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# T320 Core Router Hardware Guide



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*T320 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<sup>®</sup> technical documentation, see the product documentation page on the Juniper Networks website at <http://www.juniper.net/techpubs/>.

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 <http://www.juniper.net/books>.

## Supported Platforms

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

- T320

## Documentation Conventions

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Table 1 on page xxiv 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 xxiv 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 <code>[edit protocols ospf area area-id]</code> hierarchy level.</li> <li>The console port is labeled <b>CONSOLE</b>.</li> </ul>
< > (angle brackets)	Encloses optional keywords or variables.	<b>stub</b> <default-metric <i>metric</i> >;
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	<b>broadcast   multicast</b> <i>(string1   string2   string3)</i>
# (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 [ community-ids ]</b>
Indentation and braces ( { } )	Identifies a level in the configuration hierarchy.	<code>[edit] routing-options {   static {     route default {       nexthop <i>address</i>;       retain;     }   } }</code>
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
<b>GUI Conventions</b>		
<b>Bold text like this</b>	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 <http://www.juniper.net/techpubs/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 <http://www.juniper.net/techpubs/feedback/>.

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## 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 <http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf>.
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/>.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

## Self-Help Online Tools and Resources

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

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

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

## Opening a Case with JTAC

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

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

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



## PART 1

# Overview

- [System Overview and Architecture on page 3](#)
- [T320 Router Release Notes on page 11](#)
- [Chassis Components and Descriptions on page 13](#)
- [Cooling System Components and Descriptions on page 25](#)
- [Host Subsystem Components and Descriptions on page 29](#)
- [Line Card Components and Descriptions on page 57](#)
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- [Switch Fabric Components and Descriptions on page 79](#)



## CHAPTER 1

# System Overview and Architecture

- [T320 Router Description on page 3](#)
- [T320 Component Redundancy on page 4](#)
- [System Architecture Description for T Series Routers on page 5](#)
- [Routing Engine Functions for T Series Routers on page 5](#)
- [Packet Forwarding Engine Architecture for T Series Routers on page 7](#)

## T320 Router Description

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The T320 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).

Application-specific integrated circuits (ASICs) are a definitive part of the router design; these ASICs enable the router to achieve data forwarding rates that match current fiber-optic capacity.

The router accommodates up to eight Flexible PIC Concentrators (FPCs), which can each be configured with a variety of network media types—altogether providing up to 64 Gigabit Ethernet, 64 SONET/SDH OC-48/STM-16, or 16 SONET/SDH OC-192/STM-64 ports for the router.

The router's maximum aggregate throughput is 160 Gbps, full duplex. The router can forward traffic at high-performance rates for any combination of PICs that does not exceed 20 Gbps on a single FPC3. Any combination exceeding 20 Gbps is supported, but constitutes oversubscription. For information about the FPC types, see [“T320 FPCs Supported” on page 63](#).

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 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.

- Related Documentation**
- [T320 Chassis Description on page 13](#)
  - [T320 Physical Specifications on page 86](#)
  - [T320 Environmental Specifications on page 87](#)
  - [T320 Power Requirements on page 90](#)

## T320 Component Redundancy

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The T320 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 three SIBs. Each Type 1 FPC and Type 2 FPC has a dedicated ASIC with five high-speed links that connect to the SIBs (one link per SIB). A Type 3 FPC has two dedicated ASICs, and each ASIC has five high-speed links that connect to the SIBs (a total of 10 links). One of the three SIBs—usually **SIB0**—acts as a backup to the remaining two SIBs. In the event of a SIB failure, the backup SIB becomes active and traffic forwarding continues without any degradation. When the failed SIB is replaced, it becomes the new backup.
- **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.
- **SONET Clock Generators (SCGs)**—The router has a standard configuration of one SCG, but 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.
- **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.
- **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.

- Related Documentation**
- [T320 Router Description on page 3](#)
  - [T320 Switch Interface Boards \(SIBs\) Description on page 79](#)
  - [T320 Host Subsystem Description on page 29](#)
  - [T320 SONET Clock Generator \(SCG\) Description on page 19](#)
  - [T320 Power System Description on page 77](#)
  - [T320 Cooling System Description on page 25](#)



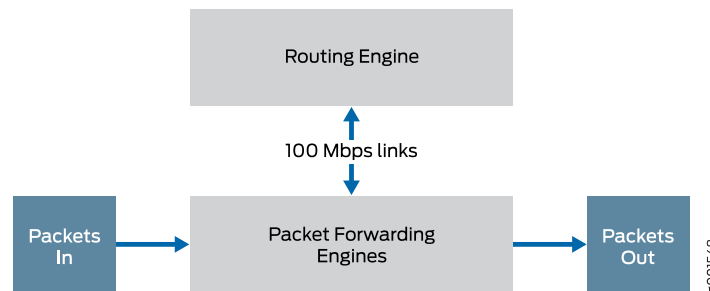
## System Architecture Description for T Series Routers

The T Series Core Routers have two main architectural components:

- **Routing Engine**—One or more Routing Engines provide Layer 3 routing services and network management.
- **Packet Forwarding Engines**—These high-performance, ASIC-based components provide Layer 2 and Layer 3 packet switching, route lookups, and packet forwarding.

The Routing Engines and the Packet Forwarding Engines perform their primary tasks independently, although they constantly communicate through multiple 100 millions of packets per second (Mbps) links. This arrangement streamlines forwarding and routing control and runs Internet-scale backbone networks at high speeds. [Figure 1 on page 5](#) shows the relationship between the Routing Engine and the Packet Forwarding Engines.

**Figure 1: Router Architecture**



### Related Documentation

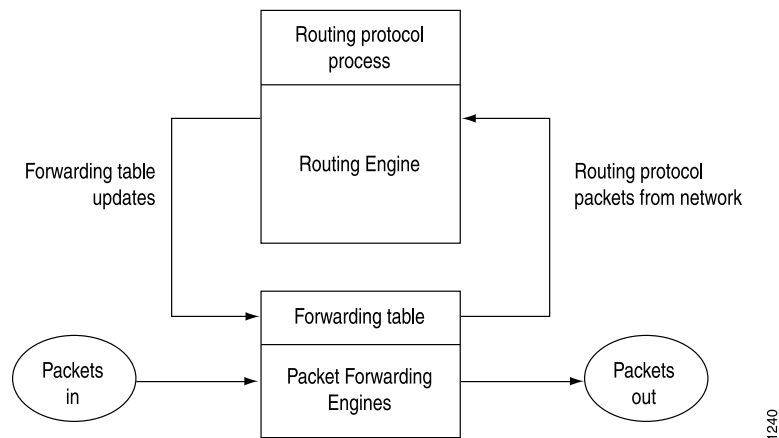
- [Routing Engine Functions for T Series Routers on page 5](#)
- [Packet Forwarding Engine Architecture for T Series Routers on page 7](#)

## Routing Engine Functions for T Series Routers

The Routing Engine handles all routing protocol processes, as well as the software processes that control the router's interfaces, the chassis components, system management, and user access to the router. The routing and software processes run on top of a kernel that interacts with the Packet Forwarding Engine.

The Routing Engine constructs and maintains one or more routing tables (see [Figure 2 on page 6](#)). From the routing tables, the Routing Engine derives a table of active routes, called the forwarding table, which is then copied into the Packet Forwarding Engine. The design of the ASICs allow the forwarding table in the Packet Forwarding Engine to be updated without interrupting forwarding performance.

**Figure 2: Control Packet Handling for Routing and Forwarding Table Updates**



The Routing Engine includes the following functions and features:

- Processing of routing protocol packets—The Routing Engine handles all packets that concern routing protocols, freeing the Packet Forwarding Engine to handle only packets that represent Internet traffic.
- Software modularity—Because each software process is devoted to a different function and uses a separate process space, the failure of one process has little or no effect on the others.
- In-depth Internet functionality—Each routing protocol is implemented with a complete set of Internet features and provides full flexibility for advertising, filtering, and modifying routes. Routing policies are set according to route parameters (for example, prefix, prefix lengths, and BGP attributes).
- Scalability—Junos OS routing tables have been designed to hold all the routes in current networks with ample capacity for expansion. Additionally, Junos OS can efficiently support large numbers of interfaces and virtual circuits.
- Management interface—Different levels of system management tools are provided, including the Junos OS command-line interface (CLI), the Junos XML management protocol, the craft interface, and SNMP.
- Storage and change management—Configuration files, system images, and microcode can be held and maintained in primary and secondary storage systems, permitting local or remote upgrades.
- Monitoring efficiency and flexibility—The router supports functions such as alarm handling and packet counting on every port, without degrading packet-forwarding performance.

**Related Documentation**

- [System Architecture Description for T Series Routers on page 5](#)
- [Packet Forwarding Engine Architecture for T Series Routers on page 7](#)

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## Packet Forwarding Engine Architecture for T Series Routers

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The Packet Forwarding Engines provide the Layer 2 and Layer 3 packet switching, forwarding, and route lookup functions. The Packet Forwarding Engines are implemented in ASICs that are physically located on the FPCs and the PICs. To ensure the efficient movement of data, the router is designed so that ASICs on the hardware components handle the forwarding of data.

- [Packet Forwarding Engine Components on page 7](#)
- [Data Flow on page 7](#)

### Packet Forwarding Engine Components

Each Packet Forwarding Engine consists of the following components:

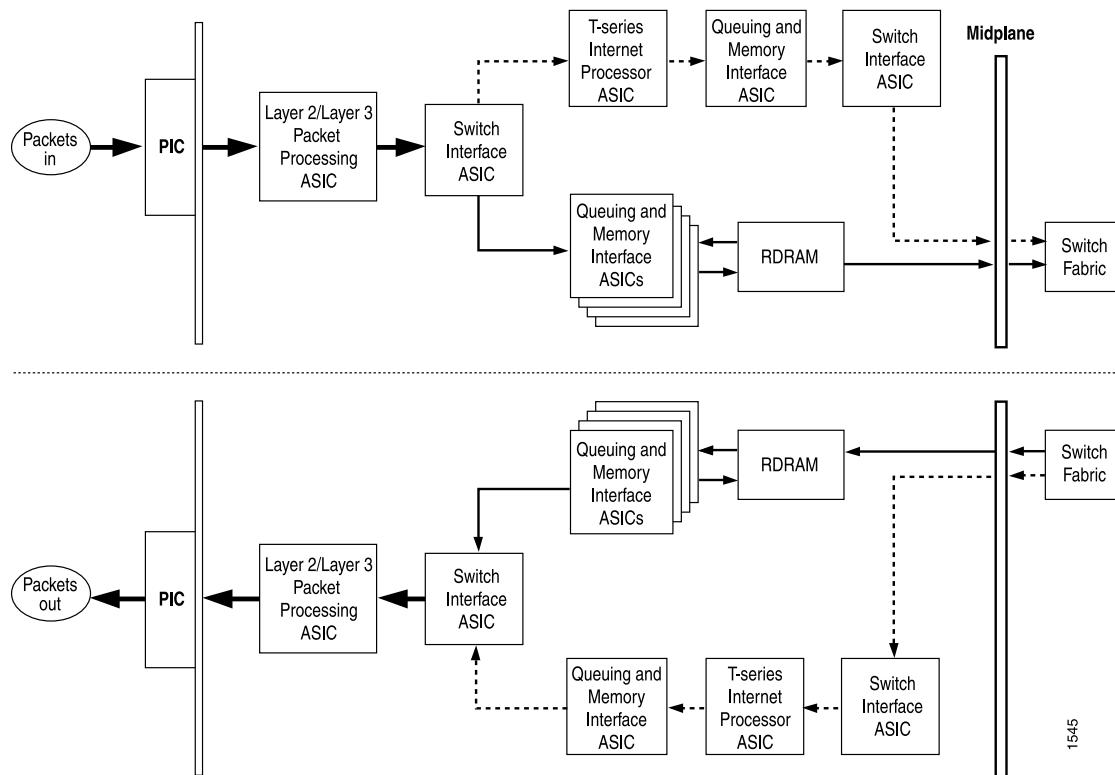
- Layer 2/Layer 3 Packet Processing ASIC, which performs Layer 2 and Layer 3 encapsulation and decapsulation, and manages the division and reassembly of packets within the router.
- Queuing and Memory Interface ASICs, which manage the buffering of data cells in memory and the queueing of notifications.
- T Series Internet Processor, which provides the route lookup function.
- Switch Interface ASICs, which extract the route lookup key and manage the flow of data cells across the switch fabric.

Media-specific ASICs on the PICs perform control functions tailored to the PIC media types.

### Data Flow

To ensure the efficient movement of data, the router is designed so that ASICs on the hardware components handle the forwarding of data. Data flows through the router in the following sequence (see [Figure 3 on page 8](#)):

Figure 3: Data Flow Through the Router



1. Packets arrive at an incoming PIC interface.
2. The PIC passes the packets to the FPC, where the Layer 2/Layer 3 Packet Processing ASIC performs Layer 2 and Layer 3 parsing and divides the packets into 64-byte cells.
3. The Switch Interface ASIC extracts the route lookup key, places it in a notification, and passes the notification to the T Series Internet Processor. The Switch Interface ASIC also passes the data cells to the Queuing and Memory Interface ASICs for buffering.
4. The Queuing and Memory Interface ASICs pass the data cells to memory for buffering.
5. The T Series Internet Processor performs the route lookup and forwards the notification to the Queuing and Memory Interface ASIC.
6. The Queuing and Memory Interface ASIC sends the notification to the Switch Interface ASIC facing the switch fabric, unless the destination is on the same Packet Forwarding Engine. In this case, the notification is sent back to the Switch Interface ASIC facing the outgoing ports, and the packets are sent to the outgoing port without passing through the switch fabric (see Step 13).

7. The Switch Interface ASIC sends bandwidth requests through the switch fabric to the destination port. The Switch Interface ASIC also issues read requests to the Queuing and Memory Interface ASIC to begin reading data cells out of memory.
8. The destination Switch Interface ASIC sends bandwidth grants through the switch fabric to the originating Switch Interface ASIC.
9. On receipt of each bandwidth grant, the originating Switch Interface ASIC sends a cell through the switch fabric to the destination Packet Forwarding Engine.
10. The destination Switch Interface ASIC receives cells from the switch fabric. It extracts the route lookup key from each cell, places it in a notification, and forwards the notification to the T Series Internet Processor.
11. The T Series Internet Processor performs the route lookup, and forwards the notification to the Queuing and Memory Interface ASIC.
12. The Queuing and Memory Interface ASIC forwards the notification, including next-hop information, to the Switch Interface ASIC.
13. The Switch Interface ASIC sends read requests to the Queuing and Memory Interface ASIC to read the data cells out of memory, and passes the cells to the Layer 2/Layer 3 Packet Processing ASIC.
14. The Layer 2/Layer 3 Packet Processing ASIC reassembles the data cells into packets, adds Layer 2 encapsulation, and sends the packets to the outgoing PIC interface.
15. The outgoing PIC sends the packets out into the network.

**Related  
Documentation**

- [System Architecture Description for T Series Routers on page 5](#)
- [Routing Engine Functions for T Series Routers on page 5](#)



## CHAPTER 2

# T320 Router Release Notes

- [Outstanding Issues with the T320 Router on page 11](#)
- [Errata with the T320 Router Documentation on page 11](#)

### Outstanding Issues with the T320 Router

This topic lists outstanding issues with the T320 Core Router. For complete information on the router, see the *T320 Core Router Hardware Guide*. For information about software issues, see the *Junos OS Release Notes*.

- The external clock inputs on the SONET Clock Generators (SCGs) are not supported before Junos OS Release 10.4.
- After powering on or off a power supply, wait at least 60 seconds before turning it back off or on again.
- After a power supply is powered on, it can take up to 60 seconds for status indicators—such as LEDs on the power supply, **show chassis** commands, and messages on the craft interface LCD—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

#### **Related Documentation**

- [Errata with the T320 Router Documentation on page 11](#)

### Errata with the T320 Router Documentation

There are no outstanding issues with the T320 router documentation.

#### **Related Documentation**

- [Outstanding Issues with the T320 Router on page 11](#)





## CHAPTER 3

# Chassis Components and Descriptions

- [T320 Chassis Description on page 13](#)
- [T320 Midplane Description on page 15](#)
- [T320 Connector Interface Panel \(CIP\) Description on page 16](#)
- [T320 Alarm Relay Contacts on page 18](#)
- [T320 Cable Management System Description on page 18](#)
- [T320 SONET Clock Generator \(SCG\) Description on page 19](#)
- [T320 SCG LEDs on page 20](#)
- [T320 Craft Interface Description on page 20](#)
- [T320 Craft Interface Alarm LEDs and ACO/LT Button on page 21](#)
- [T320 Craft Interface LCD and Navigation Buttons on page 22](#)
- [T320 Craft Interface Host Subsystem LEDs on page 23](#)
- [T320 Craft Interface FPC LEDs on page 23](#)
- [T320 Craft Interface SIB LEDs on page 24](#)

## T320 Chassis Description

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The T320 Core Router chassis is a rigid sheet metal structure that houses all the other router components (see [Figure 4 on page 14](#) and [Figure 5 on page 15](#)). The chassis measures 25.13 in. (63.82 cm) high, 31.4 in. (79.8 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 4 on page 14](#) and [Figure 5 on page 15](#)):

- A pairs of center-mounting metal brackets for center-mounting the chassis in an open-frame rack.
- Front-mounting flanges for front-mounting in an open-frame rack, or for mounting in a four-post rack or cabinet.
- 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.



**WARNING:** Before removing or installing any components of a functioning router, attach an ESD strap to one of the two ESD points on the chassis and attach the other end of the strap around your bare wrist. Failure to use an ESD strap could result in damage to the router and its components.

Figure 4: Front View of the T320 Router Chassis

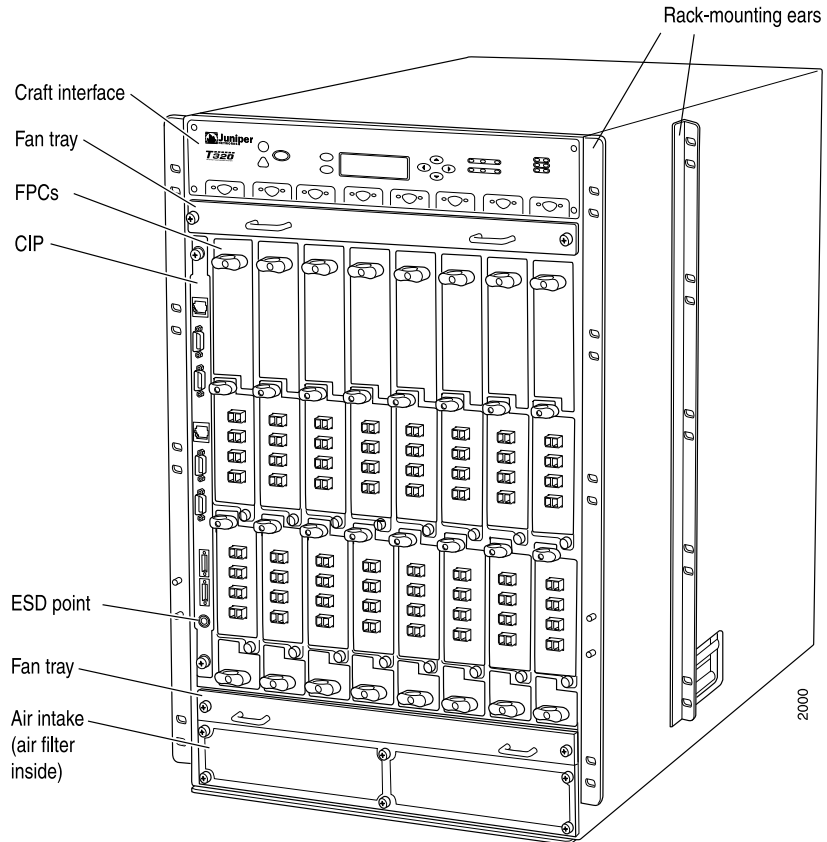
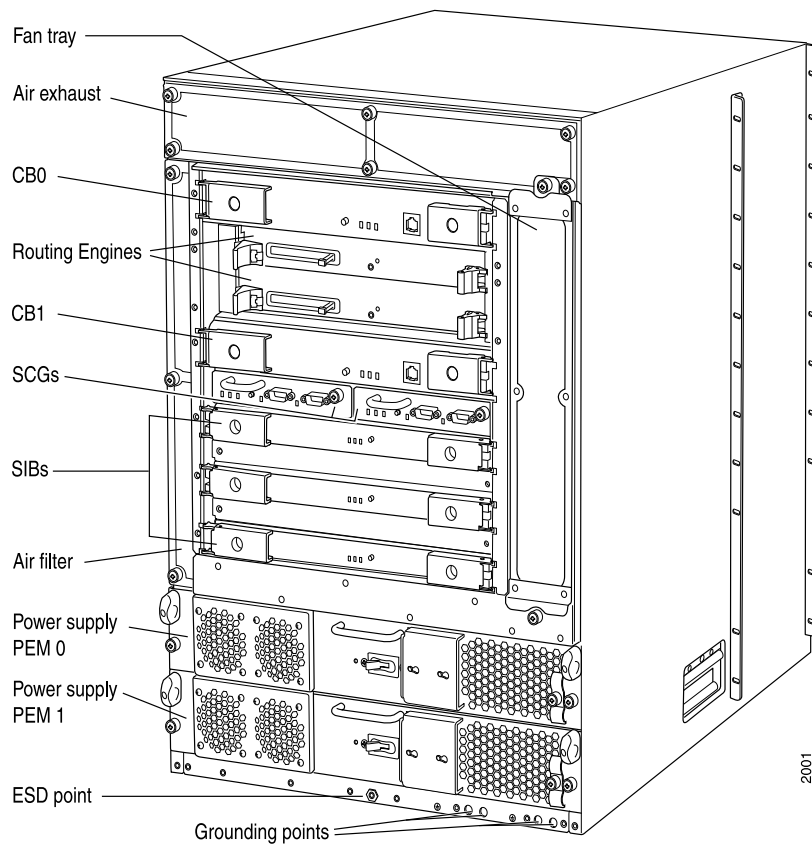


Figure 5: Rear View of the T320 Router Chassis



For chassis serial number information, see [“Locating T320 Component Serial Numbers Using the CLI”](#) on page 299.

#### Related Documentation

- [T320 Rack Requirements](#) on page 84
- [T320 Chassis Grounding Cable and Lug Specifications](#) on page 87
- [Preventing Electrostatic Discharge Damage to a T320 Router](#) on page 320
- [T320 Physical Specifications](#) on page 86

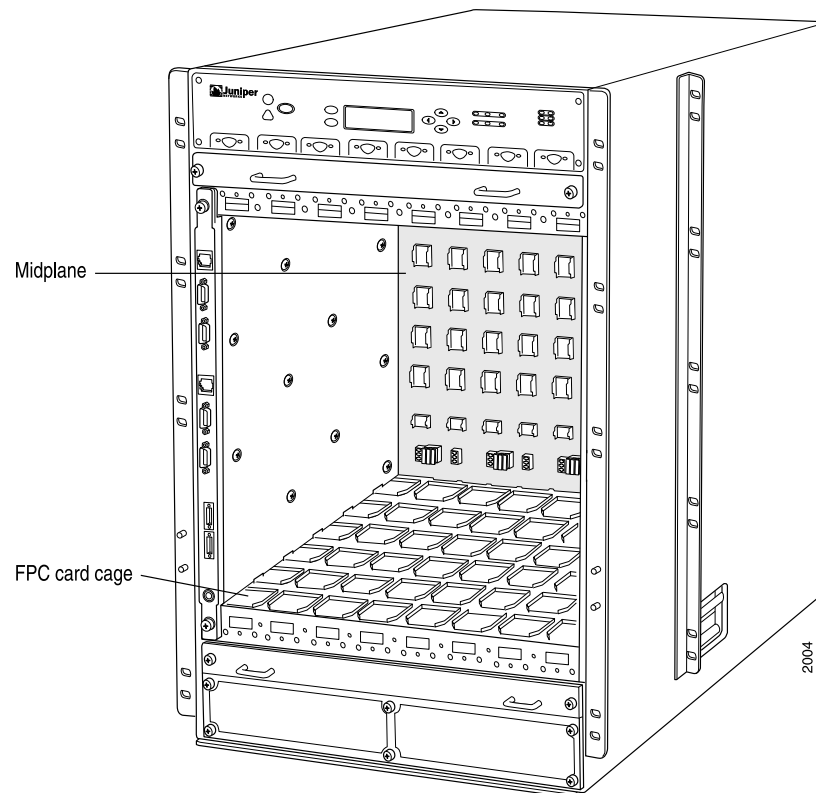
## T320 Midplane Description

The T320 Core Router midplane is located in the center of the chassis and forms the rear of the FPC card cage (see [Figure 6](#) on page 16). The FPCs install into the midplane from the front of the chassis, and the SIBs, Routing Engines, 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, control boards, and other system components for monitoring and control of the system.

Figure 6: T320 Midplane



For chassis serial number information, see [“Locating T320 Component Serial Numbers Using the CLI”](#) on page 299.

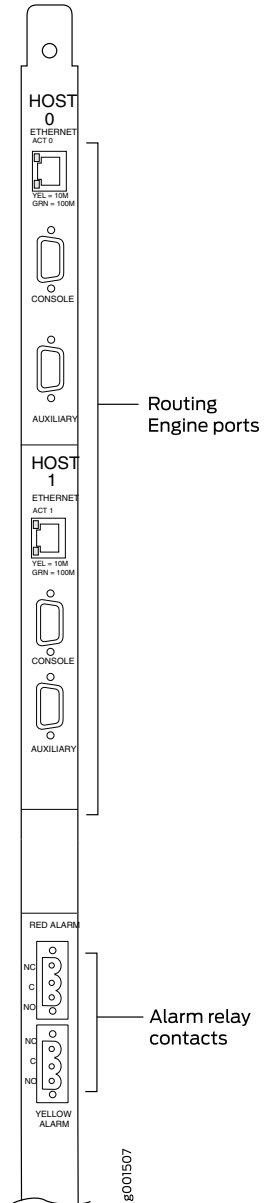
- Related Documentation**
- [T320 Router Description](#) on page 3
  - [T320 Physical Specifications](#) on page 86

## T320 Connector Interface Panel (CIP) Description

The Connector Interface Panel (CIP) consists of Ethernet, console, and auxiliary connectors for the Routing Engines and alarm relay contacts (see [Figure 7 on page 17](#)). The front electrostatic discharge point is located near the bottom of the CIP. The CIP is located at the left side of the FPC card cage.

The CIP is hot-pluggable.

Figure 7: CIP



**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [Replacing a T320 CIP](#)
- [T320 Component Serial Number Label Locations on page 300](#)

## T320 Alarm Relay Contacts

The CIP has two alarm relay contacts for connecting the router to external alarm devices. 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

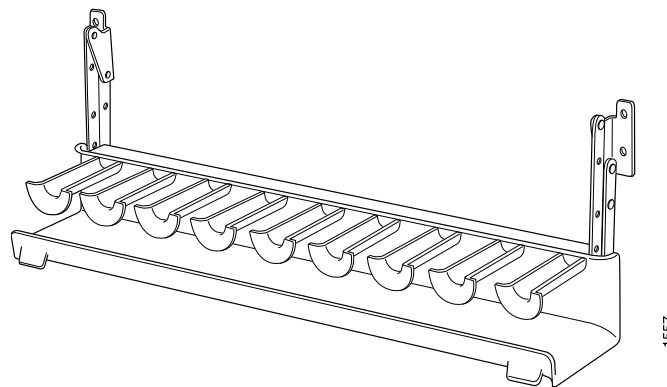
- [T320 Connector Interface Panel \(CIP\) Description on page 16](#)
- [T320 Routing Engine Ports on page 39](#)
- [Replacing the T320 Alarm Relay Wires on page 180](#)
- [T320 Routing Engine Interface Cable and Wire Specifications on page 97](#)

## T320 Cable Management System Description

The cable management system (see [Figure 8 on page 18](#)) 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 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 8: T320 Cable Management System**



### Related Documentation

- [T320 Router Description on page 3](#)
- [T320 Chassis Description on page 13](#)

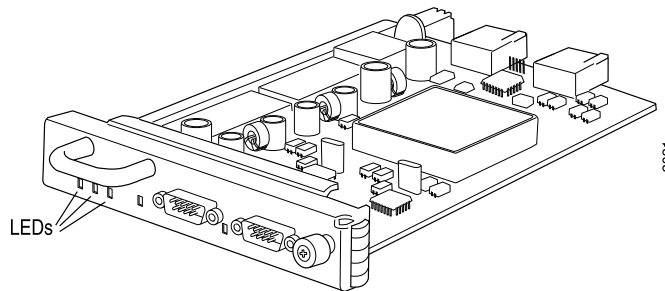
## T320 SONET Clock Generator (SCG) Description

The SONET Clock Generators (SCGs) provide 19.44-MHz Stratum 3 clock signal for the SONET/SDH interfaces on the router. One SCG is shipped as part of the standard router configuration, but up to two SCGs can be installed to provide redundancy. SCGs are installed into the rear of the chassis in the slots labeled **SCG0** and **SCG1**, which are located above the SIBs.

Backup SCGs are hot-removable and hot-insertable. Master and nonredundant SCGs are hot-pluggable.

The SCG with DB-9 ports (SCG-T320) is supported for Junos OS release 5.5 and later. [Figure 9 on page 19](#) shows the SCG.

**Figure 9: SCG with DB-9 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.

These components are located on the SCG faceplate:

- Three LEDs—**OK**, **FAIL**, and **MASTER**, which display the status of the SCG.
- SCG online/offline button.
- Two external clock inputs labeled **EXT CLK INPUT A** and **EXT CLK INPUT B**.



**NOTE:** The external clock inputs are not supported.

### Related Documentation

- [T320 SCG LEDs on page 20](#)
- [Maintaining the T320 SCGs on page 261](#)
- [Replacing a T320 SCG on page 182](#)
- [T320 Component Serial Number Label Locations on page 300](#)

## T320 SCG LEDs

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

[Table 3 on page 20](#) describes the functions of the SCG LEDs.

[Table 3 on page 20](#) describes the functions of the SONET clock generator (SCG) LEDs.

**Table 3: 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.
MASTER	Blue	On steadily	SCG is functioning as master.
		Off	SCG is not functioning as the master.

### Related Documentation

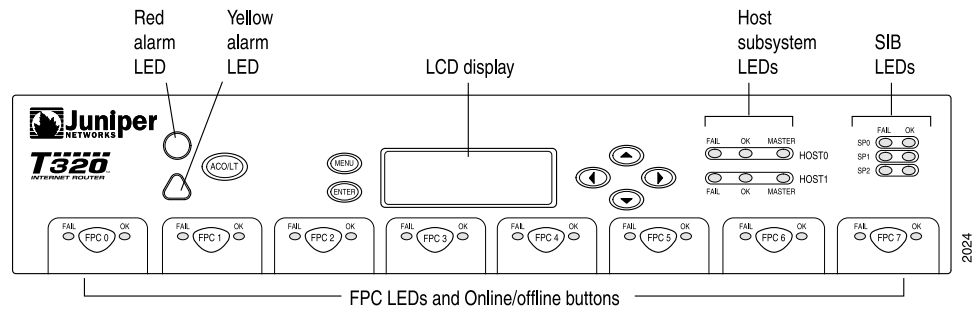
- [T320 SONET Clock Generator \(SCG\) Description on page 19](#)
- [Maintaining the T320 SCGs on page 261](#)
- [Replacing a T320 SCG on page 182](#)
- [Troubleshooting the T320 SONET Clock Generators on page 284](#)

## T320 Craft Interface Description

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 router above the FPCs and contains:



Figure 10: Front Panel of the T320 Craft Interface



- Related Documentation**
- [T320 Chassis Description on page 13](#)
  - [Replacing a T320 Craft Interface on page 184](#)

## T320 Craft Interface Alarm LEDs and ACO/LT Button




Two large alarm LEDs are located at the upper left of the craft interface (see [Figure 10 on page 21](#)). The circular red LED lights to indicate a critical condition that can result in a system shutdown. The triangular yellow LED lights to indicate a less severe condition that requires monitoring or maintenance. Both LEDs can be lit simultaneously.

