs (55 kg): Material handling systems (such as levers, slings, lifts and so on) must be used. When this is not practical, specially trained persons or systems must be used (riggers or movers).

- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [Installation Instructions Warning on page 401](#)

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## Restricted Access Warning

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**WARNING:** This unit is intended for installation in restricted access areas. A restricted access area is an area to which access can be gained only by service personnel through the use of a special tool, lock and key, or other means of security, and which is controlled by the authority responsible for the location.

**Waarschuwing** Dit toestel is bedoeld voor installatie op plaatsen met beperkte toegang. Een plaats met beperkte toegang is een plaats waar toegang slechts door servicepersoneel verkregen kan worden door middel van een speciaal instrument, een slot en sleutel, of een ander veiligheidsmiddel, en welke

beheerd wordt door de overheidsinstantie die verantwoordelijk is voor de locatie.

**Varoitus** Tämä laite on tarkoitettu asennettavaksi paikkaan, johon pääsy on rajoitettua. Paikka, johon pääsy on rajoitettua, tarkoittaa paikkaa, johon vain huoltohenkilöstö pääsee jonkin erikoistyökalun, lukkoon sopivan avaimen tai jonkin muun turvalaitteen avulla ja joka on paikasta vastuussa olevien toimivaltaisten henkilöiden valvoma.

**Attention** Cet appareil est à installer dans des zones d'accès réservé. Ces dernières sont des zones auxquelles seul le personnel de service peut accéder en utilisant un outil spécial, un mécanisme de verrouillage et une clé, ou tout autre moyen de sécurité. L'accès aux zones de sécurité est sous le contrôle de l'autorité responsable de l'emplacement.

**Warnung** Diese Einheit ist zur Installation in Bereichen mit beschränktem Zutritt vorgesehen. Ein Bereich mit beschränktem Zutritt ist ein Bereich, zu dem nur Wartungspersonal mit einem Spezialwerkzeugs, Schloß und Schlüssel oder anderer Sicherheitsvorkehrungen Zugang hat, und der von dem für die Anlage zuständigen Gremium kontrolliert wird.

**Avvertenza** Questa unità deve essere installata in un'area ad accesso limitato. Un'area ad accesso limitato è un'area accessibile solo a personale di assistenza tramite un'attrezzo speciale, lucchetto, o altri dispositivi di sicurezza, ed è controllata dall'autorità responsabile della zona.

**Advarsel** Denne enheten er laget for installasjon i områder med begrenset adgang. Et område med begrenset adgang gir kun adgang til servicepersonale som bruker et spesielt verktøy, lås og nøkkel, eller en annen sikkerhetsanordning, og det kontrolleres av den autoriteten som er ansvarlig for området.

**Aviso** Esta unidade foi concebida para instalação em áreas de acesso restrito. Uma área de acesso restrito é uma área à qual apenas tem acesso o pessoal de serviço autorizado, que possua uma ferramenta, chave e fechadura especial, ou qualquer outra forma de segurança. Esta área é controlada pela autoridade responsável pelo local.

**¡Atención!** Esta unidad ha sido diseñada para instalarse en áreas de acceso restringido. Área de acceso restringido significa un área a la que solamente tiene acceso el personal de servicio mediante la utilización de una herramienta especial, cerradura con llave, o algún otro medio de seguridad, y que está bajo el control de la autoridad responsable del local.

**Varning!** Denna enhet är avsedd för installation i områden med begränsat tillträde. Ett område med begränsat tillträde får endast tillträdas av servicepersonal med ett speciellt verktyg, lås och nyckel, eller annan säkerhetsanordning, och kontrolleras av den auktoritet som ansvarar för området.

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- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [General Electrical Safety Guidelines and Warnings on page 421](#)
  - [Installation Instructions Warning on page 401](#)
  - [Grounded Equipment Warning on page 408](#)

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## Ramp Warning



**WARNING:** When installing the device, do not use a ramp inclined at more than 10 degrees.

**Waarschuwing** Gebruik een oprijplaat niet onder een hoek van meer dan 10 graden.

**Varoitus** Älä käytä sellaista kaltevaa pintaa, jonka kaltevuus ylittää 10 astetta.

**Attention** Ne pas utiliser une rampe dont l'inclinaison est supérieure à 10 degrés.

**Warnung** Keine Rampen mit einer Neigung von mehr als 10 Grad verwenden.

**Avvertenza** Non usare una rampa con pendenza superiore a 10 gradi.

**Advarsel** Bruk aldri en rampe som heller mer enn 10 grader.

**Aviso** Não utilize uma rampa com uma inclinação superior a 10 graus.

**¡Atención!** No usar una rampa inclinada más de 10 grados

**Varning!** Använd inte ramp med en lutning på mer än 10 grader.

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- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [Installation Instructions Warning on page 401](#)
  - [Grounded Equipment Warning on page 408](#)

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## Rack-Mounting and Cabinet-Mounting Warnings

Ensure that the rack or cabinet in which the device is installed is evenly and securely supported. Uneven mechanical loading could lead to a hazardous condition.

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**WARNING:** To prevent bodily injury when mounting or servicing the device in a rack, take the following precautions to ensure that the system remains stable. The following directives help maintain your safety:

- The device must be installed in a rack that is secured to the building structure.
- The device should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting the device on a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.
- If the rack is provided with stabilizing equipment, install the stabilizers before mounting or servicing the device in the rack.

**Waarschuwing** Om lichamelijk letsel te voorkomen wanneer u dit toestel in een rek monteert of het daar een servicebeurt geeft, moet u speciale voorzorgsmaatregelen nemen om ervoor te zorgen dat het toestel stabiel blijft. De onderstaande richtlijnen worden verstrekt om uw veiligheid te verzekeren:

- De Juniper Networks switch moet in een stellage worden geïnstalleerd die aan een bouwswel is verankerd.
- Dit toestel dient onderaan in het rek gemonteerd te worden als het toestel het enige in het rek is.
- Wanneer u dit toestel in een gedeeltelijk gevuld rek monteert, dient u het rek van onderen naar boven te laden met het zwaarste onderdeel onderaan in het rek.
- Als het rek voorzien is van stabiliseringshulpmiddelen, dient u de stabilisatoren te monteren voordat u het toestel in het rek monteert of het daar een servicebeurt geeft.

**Varoitus** Kun laite asetetaan telineeseen tai huolletaan sen ollessa telineessä, on noudatettava erityisiä varotoimia järjestelmän vakavuuden säilyttämiseksi, jotta vältetään loukkaantumiselta. Noudata seuraavia turvallisuusohjeita:

- Juniper Networks switch on asennettava telineeseen, joka on kiinnitetty rakennukseen.
- Jos telineessä ei ole muita laitteita, aseta laite telineen alaosaan.
- Jos laite asetetaan osaksi täytettyyn telineeseen, aloita kuormittaminen sen alaosasta kaikkein raskaimmalla esineellä ja siirry sitten sen yläosaan.
- Jos telinettä varten on vakaimet, asenna ne ennen laitteen asettamista telineeseen tai sen huoltamista siinä.

**Attention** Pour éviter toute blessure corporelle pendant les opérations de montage ou de réparation de cette unité en casier, il convient de prendre des précautions spéciales afin de maintenir la stabilité du système. Les directives ci-dessous sont destinées à assurer la protection du personnel:

- Le rack sur lequel est monté le Juniper Networks switch doit être fixé à la structure du bâtiment.
- Si cette unité constitue la seule unité montée en casier, elle doit être placée dans le bas.
- Si cette unité est montée dans un casier partiellement rempli, charger le casier de bas en haut en plaçant l'élément le plus lourd dans le bas.
- Si le casier est équipé de dispositifs stabilisateurs, installer les stabilisateurs avant de monter ou de réparer l'unité en casier.