A condition that causes an LED to light also activates the corresponding alarm relay contact on the connector interface panel (CIP), as described in “[T320 Alarm Relay Contacts](#)” on page 18. The LCD on the craft interface reports the cause of the alarm, as described in “[T320 Craft Interface LCD and Navigation Buttons](#)” on page 22.

To deactivate red and yellow alarms, press the button labeled **ACO/LT** (for “alarm cutoff/lamp test”), which is located to the right of the alarm LEDs. Deactivating an alarm turns off both LEDs and deactivates the device attached to the corresponding alarm relay contact on the CIP. However, the LCD continues to report the alarm message until you clear the condition that caused the alarm.

[Table 4 on page 21](#) describes the alarm LEDs and alarm cutoff button in more detail.

**Table 4: T320 Alarm LEDs and Alarm Cutoff/Lamp Test Button**

Shape	Color	State	Description
	Red	On steadily	Critical alarm LED—Indicates a critical condition that can cause the router to stop functioning. Possible causes include component removal, failure, or overheating.
	Yellow	On steadily	Warning alarm LED—Indicates a serious but nonfatal error condition, such as a maintenance alert or a significant increase in component temperature.
	—	—	Alarm cutoff/lamp test button—Deactivates red and yellow alarms. Causes all LEDs on the craft interface to light (for testing) when pressed and held.

- Related Documentation**
- [T320 Chassis Description on page 13](#)
  - [Replacing a T320 Craft Interface on page 184](#)

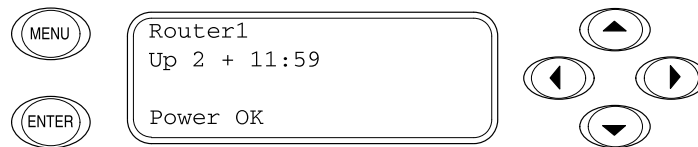
## T320 Craft Interface LCD and Navigation Buttons

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 11 on page 22](#).

**Figure 11: T320 LCD in Idle Mode**



1263

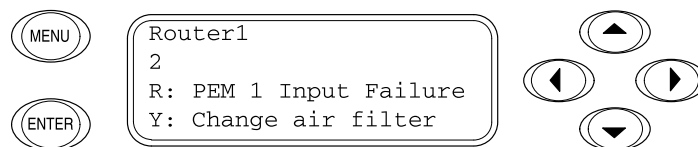
The lines in the display report the following information:

- 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. For more information, see *set chassis display message*.

When a red or yellow alarm occurs, the LCD switches to alarm mode and reports about the alarm condition, as shown in [Figure 12 on page 22](#).

**Figure 12: T320 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**

- [T320 Craft Interface Description on page 20](#)
- [T320 Craft Interface Alarm LEDs and ACO/LT Button on page 21](#)
- [T320 Craft Interface Host Subsystem LEDs on page 23](#)

## T320 Craft Interface Host Subsystem LEDs

Each host subsystem has three LEDs, located on the upper right of the craft interface, that indicate its status. The LEDs labeled **HOST0** show the status of the Routing Engine in slot **RE0** and the control board in slot **CBO**. The LEDs labeled **HOST1** show the status of the Routing Engine in slot **RE1** and the control board in slot **1**. [Table 5 on page 23](#) describes the functions of the host subsystem LEDs.

**Table 5: T320 Host Subsystem LEDs**

Label	Color	State	Description
FAIL	Red	On steadily	Host is offline.
OK	Green	On steadily	Host is online and is functioning normally.
MASTER	Green	On steadily	Host is functioning as the master.

**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [Replacing a T320 Craft Interface on page 184](#)

## T320 Craft Interface FPC LEDs

Each FPC slot has two LEDs that indicate its status. The FPC LEDs, labeled **FPC0** through **FPC7**, are located along the bottom of the craft interface. [Table 6 on page 23](#) describes the functions of the FPC LEDs.

**Table 6: FPC LEDs**

Label	Color	State	Description
FAIL	Red	On steadily	FPC has failed.

Table 6: FPC LEDs (*continued*)

Label	Color	State	Description
OK	Green	On steadily	FPC is functioning normally.
		Blinking	FPC is starting up.

- Related Documentation**
- [T320 Chassis Description on page 13](#)
  - [Replacing a T320 Craft Interface on page 184](#)

## T320 Craft Interface SIB LEDs

Each SIB has two LEDs on the craft interface that indicate its status. The SIB LEDs, labeled **SIB0** through **SIB2**, are located on the upper right of the craft interface. The **ACTIVE** LED on the SIB faceplate is not replicated on the craft interface. [Table 7 on page 24](#) describes the functions of the SIB LEDs.

Table 7: SIB LEDs on the Craft Interface

Label	Color	State	Description
FAIL	Red	On steadily	SIB has failed.
OK	Green	On steadily	SIB is functioning normally.

- Related Documentation**
- [T320 Chassis Description on page 13](#)
  - [Replacing a T320 Craft Interface on page 184](#)

## CHAPTER 4

# Cooling System Components and Descriptions

- [T320 Cooling System Description on page 25](#)

## T320 Cooling System Description

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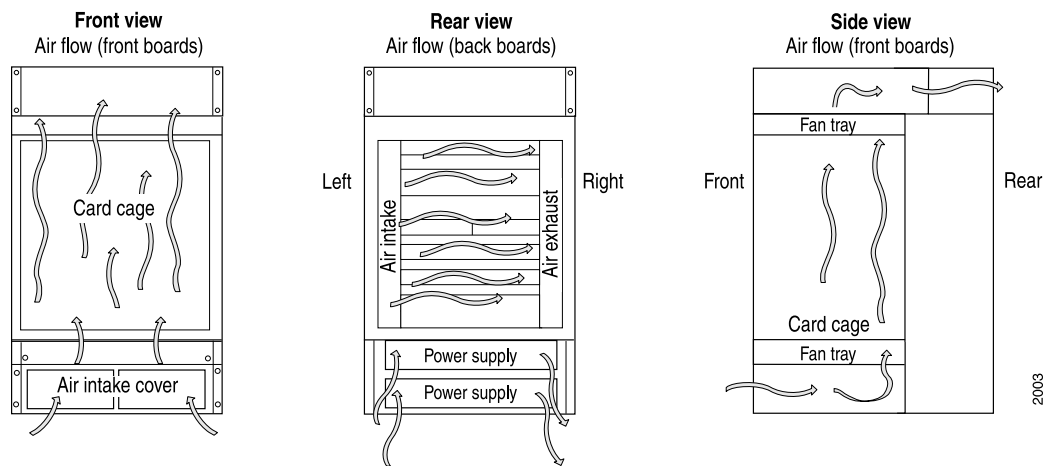
The cooling system components work together to keep all router components within the acceptable temperature range. The host subsystem monitors the temperature of the router components. When the router is operating normally, the fans function at lower than full speed. If a fan fails or the ambient temperature rises above a threshold, the speed of the remaining fans is automatically adjusted to keep the temperature within the acceptable range. 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.

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

## Airflow

[Figure 13 on page 26](#) shows the airflow through the router.

Figure 13: Airflow Through the T320 Chassis



## Fan Trays



**NOTE:** The standard fan trays and quiet fan trays are not interchangeable with each other. All fans in the chassis must be either standard fan trays or quiet fan trays.

The cooling system contains the following fan trays:

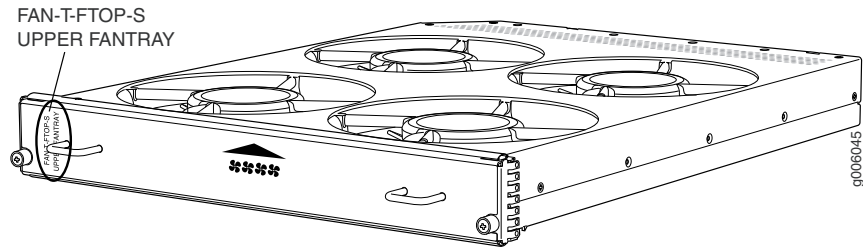
- One rear fan tray cools the components installed in the rear card cage (the Routing Engines, control boards, SCGs, and the SIBs). The T320 router supports the following types of rear fan trays:
  - The standard rear fan tray with five blowers (EOL) is supported by Junos OS 5.4 and later. It has no label and is not interchangeable with the standard front fan trays.
  - The quiet rear fan tray, labeled **REAR FANTRAY FAN-R-S** and supported by Junos OS 11.1 and later, contains eight fans and is not interchangeable with the quiet front 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 midplane). The T320 router supports the following front fan trays:
  - The upper and lower standard front fan trays, each of which contain six fans and have no labels. Both standard fan trays are interchangeable with each other.
  - Each quiet front fan tray contains four fans, as indicated by the four fan icons on the faceplate.



**NOTE:** The quiet upper front fan tray and quiet lower front fan tray are not interchangeable with each other. In addition to the labels, the quiet upper fan tray also has an upward pointing arrow above the four fan icons on the faceplate.

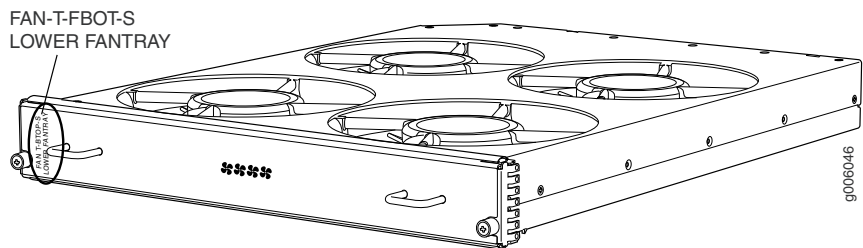
The quiet upper front fan tray is labeled **FAN-T-FTOP-S** and **UPPER FANTRAY** (see [Figure 14 on page 27](#)).

**Figure 14: Quiet Upper Front Fan Tray**



The quiet lower front fan tray is labeled **FAN-T-FBOT-S** and **LOWER FANTRAY** (see [Figure 15 on page 27](#)).

**Figure 15: Quiet Lower Front Fan Tray**



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

## 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 one fan that cools that power supply.

### Related Documentation

- [Maintaining the T320 Air Filters on page 262](#)
- [Maintaining the T320 Fan Trays on page 263](#)
- [Troubleshooting the T320 Cooling System on page 285](#)





## CHAPTER 5

# Host Subsystem Components and Descriptions

- T320 Host Subsystem Description on page 29
- T320 Control Board Description on page 30
- T320 Standard Control Board Description on page 31
- T320 T Series Control Board (T-CB) Description on page 31
- T320 Standard Control Board and T-CB LEDs on page 32
- T320 Routing Engine Description on page 33
- T320 RE-600 Description on page 34
- T320 RE-600 LEDs on page 35
- T320 RE-1600 Description on page 36
- T320 RE-1600 LEDs on page 37
- T320 RE-2000 Description on page 38
- T320 RE-2000 LEDs on page 39
- T320 Routing Engine Ports on page 39
- Routing Engine Specifications on page 41
- Supported Routing Engines by Router on page 44

## T320 Host Subsystem Description

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The host subsystem provides the routing and system management functions of the router. You can install one or two host subsystems on the router. To operate, each host subsystem functions as a unit; the Routing Engine requires the corresponding control board, and vice versa.



**NOTE:** We recommend you install two host subsystems for redundant protection. If you install only one host subsystem, we recommend you install it in slot RE0.

Each host subsystem has three LEDs that display its status. The host subsystem LEDs are located on the upper right of the craft interface. For more information about the host subsystem LEDs, see “[T320 Craft Interface Host Subsystem LEDs](#)” on page 23.

The host subsystem consists of the following components:

- One or two Routing Engines
- One or two control boards

**Related Documentation**

- [Maintaining the T320 Host Subsystem on page 263](#)
- [Replacing the T320 Host Subsystem Components on page 199](#)
- [Taking the T320 Host Subsystem Offline on page 199](#)

## T320 Control Board Description

This 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 router. 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 T320 router supports the control boards listed in [Table 8 on page 30](#).



**NOTE:** If two control boards are installed, they must both be the same hardware model during normal operations. A mix of hardware model numbers is supported only during upgrade.

**Table 8: Supported T320 Control Boards**

Name	Model Number
Standard control board (EOL PSN-2006-09-024)	CB-L-T
T Series control board (T-CB)	CB-T

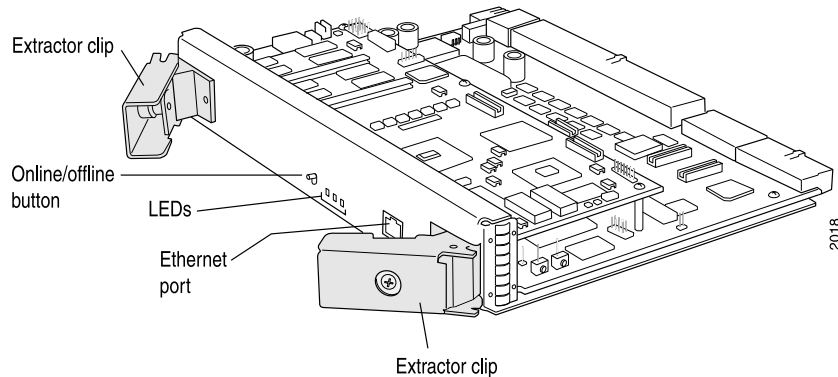
- Related Documentation**
- [T320 Host Subsystem Description on page 29](#)
  - [T320 Standard Control Board Description on page 31](#)
  - [T320 T Series Control Board \(T-CB\) Description on page 31](#)

## T320 Standard Control Board Description

Each standard control board consists of the following components:

- 10/100Base-T/TX Ethernet switch for intermodule communication.
- PCI bus to the Routing Engines.
- Switch processor mezzanine board (SPMB).

**Figure 16: T320 Standard Control Board**



The standard control board faceplate includes the following:

- Three LEDs that indicate the status of the control board. “[T320 Standard Control Board and T-CB LEDs](#)” on [page 32](#) describes the functions of the control board LEDs.
- The control board online/offline button. This button is not functional.
- One Ethernet port. This port is not used in a T320 router.

- Related Documentation**
- [T320 Host Subsystem Description on page 29](#)
  - [T320 Control Board Description on page 30](#)
  - [T320 Standard Control Board and T-CB LEDs on page 32](#)

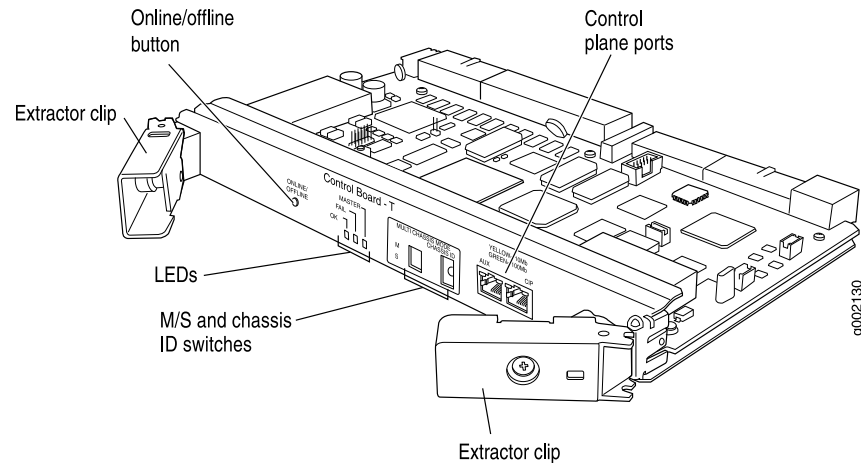
## T320 T Series Control Board (T-CB) Description

Each T-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 17: T320 T-Series Control Board (t-cb)



The T-CB faceplate contains the following:

- Three LEDs, located on the control board faceplate, indicate its status. “[T320 Standard Control Board and T-CB LEDs](#)” on page 32 describes the functions of the control board LEDs.
- The control board online/offline button. This button is not functional.
- Two configuration switches, located on the T-CB faceplate. On the T320 router, the M/S and CHASSIS ID switches must always be set to S and O.
- Two RJ-45 ports labeled **AUX** and **CIP**. These ports are not used in a T320 router.

#### Related Documentation

- [T320 Host Subsystem Description on page 29](#)
- [T320 Control Board Description on page 30](#)
- [T320 Standard Control Board and T-CB LEDs on page 32](#)
- [Maintaining the T320 Control Boards on page 265](#)
- [Replacing a T320 Standard Control Board or T-CB on page 202](#)

## T320 Standard Control Board and T-CB LEDs

Table 9 on page 32 describes the functions of the Control board LEDs.

Table 9: T320 Standard Control Board and T-CB LEDs

Label	Color	State	Description
MASTER	Blue	On steadily	Control board is functioning as the master.
FAIL	Yellow	On steadily	Control board has failed.

Table 9: T320 Standard Control Board and T-CB LEDs (*continued*)

Label	Color	State	Description
OK	Green	On steadily	Control board is online and is functioning normally.
		Blinking	Control board is powering up, but not online.

**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [Maintaining the T320 Control Boards on page 265](#)
- [Replacing a T320 Standard Control Board or T-CB on page 202](#)

## T320 Routing Engine Description

The Routing Engine runs the Junos OS. Software processes that run on the Routing Engine maintain the routing tables, manage the routing protocols used on the router, control the router interfaces, control 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**. 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 is hot-pluggable. 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.



**NOTE:** The LEDs that report host module status (including Routing Engine status) are on the craft interface rather than the Routing Engine faceplate.



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



**NOTE:** If two Routing Engines are installed, they must both be the same hardware model.

- Related Documentation**
- [T320 RE-600 Description on page 34](#)
  - [T320 RE-1600 Description on page 36](#)
  - [T320 RE-2000 Description on page 38](#)
  - [Maintaining the T320 Routing Engines on page 264](#)

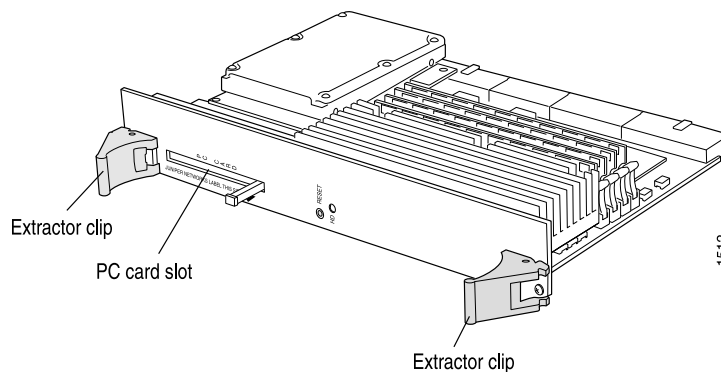
## T320 RE-600 Description

The RE-600 Routing Engine boots from the storage media in this order: the PC Card (if present), then the CompactFlash card (if present), then the hard disk. The disk from which the router boots is called the *primary boot device*, and the other disk is the *alternate boot device*.



**NOTE:** If the router boots from an alternate boot device, a yellow alarm lights the LED on the router's craft interface.

**Figure 18: T320 Routing Engine 600**



The Routing Engine 600 (shown in [Figure 18 on page 34](#)) consists of the following components:

- CPU—Runs Junos OS to maintain the router's routing tables and routing protocols.
- DRAM—Provides storage for the routing and forwarding tables and for other Routing Engine processes.
- CompactFlash card—Provides primary storage for software images, configuration files, and microcode. The drive is a fixed CompactFlash card and is inaccessible from outside the router.
- Hard disk—Provides secondary storage for log files, memory dumps, and rebooting the system if the CompactFlash card fails.
- PC card slot labeled **PC CARD**—Accepts a removable PC card, which stores software images for system upgrades. The PC card slot accepts a Type I PC Card, as defined in the *PC Card Standard* published by the Personal Computer Memory Card International Association (PCMCIA). The router is shipped with a PC Card that contains Junos OS.

The PC Card can be used to copy Junos OS from the PC Card onto the Routing Engine. You can also copy Junos OS from the Routing Engine onto a PC Card, for example, to create a backup copy of upgrade software that you have obtained from Juniper Networks. Instructions for copying software to a PC Card are available at the Juniper Networks Support Web site (<http://www.juniper.net/support/>); after logging in, navigate to the Customer Support Center, then to the download page for Junos OS.



**NOTE:** The software on a PC Card is loaded only onto the Routing Engine into which the PC Card is inserted. It is not automatically copied to the other Routing Engine.

- LED—Indicates disk activity for the internal IDE interface. It does not necessarily indicate routing-related activity.
- Interfaces for out-of-band management access—Provide information about Routing Engine status to devices (console, laptop, or terminal server) that can be attached to access ports located on the Connector Interface Panel (CIP).

Each Routing Engine has one 10/100 millions of packets per second (Mbps) Ethernet port for connecting to a management network, and two asynchronous serial ports—one for connecting to a console and one for connecting to a modem or other auxiliary device.

- EEPROM—Stores the serial number of the Routing Engine.
- Reset button—Reboots the Routing Engine when pressed.

#### Related Documentation

- [T320 Routing Engine Description on page 33](#)
- [T320 RE-600 LEDs on page 35](#)
- [T320 Routing Engine Ports on page 39](#)
- [Maintaining the T320 Routing Engines on page 264](#)
- [T320 Routing Engine Interface Cable and Wire Specifications on page 97](#)

## T320 RE-600 LEDs

The HD LED indicates activity on the hard drive. It does not necessarily indicate routing-related activity.



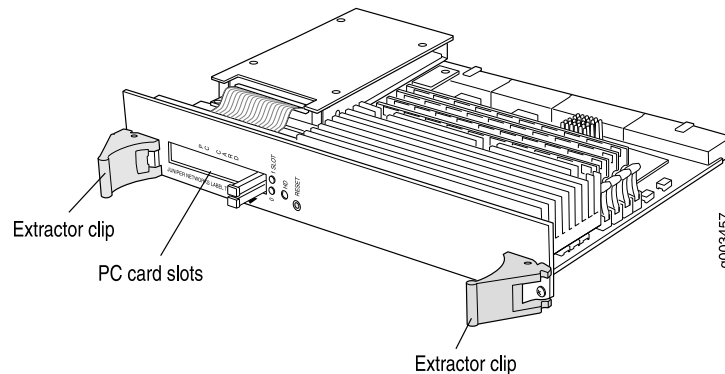
**NOTE:** The LEDs that report host module status (including Routing Engine status) are on the craft interface rather than the Routing Engine faceplate.

#### Related Documentation

- [T320 RE-600 Description on page 34](#)
- [T320 Craft Interface Host Subsystem LEDs on page 23](#)
- [Maintaining the T320 Routing Engines on page 264](#)

## T320 RE-1600 Description

Figure 19: T320 Routing Engine 1600



The Routing Engine 1600 (shown in [Figure 19 on page 36](#)) consists of the following components:

- CPU—Runs Junos OS to maintain the router's 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.
- LED—Indicates disk activity for the internal IDE interface. It does not necessarily indicate routing-related activity.
- Interfaces for out-of-band management access—Provide information about Routing Engine status to devices (console, laptop, or terminal server) that can be attached to access ports located on the Connector Interface Panel (CIP).

Each Routing Engine has one 10/100 millions of packets per second (Mbps) Ethernet port for connecting to a management network, and two asynchronous serial ports—one for connecting to a console and one for connecting to a modem or other auxiliary device.

- Reset button—Reboots the Routing Engine when pressed.
- CompactFlash card—Provides primary storage for software images, configuration files, and microcode. The drive is a fixed CompactFlash card and is inaccessible from outside the router.
- Hard disk—Provides secondary storage for log files, memory dumps, and rebooting the system if the CompactFlash card fails.
- PC card slots—Accept a removable PC card, which stores software images for system upgrades.

The PC card slots accept a Type I PC Card, as defined in the *PC Card Standard* published by the Personal Computer Memory Card International Association (PCMCIA). The router is shipped with a PC Card that contains Junos OS. The PC Card can be used to copy Junos OS from the PC Card onto the Routing Engine. You can also copy Junos OS from the Routing Engine onto a PC Card, for example, to create a backup copy of



upgrade software that you have obtained from Juniper Networks. Instructions for copying software to a PC Card are available at the Juniper Networks Support Web site (<http://www.juniper.net/support/>); after logging in, navigate to the Customer Support Center, then to the download page for Junos OS.

The disk from which the router boots is called the *primary boot device*, and the other disk is the *alternate boot device*. The RE-1600 Routing Engine boots from the storage media in this order: the PC Card in **SLOT 0** (if present), then the PC Card in **SLOT 1** (if present), then the CompactFlash card (if present), then the hard disk.



**NOTE:** If the router boots from an alternate boot device, a yellow alarm lights the LED on the router's craft interface.

- Related Documentation**
- [T320 Routing Engine Description on page 33](#)
  - [T320 RE-1600 LEDs on page 37](#)
  - [Maintaining the T320 Routing Engines on page 264](#)

## T320 RE-1600 LEDs

Table 10 on page 37 describes the functions of these LEDs.

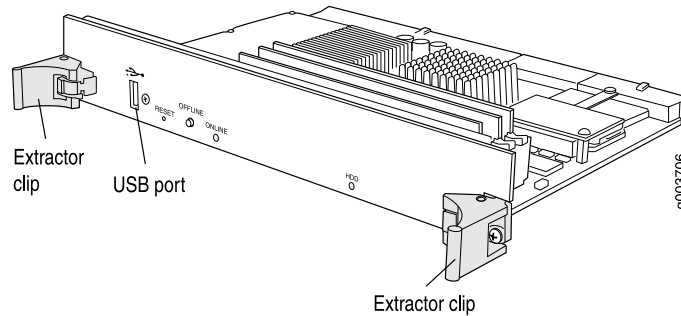
Table 10: RE-1600 LEDs

Label	Color	State	Description
HD	Yellow	On steadily or blinking	Indicates activity on the hard drive.
Slot LEDs 0 and 1	Red and green alternately	Blinking	Indicates that the Routing Engine is booting and the firmware is checking if a PC card is installed.
	Green	On steadily	Indicates that the Routing Engine booted from the PC Card.

- Related Documentation**
- [T320 RE-1600 Description on page 36](#)
  - [T320 Craft Interface Host Subsystem LEDs on page 23](#)
  - [Maintaining the T320 Routing Engines on page 264](#)

## T320 RE-2000 Description

Figure 20: Routing Engine 2000 (RE-2000)



Each RE-2000 (shown in [Figure 20 on page 38](#)) consists of the following components:

- CPU—Runs Junos OS to maintain the router's 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 Routing Engine ports located on the CIP.
- CompactFlash card—Provides primary storage for software images, configuration files, and microcode. The fixed CompactFlash card is inaccessible from outside the router.
- Hard disk—Provides secondary storage for log files, memory dumps, and rebooting the system if the CompactFlash card fails.

The disk from which the router boots is called the *primary boot device*, and the other disk is the *alternate boot device*. The RE-2000 Routing Engine boots from the storage media in this order: the USB device, then the CompactFlash card (if present), then the hard disk, then the LAN.



**NOTE:** If the router boots from an alternate boot device, a yellow alarm lights the LED on the router's craft interface.

The faceplate of the RE-2000 contains the following:

- USB port—Provides a removable media interface through which you can install the Junos OS manually. Junos OS supports USB version 1.0.
- Reset button—Reboots the Routing Engine when pressed.
- Offline button—Takes the Routing Engine offline when pressed.
- Extractor clips—Control the locking system that secures the Routing Engine.
- LEDs—“[T320 RE-2000 LEDs](#)” on [page 39](#) describes the functions of these LEDs.

- Related Documentation**
- [T320 Routing Engine Description on page 33](#)
  - [Maintaining the T320 Routing Engines on page 264](#)
  - [Replacing a T320 Routing Engine on page 207](#)

## T320 RE-2000 LEDs

Table 11 on page 39 describes the functions of the LEDs on the faceplate of the Routing Engine.



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

Table 11: Routing Engine 2000 LEDs

Label	Color	State	Description
<b>HDD</b>	Blue	On steadily	Indicates disk activity for the hard disk drive.
<b>ONLINE</b>	Green	On steadily	Routing Engine is functioning normally.
		Blinking	Routing Engine is transitioning online.
	Red	On steadily	Routing Engine has failed.

- Related Documentation**
- [T320 Routing Engine Description on page 33](#)
  - [T320 Craft Interface Host Subsystem LEDs on page 23](#)
  - [Maintaining the T320 Routing Engines on page 264](#)

## T320 Routing Engine Ports

The CIP has two sets of ports that you use to connect the Routing Engines to external management devices. From these management devices, you can use the CLI to configure the router (see [Figure 21 on page 40](#)).

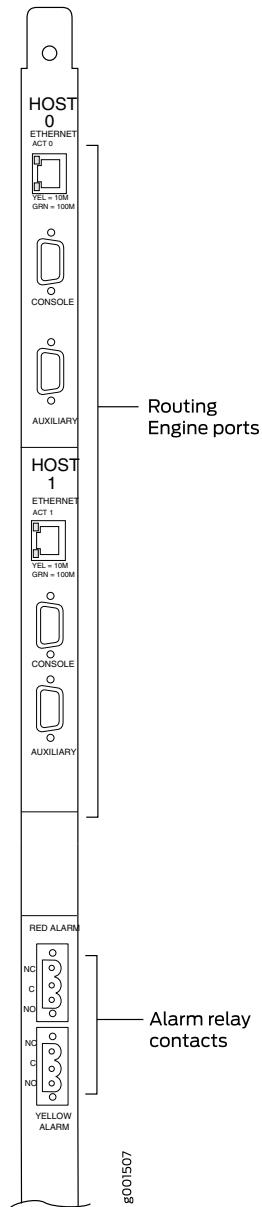
The upper set of ports, labeled **HOST 0**, connects to the Routing Engine in slot **RE0**; and the lower set, labeled **HOST 1**, connects to the Routing Engine in slot **RE1**. Each set includes the following ports:

- **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 millions of packets per second (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 millions of packets per second (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.

Figure 21: CIP Ports



- Related Documentation**
- [T320 Connector Interface Panel \(CIP\) Description on page 16](#)
  - [T320 DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports on page 98](#)
  - [T320 RJ-45 Connector Pinouts for the Routing Engine ETHERNET Port](#)

## Routing Engine Specifications

Table 12 on page 41 lists the current specifications for Routing Engines supported on M Series, MX Series, and T Series routers. Table 13 on page 43 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 44.