**Warnung** Zur Vermeidung von Körperverletzung beim Anbringen oder Warten dieser Einheit in einem Gestell müssen Sie besondere Vorkehrungen treffen, um sicherzustellen, daß das System stabil bleibt. Die folgenden Richtlinien sollen zur Gewährleistung Ihrer Sicherheit dienen:

- Der Juniper Networks switch muß in einem Gestell installiert werden, das in der Gebäudestruktur verankert ist.
- Wenn diese Einheit die einzige im Gestell ist, sollte sie unten im Gestell angebracht werden.
- Bei Anbringung dieser Einheit in einem zum Teil gefüllten Gestell ist das Gestell von unten nach oben zu laden, wobei das schwerste Bauteil unten im Gestell anzubringen ist.
- Wird das Gestell mit Stabilisierungszubehör geliefert, sind zuerst die Stabilisatoren zu installieren, bevor Sie die Einheit im Gestell anbringen oder sie warten.

**Avvertenza** Per evitare infortuni fisici durante il montaggio o la manutenzione di questa unità in un supporto, occorre osservare speciali precauzioni per garantire che il sistema rimanga stabile. Le seguenti direttive vengono fornite per garantire la sicurezza personale:

- Il Juniper Networks switch deve essere installato in un telaio, il quale deve essere fissato alla struttura dell'edificio.
- Questa unità deve venire montata sul fondo del supporto, se si tratta dell'unica unità da montare nel supporto.
- Quando questa unità viene montata in un supporto parzialmente pieno, caricare il supporto dal basso all'alto, con il componente più pesante sistemato sul fondo del supporto.
- Se il supporto è dotato di dispositivi stabilizzanti, installare tali dispositivi prima di montare o di procedere alla manutenzione dell'unità nel supporto.

**Advarsel** Unngå fysiske skader under montering eller reparasjonsarbeid på denne enheten når den befinner seg i et kabinett. Vær nøye med at systemet er stabilt. Følgende retningslinjer er gitt for å verne om sikkerheten:



- Juniper Networks switch må installeres i et stativ som er forankret til bygningsstrukturen.
- Denne enheten bør monteres nederst i kabinettet hvis dette er den eneste enheten i kabinettet.
- Ved montering av denne enheten i et kabinett som er delvis fylt, skal kabinettet lastes fra bunnen og opp med den tyngste komponenten nederst i kabinettet.
- Hvis kabinettet er utstyrt med stabiliseringsutstyr, skal stabilisatorene installeres før montering eller utføring av reparasjonsarbeid på enheten i kabinettet.

Aviso Para se prevenir contra danos corporais ao montar ou reparar esta unidade numa estante, deverá tomar precauções especiais para se certificar de que o sistema possui um suporte estável. As seguintes directrizes ajudá-lo-ão a efectuar o seu trabalho com segurança:

- O Juniper Networks switch deverá ser instalado numa prateleira fixa à estrutura do edifício.
- Esta unidade deverá ser montada na parte inferior da estante, caso seja esta a única unidade a ser montada.
- Ao montar esta unidade numa estante parcialmente ocupada, coloque os itens mais pesados na parte inferior da estante, arrumando-os de baixo para cima.
- Se a estante possuir um dispositivo de estabilização, instale-o antes de montar ou reparar a unidade.

**¡Atención!** Para evitar lesiones durante el montaje de este equipo sobre un bastidor, oerriormente durante su mantenimiento, se debe poner mucho cuidado en que el sistema quede bien estable. Para garantizar su seguridad, proceda según las siguientes instrucciones:

- El Juniper Networks switch debe instalarse en un bastidor fijado a la estructura del edificio.
- Colocar el equipo en la parte inferior del bastidor, cuando sea la única unidad en el mismo.
- Cuando este equipo se vaya a instalar en un bastidor parcialmente ocupado, comenzar la instalación desde la parte inferior hacia la superior colocando el equipo más pesado en la parte inferior.
- Si el bastidor dispone de dispositivos estabilizadores, instalar éstos antes de montar o proceder al mantenimiento del equipo instalado en el bastidor.

**Varning!** För att undvika kroppsskada när du installerar eller utför underhållsarbete på denna enhet på en ställning måste du vidta särskilda

försiktighetsåtgärder för att försäkra dig om att systemet står stadigt. Följande riktlinjer ges för att trygga din säkerhet:

- Juniper Networks switch måste installeras i en ställning som är förankrad i byggnadens struktur.
  - Om denna enhet är den enda enheten på ställningen skall den installeras längst ned på ställningen.
  - Om denna enhet installeras på en delvis fylld ställning skall ställningen fyllas nedifrån och upp, med de tyngsta enheterna längst ned på ställningen.
  - Om ställningen är försedd med stabiliseringsdon skall dessa monteras fast innan enheten installeras eller underhålls på ställningen.
- 

- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [Installation Instructions Warning on page 401](#)
  - [Grounded Equipment Warning on page 408](#)

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## Grounded Equipment Warning

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**WARNING:** The device is intended to be grounded. During normal use, ensure that you have connected earth ground to the chassis.

**Waarschuwing** Deze apparatuur hoort geaard te worden. Zorg dat de host-computer tijdens normaal gebruik met aarde is verbonden.

**Varoitus** Tämä laitteisto on tarkoitettu maadoitettavaksi. Varmista, että isäntälaitte on yhdistetty maahan normaalikäytön aikana.

**Attention** Cet équipement doit être relié à la terre. S'assurer que l'appareil hôte est relié à la terre lors de l'utilisation normale.

**Warnung** Dieses Gerät muß geerdet werden. Stellen Sie sicher, daß das Host-Gerät während des normalen Betriebs an Erde gelegt ist.

**Avvertenza** Questa apparecchiatura deve essere collegata a massa. Accertarsi che il dispositivo host sia collegato alla massa di terra durante il normale utilizzo.

**Advarsel** Dette utstyret skal jordes. Forviss deg om vertsterminalen er jordet ved normalt bruk.

**Aviso** Este equipamento deverá estar ligado à terra. Certifique-se que o host se encontra ligado à terra durante a sua utilização normal.

**¡Atención!** Este equipo debe conectarse a tierra. Asegurarse de que el equipo principal esté conectado a tierra durante el uso normal.

**Varning!** Denna utrustning är avsedd att jordas. Se till att värdenheten är jordad vid normal användning.

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**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- [Installation Instructions Warning on page 401](#)
- *AC Power Electrical Safety Guidelines*
- *DC Power Electrical Safety Guidelines*



# Radiation and Laser Safety Guidelines and Warnings

- [Radiation from Open Port Apertures Warning on page 411](#)
- [Laser and LED Safety Guidelines and Warnings on page 412](#)

## Radiation from Open Port Apertures Warning

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**WARNING:** Because invisible radiation might be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures.

**Waarschuwing** Aangezien onzichtbare straling vanuit de opening van de poort kan komen als er geen fiberkabel aangesloten is, dient blootstelling aan straling en het kijken in open openingen vermeden te worden.

**Varoitus** Koska portin aukosta voi emittoitua näkymätöntä säteilyä, kun kuitukaapelia ei ole kytkettynä, vältä säteilylle altistumista äläkä katso avoimiin aukkoihin.

**Attention** Des radiations invisibles à l'il nu pouvant traverser l'ouverture du port lorsqu'aucun câble en fibre optique n'y est connecté, il est recommandé de ne pas regarder fixement l'intérieur de ces ouvertures.

**Warnung** Aus der Port-Öffnung können unsichtbare Strahlen emittieren, wenn kein Glasfaserkabel angeschlossen ist. Vermeiden Sie es, sich den Strahlungen auszusetzen, und starren Sie nicht in die Öffnungen!

**Avvertenza** Quando i cavi in fibra non sono inseriti, radiazioni invisibili possono essere emesse attraverso l'apertura della porta. Evitate di esporvi alle radiazioni e non guardate direttamente nelle aperture.

**Advarsel** Unngå utsettelse for stråling, og stirr ikke inn i åpninger som er åpne, fordi usynlig stråling kan emitteres fra portens åpning når det ikke er tilkoblet en fiberkabel.

**Aviso** Dada a possibilidade de emissão de radiação invisível através do orifício da via de acesso, quando esta não tiver nenhum cabo de fibra conectado,

deverá evitar a exposição à radiação e não deverá olhar fixamente para orifícios que se encontrarem a descoberto.

**¡Atención!** Debido a que la apertura del puerto puede emitir radiación invisible cuando no existe un cable de fibra conectado, evite mirar directamente a las aperturas para no exponerse a la radiación.

**Varning!** Osynlig strålning kan avges från en portöppning utan ansluten fiberkabel och du bör därför undvika att bli utsatt för strålning genom att inte stirra in i oskyddade öppningar.

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**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- [Laser and LED Safety Guidelines and Warnings on page 412](#)
- [Installation Instructions Warning on page 401](#)
- [Grounded Equipment Warning on page 408](#)

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## Laser and LED Safety Guidelines and Warnings

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Juniper Networks devices are equipped with laser transmitters, which are considered a Class 1 Laser Product by the U.S. Food and Drug Administration and are evaluated as a Class 1 Laser Product per EN 60825-1 requirements.

Observe the following guidelines and warnings:

- [General Laser Safety Guidelines on page 412](#)
- [Class 1 Laser Product Warning on page 413](#)
- [Class 1 LED Product Warning on page 413](#)
- [Laser Beam Warning on page 413](#)

### General Laser Safety Guidelines

When working around ports that support optical transceivers, observe the following safety guidelines to prevent eye injury:

- Do not look into unterminated ports or at fibers that connect to unknown sources.
  - Do not examine unterminated optical ports with optical instruments.
  - Avoid direct exposure to the beam.
- 



**WARNING:** Unterminated optical connectors can emit invisible laser radiation. The lens in the human eye focuses all the laser power on the retina, so focusing the eye directly on a laser source—even a low-power laser—could permanently damage the eye.

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## Class 1 Laser Product Warning



**WARNING:** Class 1 laser product.

**Waarschuwing** Klasse-1 laser produkt.

**Varoitus** Luokan 1 lasertuote.

**Attention** Produit laser de classe I.

**Warnung** Laserprodukt der Klasse 1.

**Avvertenza** Prodotto laser di Classe 1.

**Advarsel** Laserprodukt av klasse 1.

**Aviso** Produto laser de classe 1.

**¡Atención!** Producto láser Clase I.

**Varning!** Laserprodukt av klass 1.

## Class 1 LED Product Warning



**WARNING:** Class 1 LED product.

**Waarschuwing** Klasse 1 LED-product.

**Varoitus** Luokan 1 valodiodituote.

**Attention** Alarme de produit LED Class I.

**Warnung** Class 1 LED-Produktwarnung.

**Avvertenza** Avvertenza prodotto LED di Classe 1.

**Advarsel** LED-produkt i klasse 1.

**Aviso** Produto de classe 1 com LED.

**¡Atención!** Aviso sobre producto LED de Clase 1.

**Varning!** Lysdiodprodukt av klass 1.

## Laser Beam Warning



**WARNING:** Do not stare into the laser beam or view it directly with optical instruments.

**Waarschuwing** Niet in de straal staren of hem rechtstreeks bekijken met optische instrumenten.

**Varoitus** Älä katso säteeseen äläkä tarkastele sitä suoraan optisen laitteen avulla.

**Attention** Ne pas fixer le faisceau des yeux, ni l'observer directement à l'aide d'instruments optiques.

**Warnung** Nicht direkt in den Strahl blicken und ihn nicht direkt mit optischen Geräten prüfen.

**Avvertenza** Non fissare il raggio con gli occhi né usare strumenti ottici per osservarlo direttamente.

**Advarsel** Stirr eller se ikke direkte p strlen med optiske instrumenter.

**Aviso** Não olhe fixamente para o raio, nem olhe para ele directamente com instrumentos ópticos.

**¡Atención!** No mirar fijamente el haz ni observarlo directamente con instrumentos ópticos.

**Varning!** Rikta inte blicken in mot strålen och titta inte direkt på den genom optiska instrument.

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**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- [Radiation from Open Port Apertures Warning on page 411](#)
- [Installation Instructions Warning on page 401](#)
- [Grounded Equipment Warning on page 408](#)



# Maintenance and Operational Safety Warnings

- [Maintenance and Operational Safety Guidelines and Warnings on page 415](#)

## Maintenance and Operational Safety Guidelines and Warnings

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While performing the maintenance activities for devices, observe the following guidelines and warnings:

- [Battery Handling Warning on page 415](#)
- [Jewelry Removal Warning on page 416](#)
- [Lightning Activity Warning on page 417](#)
- [Operating Temperature Warning on page 418](#)
- [Product Disposal Warning on page 419](#)

### Battery Handling Warning



**WARNING:** Replacing a battery incorrectly might result in an explosion.

Replace a battery only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

**Waarschuwing** Er is ontplofingsgevaar als de batterij verkeerd vervangen wordt. Vervang de batterij slechts met hetzelfde of een equivalent type dat door de fabrikant aanbevolen is. Gebruikte batterijen dienen overeenkomstig fabrieksvoorschriften weggeworpen te worden.

**Varoitus** Räjähdyksen vaara, jos akku on vaihdettu väärään akkuun. Käytä vaihtamiseen ainoastaan saman- tai vastaavantyyppistä akkua, joka on valmistajan suosittelema. Hävitä käytetyt akut valmistajan ohjeiden mukaan.

**Attention** Danger d'explosion si la pile n'est pas remplacée correctement. Ne la remplacer que par une pile de type semblable ou équivalent, recommandée par le fabricant. Jeter les piles usagées conformément aux instructions du fabricant.

**Warnung** Bei Einsetzen einer falschen Batterie besteht Explosionsgefahr. Ersetzen Sie die Batterie nur durch den gleichen oder vom Hersteller empfohlenen Batterietyp. Entsorgen Sie die benutzten Batterien nach den Anweisungen des Herstellers.

**Advarsel** Det kan være fare for eksplosjon hvis batteriet skiftes på feil måte. Skift kun med samme eller tilsvarende type som er anbefalt av produsenten. Kasser brukte batterier i henhold til produsentens instruksjoner.

**Avvertenza** Pericolo di esplosione se la batteria non è installata correttamente. Sostituire solo con una di tipo uguale o equivalente, consigliata dal produttore. Eliminare le batterie usate secondo le istruzioni del produttore.

**Aviso** Existe perigo de explosão se a bateria for substituída incorrectamente. Substitua a bateria por uma bateria igual ou de um tipo equivalente recomendado pelo fabricante. Destrua as baterias usadas conforme as instruções do fabricante.

**¡Atención!** Existe peligro de explosión si la batería se reemplaza de manera incorrecta. Reemplazar la batería exclusivamente con el mismo tipo o el equivalente recomendado por el fabricante. Desechar las baterías gastadas según las instrucciones del fabricante.

**Varning!** Explosionsfara vid felaktigt batteribyte. Ersätt endast batteriet med samma batterityp som rekommenderas av tillverkaren eller motsvarande. Följ tillverkarens anvisningar vid kassering av använda batterier.

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## Jewelry Removal Warning



**WARNING:** Before working on equipment that is connected to power lines, remove jewelry, including rings, necklaces, and watches. Metal objects heat up when connected to power and ground and can cause serious burns or can be welded to the terminals.

**Waarschuwing** Alvorens aan apparatuur te werken die met elektrische leidingen is verbonden, sieraden (inclusief ringen, kettingen en horloges) verwijderen. Metalen voorwerpen worden warm wanneer ze met stroom en aarde zijn verbonden, en kunnen ernstige brandwonden veroorzaken of het metalen voorwerp aan de aansluitklemmen lassen.

**Varoitus** Ennen kuin työskentelet voimavirtajohtoihin kytkettyjen laitteiden parissa, ota pois kaikki korut (sormukset, kaulakorut ja kellot mukaan lukien). Metalliesineet kuumenevat, kun ne ovat yhteydessä sähkövirran ja maan kanssa, ja ne voivat aiheuttaa vakavia palovammoja tai hitsata metalliesineet kiinni liitäntänapoihin.