**NOTE:** For information about PTX Series Routing Engine specifications, see [Routing Engines Supported on PTX Series Routers](#). For information about

**Table 12: Routing Engine Specifications**

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support
RE-400-768	400-MHz Celeron	768 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	9.0
RE-A-1000-2048	1.0-GHz Pentium	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.1
RE-A-2000-4096	2.0-GHz Pentium	4096 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.1
RE-S-1300-2048	1.3-GHz Pentium	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.2
RE-S-2000-4096	2.0-GHz Pentium	4096 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.2
RE-C1800	1.8-GHz	8 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	T1600 router in a routing matrix: 9.6R2 Standalone T640 or T1600 router: 11.2

Table 12: Routing Engine Specifications (*continued*)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support
RE-C2600	2.6-GHz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	TX Matrix Plus router: 9.6R2
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
RE-S-1800x4	1800-MHz	8GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4
RE-S-MX104	1.8-GHz	4 GB	Gigabit Ethernet	–	8 GB NAND Flash	13.2
RE-B-1800x1-4G	1.73-GHz	4 GB	Gigabit Ethernet	64 GB SSD	4 GB CompactFlash card	12.1R2, 11.4R4, and 12.2R1
RE-MX2000-1800x4	1800-GHz	16 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	12.3R2
RE-S-1800x4-32G-S	1800 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>
RE-MX2K-1800-32G-S	1800 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
RE-S-X6-64G	2 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	-	15.1F4, 16.1
RE-MX2K-X8-64G	2.3 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	15.1F5-S1, 16.1R2, and 16.2R1
RE-MX2008-X8-64G	2.3 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	-	15.1F7



**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 13: 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>
<del>RE-M40-333-768</del>	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>
<del>RE-M40-600-2048</del>	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 12 on page 41](#) 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 44](#)

## Supported Routing Engines by Router

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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 44](#)
- [M10i Routing Engines on page 45](#)
- [M40e Routing Engines on page 45](#)
- [M120 Routing Engines on page 46](#)
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### M7i Routing Engines

Table 14 on page 45 lists the Routing Engines supported by the M7i router. The M7i router supports 32-bit Junos OS only.



Table 14: 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: TSB16445)	RE-5.0	9.0	fxp0	fxp1
RE-850-1536 (EOL details: TSB15553)	RE-850	7.2	fxp0	fxp1
RE-B-1800X1-4G	RE-B-1800x1	11.4R4 12.1R2	fxp0	em0

### M10i Routing Engines

Table 15 on page 45 lists the Routing Engines supported by the M10i router. The M10i router supports 32-bit Junos OS only.

Table 15: 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: TSB16445)	RE-5.0	9.0	fxp0	fxp1 fxp2
RE-850-1536 (EOL details: TSB15553)	RE-850	7.2	fxp0	fxp1 fxp2
RE-B-1800X1-4G	RE-B-1800x1	11.4R4 12.1R2	fxp0	em0

### M40e Routing Engines

Table 16 on page 45 lists the Routing Engines supported by the M40e router.

Table 16: 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: TSB14373)	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 17 on page 46 lists the Routing Engines supported by the M120 router.

**Table 17: 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	<b>RE-A-1000</b>	8.0R2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	<b>RE-A-2000</b>	8.0R2	–	fxp0	em0 bcm0
RE-A-1800X2-8G	<b>RE-A-1800x2</b>	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	fxp1 fxp2
RE-A-1800X2-16G	<b>RE-A-1800x2</b>	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	fxp1 fxp2
RE-A-1800X4-16G	<b>RE-A-1800x4</b>	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 em1

## M320 Routing Engines

Table 18 on page 46 lists the Routing Engines supported by the M320 router.

**Table 18: 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> )	<b>RE-4.0</b>	6.2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	<b>RE-A-2000</b>	8.1	–	fxp0	em0 bcm0
RE-A-1800X2-8G	<b>RE-A-1800x2</b>	<ul style="list-style-type: none"> <li>11.4R5</li> <li>12.1R3</li> </ul>	10.4	fxp0	em0 bcm0

Table 18: M320 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	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 19 on page 47 lists the Routing Engines supported by the MX5, MX10, MX40, and MX80 routers.

Table 19: 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	Routing Engine RE-MX80	12.3	-	fxp0	em0 em1

**NOTE:** em1 is used to communicate with the MS-MIC when it is inserted.

### MX104 Routing Engines

Table 20 on page 47 lists the Routing Engines supported by MX104 routers.

Table 20: 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	Routing Engine	13.2	-	fxp0	fxp1 fxp2

### MX240 Routing Engines

Table 21 on page 48 lists the Routing Engines supported by MX240 routers.

Table 21: 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> )	RE-S-1300	9.0	–	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: <a href="#">TSB16735</a> )	RE-S-2000	9.0	–	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
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

## MX480 Routing Engines

Table 22 on page 48 lists the Routing Engines supported by MX480 routers.

Table 22: 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

Table 22: 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-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
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

## MX960 Routing Engines

Table 23 on page 49 lists the Routing Engines supported by MX960 routers.

Table 23: 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 23: 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

## MX2008 Routing Engines

Table 24 on page 50 lists the Routing Engines supported by MX2008 routers.

Table 24: 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

## MX2010 Routing Engines

Table 25 on page 50 lists the Routing Engines supported by MX2010 routers.

Table 25: 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

Table 25: MX2010 Supported Routing Engines (*continued*)

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
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

## MX2020 Supported Routing Engines

Table 26 on page 51 lists the Routing Engines supported by MX2020 routers.

Table 26: 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

## PTX3000 Routing Engines

Table 27 on page 51 lists the Routing Engines supported on the PTX3000.



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

Table 27: 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
RCB-PTX-X6-32G	RE-PTX-2X00x6	16.1R4	em0	ixlv0 ixlv1

## PTX5000 Routing Engines

Table 28 on page 52 lists the Routing Engines supported on the PTX5000.



**NOTE:** The PTX5000 supports 64-bit Junos OS only.

**Table 28: 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		
<p><b>NOTE:</b> The PTX5000 does not support Junos OS Releases 12.1, 12.2, or 13.1.</p>				
RE-PTX-X8-64G	RE-PTX-2X00x8	15.1F4	em0	ixlv0
		16.1R1		ixlv1
				em1

## T320 Routing Engines

Table 29 on page 52 lists the Routing Engines supported by the T320 router.

**Table 29: 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

## T640 Routing Engines

Table 30 on page 53 lists the Routing Engines supported by the T640 router.



Table 30: 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
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

## T1600 Routing Engines

Table 31 on page 53 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 31: 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 31: 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	RE-A-2000	8.5	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	RE-TXP-LCC or RE-DUO-1800	32-bit Junos OS on a T1600 router in a routing matrix: 9.6  <i>NOTE:</i> 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	RE-DUO-1800	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 32 on page 54 lists the Routing Engines supported by the T4000 router.



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

Table 32: 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	RE-DUO-1800	Standalone T4000 router: 12.1 T4000 router in a routing matrix: 13.1	em0	bcm0 em1
RE-DUO-C1800-16G	RE-DUO-1800	Standalone T4000 router: 12.1R2 T4000 router in a routing matrix: 13.1	em0	bcm0 em1

## TX Matrix Routing Engines

Table 33 on page 55 lists the Routing Engines supported by the TX Matrix router.

Table 33: 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> )	RE-3.0 or RE-3.0 (RE-600)	7.0	–	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: <a href="#">TSB14374</a> )	RE-4.0 (RE-1600)	7.0	–	fxp0	fxp1 fxp2
RE-A-2000-4096	RE-A-2000	8.5	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	RE-DUO-1800	11.4R9	11.4R9	em0	bcm0 em1
RE-DUO-C1800-16G	RE-DUO-1800	11.4R9	11.4R9	em0	bcm0 em1

### TX Matrix Plus Routing Engines

Table 34 on page 55 lists the Routing Engines supported by the TX Matrix Plus router.

Table 34: 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	RE-TXP-SFC or RE-DUO-2600	32-bit Junos OS: 9.6	64-bit Junos OS: 11.4	em0	ixgbe0 ixgbe1

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

Table 35 on page 55 lists the Routing Engines supported by the TX Matrix Plus router with 3D SIBs.

Table 35: 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 41](#)
  - *Understanding Internal Ethernet Interfaces*
  - *Understanding Management Ethernet Interfaces*

## CHAPTER 6

# Line Card Components and Descriptions

- [T320 Flexible PIC Concentrators \(FPCs\) Description on page 57](#)
- [T320 FPCs Supported on page 63](#)
- [T320 PIC Description on page 63](#)
- [T320 PICs Supported on page 64](#)
- [T320 End-of-Life PICs Supported on page 68](#)
- [T320 PIC/FPC Compatibility on page 70](#)

## **T320 Flexible PIC Concentrators (FPCs) Description**

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- [T320 FPC Function on page 57](#)
- [T320 FPC Slots on page 57](#)
- [T320 FPC Components on page 58](#)
- [T320 FPC Edges on page 59](#)
- [Identifying the T320 FPCs on page 60](#)

### **T320 FPC Function**

FPCs house the PICs that connect the T320 Core Router to network media. The main function of an FPC is to connect the PICs installed in it to the other 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 FPCs installed, the Packet Forwarding Engines can forward up to 385 million packets per second (Mpps) for all packet sizes. The maximum aggregate throughput rate for the router is 160 Gbps (full duplex).

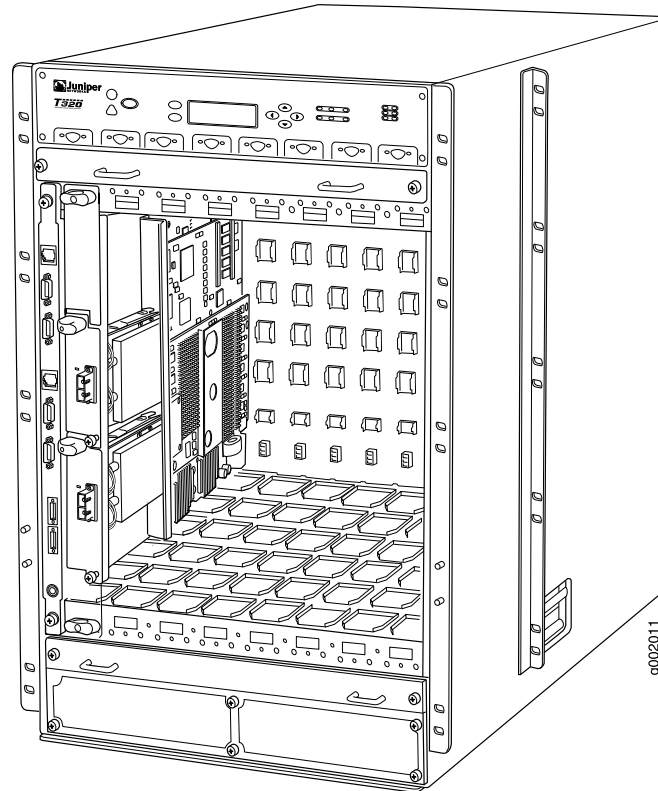
FPCs are hot-removable and hot-insertable. When you remove or install an FPC, packet forwarding is not interrupted. When you install an FPC into a functioning router, the Routing Engine downloads the FPC software, the FPC runs its diagnostics, and the PICs housed on the FPC are enabled. Forwarding continues uninterrupted during this process.

### **T320 FPC Slots**

Up to eight Flexible PIC Concentrators (FPCs) install vertically in the front of the T320 Core Router (see [Figure 22 on page 58](#)). The FPC slots are numbered left to right from **FPC0** to **FPC7**. Each FPC has two connectors into which a PIC can be installed, allowing

up to two PICs per FPC. An FPC can be installed into any FPC slot on the router, regardless of which PICs it contains. 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.

Figure 22: FPC Installed in T320 Router Chassis



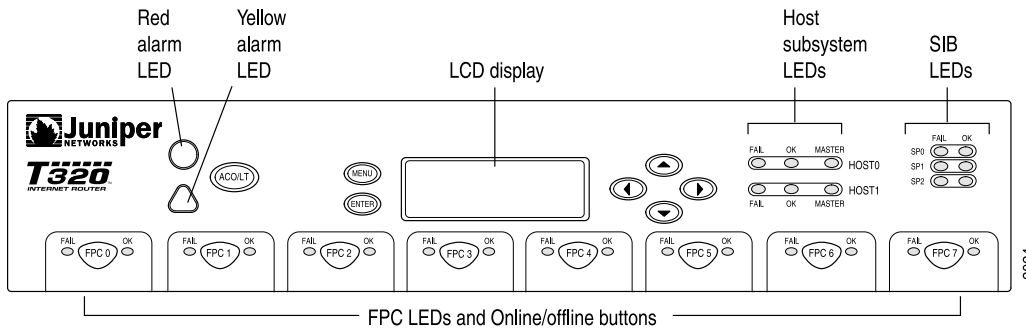
## T320 FPC Components

Each FPC consists of the following components:

- FPC card carrier.
- One Packet Forwarding Engine—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.
- Processor Mezzanine Board (PMB), which includes a 300-MHz CPU, system controller, 256 MB of SDRAM, and two Fast Ethernet interfaces.
- Each FPC contains data memory that is managed by the Queuing and Memory Interface ASICs.

- Two LEDs, located on the craft interface above the FPC, that display the status of the FPC. For more information on the FPC LEDs, see “T320 Craft Interface FPC LEDs” on page 23.
- FPC online/offline button, located on the craft interface above the FPC (see Figure 23 on page 59).

Figure 23: FPC Online/Offline Button on the Craft Interface

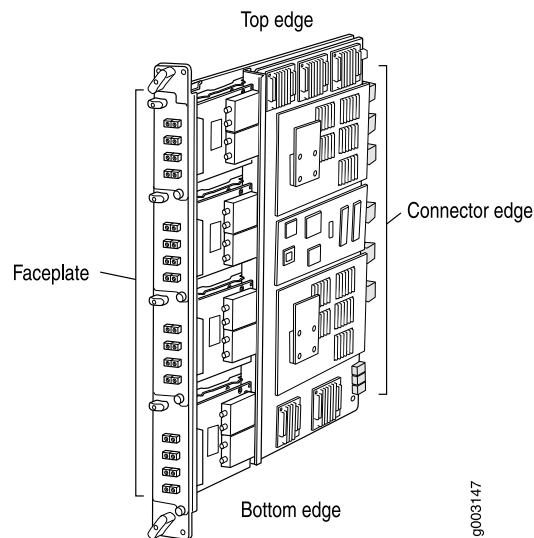


## T320 FPC Edges

Regardless of whether you are holding an FPC vertically or horizontally, this documentation uses the same terms for all four edges of the FPC (see Figure 24 on page 59):

- **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 24: FPC Edges



## Identifying the T320 FPCs

Enhanced FPCs and Enhanced II FPCs are labeled. Check the label on the faceplate to identify the FPC. However, standard FPCs are not labeled. To determine the type of standard FPC, check the location of the installed PIC's online/offline button and how the PIC is secured to the FPC ([Table 36 on page 61](#)).

Type 1 and Type 2 PICs installed in a standard FPC look similar, because both have two captive screws to secure the PIC to the FPC. Therefore, you must check the location of the PIC online/offline button.

- The PIC online/offline buttons are located on the Type 1 FPC above the PICs (see [Figure 28 on page 62](#)). Type 1 PICs do not have an online/offline button on the PIC faceplate ([Figure 25 on page 60](#)).
- The PIC online/offline buttons are located directly on the Type 2 PIC faceplates (see [Figure 26 on page 60](#)), rather than on the Type 2 FPC faceplate.

Figure 25: Type 1 PIC

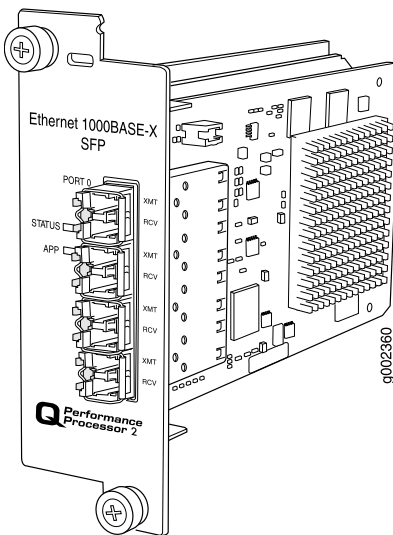
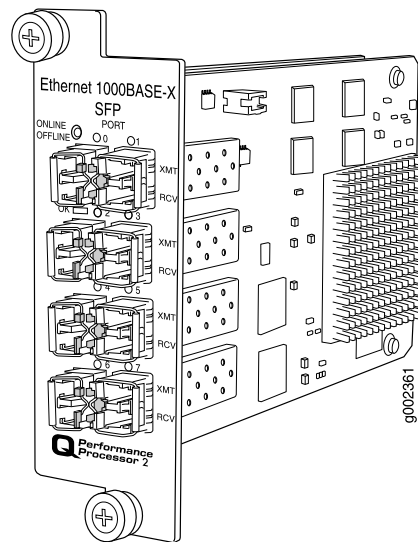


Figure 26: Type 2 PIC



Type 2 and Type 3 FPCs look similar, because both have the PIC online/offline buttons directly on the PIC faceplates. Therefore, you can distinguish between a Type 2 and Type 3 FPC by checking whether the installed PICs have a plastic ejector handle (Type 3) (see [Figure 27 on page 61](#)), or a captive screw (Type 2) (see [Figure 26 on page 60](#)), at the top of the PIC faceplate.



Figure 27: Type 3 PIC

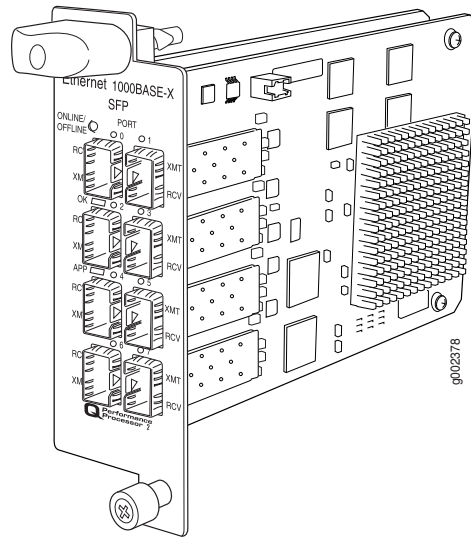


Table 36: Identifying the FPCs Supported by the T320 Router

FPC	Label on the FPC Faceplate	Location of PIC Offline Button	Method of Securing the PIC to the FPC
FPC1	None	FPC faceplate above the PICs	Two captive screws
Enhanced FPC1 (EOL)	<b>E FPC1</b>		
Enhanced II FPC1	<b>E-II FPC1</b>		
FPC2	None	PIC faceplate	Two captive screws
Enhanced FPC2 (EOL)	<b>E FPC2</b>		
Enhanced II FPC2	<b>E-II FPC2</b>		
FPC3	None	PIC faceplate	Plastic ejector handle at the top of the PIC faceplate
Enhanced FPC3 (EOL)	<b>E FPC3</b>		Captive screw at the bottom of the PIC faceplate
Enhanced II FPC3	<b>E-II FPC3</b>		

Figure 28 on page 62 shows the standard FPCs supported by the T320 router. The enhanced FPCs look similar to the standard FPCs.

Figure 28: Standard FPC1, FPC2, and FPC3 Supported by the T320 Router

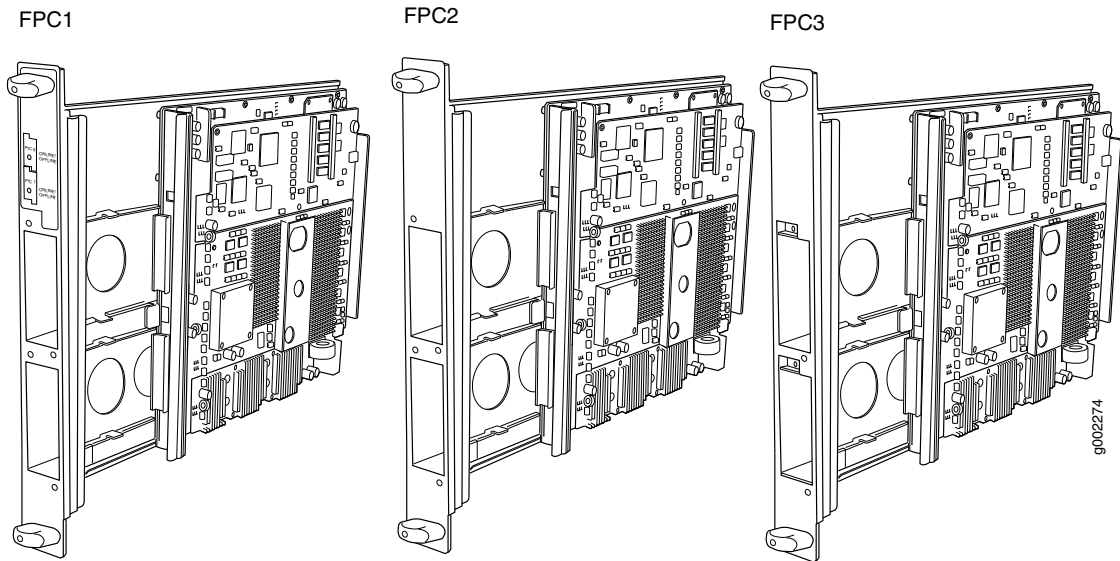
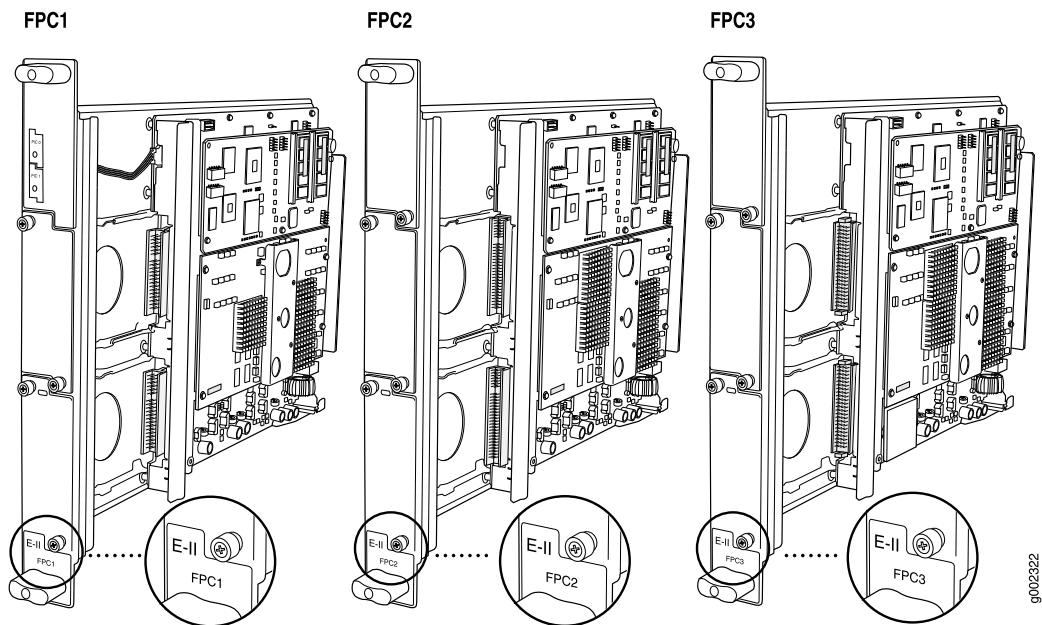


Figure 29 on page 62 shows the Enhanced II FPCs supported by the T320 router.

Figure 29: Enhanced II FPC1, FPC2, and FPC3 Supported by the T320 Router



- Related Documentation**
- [T320 FPCs Supported on page 63](#)
  - [T320 Field-Replaceable Units on page 171](#)
  - [Maintaining T320 FPCs on page 265](#)

- [Troubleshooting the T320 FPCs on page 289](#)
- [Replacing a T320 FPC on page 223](#)

## T320 FPCs Supported

T320 routers support the Flexible PIC Concentrators (FPCs) listed in [Table 37 on page 63](#).

**Table 37: FPCs Supported by the T320 Router**

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs	Maximum Throughput (Full-Duplex)	First Junos OS Release Supported
1	FPC1	T320-FPC1	2	2 Gbps	5.5
1	Enhanced FPC1 (EOL)	T320-FPC1-E	2	2 Gbps	6.3
1	Enhanced II FPC1	T320-FPC1-E2	2	2 Gbps	7.4
2	FPC2	T320-FPC2	2	8 Gbps	5.4
2	Enhanced FPC2 (EOL)	T320-FPC2-E	2	8 Gbps	6.3
2	Enhanced II FPC2	T320-FPC2-E2	2	8 Gbps	7.4
3	FPC3	T320-FPC3	2	20 Gbps	5.4
3	Enhanced FPC3 (EOL)	T320-FPC3-E	2	20 Gbps	6.3
3	Enhanced II FPC3	T320-FPC3-E2	2	20 Gbps	7.4

### Related Documentation

- [T320 Flexible PIC Concentrators \(FPCs\) Description on page 57](#)
- [T320 PICs Supported on page 64](#)
- [T320 PIC/FPC Compatibility on page 70](#)

## T320 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.

PICs are hot-removable and hot-insertable. You can install up to two or four PICs into the slots in each FPC. PICs used in a Type 1 FPC or Type 2 FPC have captive screws at

their upper and lower corners. Type 3 PICs have an upper ejector handle and a lower captive screw.

The router supports various PICs, including ATM, Channelized, Gigabit Ethernet, IP Services, 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.

- Related Documentation**
- [Maintaining T320 PICs and PIC Cables on page 270](#)
  - [Troubleshooting the T320 PICs on page 290](#)
  - [Replacing a T320 PIC on page 229](#)

## T320 PICs Supported

Table 38 on page 64 lists the PICs supported by the T320 router. The PICs are listed alphabetically by PIC family.

**Table 38: PICs Supported by the T320 Internet Router**

PIC Family and Type	Model Number	Ports	First Junos OS Release Supported
<b>ATM2 IQ</b>			
<i>ATM2 E3 IQ PIC (T320 Router)</i>	PB-2E3-ATM2	4	7.4
<i>ATM2 OC3/STM1 IQ PIC (T320 Router)</i>	PB-2OC3-ATM2-MM	2	5.7
	PB-2OC3-ATM2-SMIR		
<i>ATM2 OC12/STM4 IQ PICs (T320 Router)</i>			
• ATM2 OC12/STM4 IQ PIC	PB-1OC12-ATM2-MM	1	6.0
	PB-1OC12-ATM2-SMIR		
• ATM2 OC12/STM4 IQ PIC	PB-2OC12-ATM2-MM	2	5.5
	PB-2OC12-ATM2-SMIR		
<i>ATM2 OC48/STM16 IQ PIC with SFP (T320 Router)</i>	PB-1OC48-ATM2-SFP	1	7.3
<b>Channelized IQ</b>			
<i>Channelized DS3 IQ PIC (T320 Router)</i>	PB-4CHDS3-QPP	4	6.3
<i>Channelized OC3 IQ PIC (T320 Router)</i>	PB-1CHOC3-SMIR-QPP	1	7.1
<i>Channelized STM1 IQ PIC (T320 Router)</i>	PB-1CHSTM1-SMIR-QPP	1	6.0

Table 38: PICs Supported by the T320 Internet Router (*continued*)

PIC Family and Type	Model Number	Ports	First Junos OS Release Supported
<b>Channelized Enhanced IQ (IQE)</b>			
<i>Channelized DS3/E3 Enhanced IQ (IQE) PIC (T320 Router)</i>	PB-4CHDS3-E3-IQE-BNC	4	9.3
<i>Channelized E1/T1 Enhanced IQ (IQE) PIC (T320 Router)</i>	PB-10CHE1-T1-IQE-RJ48	10	9.5
<i>Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T320 Router)</i>	PB-2CHOC3-STM1-IQE-SFP	2	9.3
<i>Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T320 Router)</i>			
• Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	PB-1CHOC12-STM4-IQE-SFP	1	9.3
• Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	PB-4CHOC12-STM4-IQE-SFP	4	9.4
<i>Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T320 Router)</i>	PB-1CHOC48-STM16-IQE-SFP	1	9.4
<b>DS3/E3</b>			
<i>DS3/E3 Enhanced IQ (IQE) EOL PIC (T320 Router)</i>	PB-4DS3-E3-IQE-BNC	4	9.3R2
<i>E3 IQ PIC (T320 Router)</i>	PB-4E3-QPP	4	6.2
<b>Ethernet</b>			
<i>Fast Ethernet PICs (T320 Router)</i>			
• Fast Ethernet PIC	PB-4FE-TX	4	5.5
• Fast Ethernet PIC	PB-12FE-TX-MDI PB-12FE-TX-MDIX	12	6.0
• Fast Ethernet PIC	PB-48FE-TX	48	8.3
<i>Gigabit Ethernet PICs with SFP (T320 Router)</i>			
• Gigabit Ethernet PIC with SFP	PB-1GE-SFP	1	6.4
• Gigabit Ethernet PIC with SFP	PB-2GE-SFP	2	6.4
• Gigabit Ethernet PIC with SFP	PB-4GE-SFP	4	7.0
• Gigabit Ethernet PIC with SFP	PC-10GE-SFP	10	5.5

Table 38: PICs Supported by the T320 Internet Router (*continued*)

PIC Family and Type	Model Number	Ports	First Junos OS Release Supported
<i>10-Gigabit Ethernet PIC with XENPAK (T320 Router)</i>	PC-1XGE-XENPAK	1	6.2
<i>10-Gigabit Ethernet DWDM PIC (T320 Router)</i>	PC-1XGE-DWDM-CBAND	1	7.5
<i>10-Gigabit Ethernet DWDM OTN PIC (T320 Router)</i>	PC-1XGE-DWDM-OTN	1	9.4
<b>Ethernet IQ</b>			
<i>Gigabit Ethernet IQ PICs with SFP (T320 Router)</i>			
• Gigabit Ethernet IQ PIC with SFP	PB-1GE-SFP-QPP	1	6.1
• Gigabit Ethernet IQ PIC with SFP	PB-2GE-SFP-QPP	2	6.1
<b>Ethernet IQ2</b>			
<i>Gigabit Ethernet IQ2 PICs with SFP (T320 Router)</i>			
• Type 1 Gigabit Ethernet IQ2 PIC with SFP	PB-4GE-TYPE1-SFP-IQ2	4	7.6R3
• Type 2 Gigabit Ethernet IQ2 PIC with SFP	PB-8GE-TYPE2-SFP-IQ2	8	7.6R2
• Type 3 Gigabit Ethernet IQ2 PIC with SFP	PC-8GE-TYPE3-SFP-IQ2	8	8.2
<i>10-Gigabit Ethernet IQ2 PIC with XFP (T320 Router)</i>	PC-1XGE-TYPE3-XFP-IQ2	1	8.0R3
<b>Ethernet Enhanced IQ2 (IQ2E)</b>			
<i>Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T320 Router)</i>			
• Type 1 Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	PB-4GE-TYPE1-SFP-IQ2E	4	9.4
• Type 2 Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	PB-8GE-TYPE2-SFP-IQ2E	8	9.4
• Type 3 Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	PC-8GE-TYPE3-SFP-IQ2E	8	9.4
<i>10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (T320 Router)</i>	PC-1XGE-TYPE3-XFP-IQ2E	1	9.4

Table 38: PICs Supported by the T320 Internet Router (*continued*)

PIC Family and Type	Model Number	Ports	First Junos OS Release Supported
<b>Services</b>			
<i>Multiservices PICs (T320 Router)</i>			
• Multiservices 100 PIC	PB-MS-100-1	0	8.1
• Multiservices 400 PIC	PB-MS-400-2	0	8.1R2
• Multiservices 500 PIC	PC-MS-500-3	0	8.3
<i>Tunnel Services PIC (T320 Router)</i>			
• Type 1 Tunnel Services PIC	PB-TUNNEL-1	0	6.1
• Type 2 Tunnel Services PIC	PB-TUNNEL	0	6.1
• Type 3 Tunnel Services PIC	PC-TUNNEL	0	5.4
<b>SONET/SDH</b>			
<i>SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T320 Router)</i>	PB-4OC3-STM1-IQE-SFP	4	9.3R2
<i>SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T320 Router)</i>			
• SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP (Type 1)	PB-4OC3-1OC12-SON-SFP	4	8.4
• SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP (Type 2)	PB-4OC3-1OC12-SONB-SFP	4	8.3
<i>SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (T320 Router)</i>	PB-1OC12-STM4-IQE-SFP	1	9.3
<i>SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T320 Router)</i>			
• SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	PB-1OC12-SON-SFP	1	8.4
• SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	PB-4OC3-4OC12-SON-SFP	4	8.3
<i>SONET/SDH OC48c/STM16 PIC with SFP (T320 Router)</i>			
• SONET/SDH OC48c/STM16 PIC with SFP	PB-1OC48-SON-B-SFP	1	8.3
• SONET/SDH OC48c/STM16 PIC with SFP	PC-4OC48-SON-SFP	4	6.2

Table 38: PICs Supported by the T320 Internet Router (*continued*)

PIC Family and Type	Model Number	Ports	First Junos OS Release Supported
<i>SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T320 Router)</i>	PB-1OC48-SON-B-SFP	1	8.3
<i>SONET/SDH OC192c/STM64 PIC (T320 Router)</i>	PC-1OC192-SON-VSR	1	5.4
<i>SONET/SDH OC192/STM64 PIC with XFP (T320 Router)</i>	PC-1OC192-SON-XFP	1	8.1

- Related Documentation**
- [T320 PIC Description on page 63](#)
  - [T320 PIC Combination Limitations](#)
  - [T320 PIC/FPC Compatibility on page 70](#)

## T320 End-of-Life PICs Supported

Table 38 on page 64 lists the end-of-life PICs supported by the T320 router. The PICs are listed alphabetically by PIC family.