**Attention** Avant d'accéder à cet équipement connecté aux lignes électriques, ôter tout bijou (anneaux, colliers et montres compris). Lorsqu'ils sont branchés

à l'alimentation et reliés à la terre, les objets métalliques chauffent, ce qui peut provoquer des blessures graves ou souder l'objet métallique aux bornes.

**Warnung** Vor der Arbeit an Geräten, die an das Netz angeschlossen sind, jeglichen Schmuck (einschließlich Ringe, Ketten und Uhren) abnehmen. Metallgegenstände erhitzen sich, wenn sie an das Netz und die Erde angeschlossen werden, und können schwere Verbrennungen verursachen oder an die Anschlußklemmen angeschweißt werden.

**Avvertenza** Prima di intervenire su apparecchiature collegate alle linee di alimentazione, togliersi qualsiasi monile (inclusi anelli, collane, braccialetti ed orologi). Gli oggetti metallici si riscaldano quando sono collegati tra punti di alimentazione e massa: possono causare ustioni gravi oppure il metallo può saldarsi ai terminali.

**Advarsel** Fjern alle smykker (inkludert ringer, halskjeder og klokker) før du skal arbeide på utstyr som er koblet til kraftledninger. Metallgjenstander som er koblet til kraftledninger og jord blir svært varme og kan forårsake alvorlige brannskader eller smelte fast til polene.

**Aviso** Antes de trabalhar em equipamento que esteja ligado a linhas de corrente, retire todas as jóias que estiver a usar (incluindo anéis, fios e relógios). Os objectos metálicos aquecerão em contacto com a corrente e em contacto com a ligação à terra, podendo causar queimaduras graves ou ficarem soldados aos terminais.

**¡Atención!** Antes de operar sobre equipos conectados a líneas de alimentación, quitarse las joyas (incluidos anillos, collares y relojes). Los objetos de metal se calientan cuando se conectan a la alimentación y a tierra, lo que puede ocasionar quemaduras graves o que los objetos metálicos queden soldados a los bornes.

**Varning!** Tag av alla smycken (inklusive ringar, halsband och armbandsur) innan du arbetar på utrustning som är kopplad till kraftledningar. Metallobjekt hettas upp när de kopplas ihop med ström och jord och kan förorsaka allvarliga brännskador; metallobjekt kan också sammansvetsas med kontakterna.

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## Lightning Activity Warning

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**WARNING:** Do not work on the system or connect or disconnect cables during periods of lightning activity.

**Waarschuwing** Tijdens onweer dat gepaard gaat met bliksem, dient u niet aan het systeem te werken of kabels aan te sluiten of te ontkoppelen.

**Varoitus** Älä työskentele järjestelmän parissa äläkä yhdistä tai irrota kaapeleita ukkosilmalla.

**Attention** Ne pas travailler sur le système ni brancher ou débrancher les câbles pendant un orage.

**Warnung** Arbeiten Sie nicht am System und schließen Sie keine Kabel an bzw. trennen Sie keine ab, wenn es gewittert.

**Avvertenza** Non lavorare sul sistema o collegare oppure scollegare i cavi durante un temporale con fulmini.

**Advarsel** Utfør aldri arbeid på systemet, eller koble kabler til eller fra systemet når det tordner eller lyner.

**Aviso** Não trabalhe no sistema ou ligue e desligue cabos durante períodos de mau tempo (trovoada).

**¡Atención!** No operar el sistema ni conectar o desconectar cables durante el transcurso de descargas eléctricas en la atmósfera.

**Varning!** Vid åska skall du aldrig utföra arbete på systemet eller ansluta eller koppla loss kablar.

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## Operating Temperature Warning

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**WARNING:** To prevent the device from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature. To prevent airflow restriction, allow at least 6 in. (15.2 cm) of clearance around the ventilation openings.

**Waarschuwing** Om te voorkomen dat welke switch van de Juniper Networks router dan ook oververhit raakt, dient u deze niet te bedienen op een plaats waar de maximale aanbevolen omgevingstemperatuur van 40° C wordt overschreden. Om te voorkomen dat de luchtstroom wordt beperkt, dient er minstens 15,2 cm speling rond de ventilatie-openingen te zijn.

**Varoituis** Ettei Juniper Networks switch-sarjan reititin ylikuumentuisi, sitä ei saa käyttää tilassa, jonka lämpötila ylittää korkeimman suositellun ympäristölämpötilan 40° C. Ettei ilmanvaihto estyisi, tuuletusaukkojen ympärille on jätettävä ainakin 15,2 cm tilaa.

**Attention** Pour éviter toute surchauffe des routeurs de la gamme Juniper Networks switch, ne l'utilisez pas dans une zone où la température ambiante est supérieure à 40° C. Pour permettre un flot d'air constant, dégagez un espace d'au moins 15,2 cm autour des ouvertures de ventilations.

**Warnung** Um einen Router der switch vor Überhitzung zu schützen, darf dieser nicht in einer Gegend betrieben werden, in der die Umgebungstemperatur das empfohlene Maximum von 40° C überschreitet. Um Lüftungsverschluß zu verhindern, achten Sie darauf, daß mindestens 15,2 cm lichter Raum um die Lüftungsöffnungen herum frei bleibt.

**Avvertenza** Per evitare il surriscaldamento dei switch, non adoperateli in un locale che ecceda la temperatura ambientale massima di 40° C. Per evitare che la circolazione dell'aria sia impedita, lasciate uno spazio di almeno 15.2 cm di fronte alle aperture delle ventole.

**Advarsel** Unngå overoppheting av eventuelle rutere i Juniper Networks switch. Disse skal ikke brukes på steder der den anbefalte maksimale omgivelsestemperaturen overstiger 40° C (104° F). Sørg for at klaringen rundt lufteåpningene er minst 15,2 cm (6 tommer) for å forhindre nedsatt luftsirkulasjon.

**Aviso** Para evitar o sobreaquecimento do encaminhador Juniper Networks switch, não utilize este equipamento numa área que exceda a temperatura máxima recomendada de 40° C. Para evitar a restrição à circulação de ar, deixe pelo menos um espaço de 15,2 cm à volta das aberturas de ventilação.

**¡Atención!** Para impedir que un encaminador de la serie Juniper Networks switch se recaliente, no lo haga funcionar en un área en la que se supere la temperatura ambiente máxima recomendada de 40° C. Para impedir la restricción de la entrada de aire, deje un espacio mínimo de 15,2 cm alrededor de las aperturas para ventilación.

**Varning!** Förhindra att en Juniper Networks switch överhettas genom att inte använda den i ett område där den maximalt rekommenderade omgivningstemperaturen på 40° C överskrids. Förhindra att luftcirkulationen inskränks genom att se till att det finns fritt utrymme på minst 15,2 cm omkring ventilationsöppningarna.

## Product Disposal Warning



**WARNING:** Disposal of this device must be handled according to all national laws and regulations.

**Waarschuwing** Dit produkt dient volgens alle landelijke wetten en voorschriften te worden afgedankt.

**Varoitus** Tämän tuotteen lopullisesta hävittämisestä tulee huolehtia kaikkia valtakunnallisia lakeja ja säännöksiä noudattaen.

**Attention** La mise au rebut définitive de ce produit doit être effectuée conformément à toutes les lois et réglementations en vigueur.

**Warnung** Dieses Produkt muß den geltenden Gesetzen und Vorschriften entsprechend entsorgt werden.

**Avvertenza** L'eliminazione finale di questo prodotto deve essere eseguita osservando le normative italiane vigenti in materia

**Advarsel** Endelig disponering av dette produktet må skje i henhold til nasjonale lover og forskrifter.

**Aviso** A descartagem final deste produto deverá ser efectuada de acordo com os regulamentos e a legislação nacional.

**¡Atención!** El desecho final de este producto debe realizarse según todas las leyes y regulaciones nacionales

**Varning!** Slutlig kassering av denna produkt bör skötas i enlighet med landets alla lagar och föreskrifter.

**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- *AC Power Electrical Safety Guidelines*
- *DC Power Electrical Safety Guidelines*
- [Laser and LED Safety Guidelines and Warnings on page 412](#)
- [Installation Instructions Warning on page 401](#)
- [Grounded Equipment Warning on page 408](#)

# Electrical Safety Guidelines and Warnings

- General Electrical Safety Guidelines and Warnings on page 421
- Action to Take After an Electrical Accident on page 422
- Prevention of Electrostatic Discharge Damage on page 423
- T4000 DC Power Electrical Safety Guidelines on page 424
- DC Power Copper Conductors Warning on page 425
- DC Power Disconnection Warning on page 426
- DC Power Grounding Requirements and Warning on page 427
- DC Power Wiring Sequence Warning on page 428
- DC Power Wiring Terminations Warning on page 430
- Midplane Energy Hazard Warning on page 431
- Multiple Power Supplies Disconnection Warning on page 432
- TN Power Warning on page 433

## General Electrical Safety Guidelines and Warnings

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**WARNING:** Certain ports on the device are designed for use as intrabuilding (within-the-building) interfaces only (Type 2 or Type 4 ports as described in *GR-1089-CORE*) and require isolation from the exposed outside plant (OSP) cabling. To comply with NEBS requirements and protect against lightning surges and commercial power disturbances, the intrabuilding ports *must not* be metalically connected to interfaces that connect to the OSP or its wiring. The intrabuilding ports on the device are suitable for connection to intrabuilding or unexposed wiring or cabling only. The addition of primary protectors is not sufficient protection for connecting these interfaces metalically to OSP wiring.



**CAUTION:** Before removing or installing components of a device, connect an electrostatic discharge (ESD) grounding strap to an ESD point and wrap and fasten the other end of the strap around your bare wrist. Failure to use an ESD grounding strap could result in damage to the device.

- Install the device in compliance with the following local, national, and international electrical codes:
  - United States—National Fire Protection Association (NFPA 70), United States National Electrical Code.
  - Other countries—International Electromechanical Commission (IEC) 60364, Part 1 through Part 7.
  - Evaluated to the TN power system.
  - Canada—Canadian Electrical Code, Part 1, CSA C22.1.
- Locate the emergency power-off switch for the room in which you are working so that if an electrical accident occurs, you can quickly turn off the power.
- Make sure that grounding surfaces are cleaned and brought to a bright finish before grounding connections are made.
- Do not work alone if potentially hazardous conditions exist anywhere in your workspace.
- Never assume that power is disconnected from a circuit. Always check the circuit before starting to work.
- Carefully look for possible hazards in your work area, such as moist floors, ungrounded power extension cords, and missing safety grounds.
- Operate the device within marked electrical ratings and product usage instructions.
- To ensure that the device and peripheral equipment function safely and correctly, use the cables and connectors specified for the attached peripheral equipment, and make certain they are in good condition.

You can remove and replace many device components without powering off or disconnecting power to the device, as detailed elsewhere in the hardware documentation for this device. Never install equipment that appears to be damaged.

**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- *AC Power Electrical Safety Guidelines*
- *DC Power Electrical Safety Guidelines*

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## Action to Take After an Electrical Accident

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If an electrical accident results in an injury, take the following actions in this order:

1. Use caution. Be aware of potentially hazardous conditions that could cause further injury.
2. Disconnect power from the device.
3. If possible, send another person to get medical aid. Otherwise, assess the condition of the victim, then call for help.



- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [General Electrical Safety Guidelines and Warnings on page 421](#)
  - *AC Power Electrical Safety Guidelines*
  - *DC Power Electrical Safety Guidelines*

## Prevention of Electrostatic Discharge Damage

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Device components that are shipped in antistatic bags are sensitive to damage from static electricity. Some components can be impaired by voltages as low as 30 V. You can easily generate potentially damaging static voltages whenever you handle plastic or foam packing material or if you move components across plastic or carpets. Observe the following guidelines to minimize the potential for electrostatic discharge (ESD) damage, which can cause intermittent or complete component failures:

- Always use an ESD wrist strap when you are handling components that are subject to ESD damage, and make sure that it is in direct contact with your skin.

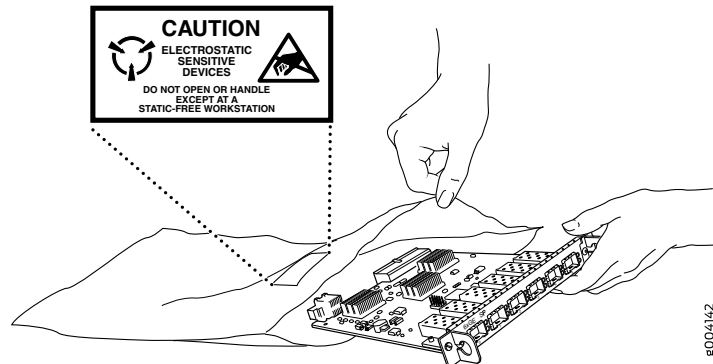
If a grounding strap is not available, hold the component in its antistatic bag (see [Figure 153 on page 424](#)) in one hand and touch the exposed, bare metal of the device with the other hand immediately before inserting the component into the device.



**WARNING:** For safety, periodically check the resistance value of the ESD grounding strap. The measurement must be in the range 1 through 10 Mohms.

- When handling any component that is subject to ESD damage and that is removed from the device, make sure the equipment end of your ESD wrist strap is attached to the ESD point on the chassis.  
  
If no grounding strap is available, touch the exposed, bare metal of the device to ground yourself before handling the component.
- Avoid contact between the component that is subject to ESD damage and your clothing. ESD voltages emitted from clothing can damage components.
- When removing or installing a component that is subject to ESD damage, always place it component-side up on an antistatic surface, in an antistatic card rack, or in an antistatic bag (see [Figure 153 on page 424](#)). If you are returning a component, place it in an antistatic bag before packing it.

Figure 153: Placing a Component into an Antistatic Bag



**CAUTION:** ANSI/TIA/EIA-568 cables such as Category 5e and Category 6 can get electrostatically charged. To dissipate this charge, always ground the cables to a suitable and safe earth ground before connecting them to the system.

#### Related Documentation

- [General Safety Guidelines and Warnings on page 393](#)

## T4000 DC Power Electrical Safety Guidelines

The following electrical safety guidelines apply to a DC-powered router:

- Incorporate an easily accessible disconnect device into the facility wiring. In the United States and Canada, the –48 VDC facility should be equipped with a circuit breaker rated a minimum of 125% of the power provisioned for the input in accordance with the National Electrical Code in the US and the Canadian Electrical Code in Canada.



**WARNING:** Failure to provide the required circuit breaker or current-limiting fuse for each DC power cable can cause injury or damage to equipment.

Each 48 VDC facility DC source input power cable must be equipped with a current-limiting fuse or circuit breaker external to the Juniper Networks equipment rated at 100 A (–48 VDC) maximum for the six-input DC power supply, or as required by local code. The voltage rating of the facility DC source circuit breaker must be 80 V minimum. We recommend an 80 A circuit breaker or current-limiting fuse rated for each 60 A DC power cable. We recommend a 100 A circuit breaker or current-limiting fuse rated for each 80 A DC power cable.

- The marked input voltage of –48 VDC for a DC-powered router is the nominal voltage associated with the battery circuit, and any higher voltages are only to be associated with float voltages for the charging function.

- A DC-powered router that is equipped with a DC terminal block is intended only for installation in a restricted access location. In the United States, a restricted access area is one in accordance with Articles 110-16, 110-17, and 110-18 of the National Electrical Code ANSI/NFPA 70.



**NOTE:** Primary overcurrent protection is provided by the building circuit breaker. This breaker should protect against excess currents, short circuits, and earth faults in accordance with NEC ANSI/NFPA70.