Table 39: End-of-Life PICs Supported in the T320 Internet Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
<b>ATM</b>				
<i>ATM OC3 EOL PIC (T320 Router)</i>	2	PB-2OC3-ATM-MM PB-2OC3-ATM-SMIR	• Optical: SC/PC	4.0
<i>ATM OC12 EOL PIC (T320 Router)</i>	1	PB-1OC12-ATM-MM PB-1OC12-ATM-SMIR	• Optical: SC/PC	4.0
<b>Channelized IQ</b>				
<i>Channelized OC12 IQ EOL PIC (T320 Router)</i>	1	PB-1CHOC12SMIR-QPP	• Optical: SC/PC	6.0
<b>DS3/E3</b>				
<i>DS3 EOL PIC (T320 Router)</i>	4	PB-4DS3	• Custom 10 ft (3.05 m) posilock SMB to BNC male cable, separate Rx and Tx (provided)	5.7
<b>Ethernet</b>				
<i>Gigabit Ethernet EOL PICs (T320 Router)</i>				



Table 39: End-of-Life PICs Supported in the T320 Internet Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
• Gigabit Ethernet PIC	2	PB-2GE-LX PB-2GE-SX	• Optical: SC/PC	5.4
• Gigabit Ethernet PIC	4	PB-4GE-SX	• Optical: SC/PC	5.4
<i>10-Gigabit Ethernet EOL PIC (T320 Router)</i>	1	PC-1XGE-LR	• Optical: SC/PC	5.4
<b>Services</b>				
<i>Adaptive Services II EOL PIC (T320 Router)</i>	0	PB-AS2	• None	6.4
<i>Adaptive Services II Layer 2 Services EOL PIC (T320 Router)</i>	0	PB-AS2-LAYER2SERVICES	• None	7.5
<i>ES EOL PIC (T320 Router)</i>	0	PB-ES-800	• None	6.0
<i>Link Services PIC (T320 Router)</i>	0	PB-LS-4 PE-LS-32 PE-LS-128	• None	6.1
<i>Monitoring Services II EOL PIC (T320 Router)</i>	0	PB-PM2	• None	7.1R2
<i>Monitoring Services III EOL PIC (T320 Router)</i>	0	PB-PM3	• None	7.4
<b>SONET/SDH</b>				
<i>SONET/SDH OC3c/STM1 EOL PICs (T320 Router)</i>				
• SONET/SDH OC3/STM1 PIC	4	PB-4OC3-SON-MM PB-4OC3-SON-SMIR	• Optical: SC/PC	7.1
• SONET/SDH OC3/STM1 PIC	4	PB-4OC3-SON-MM PB-4OC3-SON-SMIR	• Optical: SC/PC	5.5
<i>SONET/SDH OC12c/STM4 EOL PICs (T320 Router)</i>				
• SONET/SDH OC12/STM4 PIC	4	PB-4OC12-SON-MM PB-4OC12-SON-SMIR	• Optical: SC/PC	5.4
• SONET/SDH OC12/STM4 PIC	1	PB-1OC12-SON-MM	• Optical: SC/PC	7.5
<i>SONET/SDH OC48c/STM16 EOL PICs (T320 Router)</i>				

Table 39: End-of-Life PICs Supported in the T320 Internet Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
• SONET/SDH OC48c/STM16 PIC	1	PB-1OC48-SON-SMLR PB-1OC48-SON-SMSR	• Optical: SC/PC	5.4
• SONET/SDH OC48c/STM16 PIC	4	PC-4OC48-SON-SMSR	• Optical: SC/PC	5.4
<i>SONET/SDH OC48c/STM16 EOL PIC with SFP (T320 Router)</i>	1	PB-1OC48-SON-SFP	• Optical: LC/PC	6.1
<i>SONET/SDH OC192c/STM64 EOL PICs (T320 Router)</i>	1	PB-1OC192-SON-LR PB-1OC192-SON-SR2	• Optical: SC/PC	5.4

**Related Documentation** • [T320 PIC Description on page 63](#)

## T320 PIC/FPC Compatibility

The PIC/FPC compatibility matrixes list the current PICs for T320 routers, and the first Junos OS release in which the FPC supports the PIC. For example, Junos OS Release 7.4 is the first release in which the T320 E-II-FPC1 supports the ATM2 OC3/STM1 IQ, 2-port PIC.



**NOTE:** A dash (–) indicates that the PIC is not supported on the FPC.

- [Type 1 PIC/FPC Compatibility on page 70](#)
- [Type 2 PIC/FPC Compatibility on page 73](#)
- [Type 3 PIC/FPC Compatibility on page 75](#)

### Type 1 PIC/FPC Compatibility

Table 40: T320 PIC/FPC Compatibility (Type 1)

PIC Type	PIC Model Number	T320 FPC1	T320 E-FPC	T320 E-II- FPC1
<b>ATM2 IQ PICs</b>				
ATM2 E3 IQ, 4-port	PB-4E3-ATM2 <i>ATM2 E3 IQ PIC (T320 Router)</i>	7.4	7.4	7.4
ATM2 OC3/STM1 IQ, 2-port	PB-2OC3-ATM2-MM PB-2OC3-ATM2-SMIR <i>ATM2 OC3/STM1 IQ PIC (T320 Router)</i>	5.7	6.3	7.4

Table 40: T320 PIC/FPC Compatibility (Type 1) (continued)

PIC Type	PIC Model Number	T320 FPC1	T320 E-FPC	T320 E-II- FPC1
ATM2 OC12/STM4 IQ, 1-port	PB-1OC12-ATM2-MM	6.0	6.3	7.4
	PB-1OC12-ATM2-SMIR			
	<i>ATM2 OC12/STM4 IQ PICs (T320 Router)</i>			
<b>Channelized IQ PICs</b>				
ChDS3 IQ, 4-port	PB-4CHDS3-QPP	6.3	6.3	7.4
	<i>Channelized DS3 IQ PIC (T320 Router)</i>			
ChOC3 IQ, 1-port	PB-1CHOC3-SMIR-QPP	7.1	7.1	7.4
	<i>Channelized OC3 IQ PIC (T320 Router)</i>			
ChSTM1 IQ, 1-port	PB-1CHSTM1-SMIR-QPP	6.0	6.3	7.4
	<i>Channelized STM1 IQ PIC (T320 Router)</i>			
<b>Channelized Enhanced IQ (IQE) PICs</b>				
ChDS3/E3 IQE, 4-port	PB-4CHDS3-E3-IQE-BNC	–	9.3	9.3
	<i>Channelized DS3/E3 Enhanced IQ (IQE) PIC (T320 Router)</i>			
ChE1/T1 IQE, 10-port	PB-10CHE1-T1-IQE-RJ48	–	9.5	9.5
	<i>Channelized E1/T1 Enhanced IQ (IQE) PIC (T320 Router)</i>			
ChOC3/STM1 IQE, 2-port	PB-2CHOC3-STM1-IQE-SFP	–	9.3	9.3
	<i>Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T320 Router)</i>			
ChOC12/STM4 IQE, 1-port	PB-1CHOC12-STM4-IQE-SFP	–	9.3	9.3
	<i>Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T320 Router)</i>			
<b>DS3 and E3 PICs</b>				
DS3/E3 IQE, 4-port	PB-4DS3-E3-IQE-BNC	–	9.3R2	9.3R2
	<i>DS3/E3 Enhanced IQ (IQE) EOL PIC (T320 Router)</i>			
E3 IQ 4-port	PB-4E3-QPP	6.2	6.3	7.4
	<i>E3 IQ PIC (T320 Router)</i>			

Table 40: T320 PIC/FPC Compatibility (Type 1) (continued)

PIC Type	PIC Model Number	T320 FPC1	T320 E-FPC	T320 E-II- FPC1
DS3 4-port	PB-4DS3 <i>DS3 EOL PIC (M320 Router)</i>	6.2	6.2	6.2
<b>Fast Ethernet PICs</b>				
Fast Ethernet, 4-port	PB-4FE-TX <i>Fast Ethernet PICs (T320 Router)</i>	5.5	6.3	7.4
Fast Ethernet, 12-port	PB-12FE-TX-MDI PB-12FE-TX-MDIX <i>Fast Ethernet PICs (T320 Router)</i>	6.0	6.3	7.4
<b>Gigabit Ethernet PICs</b>				
Gigabit Ethernet, 1-port SFP	PB-1GE-SFP <i>Gigabit Ethernet PICs with SFP (T320 Router)</i>	6.4	6.4	7.4
<b>Ethernet IQ PICs</b>				
Gigabit Ethernet IQ, 1-port SFP	PB-1GE-SFP-QPP <i>Gigabit Ethernet IQ PICs with SFP (T320 Router)</i>	6.1	6.3	7.4
<b>Ethernet IQ2 PICs</b>				
Gigabit Ethernet IQ2, 4-port SFP	PB-4GE-TYPE1-SFP-IQ2 <i>Gigabit Ethernet IQ2 PICs with SFP (T320 Router)</i>	–	7.6R3	7.6R3
<b>Ethernet Enhanced IQ2 (IQ2E) PICs</b>				
Gigabit Ethernet IQ2E, 4-port SFP	PB-4GE-TYPE1-SFP-IQ2E <i>Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T320 Router)</i>	–	9.4	9.4
<b>Service PICs</b>				
Monitoring Services II	PB-PM2 <i>Monitoring Services II EOL PIC (T320 Router)</i>	7.1R2	7.1R2	7.1R2
Monitoring Services III	PB-PM3 <i>Monitoring Services III EOL PIC (T320 Router)</i>	7.4	7.4	7.4
Multiservices 100	PB-MS-100-1 <i>Multiservices PICs (T320 Router)</i>	–	8.1	8.1

Table 40: T320 PIC/FPC Compatibility (Type 1) (continued)

PIC Type	PIC Model Number	T320 FPC1	T320 E-FPC	T320 E-II- FPC1
Tunnel Services	PB-TUNNEL-1 <i>Tunnel Services PIC (T320 Router)</i>	6.1	6.3	7.4
<b>SONET/SDH PICs</b>				
OC3/STM1 IQE, 4-port SFP (Type 1)	PB-4OC3-STM1-IQE-SFP <i>SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T320 Router)</i>	–	9.3R2	9.3R2
OC3/STM1 (Multi-Rate), 4-port SFP (Type 1)	PB-4OC3-1OC12-SON-SFP <i>SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T320 Router)</i>	–	8.4	8.4
OC12/STM4 IQE, 4-port SFP	PB-1OC12-SON-SFP <i>SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (T320 Router)</i>	–	9.3	9.3
OC12/STM4 (Multi-Rate), 1-port SFP (Type 1)	PB-1OC12-STM4-IQE-SFP <i>SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T320 Router)</i>	–	8.4	8.4

### Type 2 PIC/FPC Compatibility

Table 41: T320 PIC/FPC Compatibility

PIC Type	PIC Model Number	T320 FPC2	T320 E-FPC2	T320 E-II-FPC2
<b>ATM2 IQ PICs</b>				
ATM2 OC12/STM4 IQ, 2-port	PB-2OC12-ATM2-MM PB-2OC12-ATM2-SMIR <i>ATM2 OC12/STM4 IQ PICs (T320 Router)</i>	5.5	6.3	7.4
ATM2OC48/STM16 IQ, 1-port	PB-1OC12-ATM2-MM PB-1OC12-ATM2-SMIR <i>ATM2 OC48/STM16 IQ PIC with SFP (T320 Router)</i>	7.3	7.3	7.4
<b>Channelized Enhanced IQ (IQE) PICs</b>				
ChOC12/STM4 IQE, 4-port	PB-4CHOC12-STM4-IQE-SFP <i>Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T320 Router)</i>	–	9.4	9.4

Table 41: T320 PIC/FPC Compatibility (*continued*)

PIC Type	PIC Model Number	T320 FPC2	T320 E-FPC2	T320 E-II-FPC2
ChOC48/STM16 IQE, 1-port	PB-1CHOC48-STM16-IQE-SFP <i>Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T320 Router)</i>	–	9.4	9.4
<b>Fast Ethernet PICs</b>				
Fast Ethernet, 48-port	PB-48FE-TX <i>Fast Ethernet PICs (T320 Router)</i>	8.3	8.3	8.3
<b>Gigabit Ethernet PICs</b>				
Gigabit Ethernet, 2-port SFP	PB-2GE-SFP <i>Gigabit Ethernet PICs with SFP (T320 Router)</i>	6.4	6.4	7.4
Gigabit Ethernet, 4-port SFP	PB-4GE-SFP <i>Gigabit Ethernet PICs with SFP (T320 Router)</i>	7.0	7.0	7.4
<b>Ethernet IQ PICs</b>				
Gigabit Ethernet IQ, 2-port SFP	PB-2GE-SFP-QPP <i>Gigabit Ethernet IQ PICs with SFP (T320 Router)</i>	6.1	6.3	7.4
<b>Ethernet IQ2 PICs</b>				
Gigabit Ethernet IQ2, 8-port SFP (Type 2)	PB-8GE-TYPE2-SFP-IQ2 <i>Gigabit Ethernet IQ2 PICs with SFP (T320 Router)</i>	–	7.6R2	7.6R2
<b>Ethernet Enhanced IQ2 (IQ2E) PICs</b>				
Gigabit Ethernet IQ2E, 8-port SFP (Type 2)	PB-8GE-TYPE2-SFP-IQ2E <i>Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T320 Router)</i>	–	9.4	9.4
<b>Service PICs</b>				
Multiservices 400	PB-MS-400-2 <i>Multiservices PICs (T320 Router)</i>	–	8.1R2	8.1R2
Tunnel Services	PB-TUNNEL <i>Tunnel Services PIC (T320 Router)</i>	6.1	6.3	7.4
<b>SONET/SDH PICs</b>				

Table 41: T320 PIC/FPC Compatibility (*continued*)

PIC Type	PIC Model Number	T320 FPC2	T320 E-FPC2	T320 E-II-FPC2
OC3/STM1 (Multi-Rate), 4-port SFP (Type 1)	PB-4OC3-4OC12-SON-SFP <i>SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T320 Router)</i>	8.4	8.4	8.4
OC3/STM1 (Multi-Rate), 4-port SFP (Type 2)	PB-4OC3-1OC12-SON2-SFP <i>SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T320 Router)</i>	–	8.3	8.3
OC48c/STM16, 1-port SFP	PB-1OC48-SON-B-SFP <i>SONET/SDH OC48c/STM16 PIC with SFP (T320 Router)</i>	8.3	8.3	8.3
OC48/STM16 (Multi-Rate), 4-port SFP	PB-4OC48-SON-SFP <i>SONET/SDH OC48c/STM16 PIC with SFP (T320 Router)</i>	–	8.3	8.3

### Type 3 PIC/FPC Compatibility

Table 42: T320 Type 3 PIC/FPC Compatibility

PIC Type	PIC Model Number	T320 FPC3	T320 E-FPC3	T320 E-II-FPC3
<b>Gigabit Ethernet PICs</b>				
Gigabit Ethernet, 10-port SFP	PC-10GE-SFP <i>Gigabit Ethernet PICs with SFP (T320 Router)</i>	5.5	6.3	7.4
<b>10-Gigabit Ethernet PICs</b>				
10-Gigabit Ethernet, 1-port XENPAK	PC-1XGE-XENPAK <i>10-Gigabit Ethernet PIC with XENPAK (T320 Router)</i>	6.2	6.3	7.4
10-Gigabit Ethernet, 1-port DWDM	PC-1XGE-DWDM-CBAND <i>10-Gigabit Ethernet DWDM PIC (T320 Router)</i>	7.5	7.5	7.5
10-Gigabit Ethernet, 1-port DWDM OTN	PC-1XGE-DWDM-OTN <i>10-Gigabit Ethernet DWDM OTN PIC (T320 Router)</i>	--	9.4	9.4
<b>Ethernet IQ2 PICs</b>				
Gigabit Ethernet IQ2, 8-port SFP (Type 3)	PC-8GE-TYPE3-SFP-IQ2 <i>Gigabit Ethernet IQ2 PICs with SFP (T320 Router)</i>	8.2	8.2	8.2

Table 42: T320 Type 3 PIC/FPC Compatibility (*continued*)

PIC Type	PIC Model Number	T320 FPC3	T320 E-FPC3	T320 E-II-FPC3
10-Gigabit Ethernet IQ2, 1-port XFP (Type 3)	PC-1XGE-TYPE3-XFP-IQ2 <i>10-Gigabit Ethernet IQ2 PIC with XFP (T320 Router)</i>	8.0R3	8.0R3	8.0R3
<b>Ethernet Enhanced IQ2 (IQ2E) PICs</b>				
Gigabit Ethernet IQ2E, 8-port SFP (Type 3)	PC-8GE-TYPE3-SFP-IQ2E <i>Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T320 Router)</i>	9.4	9.4	9.4
10-Gigabit Ethernet IQ2E, 1-port XFP (Type 3)	PC-1XGE-TYPE3-XFP-IQ2E <i>Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T320 Router)</i>	9.4	9.4	9.4
<b>Service PICs</b>				
Multiservices 500	PC-MS-500-3 <i>Multiservices PICs (T320 Router)</i>	8.3	8.3	–
Tunnel Services	PC-TUNNEL <i>Tunnel Services PIC (T320 Router)</i>	5.4	6.3	7.4
<b>SONET/SDH PICs</b>				
OC48c/STM16, 4-port	PC-4OC48-SON-SFP <i>SONET/SDH OC48c/STM16 PIC with SFP (T320 Router)</i>	6.2	6.3	7.4
OC192c/STM64, 1-port	PC-1OC192-SON-VSR <i>SONET/SDH OC192c/STM64 PIC (T320 Router)</i>	5.4	6.3	7.4
OC192/STM64 with XFP, 1-port	PC-1OC192-SON-XFP <i>SONET/SDH OC192/STM64 PIC with XFP (T320 Router)</i>	8.1	8.1	8.1

- Related Documentation**
- [T320 PIC Description on page 63](#)
  - [T320 PICs Supported on page 64](#)
  - [T320 FPCs Supported on page 63](#)



## CHAPTER 7

# Power System Components and Descriptions

- [T320 Power System Description on page 77](#)
- [T320 Power Supply LEDs on page 78](#)

### T320 Power System Description

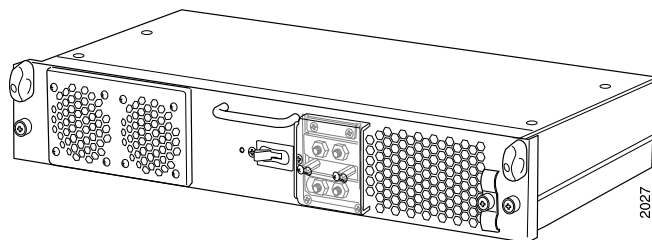
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The T320 Core Router supports DC power only. The router is equipped with two redundant, load-sharing DC power supplies (see [Figure 30 on page 77](#)), located at the lower rear of the chassis in slots **PEM0** and **PEM1** (top to bottom). Each power supply has one input, which has its own circuit breaker, and which requires a dedicated DC power source. The power supplies connect to the midplane, which distributes the different output voltages produced by the power supplies to the router components, depending on their voltage requirements.

When the 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.

Power supplies are hot-removable and hot-insertable. Each power supply is cooled by its own internal cooling system.

**Figure 30: T320 Power Supply**



For power supply and power system electrical specifications, see [“T320 Power System Electrical Specifications” on page 90](#).

- Related Documentation**
- [Powering On the T320 Router on page 159](#)
  - [Maintaining the T320 Power Supplies on page 272](#)

## T320 Power Supply LEDs

One LED on each power supply faceplate indicated the status of the power supply. In addition, a power supply failure triggers the red alarm LED on the craft interface. [Table 43 on page 78](#) describes the functions of the power supply LEDs.

**Table 43: T320 Power Supply LED**

LED	Color	State	Description
DC OK	Blue	Off	No power applied to power supply.
		Blinking	<ul style="list-style-type: none"> <li>• Power supply LED blinks for five seconds after initial power on.</li> <li>• Power supply is installed, but not powered on, and is receiving bias power from a powered on power supply.</li> <li>• Input voltage is invalid.</li> <li>• Power supply has failed.</li> </ul>
		On steadily	Power supply is installed correctly and is functioning normally.

- Related Documentation**
- [T320 Power System Description on page 77](#)
  - [Powering On the T320 Router on page 159](#)
  - [Maintaining the T320 Power Supplies on page 272](#)

# Switch Fabric Components and Descriptions

- T320 Switch Interface Boards (SIBs) Description on page 79
- T320 SIB LEDs on page 80

## T320 Switch Interface Boards (SIBs) Description

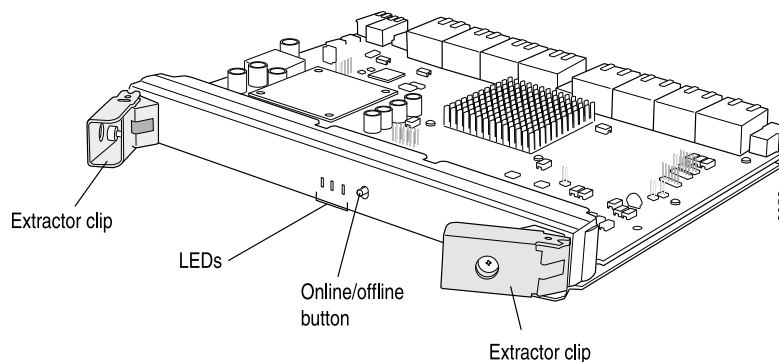
The Switch Interface Boards (SIBs) provide the switching function to the destination FPC (see [Figure 31 on page 79](#)). The SIBs create the switch fabric for the router, providing up to a total of 385 million packets per second (Mpps) of forwarding.

Three SIBs are installed in the T320 router. The SIBs are located at the center rear of the chassis in the slots labeled **SIB0** through **SIB2** (top to bottom).

**SIB0** acts as a backup to **SIB1** and **SIB2**. If a SIB in slots **SIB1** or **SIB2** fails or is removed, **SIB0** becomes active. A slight degradation in performance might occur. When the SIB in slots **SIB1** or **SIB2** is replaced or reinstalled, it will become active again and **SIB0** reverts to backup. The router will regain full forwarding capacity.

SIBs are hot-insertable and hot-removable.

**Figure 31: T320 SIB**



Each SIB consists of the following components:

- Switch Fabric ASICs.
- High-speed links (HSLs) to each FPC.

Each Type 1 FPC and Type 2 FPC has one dedicated ASIC with five high-speed links that connect to the three SIBs:

- One high-speed link connects to **SIB0**.
- Two high-speed links connect to **SIB1**
- Two high-speed links connect to **SIB2**.

Each Type 3 FPC has two dedicated ASICs with five high-speed links that connect to the three SIBs.

- Three LEDs located on the SIB faceplate that display the status of the SIB. [“T320 SIB LEDs” on page 80](#) describes the functions of the SIB LEDs.
- SIB online/offline button, located on the SIB faceplate.

#### Related Documentation

- [T320 SIB LEDs on page 80](#)
- [Maintaining the T320 SIBs on page 274](#)
- [Replacing a T320 SIB on page 247](#)

## T320 SIB LEDs

[Table 44 on page 80](#) describes the functions of the T320 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 44: T320 SIB LEDs**

Label	Color	State	Description
ACTIVE	Green	On steadily	SIB is in active mode.
OK	Green	On steadily	SIB is functioning normally.
		Blinking	SIB is starting up.
FAIL	Yellow	On steadily	SIB has failed.

#### Related Documentation

- [T320 Switch Interface Boards \(SIBs\) Description on page 79](#)
- [Maintaining the T320 SIBs on page 274](#)
- [Replacing a T320 SIB on page 247](#)

## PART 2

# Site Planning, Preparation, and Specifications

- [Preparation Overview on page 83](#)
- [DC Power Specifications on page 89](#)
- [Network Cable and Transceiver Specifications on page 93](#)
- [Management Cable Specifications and Pinouts on page 97](#)



## CHAPTER 9

# Preparation Overview

- [T320 Site Preparation Checklist Requirements on page 83](#)
- [T320 Rack Requirements on page 84](#)
- [T320 Clearance Requirements for Airflow and Hardware Maintenance on page 85](#)
- [T320 Physical Specifications on page 86](#)
- [T320 Environmental Specifications on page 87](#)
- [T320 Chassis Grounding Cable and Lug Specifications on page 87](#)

### T320 Site Preparation Checklist Requirements

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The checklist in [Table 45 on page 83](#) summarizes the tasks you need to perform when preparing a site for router installation.

**Table 45: T320 Site Preparation Checklist**

Item or Task	For More Information	Performed By	Date
<b>Environment</b>			
Verify that environmental factors such as temperature and humidity do not exceed router tolerances.	<a href="#">"T320 Physical Specifications" on page 86</a>		
<b>Power</b>			
Measure distance between external power sources and router installation site.	<a href="#">"T320 DC Power Cable Specifications" on page 89</a>		
Locate sites for connection of system grounding.	<a href="#">"T320 Chassis Grounding Cable and Lug Specifications" on page 87</a>		
Calculate the power consumption and requirements.	<a href="#">"T320 Power Requirements" on page 90</a>		
<b>Rack</b>			
Verify that your rack meets the minimum requirements for the installation of the router.	<a href="#">"T320 Rack Requirements" on page 84</a>		

Table 45: T320 Site Preparation Checklist (*continued*)

Item or Task	For More Information	Performed By	Date
Plan rack location, including required space clearances.	"T320 Clearance Requirements for Airflow and Hardware Maintenance" on page 85		
If a rack is used, secure rack to floor and building structure.	"T320 Rack Requirements" on page 84		
<b>Cables</b>			
Acquire cables and connectors:	"Calculating Power Budget and Power Margin for Fiber-Optic Cables" on page 94		
<ul style="list-style-type: none"> <li>Determine the number of cables needed based on your planned configuration.</li> <li>Review the maximum distance allowed for each cable. Choose the length of cable based on the distance between the hardware components being connected.</li> </ul>			
Plan the cable routing and management.	"Maintaining T320 PICs and PIC Cables" on page 270		

**Related Documentation**

- [T320 Router Installation Summary on page 101](#)

## T320 Rack Requirements

The T320 Core Router can be installed many types of racks, including four-post racks or cabinets and open-frame racks. An example of an open-frame rack appears in [Figure 32 on page 85](#).

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 is designed to 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: 25.13 in. (63.82 cm) high, 31.4 in. (79.8 cm) deep, and 17.43 in. (44.3 cm) wide. The outer edges of the front-mounting flanges and center-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 that are specified in "[T320 Clearance Requirements for Airflow and Hardware Maintenance](#)" on page 85.

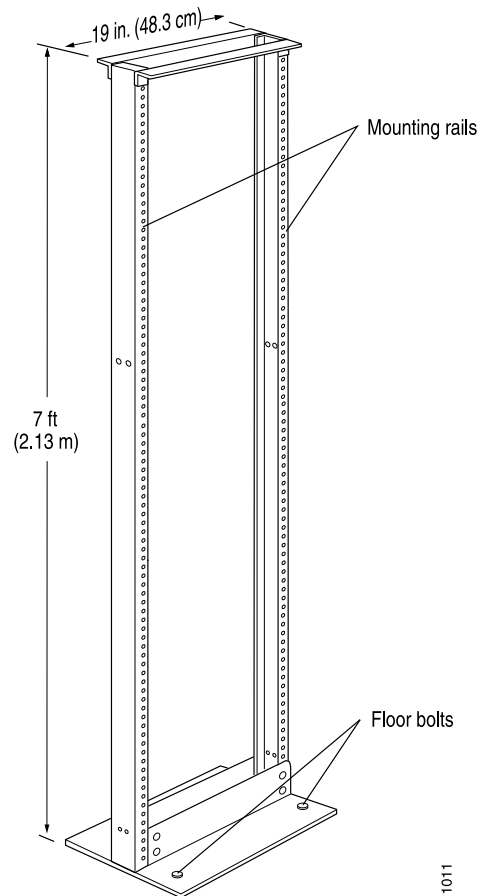
The chassis height of 25.13 in. (63.82 cm) is approximately 14.4 U. A U is the standard rack unit defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number



EIA-310-D) published by the Electronics Industry Association. You can stack three routers in a rack that has at least 44 U (77 in. or 1.96 m) of usable vertical space.

The rack must be strong enough to support the weight of the fully configured router, up to approximately 370 lb (168 kg). If you stack three fully configured routers in one rack, it must be capable of supporting about 1110 lb (504 kg).

**Figure 32: Typical Open-Frame Rack**



**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [Installing the T320 Mounting Hardware for a Four-Post Rack or Cabinet on page 111](#)
- [Installing the T320 Mounting Hardware for an Open-Frame Rack on page 109](#)

## T320 Clearance Requirements for Airflow and Hardware Maintenance

When planning the installation site, you must allow sufficient clearance around the rack (see [Figure 33 on page 86](#)):

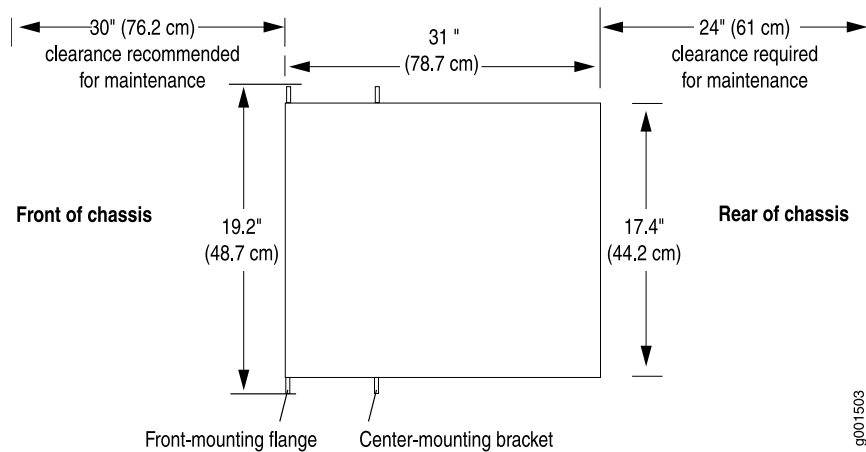
- For the cooling system to function properly, the airflow around the chassis must be unrestricted. [Figure 13 on page 26](#) depicts the airflow in the router.