- A DC-powered router is equipped with a DC terminal block that is rated for the power requirements of a maximally configured router. To supply sufficient power, terminate the DC input wiring on a facility DC source capable of supplying at least 60 A @ –48 VDC per input for the six-input DC power supply.

Run two wires from the circuit breaker box to a source of 48 VDC. Use appropriate gauge wire to handle up to 80 A for 60 A DC power cables or 100 A for 80 A DC power cables. .



**NOTE:** Only 60 A feeds are currently supported.

- Be sure to connect the ground wire or conduit to a solid office (earth) ground. A closed loop ring is recommended for terminating the ground conductor at the ground stud.
- Ensure that the polarity of the DC input wiring is correct. Under certain conditions, connections with reversed polarity might trip the primary circuit breaker or damage the equipment.
- For personal safety, connect the green and yellow wire to safety (earth) ground at both the router and the supply side of the DC wiring.
- Because the router is a positive ground system, you must connect the positive lead to the terminal labeled **RTN**, the negative lead to the terminal labeled **–48V**, and the earth ground to the chassis grounding points.

#### Related Documentation

- [Site Electrical Wiring Guidelines on page 93](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- [T4000 DC Power System Electrical Specifications on page 101](#)

## DC Power Copper Conductors Warning



**WARNING:** Use copper conductors only.

**Waarschuwing** Gebruik alleen koperen geleiders.

**Varoitus** Käytä vain kuparijohtimia.

**Attention** Utilisez uniquement des conducteurs en cuivre.

**Warnung** Verwenden Sie ausschließlich Kupferleiter.

**Avvertenza** Usate unicamente dei conduttori di rame.

**Advarsel** Bruk bare kobberledninger.

**Aviso** Utilize apenas fios condutores de cobre.

**¡Atención!** Emplee sólo conductores de cobre.

**Varning!** Använd endast ledare av koppar.

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## DC Power Disconnection Warning

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**WARNING:** Before performing any of the DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the device handle of the circuit breaker in the OFF position.

**Waarschuwing** Voordat u een van de onderstaande procedures uitvoert, dient u te controleren of de stroom naar het gelijkstroom circuit uitgeschakeld is. Om u ervan te verzekeren dat alle stroom UIT is geschakeld, kiest u op het schakelbord de stroomverbreker die het gelijkstroom circuit bedient, draait de stroomverbreker naar de UIT positie en plakt de schakelaarhandel van de stroomverbreker met plakband in de UIT positie vast.

**Varoitus** Varmista, että tasavirtapiirissä ei ole virtaa ennen seuraavien toimenpiteiden suorittamista. Varmistaaksesi, että virta on KATKAISTU täysin, paikanna tasavirrasta huolehtivassa kojetaulussa sijaitseva suojakytkin, käännä suojakytkin KATKAISTU-asentoon ja teippaa suojakytkimen varsi niin, että se pysyy KATKAISTU-asennossa.

**Attention** Avant de pratiquer l'une quelconque des procédures ci-dessous, vérifiez que le circuit en courant continu n'est plus sous tension. Pour en être sûr, localiser le disjoncteur situé sur le panneau de service du circuit en courant continu, placer le disjoncteur en position fermée (OFF) et, à l'aide d'un ruban adhésif, bloquer la poignée du disjoncteur en position OFF.

**Warnung** Vor Ausführung der folgenden Vorgänge ist sicherzustellen, daß die Gleichstromschaltung keinen Strom erhält. Um sicherzustellen, daß sämtlicher Strom abgestellt ist, machen Sie auf der Schalttafel den Unterbrecher für die Gleichstromschaltung ausfindig, stellen Sie den Unterbrecher auf AUS, und kleben Sie den Schaltergriff des Unterbrechers mit Klebeband in der AUS-Stellung fest.

**Avvertenza** Prima di svolgere una qualsiasi delle procedure seguenti, verificare che il circuito CC non sia alimentato. Per verificare che tutta l'alimentazione sia scollegata (OFF), individuare l'interruttore automatico sul quadro strumenti che alimenta il circuito CC, mettere l'interruttore in posizione OFF e fissarlo con nastro adesivo in tale posizione.

**Advarsel** Før noen av disse prosedyrene utføres, kontroller at strømmen er frakoblet likestrømkretsen. Sørg for at all strøm er slått AV. Dette gjøres ved å lokalisere strømbryteren på brytertavlen som betjener likestrømkretsen, slå strømbryteren AV og teipe bryterhåndtaket på strømbryteren i AV-stilling.

**Aviso** Antes de executar um dos seguintes procedimentos, certifique-se que desligou a fonte de alimentação de energia do circuito de corrente contínua. Para se assegurar que toda a corrente foi DESLIGADA, localize o disjuntor no painel que serve o circuito de corrente contínua e coloque-o na posição OFF (Desligado), segurando nessa posição a manivela do interruptor do disjuntor com fita isoladora.

**¡Atención!** Antes de proceder con los siguientes pasos, comprobar que la alimentación del circuito de corriente continua (CC) esté cortada (OFF). Para asegurarse de que toda la alimentación esté cortada (OFF), localizar el interruptor automático en el panel que alimenta al circuito de corriente continua, cambiar el interruptor automático a la posición de Apagado (OFF), y sujetar con cinta la palanca del interruptor automático en posición de Apagado (OFF).

**Varning!** Innan du utför någon av följande procedurer måste du kontrollera att strömförsörjningen till likströmskretsen är bruten. Kontrollera att all strömförsörjning är BRUTEN genom att slå AV det överspänningsskydd som skyddar likströmskretsen och tejpa fast överspänningsskyddets omkopplare i FRÅN-läget.

- Related Documentation**
- [General Safety Guidelines and Warnings on page 393](#)
  - [General Electrical Safety Guidelines and Warnings on page 421](#)
  - [DC Power Electrical Safety Guidelines](#)
  - [DC Power Grounding Requirements and Warning on page 427](#)
  - [DC Power Wiring Sequence Warning on page 428](#)
  - [DC Power Wiring Terminations Warning on page 430](#)

## DC Power Grounding Requirements and Warning

An insulated grounding conductor that is identical in size to the grounded and ungrounded branch circuit supply conductors but is identifiable by green and yellow stripes is installed as part of the branch circuit that supplies the device. The grounding conductor is a separately derived system at the supply transformer or motor generator set.



**WARNING:** When you install the device, the ground connection must always be made first and disconnected last.

**Waarschuwing** Bij de installatie van het toestel moet de aardverbinding altijd het eerste worden gemaakt en het laatste worden losgemaakt.

**Varoitus** Laitetta asennettaessa on maahan yhdistäminen aina tehtävä ensiksi ja maadoituksen irti kytkeminen viimeiseksi.

**Attention** Lors de l'installation de l'appareil, la mise à la terre doit toujours être connectée en premier et déconnectée en dernier.

**Warnung** Der Erdanschluß muß bei der Installation der Einheit immer zuerst hergestellt und zuletzt abgetrennt werden.

**Avvertenza** In fase di installazione dell'unità, eseguire sempre per primo il collegamento a massa e disconnetterlo per ultimo.

**Advarsel** Når enheten installeres, må jordledningen alltid tilkobles først og frakobles sist.

**Aviso** Ao instalar a unidade, a ligação à terra deverá ser sempre a primeira a ser ligada, e a última a ser desligada.

**¡Atención!** Al instalar el equipo, conectar la tierra la primera y desconectarla la última.

**Varning!** Vid installation av enheten måste jordledningen alltid anslutas först och kopplas bort sist.

#### Related Documentation

- [General Safety Guidelines and Warnings on page 393](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- *DC Power Electrical Safety Guidelines*
- [DC Power Copper Conductors Warning on page 425](#)
- [DC Power Disconnection Warning on page 426](#)
- [DC Power Wiring Sequence Warning on page 428](#)
- [DC Power Wiring Terminations Warning on page 430](#)

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## DC Power Wiring Sequence Warning



**WARNING:** Wire the DC power supply using the appropriate lugs. When connecting power, the proper wiring sequence is ground to ground, +RTN to +RTN, then –48 V to –48 V. When disconnecting power, the proper wiring

sequence is –48 V to –48 V, +RTN to +RTN, then ground to ground. Note that the ground wire must always be connected first and disconnected last.