**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) is required both in front of and behind the router. NEBS GR-63 recommends that you allow at least 30 in. (72.6 cm) in front of the rack.

**Figure 33: T320 Chassis Dimensions and Clearance Requirements**



#### Related Documentation

- [T320 Cooling System Description on page 25](#)
- [T320 Chassis Description on page 13](#)
- [T320 Physical Specifications on page 86](#)

## T320 Physical Specifications

Table 46 on page 86 lists the T320 router's physical specifications.

**Table 46: T320 Physical Specifications**

Description	Weight
Chassis dimensions	25.13 in. (63.82 cm) high 17.43 in. (44.3 cm) wide 31 in. (78.7 cm) deep (including cable management system) 35.5 in. (90.2 cm)
Router weight	Chassis with midplane: 131.4 lb (59.6 kg) Minimum configuration: 272.1 lb (123.4 kg) Maximum configuration: 369.9 lb (167.8 kg)

- Related Documentation**
- [T320 Router Description on page 3](#)
  - [T320 Chassis Description on page 13](#)
  - [T320 Environmental Specifications on page 87](#)

## T320 Environmental Specifications

Table 47 on page 87 specifies the environmental specifications required for normal router operation. In addition, the site should be as dust-free as possible.

**Table 47: 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
Temperature	Normal operation ensured in temperature range of 32°F (0°C) to 104°F (40°C)  Nonoperating storage temperature in shipping crate: –40°F (–40°C) to 158°F (70°C)
Seismic	Designed to meet Telcordia Technologies Zone 4 earthquake requirements
Maximum thermal output	DC power: 28,498 BTU/hour (8350 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**
- [T320 Router Description on page 3](#)
  - [T320 Chassis Description on page 13](#)
  - [T320 Physical Specifications on page 86](#)

## T320 Chassis Grounding Cable and Lug Specifications



**WARNING:** Power plant ground and chassis ground must be connected to the same building ground.

You must provide grounding cables that meets these requirements:

- The cable must be able to handle up to 75 A.
- 6-AWG (13.3 mm<sup>2</sup>), minimum 90°C wire, or as permitted by the local code

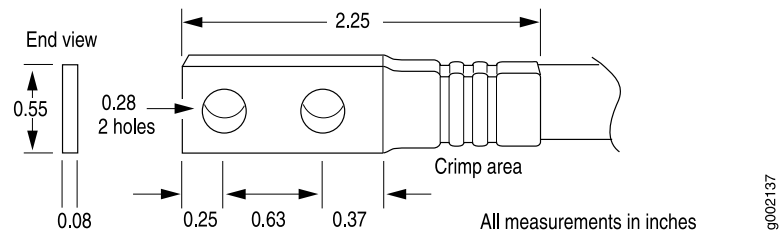
**Table 48: Grounding Cable Specifications**

Cable Type	Quantity and Specification	Maximum Equal Length
Grounding	6-AWG (13.3 mm <sup>2</sup> ), minimum 90°C wire, or as permitted by the local code	None



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

The cable lug shown in [Figure 34 on page 88](#) is required for the grounding cables and for the DC power cables.

**Figure 34: DC Power and Grounding Cable Lug**

**Related Documentation**

- [Tools and Parts Required to Ground the T320 Router on page 147](#)
- [Connecting the T320 Grounding Cable on page 147](#)

# DC Power Specifications

- [T320 DC Power Cable Specifications on page 89](#)
- [T320 Power System Electrical Specifications on page 90](#)
- [T320 Power Requirements on page 90](#)
- [T320 DC Power Distribution on page 92](#)

## T320 DC Power Cable Specifications

The accessory box shipped with the router includes the cable lugs that attach to the terminal studs of each power supply (see [Figure 34 on page 88](#)). (The cable lug shown in [Figure 34 on page 88](#) is also used for the grounding the chassis.)



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

[Table 49 on page 89](#) summarizes the specifications for the power cables, which you must supply.

**Table 49: Power Cable Specifications**

Cable Type	Quantity and Specification	Connector Specification
Power	Eight 4-AWG (21.2 mm <sup>2</sup> ) (minimum) copper conductor, or as permitted by the local code.	Cable lug; dual hole, sized to fit 1/4-20 UNC terminal studs at 15.86-mm (0.625-in.) center line.

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.



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

For other electrical safety information, see [“T320 General Electrical Safety Guidelines and Electrical Codes” on page 343](#).



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

**Related Documentation**

- [T320 Power System Description on page 77](#)
- [Connecting DC Power to the T320 Router on page 157](#)
- [Replacing a T320 DC Power Supply Cable on page 244](#)

## T320 Power System Electrical Specifications

Table 50 on page 90 lists the power system electrical specifications.

**Table 50: Power System Electrical Specifications**

Item	Specification
DC input voltage	Operating range: –40.5 to –72 VDC  <i>NOTE:</i> If the input voltage from the DC power source drops below –40.5 VDC, the platform automatically shuts down. During automatic shutdown, the circuit remains active. When the input voltage returns to –42.75 VDC, the platform automatically starts up again and the system returns to normal operation within 30 minutes. No operator intervention is required.
DC system current rating	60 A @ –48 VDC (nominal)
Maximum input power	3200 W

**Related Documentation**

- [T320 Power System Description on page 77](#)
- [Maintaining the T320 Power Supplies on page 272](#)
- [T320 Power Requirements on page 90](#)

## T320 Power Requirements

Table 51 on page 91 lists the power requirements for various hardware components when the router is operating under typical voltage conditions. For PIC power requirements, see the *T320 Core Router PIC Guide*.

Table 51: Component Power Requirements

Component	Current Requirement (Amps @ -48 VDC)
Base system, not including FPCs and PICs (includes three SIBs, one host subsystem, one SCG, two power supplies, cooling system, and craft interface)	9 A
SIB	0.8 A
Type 1 FPC (without PICs)	3.3 A
Type 2 FPC (without PICs)	3.3 A
Type 3 FPC (without PICs)	3.3 A
Host subsystem (Routing Engine and control board)	2.6 A
SCG	0.2 A
Power supply	0.8 A
Cooling system (normal speed)	1.7 A
Cooling system (full speed)	4.5 A

- Power consumption for minimum configuration:
  - Base System + 1 FPC3 + 2 PICs =  
 $9\text{ A} + 3.3\text{ A} + 2(0.625)\text{ A} = 13.6\text{ A @ } -48\text{ VDC} = 653\text{ W}$
- Power consumption for maximum configuration:
  - Base System + 8 FPC3 + 1 Host + 1 SCG + 16 PICs =  
 $9\text{ A} + 8(3.3\text{ A}) + 2.6\text{ A} + 0.2\text{ A} + 16(0.625\text{ A}) =$   
 $9\text{ A} + 26.4\text{ A} + 2.6\text{ A} + 0.2\text{ A} + 10\text{ A} = 48.2\text{ A @ } -48\text{ VDC} = 2,314\text{ W}$
- 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) =  
 $X\text{ A} - 1.7\text{ A} + 4.5\text{ A} = X\text{ A} + 2.8\text{ A}$
- Input current from a DC source other than -48 VDC (based on maximum configuration):
  - (-54 VDC input) x (input current X) = (-48 VDC) x (input current Y)  
 $54 \times X = 48 \times 48.2$   
 $X = 48 \times 48.2 / 54 = 42.8\text{ A}$
- System thermal output for maximally configured router:
  - Watts DC / 0.293 = BTU/hr  
 $2314 / 0.293 = 7,898\text{ BTU/hr}$

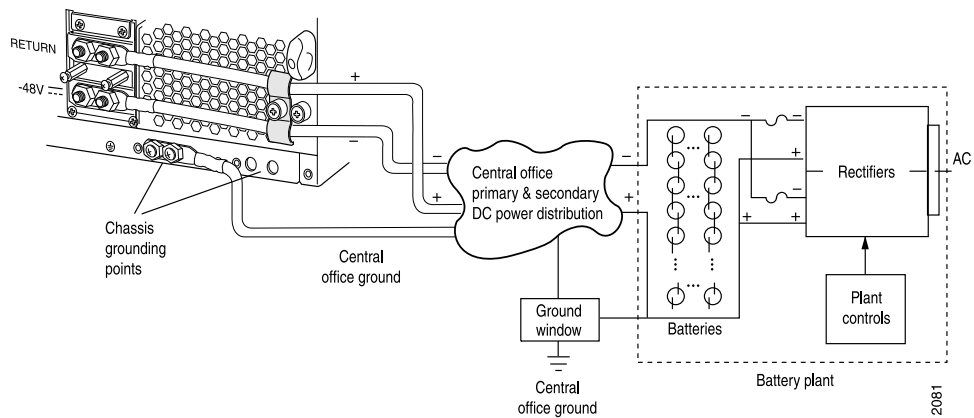
- Related Documentation**
- [T320 Power System Description on page 77](#)
  - [T320 Site Preparation Checklist Requirements on page 83](#)
  - [Maintaining the T320 Power Supplies on page 272](#)
  - [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)

## T320 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.

Figure 35 on page 92 shows a typical DC source cabling arrangement.

**Figure 35: Typical DC Source Cabling to the Router**



- Related Documentation**
- [T320 Power System Electrical Specifications on page 90](#)
  - [T320 Power Requirements on page 90](#)
  - [T320 DC Power Cable Specifications on page 89](#)



# Network Cable and Transceiver Specifications

- [Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion on page 93](#)
- [Calculating Power Budget and Power Margin for Fiber-Optic Cables on page 94](#)

## 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. For information about calculating power budget and power margin for fiber-optic cable, see [“Calculating Power Budget and Power Margin for Fiber-Optic Cables” on page 94](#).

- [Signal Loss in Multimode and Single-Mode Fiber-Optic Cable on page 93](#)
- [Attenuation and Dispersion in Fiber-Optic Cable on page 93](#)

### 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.

**Related  
Documentation**

- *Determining Transceiver Support and Specifications for Juniper Networks Devices*

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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 95](#)
2. [Calculating Power Margin for Fiber-Optic Cable on page 95](#)

## 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 52 on page 95](#) 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 52: 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

Table 52: Estimated Values for Factors Causing Link Loss (*continued*)

Link-Loss Factor	Estimated Link-Loss Value
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 52 on page 95](#) 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:

$$P_M = P_B - LL$$

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

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

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

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 52 on page 95](#) 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:

$$P_M = P_B - LL$$

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

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

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

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.

#### Related Documentation

- [Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion on page 93](#)

# Management Cable Specifications and Pinouts

- [T320 Routing Engine Interface Cable and Wire Specifications on page 97](#)
- [T320 DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports on page 98](#)

## T320 Routing Engine Interface Cable and Wire Specifications

[Table 53 on page 97](#) lists the specifications for the cables that connect to management ports and the wires that connect to the alarm relay contacts.

**Table 53: Cable and Wire Specifications for Routing Engine Management and Alarm Interfaces**

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
Alarm relay contacts	Wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm <sup>2</sup> )	NO	None	—

### Related Documentation

- [Replacing the T320 Connections to Routing Engine Interface Ports](#)
- [T320 Routing Engine Description on page 33](#)

## T320 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 54 on page 98](#) describes the DB-9 connector pinouts.

**Table 54: 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

- [T320 Connector Interface Panel \(CIP\) Description on page 16](#)
- [T320 Routing Engine Ports on page 39](#)
- [T320 Site Preparation Checklist Requirements on page 83](#)

## PART 3

# Initial Installation and Configuration

- [Installation Overview on page 101](#)
- [Unpacking the T320 on page 103](#)
- [Installing the Mounting Hardware on page 109](#)
- [Installing the T320 into a Rack on page 117](#)
- [Installing the T320 With a Mechanical Lift on page 119](#)
- [Installing the T320 Without a Mechanical Lift on page 125](#)
- [Connecting the T320 to Ground on page 147](#)
- [Connecting the T320 to External Devices on page 149](#)
- [Providing Power to the T320 on page 157](#)
- [Configuring the Junos OS Software on page 163](#)





## CHAPTER 13

# Installation Overview

- [T320 Router Installation Summary on page 101](#)

## T320 Router Installation Summary

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Proceed through the installation process in the following order:

1. Prepare your installation site.  
[See “T320 Site Preparation Checklist Requirements” on page 83](#) when you are ready to unpack and install the router.
2. Review the safety guidelines.  
[See “Installation Safety Warnings for Juniper Networks Devices” on page 326](#).
3. Unpack the router and verify the parts received.
4. Install the mounting hardware.  
[See “Installing the T320 Mounting Hardware for a Four-Post Rack or Cabinet” on page 111](#) or [“Installing the T320 Mounting Hardware for an Open-Frame Rack” on page 109](#).
5. Install the router.  
[See “Installing the T320 Router Using a Mechanical Lift” on page 120](#) or [“Installing the T320 Chassis in the Rack Manually” on page 134](#).
6. Perform the initial system startup.  
[See “Initially Configuring the T320 Router” on page 163](#).

### Related Documentation

- [T320 Chassis Description on page 13](#)
- [T320 Installation Safety Guidelines on page 325](#)



# Unpacking the T320

- [Tools and Parts Required to Unpack the T320 Router on page 103](#)
- [Unpacking the T320 Router on page 103](#)
- [Verifying the T320 Router Parts Received on page 105](#)

## Tools and Parts Required to Unpack the T320 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

- [T320 Chassis Description on page 13](#)

## Unpacking the T320 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 50 in. (127 cm) high, 30 in. (76.2 cm) wide, and 41 in. (104 cm) deep. The total weight of the crate containing the router and accessories can range from 582 lb (267 kg) to 650 lb (295 kg).

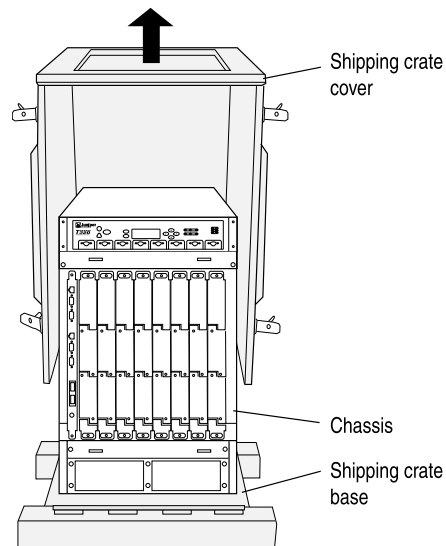


**NOTE:** The router is maximally protected inside the shipping crate. Do not unpack it until you are ready to begin installation.

To unpack:

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.
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.
13. Proceed with the installation.

Figure 36: Contents of the Shipping Crate



#### Related Documentation

- [T320 Chassis Description on page 13](#)
- [Verifying the T320 Router Parts Received on page 105](#)
- [Installing the T320 Router Using a Mechanical Lift on page 120](#)
- [Installing the T320 Chassis in the Rack Manually on page 134](#)

## Verifying the T320 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 55 on page 105](#), and an accessory box, which contains the parts listed in [Table 56 on page 107](#).

**Table 55: T320 Router Parts List**

Component	Quantity
Chassis, including midplane, craft interface, and center-mounting brackets	1
FPCs	Up to 8
PICs	Up to 2 per FPC
SIBs	3

Table 55: T320 Router Parts List (*continued*)

Component	Quantity
Routing Engines	1 or 2
Control boards	1 or 2
SCGs	1 or 2
Power supplies	2
CIP	1
Front fan trays	2
Rear fan tray	1
Quick start installation	1
Front mounting shelf	1
Rear mounting shelf	1
Spacer bars	2
Blank panels for slots without components installed	One blank panel for each slot not occupied by a component

Table 56: T320 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	5
Read me first document	1
Screws to fasten grounding cable to chassis	2
Screws to mount chassis	Bag of 14
Serial cable, 6-ft length, to connect Routing Engine to management console	1
Software license agreement	1
Washers for grounding cable lug	2

**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [Installing the T320 Router Using a Mechanical Lift on page 120](#)
- [Installing the T320 Chassis in the Rack Manually on page 134](#)





# Installing the Mounting Hardware

- [Installing the T320 Mounting Hardware for an Open-Frame Rack on page 109](#)
- [Installing the T320 Mounting Hardware for a Four-Post Rack or Cabinet on page 111](#)

## Installing the T320 Mounting Hardware for an Open-Frame Rack

To prepare to mount the T320 Core Router into an open-frame rack, install the large mounting shelf on the rack. Install cage nuts, if needed. The small mounting shelf and the spacer bars are not needed.

For open-frame racks, center-mounting the chassis is preferable to front-mounting because the more even distribution of weight provides greater stability. You use the center-mounting brackets to center-mount the chassis in an open-frame rack; you use the front-mounting flanges to front-mount the chassis in an open-frame rack.

For an open-frame rack, [Table 57 on page 109](#) 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. For reference, the bottom of all mounting shelves is at 0.0015 in. (0.01 U) above a U division.

**Table 57: T320 Open-Frame Rack Mounting Hole Locations**

Hole	Distance Above U Division		Large Shelf	Chassis
39	22.51 in. (57.2 cm)	12.86 U	–	X
30	17.26 in. (43.8 cm)	9.86 U	X	X
21	12.01 in. (30.5 cm)	6.86 U	X	X
12	6.76 in. (17.1 cm)	3.86 U	X	X
3	1.51 in. (3.8 cm)	0.86 U	X	X

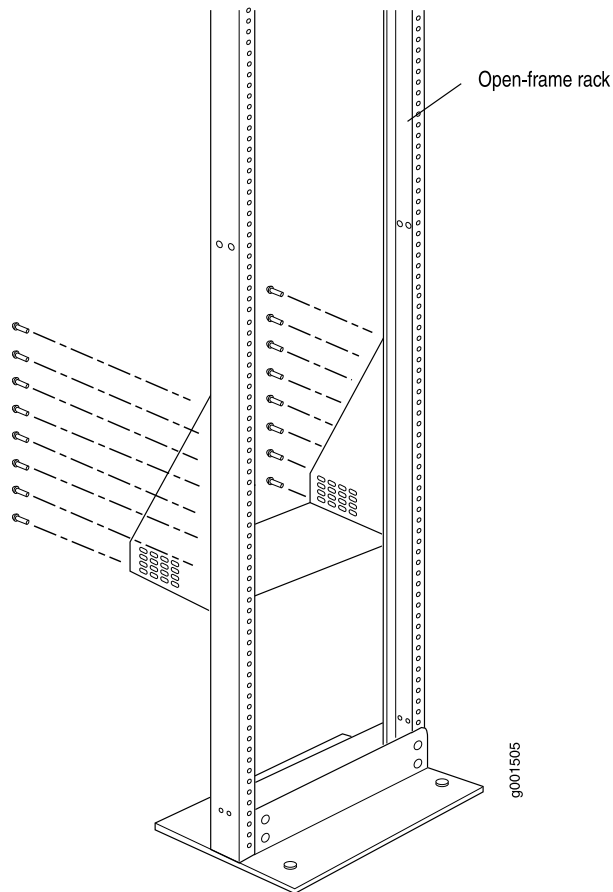
To install the large mounting shelf (see [Figure 37 on page 111](#)):

1. Install cage nuts, if needed, in the mounting holes specified in [Table 57 on page 109](#):
2. • On the front side of the rack rails, install cage nuts for the chassis.

- On the rear side of the rack rails, install cage nuts for the large shelf.
3. On the rear of each rack rail, partially insert a mounting screw into the highest hole specified for the large shelf in [Table 57 on page 109](#).
  4. Install the large shelf on the rack. Hang the shelf over the mounting screws using the keyhole slots located near the top of the large shelf flanges.
  5. Partially insert screws into the open holes in the ears of the large shelf.
  6. Tighten all the screws completely.
  7. Remove the center-mounting brackets by loosening the screws at the top and bottom of each bracket.
  8. Optionally, remove the screws that fasten the spacer bars to the front-mounting flange.

The router is shipped with a spacer bar attached to the rear of each front-mounting flange, and two center-mounting brackets attached to the chassis.

Figure 37: Installing the Mounting Hardware for an Open-Frame Rack



**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [T320 Site Preparation Checklist Requirements on page 83](#)
- [T320 Clearance Requirements for Airflow and Hardware Maintenance on page 85](#)

## Installing the T320 Mounting Hardware for a Four-Post Rack or Cabinet

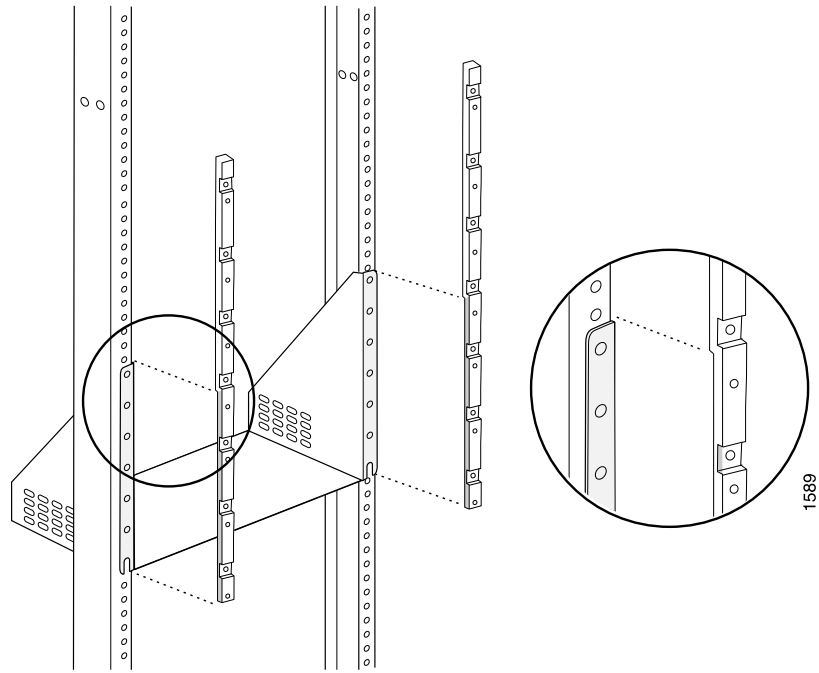
To prepare to install the T320 router into a four-post rack or cabinet:

- Install cage nuts, if needed.
- Install the large mounting shelf and spacer bars on the front rail.
- Install the small mounting shelf on the rear rail.
- Remove the center-mounting brackets from the chassis.

To install the mounting shelves and spacer bars:

1. Install cage nuts, if needed, in the mounting holes specified in [Table 58 on page 114](#):
  - On the front rack rails, install cage nuts in the holes specified for the large shelf and the spacer bars.
  - On the rear rack rails, install cage nuts in the holes specified for the small shelf.
2. On the front of each front rack rail, partially insert a mounting screw into the lowest hole specified in [Table 58 on page 114](#) for the large shelf and the spacer bars.
3. Install the large shelf on the front rack rails. Rest the bottom slot of each flange on a mounting screw.
4. Tighten all the screws completely.
5. The router is shipped with each spacer bar attached to the rear of each front-mounting flange. Remove each spacer bar by removing the screws that fasten the spacer bar to the front-mounting flange.
6. Place one of the spacer bars over a flange of the installed 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 38 on page 113](#)).
7. 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.
8. Repeat Steps 6 and 7 for the other spacer bar.
9. Tighten all the screws completely.
10. On the back of each rear rack rail, partially insert a mounting screw into the lowest hole specified in [Table 58 on page 114](#) for the small shelf.
11. 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.
12. Partially insert screws into the open holes in the ears of the small shelf.
13. Tighten all the screws completely.
14. Remove the mounting brackets from the chassis by loosening the screws at the top and bottom of each bracket.

Figure 38: Positioning the Spacer Bar on the Rack



**Figure 39: Installing the Mounting Hardware for a Four-Post Rack or Cabinet**

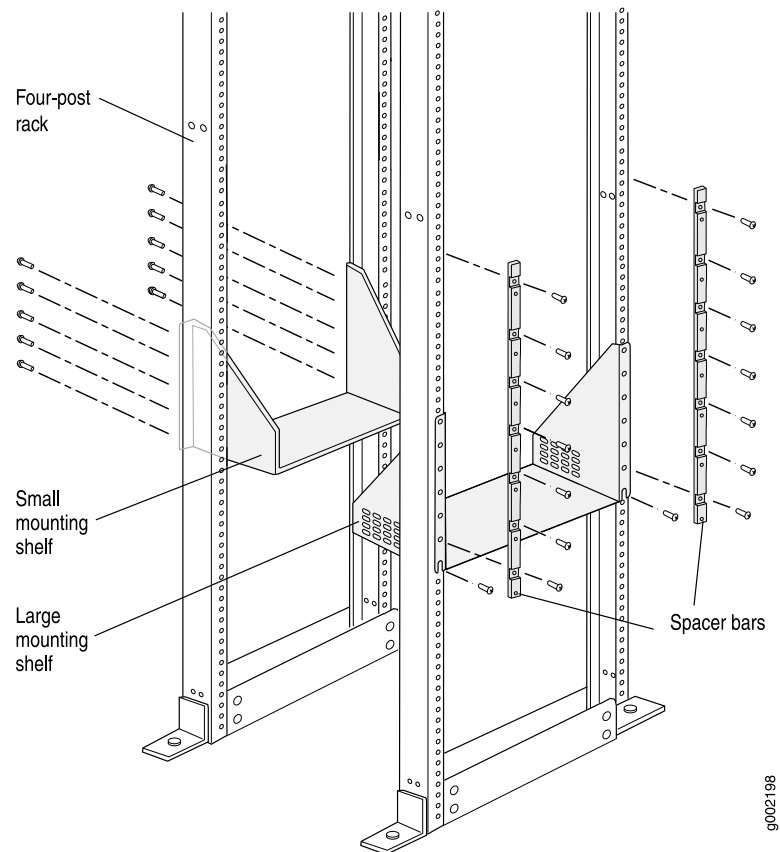


Table 58 on page 114 specifies the holes in which you insert mounting screws (an X indicates a mounting hole location), and cage nuts if needed. The hole distances are relative to one of the standard U divisions on the rack. The bottom of all mounting shelves is at 0.0015 in. (0.01 U) above a U division.

**Table 58: T320 Four-Post or Cabinet Rack Mounting Hole Locations**

Hole	Distance Above U Division		Large Shelf	Spacer Bars	Small Shelf
42	24.26 in. (61.6 cm)	13.86 U	–	X	–
33	19.01 in. (48.3 cm)	10.86 U	–	X	–
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)	4.86 U	–	–	X

**Table 58: T320 Four-Post or Cabinet Rack Mounting Hole Locations** (*continued*)

Hole	Distance Above U Division		Large Shelf	Spacer Bars	Small Shelf
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	–	–

**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [T320 Site Preparation Checklist Requirements on page 83](#)
- [T320 Clearance Requirements for Airflow and Hardware Maintenance on page 85](#)





# Installing the T320 into a Rack

- [Overview of Installing the T320 Router into a Rack on page 117](#)

## Overview of Installing the T320 Router into a Rack

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Verify that the following tasks have been completed before installing the router in a rack:

1. Verify that all the tasks required to prepare the site for router installation have been completed.

See [“T320 Site Preparation Checklist Requirements” on page 83](#).

2. Review the safety information.

See [“T320 Installation Safety Guidelines” on page 325](#) and [“General Safety Guidelines for Juniper Networks Devices” on page 317](#).



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

3. Remove the router from the shipping crate.

See [“Unpacking the T320 Router” on page 103](#).

4. Install the mounting hardware.

See [“Installing the T320 Mounting Hardware for a Four-Post Rack or Cabinet” on page 111](#) or [“Installing the T320 Mounting Hardware for an Open-Frame Rack” on page 109](#)

Because of the T320 router's size and weight—up to 370 lb (168 kg) depending on the configuration—we strongly recommend that you install the router using a mechanical lift, as described in [“Overview of Installing a T320 Router Using a Mechanical Lift” on page 119](#).

If you are unable to use a lift to install the router, refer to [“Overview of Installing the T320 Router Without a Mechanical Lift”](#) on page 125 for complete instructions to safely install the router. Without a mechanical lift, at least three people are needed to safely lift the chassis into the rack or cabinet.

# Installing the T320 With a Mechanical Lift

- [Overview of Installing a T320 Router Using a Mechanical Lift on page 119](#)
- [Tools Required to Install the T320 Router Using a Mechanical Lift on page 119](#)
- [Installing the T320 Router Using a Mechanical Lift on page 120](#)

## Overview of Installing a T320 Router Using a Mechanical Lift

Because of the T320 router's size and weight—up to 370 lb (168 kg) depending on the configuration—we strongly recommend that you install the router using a mechanical lift.

1. Gather the tools required to install the router.  
[See “Tools Required to Install the T320 Router Using a Mechanical Lift” on page 119.](#)
2. Install the router using a mechanical lift.  
[See “Installing the T320 Router Using a Mechanical Lift” on page 120.](#)
  - a. Remove the power supplies.
  - b. Attach the installation handle.
  - c. Mount the chassis in the rack or cabinet.
  - d. Remove the installation handle, and reinstall the power supplies.

## Tools Required to Install the T320 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 the T320 Router Without a Mechanical Lift on page 125](#)
  - [T320 Installation Safety Guidelines on page 325](#)
  - [T320 Router Installation Summary on page 101](#)

## Installing the T320 Router Using a Mechanical Lift

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- [Removing the T320 Power Supplies on page 120](#)
- [Attaching the T320 Router Installation Handle on page 121](#)
- [Installing the T320 Router Using a Mechanical Lift on page 122](#)
- [Removing the T320 Router Installation Handle and Reinstalling the Power Supplies on page 123](#)

### Removing the T320 Power Supplies

To remove the power supplies:

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. Switch the circuit breaker on the power supply faceplate to the off position (O). We recommend this even though the power supplies are not connected to power sources.
3. Loosen the captive screws on the lower corners of the power supply faceplate completely. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.
4. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.
5. 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 40 on page 121](#)).
6. Place one hand underneath the power supply to support it and slide it completely out of the chassis.



**CAUTION:** Each power supply weighs approximately 12 lb (5.4 kg). Be prepared to support the full weight of the power supply as you remove it from the router.

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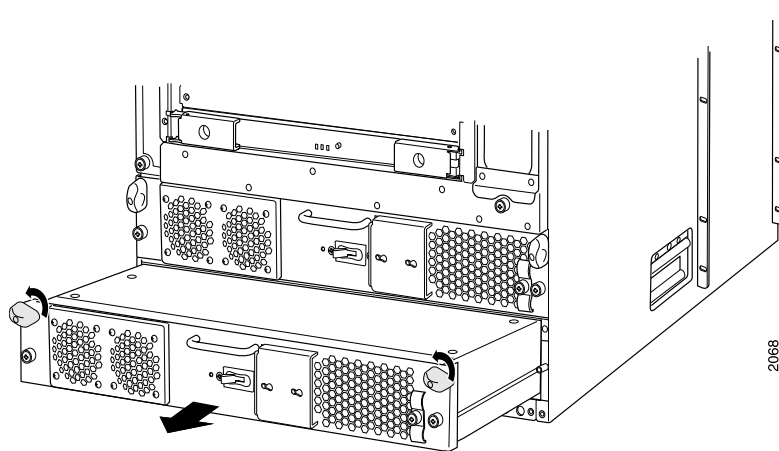
7. Repeat the procedure for the other power supply.