**Waarschuwing** De juiste bedradingsvolgorde verbonden is aarde naar aarde, +RTN naar +RTN, en –48 V naar – 48 V. De juiste bedradingsvolgorde losgemaakt is en –48 naar –48 V, +RTN naar +RTN, aarde naar aarde.

**Varoituis** Oikea yhdistettävä kytkentäjäjestys on maajohto maajohtoon, +RTN varten +RTN, –48 V varten – 48 V. Oikea irrotettava kytkentäjäjestys on –48 V varten – 48 V, +RTN varten +RTN, maajohto maajohtoon.

**Attention** Câblez l'alimentation d'alimentation CC En utilisant les crochets appropriés à l'extrémité de câblage. En reliant la puissance, l'ordre approprié de câblage est rectifié pour rectifier, +RTN à +RTN, puis –48 V à –48 V. En débranchant la puissance, l'ordre approprié de câblage est –48 V à –48 V, +RTN à +RTN, a alors rectifié pour rectifier. Notez que le fil de masse devrait toujours être relié d'abord et débranché pour la dernière fois. Notez que le fil de masse devrait toujours être relié d'abord et débranché pour la dernière fois.

**Warnung** Die Stromzufuhr ist nur mit geeigneten Ringösen an das DC Netzteil anzuschliessen. Die richtige Anschlusssequenz ist: Erdanschluss zu Erdanschluss, +RTN zu +RTN und dann –48V zu –48V. Die richtige Sequenz zum Abtrennen der Stromversorgung ist –48V zu –48V, +RTN zu +RTN und dann Erdanschluss zu Erdanschluss. Es ist zu beachten dass der Erdanschluss immer zuerst angeschlossen und als letztes abgetrennt wird.

**Avvertenza** Mostra la morsettiera dell'alimentatore CC. Cablare l'alimentatore CC usando i connettori adatti all'estremità del cablaggio, come illustrato. La corretta sequenza di cablaggio è da massa a massa, da positivo a positivo (da linea ad L) e da negativo a negativo (da neutro a N). Tenere presente che il filo di massa deve sempre venire collegato per primo e scollegato per ultimo.

**Advarsel** Riktig tilkoples tilkoplingssekvens er jord til jord, +RTN til +RTN, –48 V til – 48 V. Riktig frakoples tilkoplingssekvens er –48 V til – 48 V, +RTN til +RTN, jord til jord.

**Aviso** Ate con alambre la fuente de potencia cc Usando los terminales apropiados en el extremo del cableado. Al conectar potencia, la secuencia apropiada del cableado se muele para moler, +RTN a +RTN, entonces –48 V a –48 V. Al desconectar potencia, la secuencia apropiada del cableado es –48 V a –48 V, +RTN a +RTN, entonces molió para moler. Observe que el alambre de tierra se debe conectar siempre primero y desconectar por último. Observe que el alambre de tierra se debe conectar siempre primero y desconectar por último.

**¡Atención!** Wire a fonte de alimentação de DC Usando os talões apropriados na extremidade da fiação. Ao conectar a potência, a seqüência apropriada da fiação é moída para moer, +RTN a +RTN, então –48 V a –48 V. Ao desconectar a potência, a seqüência apropriada da fiação é –48 V a –48 V,

+RTN a +RTN, moeu então para moer. Anote que o fio à terra deve sempre ser conectado primeiramente e desconectado por último. Anote que o fio à terra deve sempre ser conectado primeiramente e desconectado por último.

**Varning!** Korrekt kopplingssekvens ar jord till jord, +RTN till +RTN, –48 V till –48 V. Korrekt kopplas kopplingssekvens ar –48 V till –48 V, +RTN till +RTN, jord till jord.

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**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- [DC Power Electrical Safety Guidelines](#)
- [DC Power Disconnection Warning on page 426](#)
- [DC Power Grounding Requirements and Warning on page 427](#)
- [DC Power Wiring Terminations Warning on page 430](#)

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## DC Power Wiring Terminations Warning

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**WARNING:** When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations must be the appropriate size for the wires and must clamp both the insulation and conductor.

**Waarschuwing** Wanneer geslagen bedrading vereist is, dient u bedrading te gebruiken die voorzien is van goedgekeurde aansluitingspunten, zoals het gesloten-lus type of het grijperschop type waarbij de aansluitpunten omhoog wijzen. Deze aansluitpunten dienen de juiste maat voor de draden te hebben en dienen zowel de isolatie als de geleider vast te klemmen.

**Varoitus** Jos säikeellinen johdin on tarpeen, käytä hyväksyttyä johdinliitintä, esimerkiksi suljettua silmukkaa tai kourumaista liitintä, jossa on ylöspäin käännetyt kiinnityskorvat. Tällaisten liitäntöjen tulee olla kooltaan johtimiin sopivia ja niiden tulee puristaa yhteen sekä eristeen että johdinosan.

**Attention** Quand des fils torsadés sont nécessaires, utiliser des douilles terminales homologuées telles que celles à circuit fermé ou du type à plage ouverte avec cosses rebroussées. Ces douilles terminales doivent être de la taille qui convient aux fils et doivent être refermées sur la gaine isolante et sur le conducteur.

**Warnung** Wenn Litzenverdrahtung erforderlich ist, sind zugelassene Verdrahtungsabschlüsse, z.B. für einen geschlossenen Regelkreis oder gabelförmig, mit nach oben gerichteten Kabelschuhen zu verwenden. Diese Abschlüsse sollten die angemessene Größe für die Drähte haben und sowohl die Isolierung als auch den Leiter festklemmen.



**Avvertenza** Quando occorre usare trecce, usare connettori omologati, come quelli a occhiello o a forcilla con linguette rivolte verso l'alto. I connettori devono avere la misura adatta per il cablaggio e devono serrare sia l'isolante che il conduttore.

**Advarsel** Hvis det er nødvendig med flertrådede ledninger, brukes godkjente ledningsavslutninger, som for eksempel lukket sløyfe eller spadetype med oppoverbøyde kabelsko. Disse avslutningene skal ha riktig størrelse i forhold til ledningene, og skal klemme sammen både isolasjonen og ledaren.

**Aviso** Quando forem requeridas montagens de instalação eléctrica de cabo torcido, use terminações de cabo aprovadas, tais como, terminações de cabo em circuito fechado e planas com terminais de orelha voltados para cima. Estas terminações de cabo deverão ser do tamanho apropriado para os respectivos cabos, e deverão prender simultaneamente o isolamento e o fio condutor.

**¡Atención!** Cuando se necesite hilo trenzado, utilizar terminales para cables homologados, tales como las de tipo "bucle cerrado" o "espada", con las lengüetas de conexión vueltas hacia arriba. Estos terminales deberán ser del tamaño apropiado para los cables que se utilicen, y tendrán que sujetar tanto el aislante como el conductor.

**Varning!** När flertrådiga ledningar krävs måste godkända ledningskontakter användas, t.ex. kabelsko av sluten eller öppen typ med uppåtvänd tapp. Storleken på dessa kontakter måste vara avpassad till ledningarna och måste kunna hålla både isoleringen och ledaren fastklämda.

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**Related  
Documentation**

- [General Safety Guidelines and Warnings on page 393](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- [DC Power Electrical Safety Guidelines](#)
- [DC Power Disconnection Warning on page 426](#)
- [DC Power Grounding Requirements and Warning on page 427](#)
- [DC Power Wiring Sequence Warning on page 428](#)

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## Midplane Energy Hazard Warning



**WARNING:** High levels of electrical energy are distributed across the midplane. Be careful not to contact the midplane connectors, or any component connected to the midplane, with any metallic object while servicing components.