## Attaching the T320 Router Installation Handle

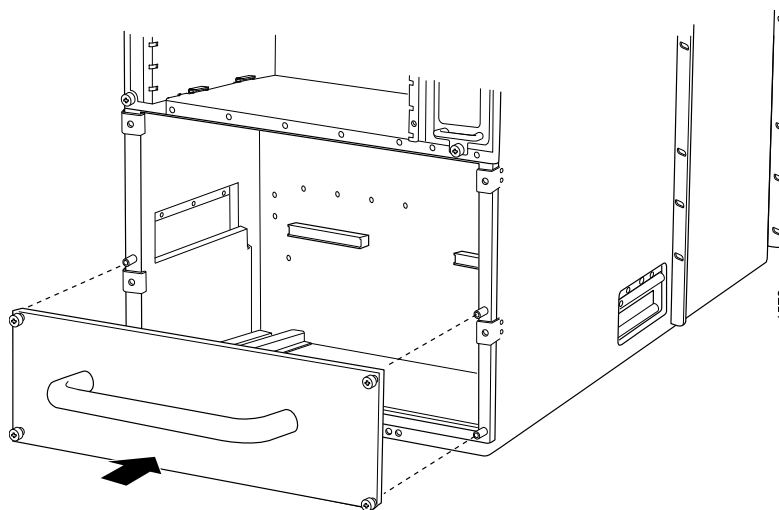
To assist you with the installation of the T320 router, attach the installation handle over the power supply slots of the chassis. To attach the handle:

1. 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 41 on page 121](#)).

**Figure 40: Removing a Power Supply Before Installing the Installation Handle**



**Figure 41: Attaching the Installation Handle**



## Installing the T320 Router Using a Mechanical 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.

To install the router using a lift (see [Figure 42 on page 123](#)):

1. 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 “[T320 Site Preparation Checklist Requirements](#)” on page 83.

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

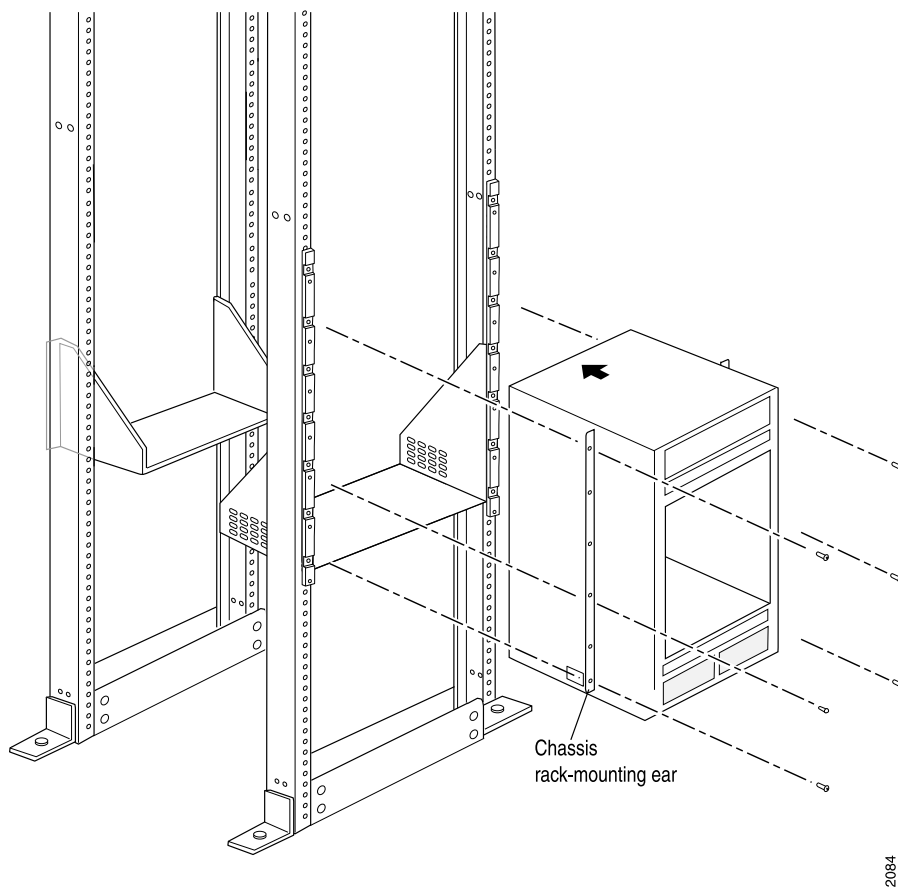


**CAUTION:** Do not lift the router using the craft interface, installation handle, or the handles on the sides of the chassis. Use these handles only to help position the router.

3. Using the lift, position the router 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 router onto the mounting shelves so that the bottom of the chassis and the mounting shelves overlap by approximately two 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 router onto the mounting shelves until the center-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. Install the mounting screws:
  - Four-post rack or cabinet—Install a mounting screw into each of the holes in the spacer bars.

- 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 42: Installing the T320 Router in the Rack



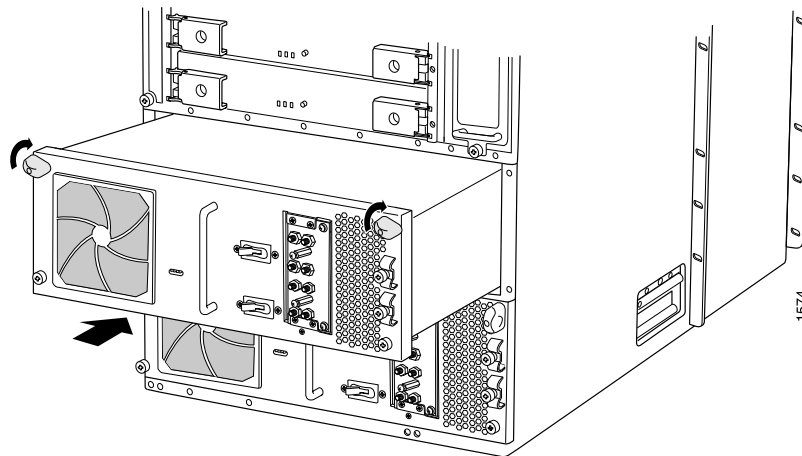
**NOTE:** This illustration depicts the router being installed in a four-post rack. For an illustration of the mounting hardware required for an open-frame rack, see [Figure 37 on page 111](#).

## Removing the T320 Router Installation Handle and Reinstalling the Power Supplies

After you have installed the T320 router, remove the installation handle and reinstall the two power supplies in the chassis by following this procedure, starting with the lower power supply (see [Figure 43 on page 124](#)):

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
2. Loosen the captive screws on the installation handle completely, and remove the handle from the chassis.
3. Make sure that the circuit breaker on the power supply faceplate is in the off position (O).
4. Using both hands, slide the power supply into the chassis until you feel resistance.
5. Twist the ejector handles at the upper corners of the power supply faceplate clockwise until they stop.
6. Tighten the captive screws at the lower corners of the power supply faceplate to secure the power supply in the chassis.
7. Repeat the procedure for the upper power supply.

**Figure 43: Reinstalling a Power Supply**



**Related Documentation**

- [T320 Router Installation Summary on page 101](#)
- [Overview of Installing the T320 Router Without a Mechanical Lift on page 125](#)
- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 Installation Safety Guidelines on page 325](#)



# Installing the T320 Without a Mechanical Lift

- Overview of Installing the T320 Router Without a Mechanical Lift on page 125
- Tools and Parts Required to Install the T320 Router Without a Mechanical Lift on page 126
- Removing T320 Components from the Chassis on page 127
- Installing the T320 Chassis in the Rack Manually on page 134
- Reinstalling T320 Components in the Chassis on page 138

## Overview of Installing the T320 Router Without a Mechanical Lift

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**WARNING:** Because of the router's size and weight—up to 370 lb (168 kg) depending on configuration—we strongly recommend that you install the router using a lift., as described in “[Installing the T320 Router Using a Mechanical Lift](#)” on page 120.

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If you cannot use a mechanical lift to install the T320 router, you can install it manually. Before installing the router manually, you must first remove components from the chassis, and you must reinstall the components after the router is installed in the rack. At least three people are needed to safely lift the chassis into the rack or cabinet. With components removed, the chassis weighs approximately 131.4 lb (59.6 kg).

To safely install the T320 router without a mechanical lift:

1. Review the safety information.

See [“General Safety Guidelines for Juniper Networks Devices”](#) on page 317, and [“T320 Installation Safety Guidelines”](#) on page 325.



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

2. Verify that the site has been prepared for the router installation.

See [“T320 Site Preparation Checklist Requirements”](#) on page 83.

3. Verify that the mounting hardware has been installed.

See [“Installing the T320 Mounting Hardware for a Four-Post Rack or Cabinet”](#) on page 111 or [“Installing the T320 Mounting Hardware for an Open-Frame Rack”](#) on page 109..

4. Remove the router from the shipping crate and verify the parts received.

See [“Unpacking the T320 Router”](#) on page 103.

5. Gather the tools required to install the router.

See [“Tools and Parts Required to Install the T320 Router Without a Mechanical Lift”](#) on page 126.

6. Remove components from the chassis to make it easier to install into the rack or chassis.

See [“Removing T320 Components from the Chassis”](#) on page 127.

7. Install the T320 Chassis in the Rack Manually. With components removed, the chassis weighs approximately 131.4 lb (59.6 kg). At least three people are needed to safely lift the chassis into the rack or cabinet.

See [“Installing the T320 Chassis in the Rack Manually”](#) on page 134.

8. Reinstall the components removed from the chassis.

See [“Reinstalling T320 Components in the Chassis”](#) on page 138.

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## Tools and Parts Required to Install the T320 Router Without a Mechanical Lift

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To install the T320 router, you need the following tools and parts:

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

**Related  
Documentation**

- [T320 Router Installation Summary on page 101](#)

## Removing T320 Components from the Chassis

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To make the T320 router light enough to install manually, you first remove most components from the chassis. The procedures in this section for removing components from the chassis are for initial installation only, and assume that you have not connected power cables to the router. The following procedures describe how to remove components from the chassis, first from the rear and then from the front:

1. [Removing the T320 Power Supplies on page 127](#)
2. [Removing the T320 SIBs on page 128](#)
3. [Removing the T320 Control Boards on page 129](#)
4. [Removing the T320 SCGs on page 130](#)
5. [Removing the T320 Rear Fan Tray on page 131](#)
6. [Removing the T320 Cable Management System on page 132](#)
7. [Removing the T320 FPCs on page 132](#)

### Removing the T320 Power Supplies

The power supplies are located at the rear of the T320 chassis below the SIBs. Each power supply weighs approximately 12 lb (5.4 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. Switch the circuit breaker on the power supply faceplate to the off position (O). We recommend this even though the power supplies are not connected to power sources.
3. Loosen the captive screws on the lower corners of the power supply faceplate completely. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.
4. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.

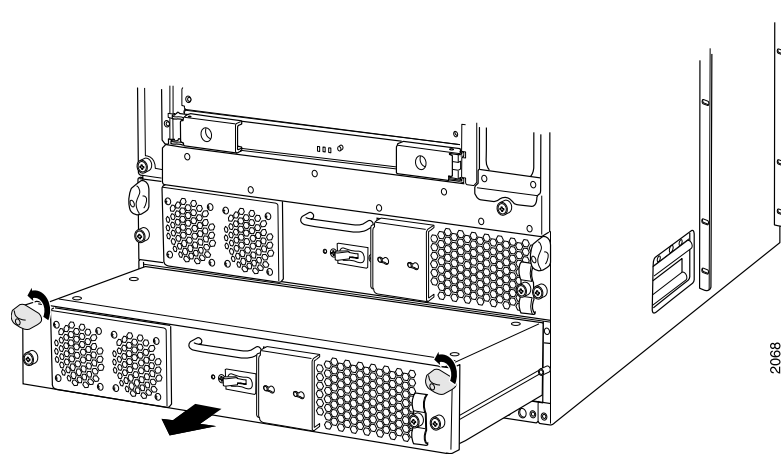
5. Grasp the handle on the power supply faceplate and pull firmly to start removing the power supply. Slide it halfway out of the chassis (see [Figure 44 on page 128](#)).
6. Place one hand underneath the power supply to support it and slide it completely out of the chassis.



**CAUTION:** Each power supply weighs approximately 12 lb (5.4 kg). Be prepared to support the full weight of the power supply as you remove it from the router.

7. Repeat the procedure for the other power supply.

**Figure 44: Removing a Power Supply Before Installing the Router**



## Removing the T320 SIBs

Three SIBs are installed in the router. The SIBs are located in the rear of the chassis in the slots marked **SIB0** through **SIB2**. Each SIB weighs approximately 4.5 lb (2.0 kg).

To remove the SIBs (see [Figure 45 on page 129](#)):

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
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.

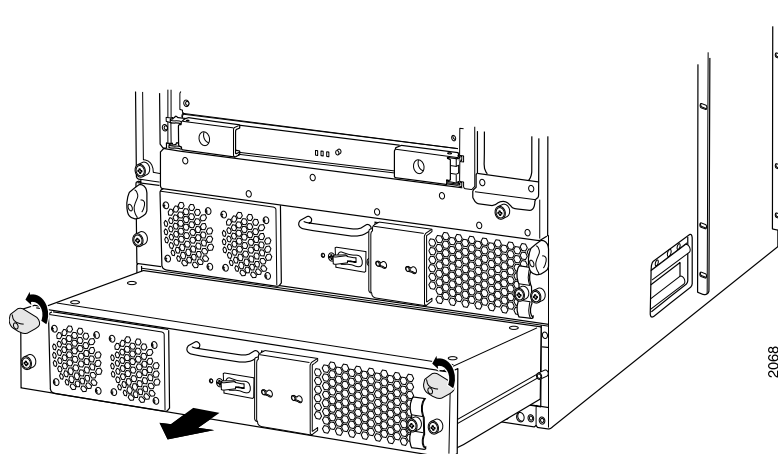
5. Grasp both ejector handles, pull firmly, and slide the SIB about three-quarters of the way out of the chassis.
6. Place one hand underneath the SIB to support it and slide it completely out of the chassis. Place it on the antistatic mat.



**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 45: Removing a T320 SIB



## Removing the T320 Control Boards

The router can have up to two control boards. These are located in the upper rear of the chassis in the slots marked **CB0** and **CB1**. Each one weighs approximately 5 lb (2.3 kg).

To remove a control board (see [Figure 46 on page 130](#)):

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.

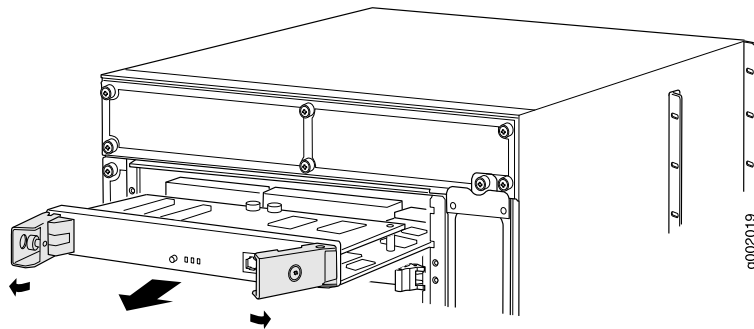
- Place one hand underneath the control board to support it and slide it completely out of the chassis. Place it on the antistatic mat.



**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.

- Repeat the procedure for the second control board, if present.

**Figure 46: Removing a T320 Control Board**



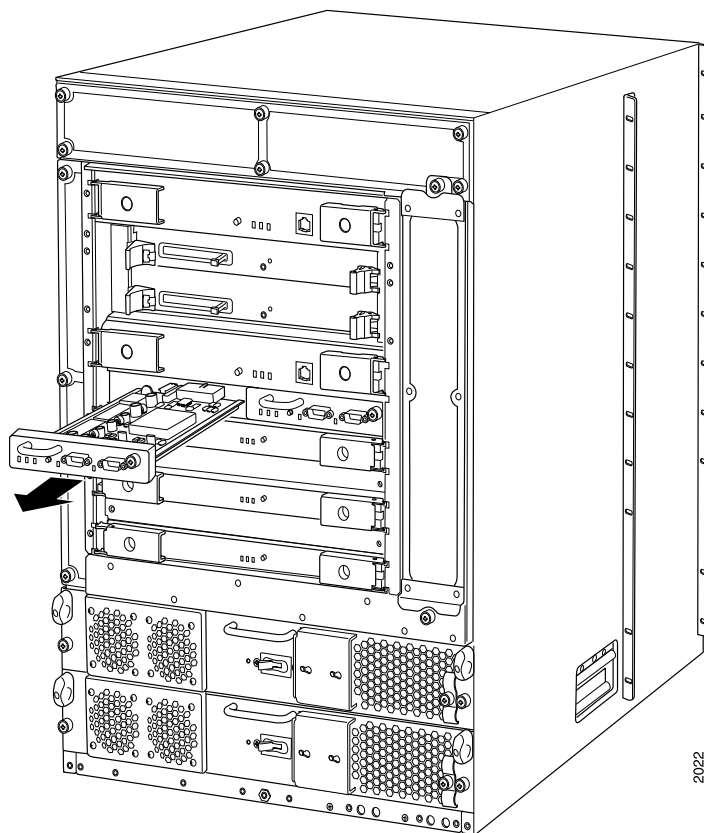
## Removing the T320 SCGs

The router can have one or two SCGs installed. The SCGs are located in the rear of the chassis, above the SIBs. Each SCG weighs approximately 1.9 lb (0.9 kg).

To remove the SCGs (see [Figure 47 on page 131](#)):

- Place an electrostatic bag or antistatic mat on a flat, stable surface.
- Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
- Press the online/offline button on the SCG faceplate and hold it down until the LED goes out (about 5 seconds).
- Loosen the captive screws on the edges of the SCG faceplate.
- Grasp the SCG by the handle on the faceplate and slide it out of the chassis.
- Place the SCG on the antistatic mat.
- Repeat the procedure for the second SCG.

Figure 47: Removing a T320 SCG



### Removing the T320 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 five fans. The fan tray weighs about 7.3 lb (3.3 kg).

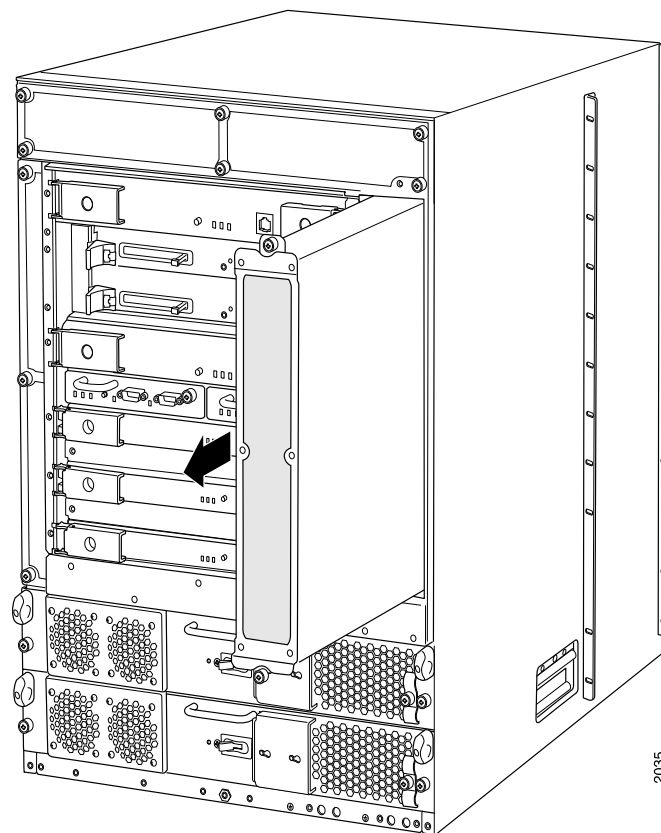


**CAUTION:** To maintain proper cooling, do not operate the router with the rear fan tray removed for more than one minute.

To remove the rear fan tray (see [Figure 48 on page 132](#)):

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 48: Removing the Rear T320 Fan Tray



## Removing the T320 Cable Management System

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

To remove the 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 T320 FPCs

The router holds up to eight FPCs, which are installed vertically in the front of the router. An empty FPC weighs approximately 14.8 lb (6.7 kg) and a fully configured FPC can weigh up to 19 lb (8.6 kg).



Each FPC slot not occupied by an FPC must be covered by an FPC blank panel. An FPC blank panel weighs 6.3 lb (2.9 kg).

To remove an FPC (see [Figure 49 on page 134](#)):

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
3. Before removing the FPCs, record their location in the chassis so that you can reinstall each FPC in the correct slot.
4. If you are removing a Type 2 or a Type 3 FPC, loosen the screws inside the ejector handles at the top and bottom of the FPC faceplate.
5. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.
6. Grasp the handles and slide the FPC straight out of the card cage halfway.
7. 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.



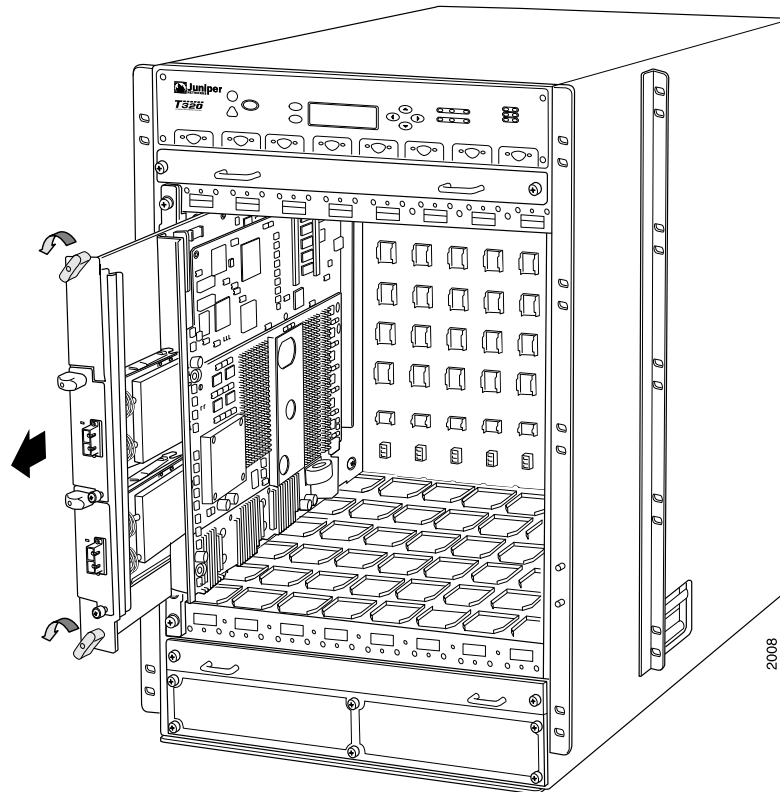
**CAUTION:** The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 19 lb (8.6 kg)—as you slide the FPC out of the chassis.

When the FPC is out of the chassis, do not hold it by the ejector handles 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.

8. Repeat the procedure for each remaining FPC.

Figure 49: Removing a T320 FPC



#### Related Documentation

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 Flexible PIC Concentrators \(FPCs\) Description on page 57](#)
- [T320 T Series Control Board \(T-CB\) Description on page 31](#)
- [T320 Switch Interface Boards \(SIBs\) Description on page 79](#)
- [T320 Power System Description on page 77](#)
- [T320 Cooling System Description on page 25](#)

## Installing the T320 Chassis in the Rack Manually



**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.

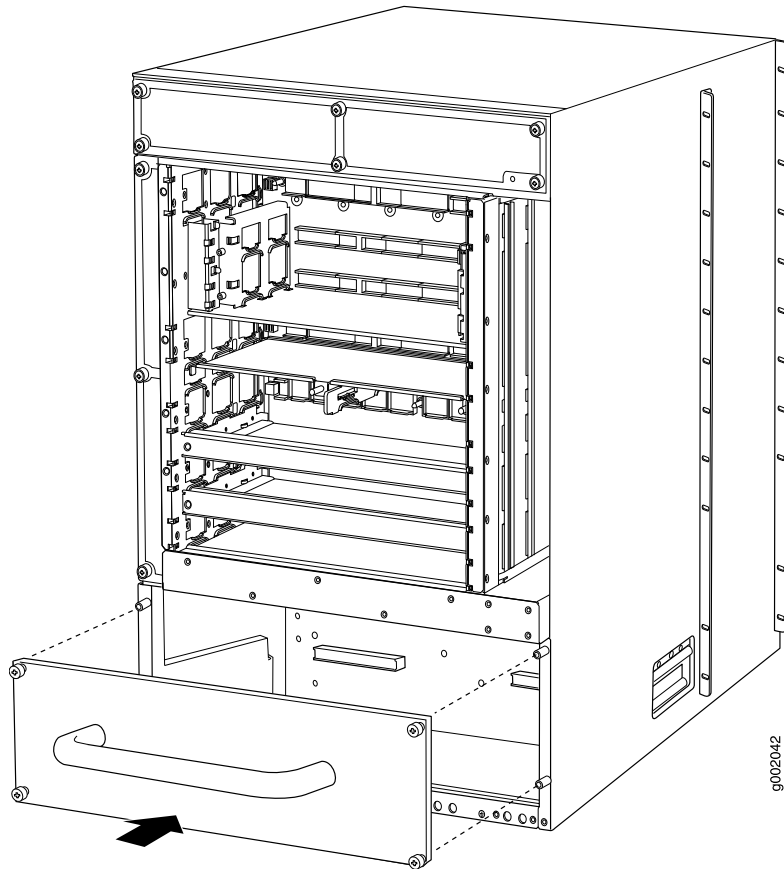


**CAUTION:** Lifting the chassis and mounting it in a rack requires four people. The empty chassis weighs approximately 131.4 lb (59.6 kg).

To install the router in the rack (see [Figure 51 on page 137](#)):

1. 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 “[T320 Site Preparation Checklist Requirements](#)” on [page 83](#).
2. 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 50 on page 135](#)). Tighten the screws, using a Phillips (+) screwdriver, number 2.

**Figure 50: Attaching the Installation Handle**



3. 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.



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

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4. 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.
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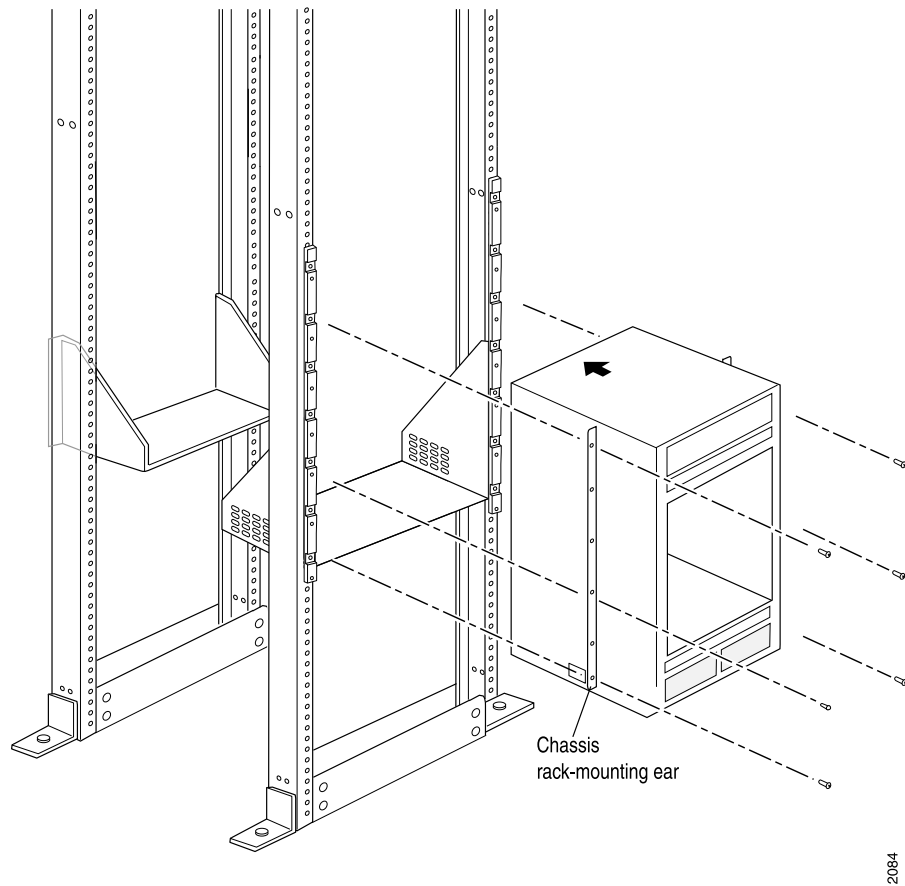


**WARNING:** To prevent injury, keep your back straight and lift with your legs, not your back. Avoid twisting your body as you lift. Balance the load evenly and be sure that your footing is solid.

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5. 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 center-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.
6. Install the mounting screws:
  - Four-post rack or cabinet—Install a mounting screw through each of the holes in the spacer bars.
  - Open-frame rack—Install a mounting screw into each of the open mounting holes aligned with the rack, starting from the bottom.
7. Loosen the captive screws on the installation handle completely, and remove the handle from the chassis.
8. 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 51: Installing the T320 Router in the Rack



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**NOTE:** This illustration depicts the router being installed in a four-post rack. For an illustration of the mounting hardware required for an open-frame rack, see [Figure 37](#) on page 111.

#### Related Documentation

- [Preventing Electrostatic Discharge Damage to a T320 Router](#) on page 320
- [T320 Router Installation Summary](#) on page 101
- [Installing the T320 Router Using a Mechanical Lift](#) on page 120
- [T320 Installation Safety Guidelines](#) on page 325

## Reinstalling T320 Components in the Chassis

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After the T320 router is installed in the rack, you reinstall the removed components before booting and configuring the router. The following procedures describe how to reinstall components in the chassis, first in the rear and then in the front:

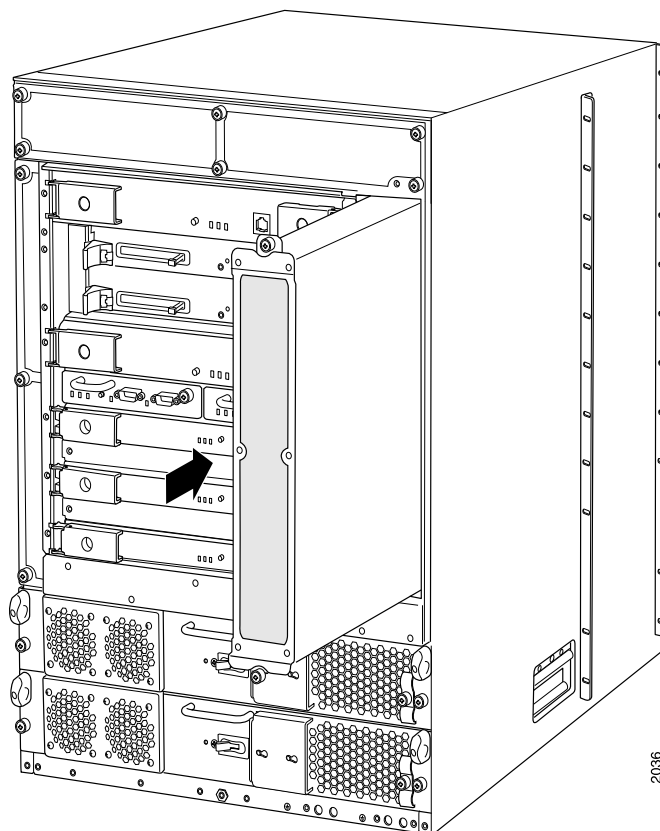
1. [Reinstalling the T320 Rear Fan Tray on page 138](#)
2. [Reinstalling the T320 SCGs on page 139](#)
3. [Reinstalling the T320 Control Boards on page 140](#)
4. [Reinstalling the T320 SIBs on page 141](#)
5. [Reinstalling the T320 Power Supplies on page 142](#)
6. [Reinstalling the T320 FPCs on page 143](#)
7. [Reinstalling T320 Front Fan Trays on page 145](#)
8. [Reinstalling the T320 Cable Management System on page 145](#)

### Reinstalling the T320 Rear Fan Tray

To reinstall the rear fan tray (see [Figure 52 on page 139](#)):

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 the fan tray by its handles and insert it straight into the chassis.
3. Tighten the captive screws on the top and bottom of the fan tray faceplate to secure it in the chassis.

Figure 52: Reinstalling the Rear T320 Fan Tray

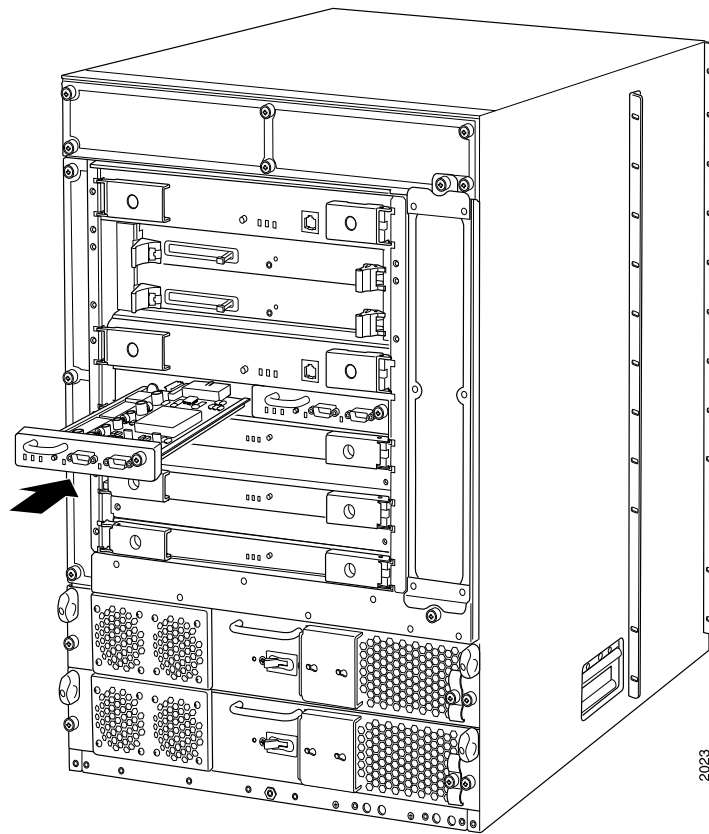


### Reinstalling the T320 SCGs

To reinstall the SCGs (see [Figure 53 on page 140](#)):

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. Repeat the procedure to reinstall the remaining SCG.

Figure 53: Reinstalling a T320 SCG



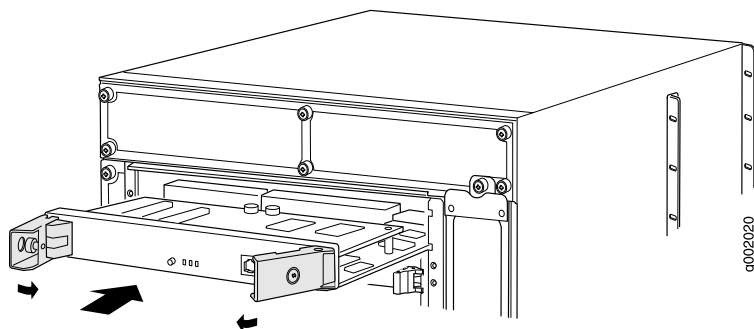
## Reinstalling the T320 Control Boards

To reinstall the control boards (see [Figure 54 on page 141](#)):

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 board with the guides inside the chassis.
3. Slide the control board 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 54: Reinstalling a Control Board

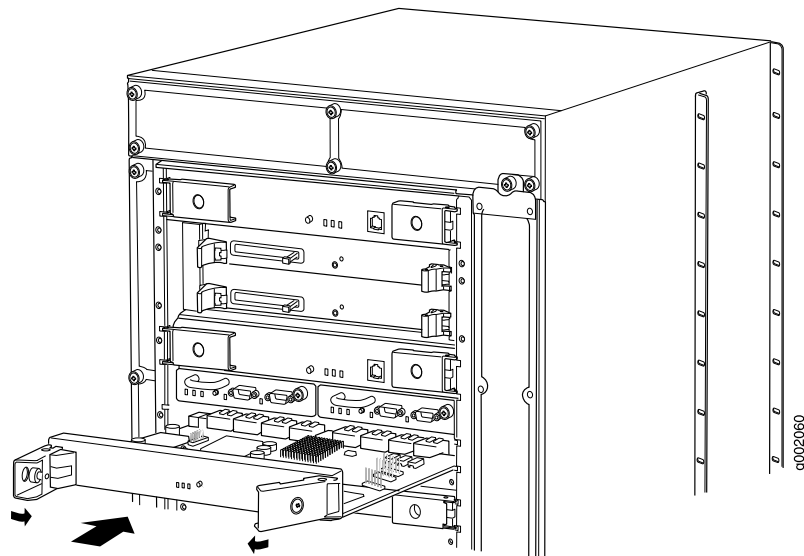


### Reinstalling the T320 SIBs

To reinstall the SIBs (see [Figure 55 on page 142](#)):

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 55: Reinstalling a SIB

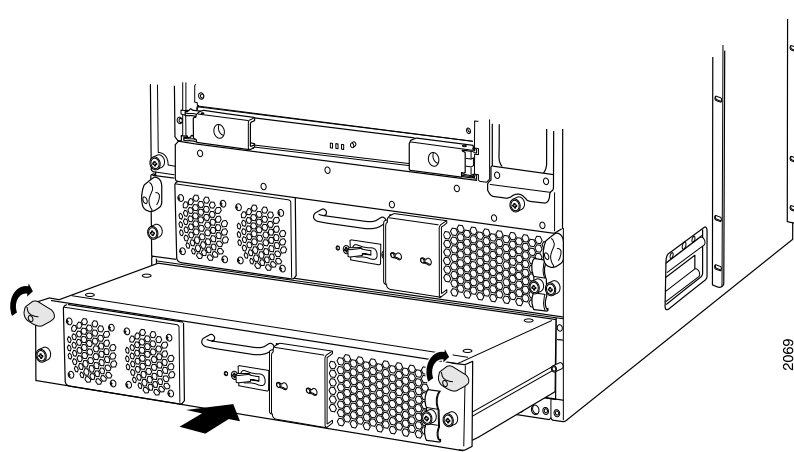


### Reinstalling the T320 Power Supplies

If the T320 router has two power supplies, reinstall the lower power supply first, then the upper power supply. To reinstall the power supplies (see [Figure 56 on page 143](#)):

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. Switch the circuit breaker on the power supply faceplate to the off position (O).
3. Using both hands, slide the power supply into the chassis until you feel resistance.
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. Repeat the procedure for the upper power supply.

Figure 56: Reinstalling a T320 Power Supply



### Reinstalling the T320 FPCs

To reinstall FPCs (see [Figure 57 on page 144](#)):

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. Inspect the slots in the FPC card cage to verify that there are no missing or bent pins on the midplane.
4. Inspect each FPC to verify that the connectors are not misaligned or damaged.



**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.

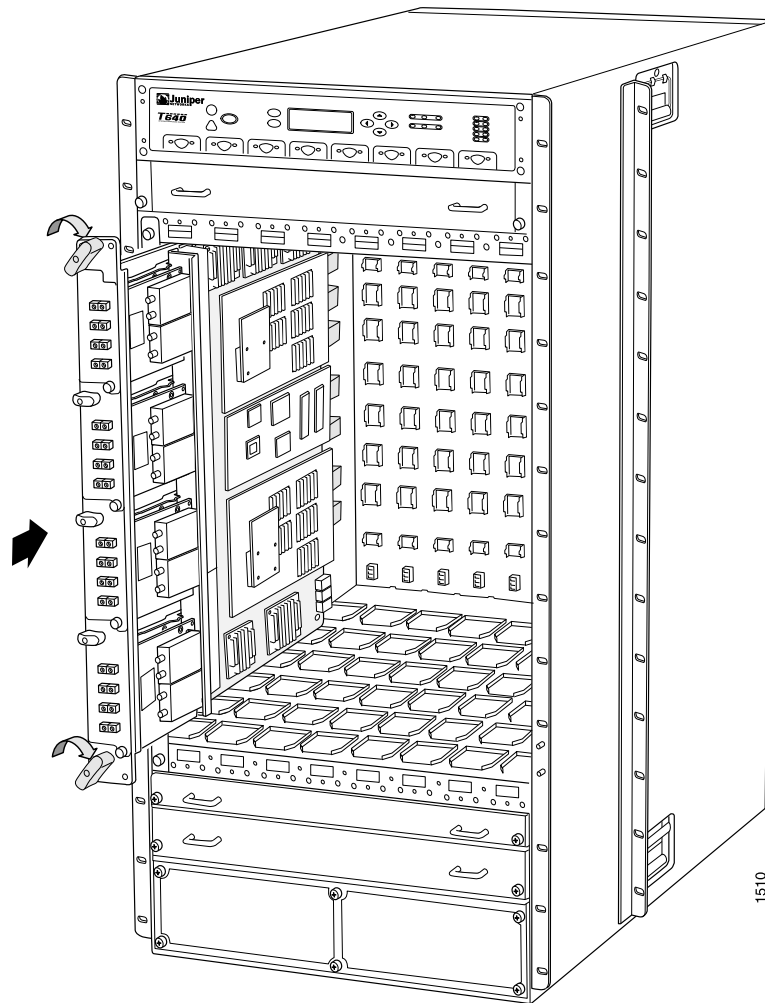
5. Lift the FPC into place and carefully align first the bottom and top of the FPC with the guides inside the card cage. Be sure the FPC is right-side up, with the components on the right of the FPC.
6. Gently rest the bottom edge of the FPC on the bottom edge of the slot opening, making contact a short distance forward of the power connector.



**CAUTION:** Take care not to bend or otherwise damage the power connector prongs.

7. Slide the FPC all the way into the card cage until you feel resistance.
8. Starting with the ejector handles on the FPC faceplate nearly horizontal, simultaneously turn both ejector handles clockwise to seat the FPC.
9. If you are installing a Type 2 FPC or Type 3 FPC, tighten the screws inside the ejector handles to secure the FPC. Do not overtighten them.
10. Repeat the procedure to reinstall each remaining FPC.

Figure 57: Reinstalling an FPC

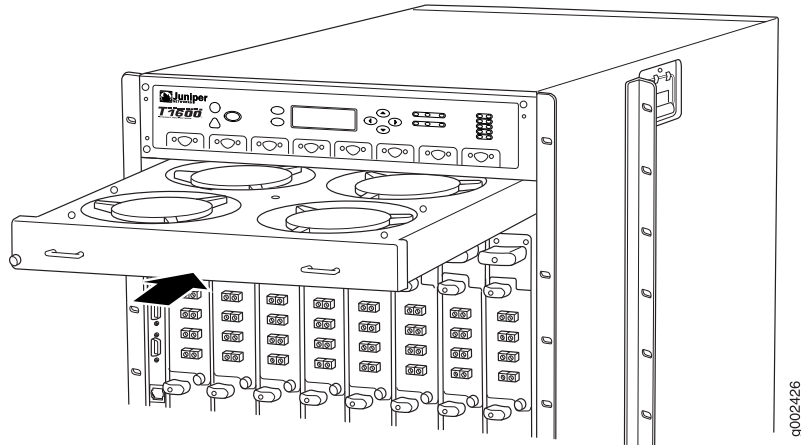


## Reinstalling T320 Front Fan Trays

To reinstall the standard front fan trays (see [Figure 58 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. 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 58: Reinstalling a Front Fan Tray**



## Reinstalling the T320 Cable Management System

To reinstall the cable management system:

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

### Related Documentation

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 Flexible PIC Concentrators \(FPCs\) Description on page 57](#)

- [T320 Switch Interface Boards \(SIBs\) Description on page 79](#)
- [T320 T Series Control Board \(T-CB\) Description on page 31](#)
- [T320 Power System Description on page 77](#)
- [T320 Cooling System Description on page 25](#)

## CHAPTER 19

# Connecting the T320 to Ground

- [Tools and Parts Required to Ground the T320 Router on page 147](#)
- [Connecting the T320 Grounding Cable on page 147](#)

## Tools and Parts Required to Ground the T320 Router

---

To ground the router, you need:

- Grounding cable (which you must provide)
- Grounding lug (provided with the router)
- M6 screws or UNC 1/4-20 screws
- Electrostatic discharge (ESD) grounding wrist strap

### Related Documentation

- [T320 Chassis Description on page 13](#)
- [T320 Chassis Grounding Cable and Lug Specifications on page 87](#)
- [Connecting the T320 Grounding Cable on page 147](#)
- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)

## Connecting the T320 Grounding Cable

---

To meet safety and electromagnetic interference (EMI) requirements and to ensure proper operation, the T320 router must be adequately grounded before power is connected.

You must provide the grounding cables. For grounding cable specifications, see “[T320 Chassis Grounding Cable and Lug Specifications](#)” on page 87. The accessory box shipped with the router includes the cable lug that attaches to the grounding cable and two UNC 1/4–20 screws.

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.



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

1. Connect the grounding cable to a proper earth ground.
2. Verify that a licensed electrician has attached the cable lug provided with the router to the grounding cable.
3. Make sure that grounding surfaces are clean and brought to a bright finish before grounding connections are made.
4. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
5. Place the grounding cable lug over the grounding points. The left pair is sized for M6 bolts, and the right pair is sized for UNC 1/4-20 bolts.
6. Secure the grounding cable lug to the grounding points, first with the washers, then with the screws.
7. 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.

**Related Documentation**

- [Tools and Parts Required to Ground the T320 Router on page 147](#)
- [T320 Chassis Description on page 13](#)
- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)



# Connecting the T320 to External Devices

- [Overview of Connecting the T320 Router to External Devices on page 149](#)
- [Tools and Parts Required to Connect the T320 Router to External Devices on page 150](#)
- [Connecting PIC Cables to the T320 Router on page 150](#)
- [Connecting the T320 Router to an External Alarm-Reporting Device on page 151](#)
- [Connecting the T320 Router to a Management Console or Auxiliary Device on page 153](#)
- [Connecting the T320 Router to a Network for Out-of-Band Management on page 154](#)

## Overview of Connecting the T320 Router to External Devices

After you have grounded the T320 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 T320 Router to a Management Console or Auxiliary Device” on page 153.](#)
- A laptop, modem, or other auxiliary device to the **AUXILIARY** ports on the Connector Interface Panel (CIP).  
[See “Connecting the T320 Router to a Management Console or Auxiliary Device” on page 153.](#)
- A management network to the **ETHERNET** ports on the Connector Interface Panel (CIP).  
[See “Connecting the T320 Router to a Network for Out-of-Band Management” on page 154.](#)
- An external alarm-reporting device to the alarm relay contacts on the CIP.  
[See “Connecting the T320 Router to an External Alarm-Reporting Device” on page 151.](#)
- A network connection to the ports on the PICs.  
[See “Connecting PIC Cables to the T320 Router” on page 150.](#)

- Related Documentation**
- [Tools and Parts Required to Connect the T320 Router to External Devices on page 150](#)

## Tools and Parts Required to Connect the T320 Router to External Devices

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To connect the router to external management devices and PICs, you need the following tools and parts:

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

- Related Documentation**
- [Overview of Connecting the T320 Router to External Devices on page 149](#)

## Connecting PIC Cables to the T320 Router

---

To connect cable to the PICs (see [Figure 59 on page 151](#), which shows a fiber-optic PIC):

1. Have ready a length of the type of cable used by the PIC. For cable specifications, see the *T320 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 in the cable management system. Placing fasteners on the loop helps to maintain its shape.

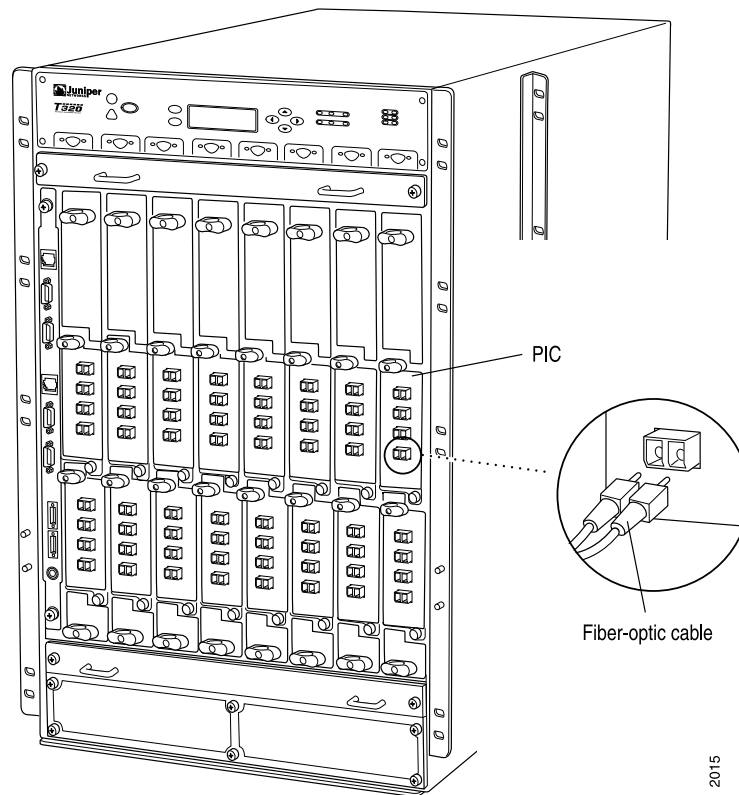


**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.



**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 59: Attach Cable to a PIC



**Related Documentation**

- [T320 PIC Description on page 63](#)

## Connecting the T320 Router to an External Alarm-Reporting Device

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**

- [T320 Site Preparation Checklist Requirements on page 83](#)
- [Connecting the T320 Grounding Cable on page 147](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)

## Connecting the T320 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 60 on page 154](#)) of a serial cable with a DB-9 female connector to the appropriate **CONSOLE** or **AUXILIARY** port (see [Figure 61 on page 154](#)). 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 60: Console and Auxiliary Serial Port Connector

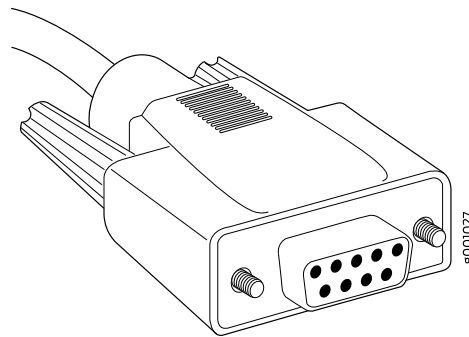
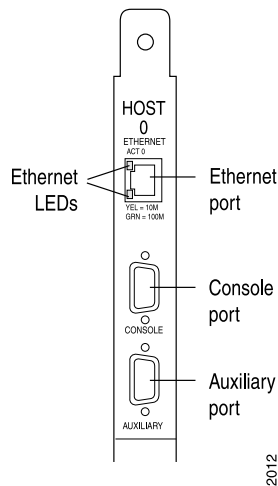


Figure 61: Console and Auxiliary Ports on the CIP



#### Related Documentation

- [T320 Site Preparation Checklist Requirements on page 83](#)
- [Connecting the T320 Grounding Cable on page 147](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)

## Connecting the T320 Router to a Network for Out-of-Band Management

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 62 on page 155](#) shows the connector) in to the appropriate **ETHERNET** port on the CIP (see [Figure 63 on page 156](#)). 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 62: Routing Engine Ethernet Cable Connector**

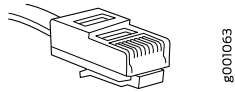
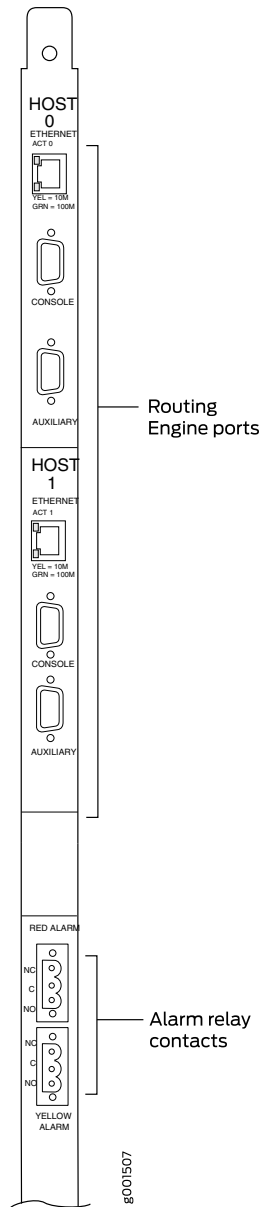


Figure 63: ETHERNET Port on the CIP



**Related Documentation**

- [T320 Connector Interface Panel \(CIP\) Description on page 16](#)
- [T320 Routing Engine Interface Cable and Wire Specifications on page 97](#)
- [T320 RJ-45 Connector Pinouts for the Routing Engine ETHERNET Port](#)



## CHAPTER 21

# Providing Power to the T320

- [Tools and Parts Required to Provide Power to the T320 Router on page 157](#)
- [Connecting DC Power to the T320 Router on page 157](#)
- [Powering On the T320 Router on page 159](#)
- [Powering Off the T320 Router on page 161](#)

## Tools and Parts Required to Provide Power to the T320 Router

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To provide power to the router, you need:

- 7/16-in. (11 mm) hexagonal-head external drive socket wrench, or 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.
- Electrostatic discharge (ESD) grounding wrist strap.

### Related Documentation

- [Connecting DC Power to the T320 Router on page 157](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)
- [Site Electrical Wiring Guidelines for Juniper Networks Devices on page 351](#)

## Connecting DC Power to the T320 Router

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You connect DC power to the T320 router by attaching power cables from the DC power sources to the terminal studs on the power supply faceplates. To connect power to the router, you must provide DC power cables (the cable lugs are supplied with the router). For power cable specifications, see [“T320 DC Power Cable Specifications” on page 89](#).

To connect the DC source power cables to the router for each power supply:

1. 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.



**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.

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. Verify that the source power cabling is correct, that the cables are not touching or blocking access to router components, and that they do not drape where people could trip on them.
4. Switch the circuit breaker on the power supply faceplate to the off position (O).
5. Remove the clear plastic cover protecting the terminal studs on the faceplate.
6. Remove the nuts and washers from the terminal studs.
7. Attach the lugs on the DC source power cables to the terminal studs. Secure the cable lugs to the terminal studs, first with the washers, then with the nuts (see [“Connect Power Cables to the T320 Power Supply” on page 242](#)). Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.
  - a. Attach the positive (+) DC source power cable lugs to the **RETURN** (return) terminals.
  - b. Attach the negative (–) DC source power cable lugs to the **–48V** (input) terminals.

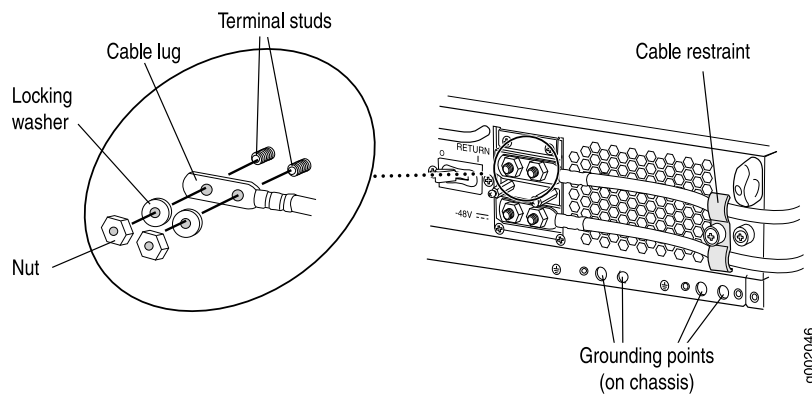


**CAUTION:** Each power supply must be connected to a dedicated DC power source.

8. Loosen the captive screws on the cable restraint on the right edge of the power supply faceplate.
9. Route the positive and negative DC power cables through the top and bottom of the cable restraint.

10. Tighten the cable restraint captive screw to hold the power cables in place.
11. Verify that the ground and power cabling are correct, that they are not touching or blocking access to router components, and that they do not drape where people could trip on them.
12. Replace the clear plastic cover over the terminal studs on the faceplate.

**Figure 64: Connecting DC Power to the T320 Router**



**Related Documentation**

- [Overview of Connecting the T320 Router to External Devices on page 149](#)
- [Connecting the T320 Grounding Cable on page 147](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)
- [Site Electrical Wiring Guidelines for Juniper Networks Devices on page 351](#)

## Powering On the T320 Router

To power on the 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 **RETURN**) 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**). For more information about connecting management devices, see [“Overview of Connecting the T320 Router to External Devices” on page 149](#).
4. Turn on the power to the external management device.

5. Switch the circuit breaker on one of the power supplies to the on position (I) and observe the LEDs on the power supply faceplate. If the power supply is correctly installed and is functioning properly, the **DC OK** LED lights steadily, and the **CB ON** LED blinks momentarily, then lights steadily.



**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on. After powering on a power supply, wait at least 60 seconds before turning it off.

If the system is completely powered off when you power on the power supply, the Routing Engine boots as the power supply completes its startup sequence. If the Routing Engine finishes booting and you need to power off the system again, see [“Powering Off the T320 Router” on page 161](#).

After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the output status LEDs on the power supply, the command display output, and messages on the LCD on the craft interface—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

6. Repeat Step 5 for the remaining power supply.



**NOTE:** If any of the output status LEDs does not light steadily, repeat the installation and cabling procedures described in [“Replacing a T320 DC Power Supply” on page 239](#) and [“Connecting DC Power to the T320 Router” on page 157](#).

7. On the external management device connected to the Routing Engine, monitor the startup process to verify that the system has booted properly.

**Related Documentation**

- [Connecting the T320 Grounding Cable on page 147](#)
- [Powering Off the T320 Router on page 161](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)
- [Site Electrical Wiring Guidelines for Juniper Networks Devices on page 351](#)

## Powering Off the T320 Router

To power off a T320 router:

1. On the external management device connected to the Routing Engine, issue the **request system halt both-routing-engines** 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
```

For more information about these commands, see *request system halt*.

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. 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. Switch the circuit breakers on each power supply faceplate to the off position (O).

### Related Documentation

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [Overview of Connecting the T320 Router to External Devices on page 149](#)
- [Connecting DC Power to the T320 Router on page 157](#)
- [Powering On the T320 Router on page 159](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)
- [Site Electrical Wiring Guidelines for Juniper Networks Devices on page 351](#)



## CHAPTER 22

# Configuring the Junos OS Software

- [Preparing to Configure the T320 Router on page 163](#)
- [Initially Configuring the T320 Router on page 163](#)

## Preparing to Configure the T320 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

### Related Documentation

- [T320 Router Description on page 3](#)
- [Connecting DC Power to the T320 Router on page 157](#)
- [Powering On the T320 Router on page 159](#)
- [Initially Configuring the T320 Router on page 163](#)
- [T320 Physical Specifications on page 86](#)

## Initially Configuring the T320 Router

---

The T320 Core Router is shipped with the Junos OS preinstalled and ready to be configured when the router is powered on. There are three copies of the software: one on a CompactFlash card (if installed) in the Routing Engine, one on the hard disk in the Routing Engine, and one on a PC card or USB device that can be inserted into the slot in the Routing Engine faceplate.

You configure the router by issuing Junos OS command-line interface (CLI) commands, either on a console device attached to the **CONSOLE** port on the CIP, or over a telnet connection to a network connected to the **ETHERNET** port on the CIP.



**NOTE:** These procedures enable you to use the ETHERNET management port. For the initial configuration, use a device attached to the CONSOLE port on the CIP.

1. [Entering Configuration Mode on page 164](#)
2. [Configuring User Accounts and Passwords on page 164](#)
3. [Configuring System Attributes on page 165](#)
4. [Committing the Configuration on page 166](#)

## 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*.

1. Add a password to the root administration user account. Enter a clear-text password.

```
[edit]  
root# set system root-authentication plain-text-password  
New password: password  
Retype new password: password
```

2. Create a management console user account.

```
[edit]  
root# 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@# set system login user user-name class super-user
```

## Configuring System Attributes

For more information on the backup router 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@# 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 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:

```
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 Ethernet interface.

```
[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@host# commit
```

4. When you have finished configuring the router, exit configuration mode.

```
[edit]
root@host# exit
root@host>
```

### Related Documentation

- [T320 Router Description on page 3](#)
- [Connecting DC Power to the T320 Router on page 157](#)
- [Powering On the T320 Router on page 159](#)

- [Preparing to Configure the T320 Router on page 163](#)
- [T320 Physical Specifications on page 86](#)



## PART 4

# Installing and Replacing Components

- [Overview of Installing and Replacing Components on page 171](#)
- [Replacing Chassis Components on page 175](#)
- [Replacing Cooling System Components on page 187](#)
- [Replacing Host Subsystem Components on page 199](#)
- [Replacing Line Card Components on page 223](#)
- [Replacing Power System Components on page 239](#)
- [Replacing Switch Fabric Components on page 247](#)



# Overview of Installing and Replacing Components

- [T320 Field-Replaceable Units on page 171](#)
- [Tools and Parts Required to Replace the T320 Hardware Components on page 172](#)

## T320 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. The router uses the following types of FRUs:

- 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.

If the router contains a redundant host subsystem, the backup control board (), and the backup Routing Engine are hot-removable and hot-insertable. Before you replace a control board or Routing Engine, you must take the host subsystem offline.

[Table 59 on page 172](#) lists the FRUs for the T320 Core Router.

Table 59: T320 Field-Replaceable Units

Hot-Removable and Hot-Insertable FRUs	Hot-Pluggable FRUs
<ul style="list-style-type: none"> <li>• Craft interface</li> <li>• Flexible PIC Concentrators (FPCs)</li> <li>• Physical Interface Cards (PICs)</li> <li>• Switch Interface Boards (SIBs)</li> <li>• SONET Clock Generators (SCGs)</li> <li>• Power supplies</li> <li>• Front and rear fan trays</li> <li>• Air filters</li> <li>• Backup control board</li> <li>• Backup Routing Engine</li> </ul>	<ul style="list-style-type: none"> <li>• Routing Engine (if not redundant)</li> <li>• Master routing engine</li> <li>• Control board (if not redundant)</li> <li>• Master control board</li> <li>• Connector Interface Panel (CIP)</li> </ul>

**Related Documentation**

- [T320 Router Description on page 3](#)
- [Taking the T320 Host Subsystem Offline on page 199](#)

## Tools and Parts Required to Replace the T320 Hardware Components

To replace hardware components, you need the tools and parts listed in [Table 60 on page 172](#).

Table 60: Tools and Parts Required for Component Replacement

Tool or part	Components
7/16-in. nut driver or pliers	Cables and connectors DC power supply
Blank panels (if component is not reinstalled)	Control board FPC PIC Routing Engine SIB
Electrostatic bag or antistatic mat	Control board FPC PIC Routing Engine SIB



**Table 60: Tools and Parts Required for Component Replacement** (*continued*)

Tool or part	Components
Electrostatic discharge (ESD) grounding wrist strap	All
Flat-blade (-) screwdriver	Cables and connectors PIC (in a Type 1 FPC) Serial cable to <b>AUXILIARY</b> or <b>CONSOLE</b> Routing Engine port
Phillips (+) screwdrivers, numbers 1 and 2	Air filter (front or rear) Cables and connectors Control board CIP Craft interface FPC Fan tray (front or rear) PIC Power supply Routing Engine SCG SIB
Rubber safety cap	Fiber-optic PIC or PIC cable
Wire cutters	Cables and connectors DC power supply

**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 307](#)
- [Contacting Customer Support on page 297](#)



# Replacing Chassis Components

- Removing the T320 CIP on page 175
- Replacing the T320 Management Ethernet Cables on page 176
- Replacing the T320 Console or Auxiliary Cable on page 178
- Replacing the T320 Alarm Relay Wires on page 180
- Replacing a T320 SCG on page 182
- Replacing a T320 Craft Interface on page 184

## Removing the T320 CIP

---

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 6 lb (2.7 kg). When the CIP is removed, you cannot control or communicate with the router using an external device.