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## Multiple Power Supplies Disconnection Warning

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**WARNING:** The network device has more than one power supply connection. All connections must be removed completely to remove power from the unit completely.

**Waarschuwing** Deze eenheid heeft meer dan één stroomtoevoerverbinding; alle verbindingen moeten volledig worden verwijderd om de stroom van deze eenheid volledig te verwijderen.

**Varoitus** Tässä laitteessa on useampia virtalähdekytkentöjä. Kaikki kytkennät on irrotettava kokonaan, jotta virta poistettaisiin täysin laitteesta.

**Attention** Cette unité est équipée de plusieurs raccordements d'alimentation. Pour supprimer tout courant électrique de l'unité, tous les cordons d'alimentation doivent être débranchés.

**Warnung** Diese Einheit verfügt über mehr als einen Stromanschluß; um Strom gänzlich von der Einheit fernzuhalten, müssen alle Stromzufuhren abgetrennt sein.

**Avvertenza** Questa unità ha più di una connessione per alimentatore elettrico; tutte le connessioni devono essere completamente rimosse per togliere l'elettricità dall'unità.

**Advarsel** Denne enheten har mer enn én strømtilkobling. Alle tilkoblinger må kobles helt fra for å eliminere strøm fra enheten.

**Aviso** Este dispositivo possui mais do que uma conexão de fonte de alimentação de energia; para poder remover a fonte de alimentação de energia, deverão ser desconectadas todas as conexões existentes.

**¡Atención!** Esta unidad tiene más de una conexión de suministros de alimentación; para eliminar la alimentación por completo, deben desconectarse completamente todas las conexiones.

**Varning!** Denna enhet har mer än en strömförsörjningsanslutning; alla anslutningar måste vara helt avlägsnade innan strömtillförseln till enheten är fullständigt bruten.

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### Related Documentation

- [General Safety Guidelines and Warnings on page 393](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- *AC Power Electrical Safety Guidelines*
- *DC Power Electrical Safety Guidelines*

## TN Power Warning



**WARNING:** The device is designed to work with a TN power system.

**Waarschuwing** Het apparaat is ontworpen om te functioneren met TN energiesystemen.

**Varoitus** Koje on suunniteltu toimimaan TN-sähkövoimajärjestelmien yhteydessä.

**Attention** Ce dispositif a été conçu pour fonctionner avec des systèmes d'alimentation TN.

**Warnung** Das Gerät ist für die Verwendung mit TN-Stromsystemen ausgelegt.

**Avvertenza** Il dispositivo è stato progettato per l'uso con sistemi di alimentazione TN.

**Advarsel** Utstyret er utfomet til bruk med TN-strømsystemer.

**Aviso** O dispositivo foi criado para operar com sistemas de corrente TN.

**¡Atención!** El equipo está diseñado para trabajar con sistemas de alimentación tipo TN.

**Varning!** Enheten är konstruerad för användning tillsammans med elkraftssystem av TN-typ.

### Related Documentation

- [General Safety Guidelines and Warnings on page 393](#)
- [General Electrical Safety Guidelines and Warnings on page 421](#)
- [Grounded Equipment Warning on page 408](#)
- [Multiple Power Supplies Disconnection Warning on page 432](#)



## CHAPTER 46

# Agency Approvals and Compliance Statements

- [T4000 Agency Approvals on page 435](#)
- [Compliance Statements for EMC Requirements on page 436](#)
- [Compliance Statements for Environmental Requirements on page 437](#)
- [T4000 Compliance Statements for NEBS on page 437](#)
- [T4000 Compliance Statements for Acoustic Noise on page 438](#)

## T4000 Agency Approvals

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The router complies with the following standards:

- Safety
  - CAN/CSA-22.2 No. 60950-1-07/UL 60950-1, 2nd Ed., Safety of Information Technology Equipment
  - EN 60825-1 +A1+A2 (1994) Safety of Laser Products - Part 1: Equipment Classification
- EMC
  - AS/NZS 3548 Class A (Australia/New Zealand)
  - EN55022 Class A (Europe)
  - FCC Part 15 Class A (USA)
  - VCCI Class A (Japan)
- Immunity
  - EN-61000-3-3 Voltage Fluctuations and Flicker
  - EN-61000-4-2 ESD
  - EN-61000-4-3 Radiated Immunity
  - EN-61000-4-4 EFT

- EN-61000-4-5 Surge
- EN-61000-4-6 Low Frequency Common Immunity
- ETSI EN-300386-2 Telecommunication Network Equipment. Electromagnetic Compatibility Requirements

The router is designed to comply with the following standards:

- NEBS
  - GR-1089-Core: EMC and Electrical Safety for Network Telecommunications Equipment
  - SR-3580 NEBS Criteria Levels (Level 3 Compliance)
  - GR-63-Core: NEBS, Physical Protection

**Related  
Documentation**

- [T4000 Router Description on page 3](#)
- [Compliance Statements for EMC Requirements on page 436](#)
- [Compliance Statements for Environmental Requirements on page 437](#)
- [T4000 Compliance Statements for NEBS on page 437](#)
- [T4000 Compliance Statements for Acoustic Noise on page 438](#)

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## Compliance Statements for EMC Requirements

- [Canada on page 436](#)
- [European Community on page 436](#)
- [Israel on page 437](#)
- [Japan on page 437](#)
- [United States on page 437](#)

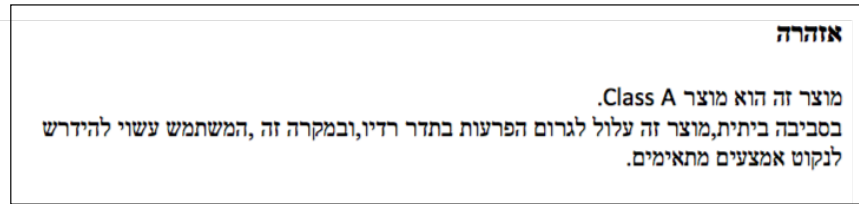
### Canada

CAN ICES-3 (A)/NMB-3(A)

### European Community

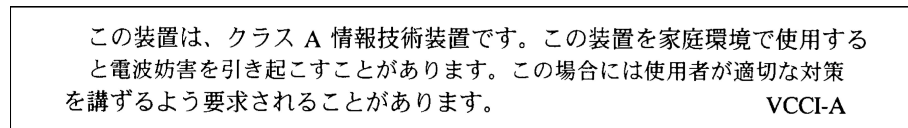
This is a Class A product. In a domestic environment, this product might cause radio interference in which case the user might be required to take adequate measures.

## Israel



Translation from Hebrew—Warning: This product is Class A. In residential environments, the product might cause radio interference, and in such a situation, the user might be required to take adequate measures.

## Japan



The preceding translates as follows:

This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this product is used near a radio or television receiver in a domestic environment, it might cause radio interference. Install and use the equipment according to the instruction manual. VCCI-A.

## United States

The hardware equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## Compliance Statements for Environmental Requirements

Batteries in this product are not based on mercury, lead, or cadmium substances. The batteries used in this product are in compliance with EU Directives 91/157/EEC, 93/86/EEC, and 98/101/EEC. The product documentation includes instructional information about the proper method of reclamation and recycling.

## T4000 Compliance Statements for NEBS

- The equipment is suitable for installation as part of the Common Bonding Network (CBN).

- The equipment is suitable for installation in locations where the National Electrical Code (NEC) applies.
- The battery return connection is to be treated as an isolated DC return (i.e. DC-I), as defined in GR-1089-CORE.

**Related Documentation** • [T4000 Agency Approvals on page 435](#)

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## T4000 Compliance Statements for Acoustic Noise

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Maschinenlärminformations-Verordnung - 3. GPSGV, der höchste Schalldruckpegel beträgt 76.5 dB(A) oder weniger gemäss EN ISO 7779

Translation:

The emitted sound pressure resulted in 76.5 dB(A) per EN ISO 7779.

**Related Documentation** • [T4000 Agency Approvals on page 435](#)