To remove the CIP, (see [Figure 65 on page 176](#)):

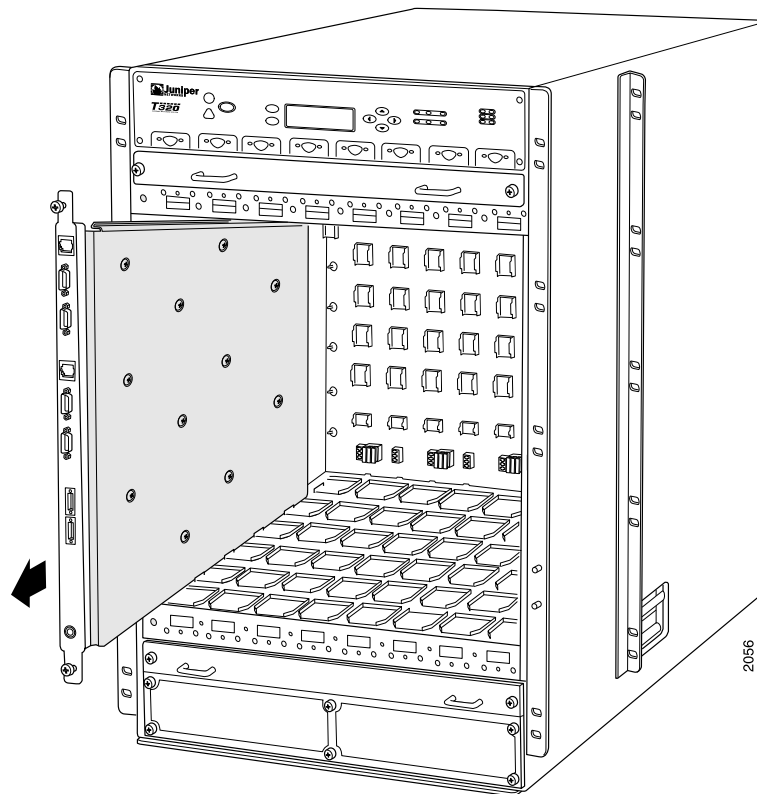
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Disconnect any external devices connected to the CIP.
3. Loosen the captive screws at the top and bottom of the CIP faceplate.
4. Grasp the handle on the CIP 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 65: Removing the CIP



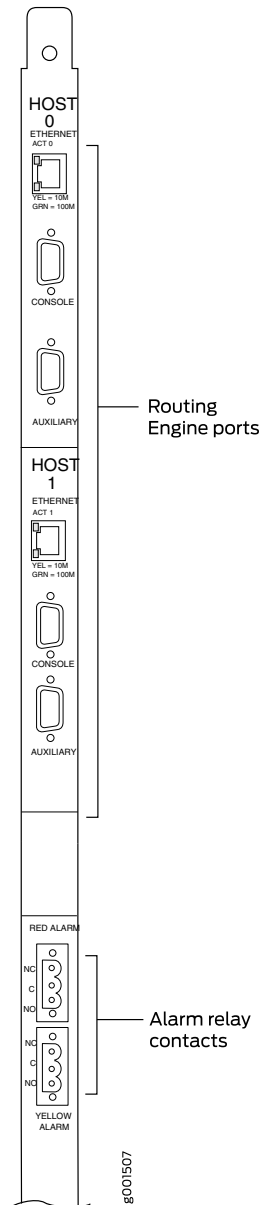
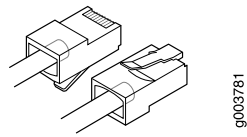
- Related Documentation**
- [T320 Connector Interface Panel \(CIP\) Description on page 16](#)
  - [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)

## Replacing the T320 Management Ethernet Cables

To replace the management Ethernet cable:

1. Press the tab on the connector and pull the connector straight out of the **ETHERNET** port. [Figure 66 on page 177](#) shows the connector.
2. Disconnect the cable from the network device.
3. 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**).
4. Plug the other end of the cable into the network device.

Figure 66: Ethernet Cable Connectors



- Related Documentation**
- [T320 Routing Engine Interface Cable and Wire Specifications on page 97](#)
  - [T320 RJ-45 Connector Pinouts for the Routing Engine ETHERNET Port](#)

## Replacing the T320 Console or Auxiliary Cable

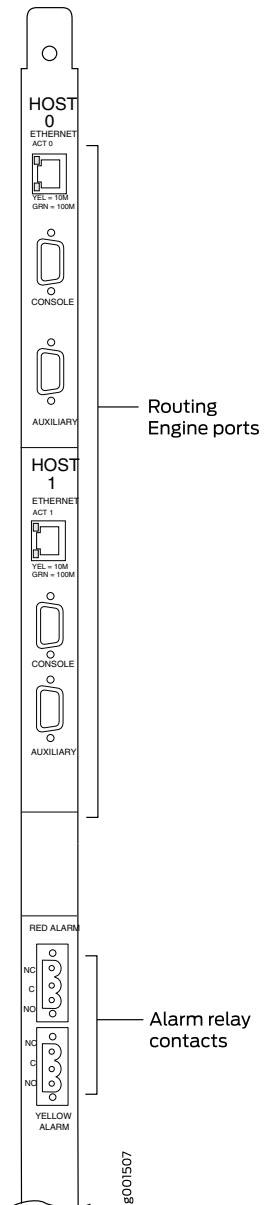
---

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 a cable with an RJ-45 connector. One RJ-45/DB-9 cable is provided with the router. If you want to connect a device to both ports, you must supply another cable.

To connect a management console or auxiliary device:

1. Plug one end of the replacement cable into the appropriate **CONSOLE** or **AUXILIARY** port. [Figure 67 on page 179](#) shows the external device ports on the CIP. 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 device's serial port.

Figure 67: Routing Engine Console



**Related Documentation**

- [Connecting the T320 Router to a Management Console or Auxiliary Device on page 153](#)
- [T320 Routing Engine Interface Cable and Wire Specifications on page 97](#)
- [T320 DB-9 Connector Pinouts for the Routing Engine AUXILIARY and CONSOLE Ports on page 98](#)

## Replacing the T320 Alarm Relay Wires

---

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.

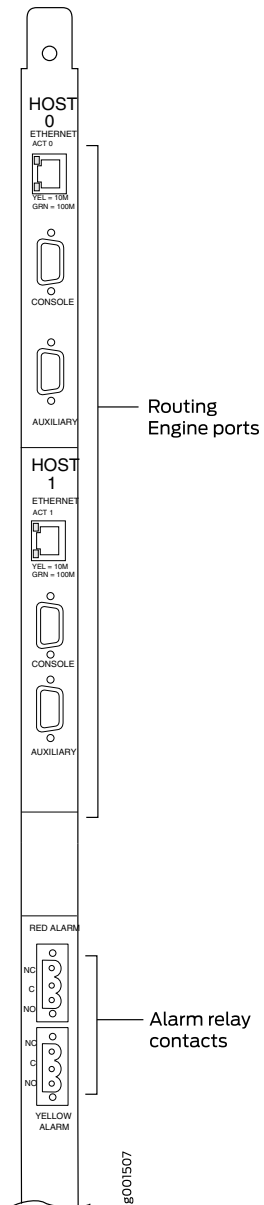
The terminal blocks that plug into the alarm relay contacts are supplied with the router. They accept wire of any gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>), which is not provided. Use the wire gauge appropriate for the external device you are connecting.

To replace the wires connecting to an alarm-reporting device (see [Figure 68 on page 181](#)):

1. Disconnect the existing wire at the external device.
2. Prepare the required length of replacement wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>).
3. 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.
4. 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.
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.



Figure 68: Routing Engine Alarm Relay Wires



**Related Documentation**

- [T320 Alarm Relay Contacts on page 18](#)
- [Overview of Connecting the T320 Router to External Devices on page 149](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)

## Replacing a T320 SCG

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The SCGs are hot-pluggable. If two SCGs are installed and both are functioning normally, **SCG0** is the master and **SCG1** is the backup. 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.

You can determine which SCG is functioning as the master in one of two ways:

- Check the blue **MASTER** LED on the SCG faceplate. If this LED is on steadily, the SCG is functioning as the master.
- To display which SCG is functioning as the master:

```
user@host> show chassis clocks
```

To replace an SCG, perform the following procedures:

1. [Removing a T320 SCG on page 182](#)
2. [Installing a T320 SCG on page 183](#)

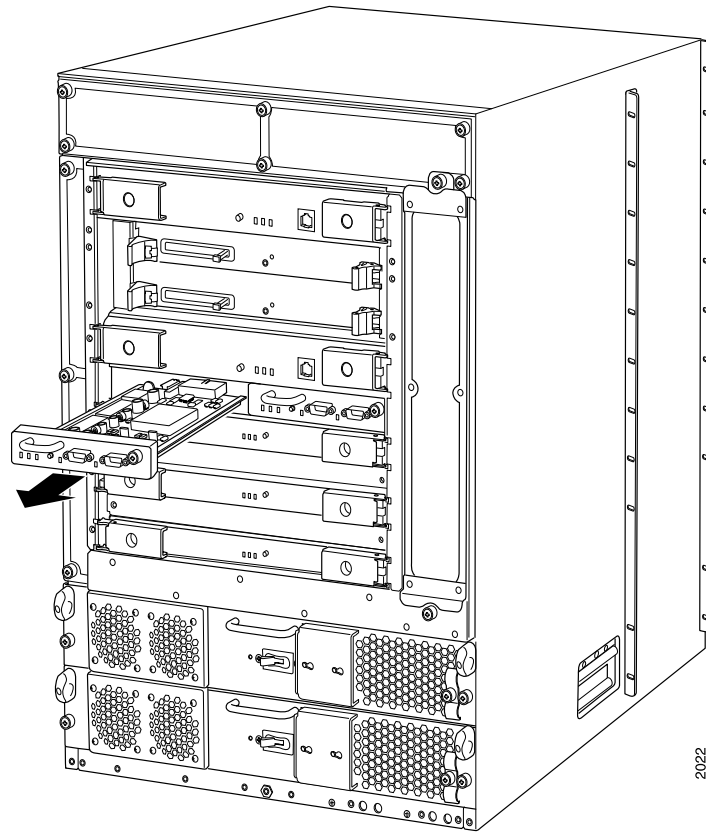
## Removing a T320 SCG

The router can have one or two SCGs installed. The SCGs are located in the rear of the chassis, above the SIBs. Each SCG weighs approximately 1.9 lb (0.9 kg).

To remove an SCG (see [Figure 69 on page 183](#)):

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 **OK** 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 69: Removing a T320 SCG



## Installing a T320 SCG

To install a replacement SCG (see [Figure 70 on page 184](#)):

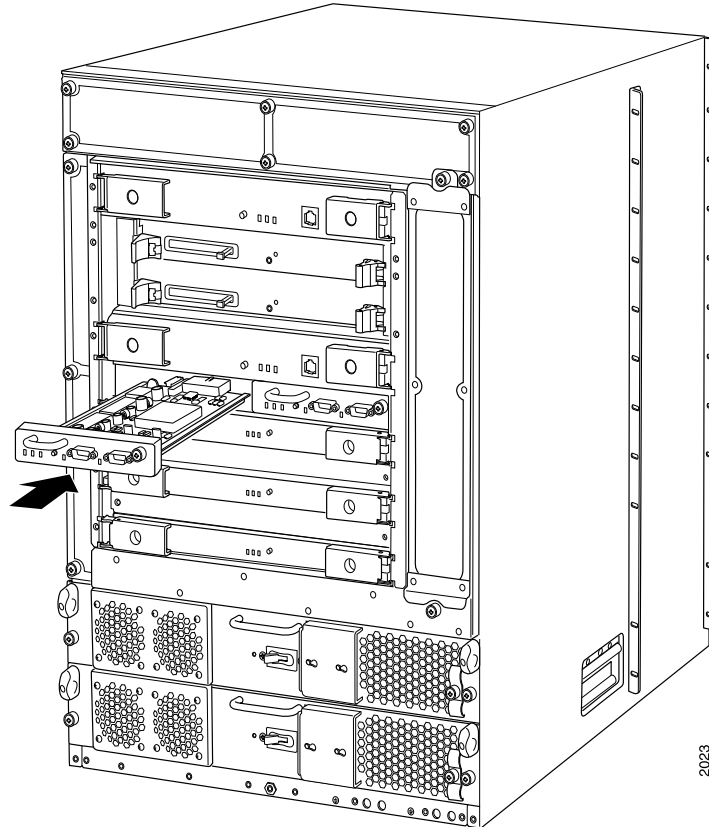
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Carefully align the sides of the SCG with the guides in the SCG slot.
3. Grasp the SCG by its handle and slide it straight into the chassis until it contacts 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:

```
user@host> show chassis environment scg
```

For more information about using the CLI, see *show chassis environment scg*.

Figure 70: Installing a T320 SCG



- Related Documentation**
- [T320 SONET Clock Generator \(SCG\) Description on page 19](#)
  - [T320 SCG LEDs on page 20](#)
  - [Maintaining the T320 SCGs on page 261](#)

## Replacing a T320 Craft Interface

The craft interface is hot-insertable and hot-removable. When you install the craft interface, allow several minutes for the display to reflect the current state of the router. Before you remove the craft interface, remove the front upper fan tray. For instructions on removing a front fan tray, see [“Removing a T320 Front Fan Tray” on page 193](#).

1. [Removing a T320 Craft Interface on page 185](#)
2. [Installing a T320 Craft Interface on page 185](#)

## Removing a T320 Craft Interface

The craft interface is located on the front of the chassis above the FPC card cage. The craft interface weighs approximately 2 lb (0.9 kg).

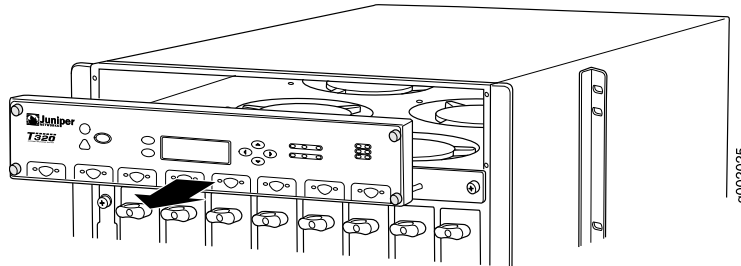


**NOTE:** Removing the front upper fan tray before you remove the craft interface might make it easier to grasp the craft interface as you remove it. For instructions on removing a front fan tray, see [“Removing a T320 Front Fan Tray” on page 193](#).

To remove the craft interface (see [Figure 71 on page 185](#)):

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. Repeat [Step 3](#) for the other side of the craft interface.
5. Grasp the craft interface by the top and bottom edges and carefully pull it straight out of the chassis.

**Figure 71: Removing a T320 Craft Interface**



## Installing a T320 Craft Interface

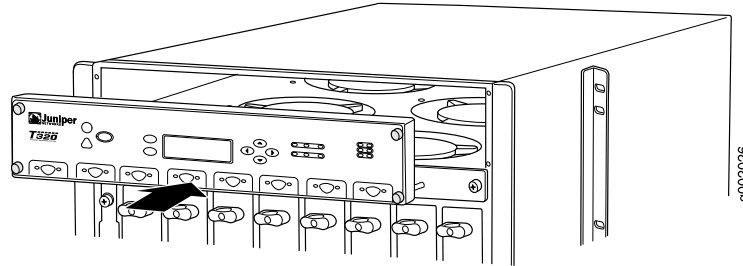
To install the craft interface (see [Figure 72 on page 186](#)):

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.

Figure 72: Installing a Replacement T320 Craft Interface



**Related  
Documentation**

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 Craft Interface Description on page 20](#)
- [T320 Craft Interface LCD and Navigation Buttons on page 22](#)

# Replacing Cooling System Components

- Replacing a T320 Air Filter on page 187
- Replacing a T320 Fan Tray on page 192

## Replacing a T320 Air Filter

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1. Removing a Front T320 Air Filter on page 187
2. Installing a Front T320 Air Filter on page 188
3. Removing a Rear T320 Air Filter on page 189
4. Installing a Rear T320 Air Filter on page 191

### Removing a Front T320 Air Filter

The front air filter, located below the FPC card cage in the front of the chassis, and 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 73 on page 188](#)):

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.

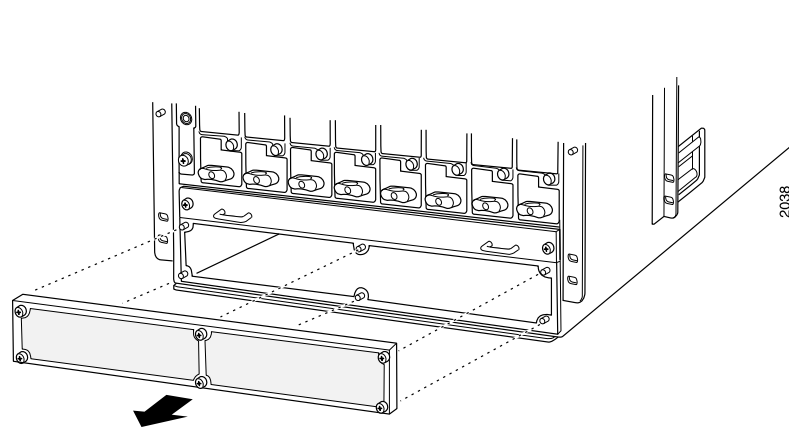


**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

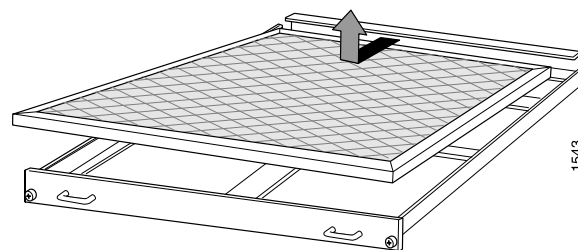
3. Simultaneously pull the two releases on the cable management system. Lift it up and outward to lock it in place to access the air filter.
4. Loosen the captive screws on the corners of the air filter faceplate.

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 74 on page 188](#)).

**Figure 73: Removing the Front Air Filter**



**Figure 74: Replacing the Front Filter Element**



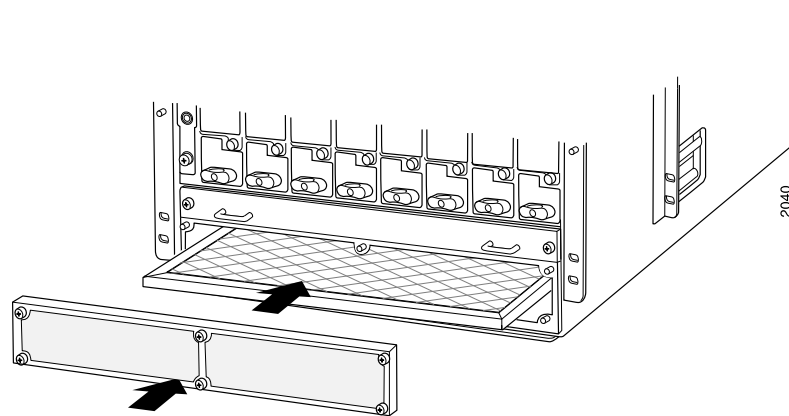
### Installing a Front T320 Air Filter

To install the front air filter (see [Figure 75 on page 189](#)):

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 75: Installing the Front Air Filter



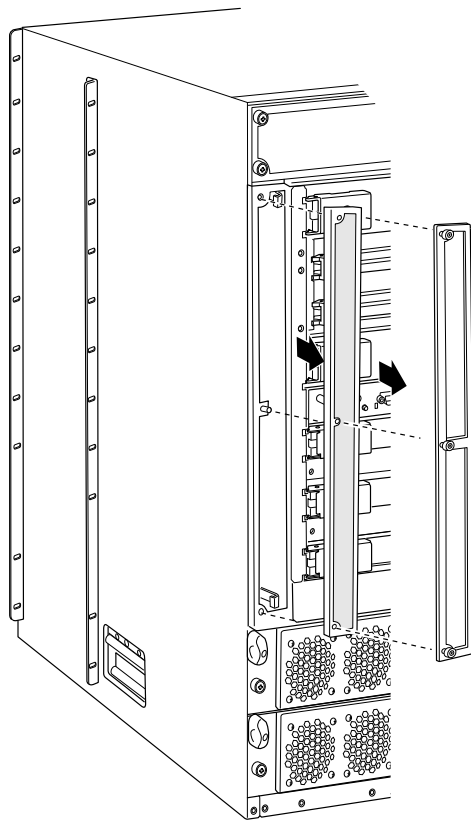
### Removing a Rear T320 Air Filter

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:

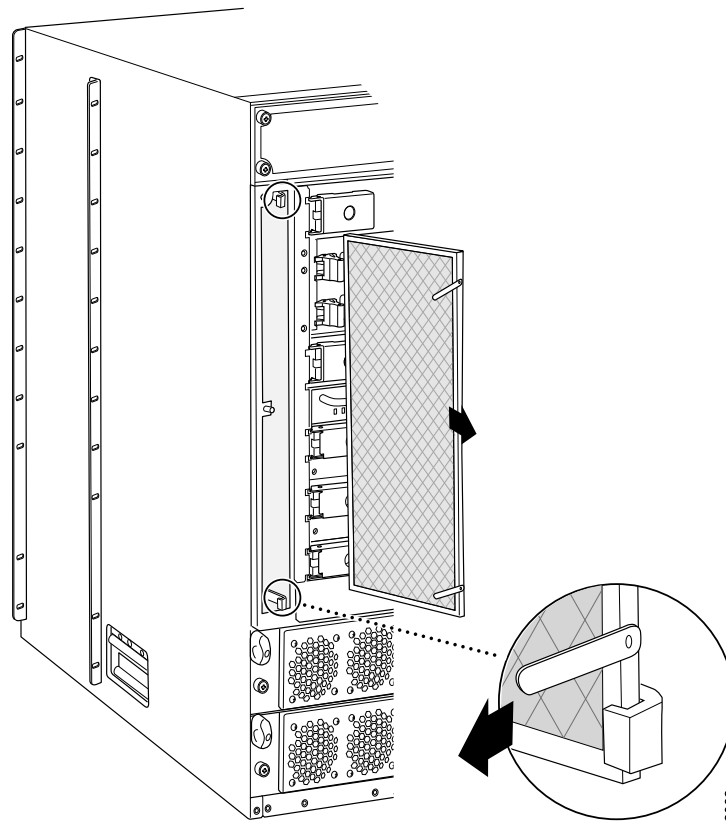
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Loosen the captive screws at the top, center, and bottom of the air filter, using a Phillips (+) screwdriver, number 2.
3. Grasp the air filter cover by the captive screws, and pull firmly to remove the cover and honeycomb assembly from the chassis (see [Figure 76 on page 190](#)).
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 77 on page 191](#)).

Figure 76: Removing the Rear Air Filter



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Figure 77: Removing the Rear Air Filter Element



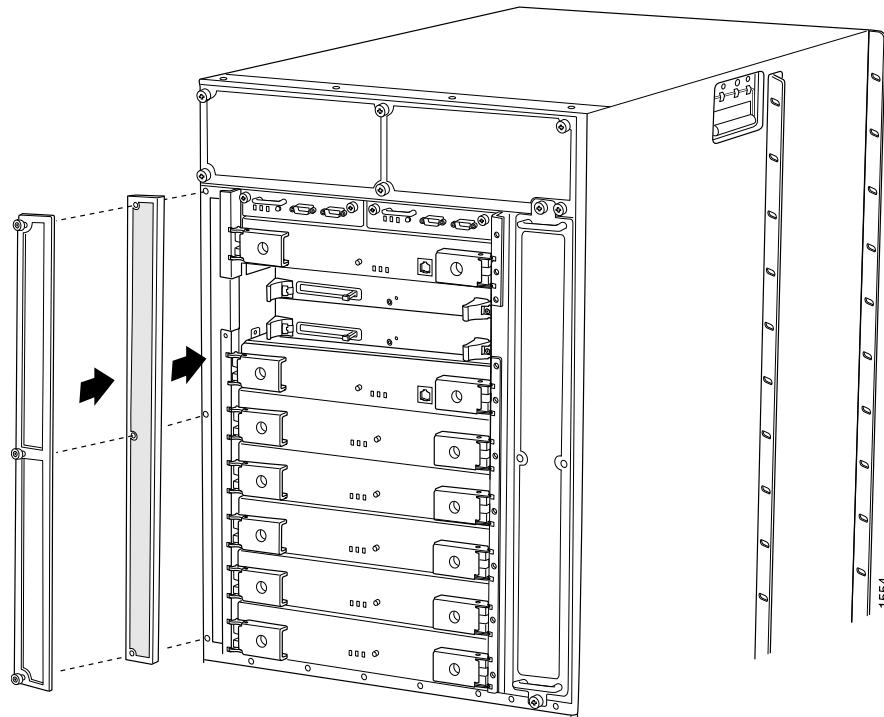
### Installing a Rear T320 Air Filter

To install the rear air filter (see [Figure 78](#) on page 192):

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 78: Installing the Rear Air Filter**



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 Cooling System Description on page 25](#)
- [Maintaining the T320 Air Filters on page 262](#)
- [Troubleshooting the T320 Cooling System on page 285](#)
- [Replacing the T320 Connections to Routing Engine Interface Ports](#)

## Replacing a T320 Fan Tray

The T320 router has two front fan trays. The front fan trays install horizontally in the front of the chassis. Each front fan tray contains six fans. The two front fan trays are interchangeable, but the rear fan tray is not interchangeable with the front fan trays. The fan trays are hot-insertable and hot-removable.

1. [Removing a T320 Front Fan Tray on page 193](#)
2. [Installing a T320 Front Fan Tray on page 194](#)

3. [Removing a T320 Rear Fan Tray on page 195](#)
4. [Installing a T320 Rear Fan Tray on page 196](#)

## Removing a T320 Front Fan Tray

The upper front fan tray is located above the FPC card cage, and the lower front fan tray is located below the front air filter. Each fan tray weighs about 13.3 lb (6.0 kg).

To remove a front fan tray (see [Figure 79 on page 194](#)):

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
2. If you are removing the lower fan tray:
  - a. 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.

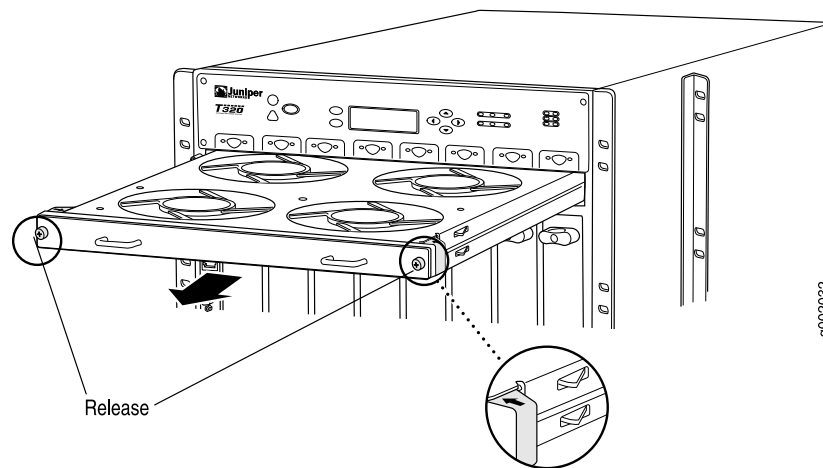
- b. Simultaneously pull the two releases on the cable management system. Lift it up and outward to lock it in place to access the lower fan tray.
3. Loosen the captive screws on the corners of the fan tray faceplate.
4. Grasp the handles and pull the fan tray halfway out of the chassis.



**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.

5. 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 79: Removing a Front T320 Fan Tray

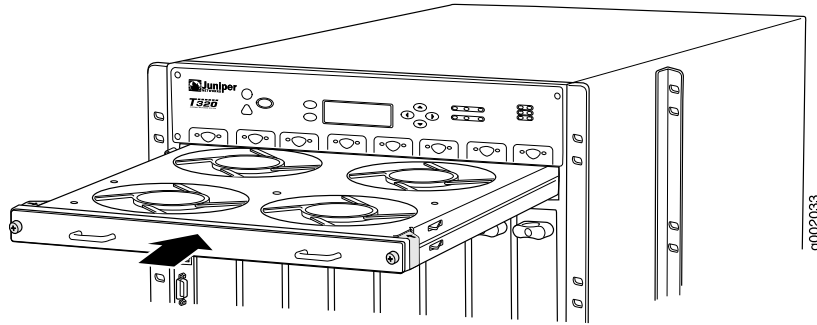


### Installing a T320 Front Fan Tray

To install a front fan tray (see [Figure 80](#) on page 195):

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router”](#) on page 320.
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. If you are installing the lower fan tray, follow these steps:
  - a. Unlock the cable management system and lower it to the fully lowered position.
  - b. Rearrange the PIC cables in the cable management system. For more information about proper cable arrangement, see [“Maintaining T320 PICs and PIC Cables”](#) on page 270.

Figure 80: Installing a Front T320 Fan Tray



### Removing a T320 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 five fans. The fan tray weighs about 7.3 lb (3.3 kg).



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

To remove the rear fan tray (see [Figure 81](#) on page 196):

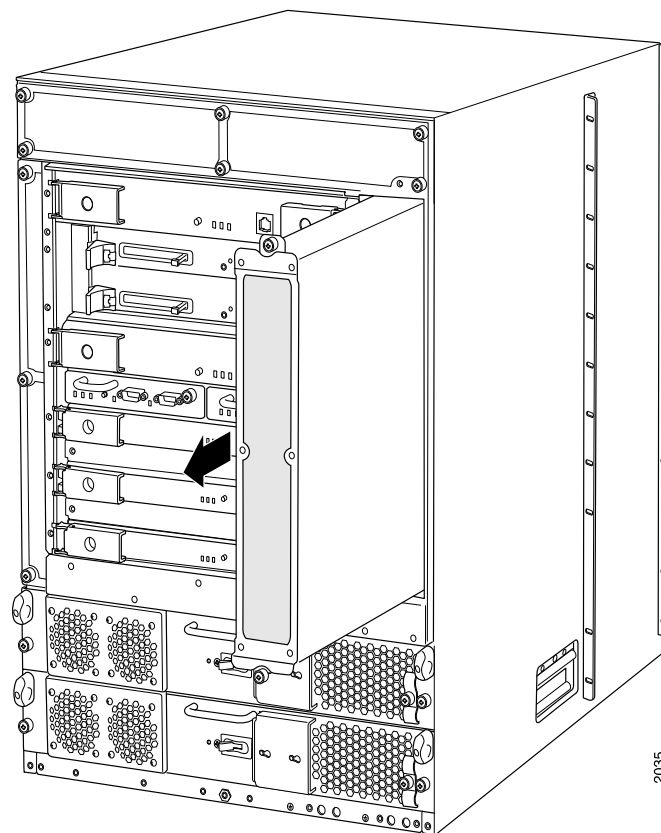
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis. For more information about ESD, see “[Preventing Electrostatic Discharge Damage to a T320 Router](#)” on page 320.
2. Loosen the captive screws on the top and bottom of the fan tray faceplate, using a Phillips (+) screwdriver, number 2.
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, grasp the handles and pull the fan tray completely out of the chassis.

Figure 81: Removing a Rear T320 Fan Tray



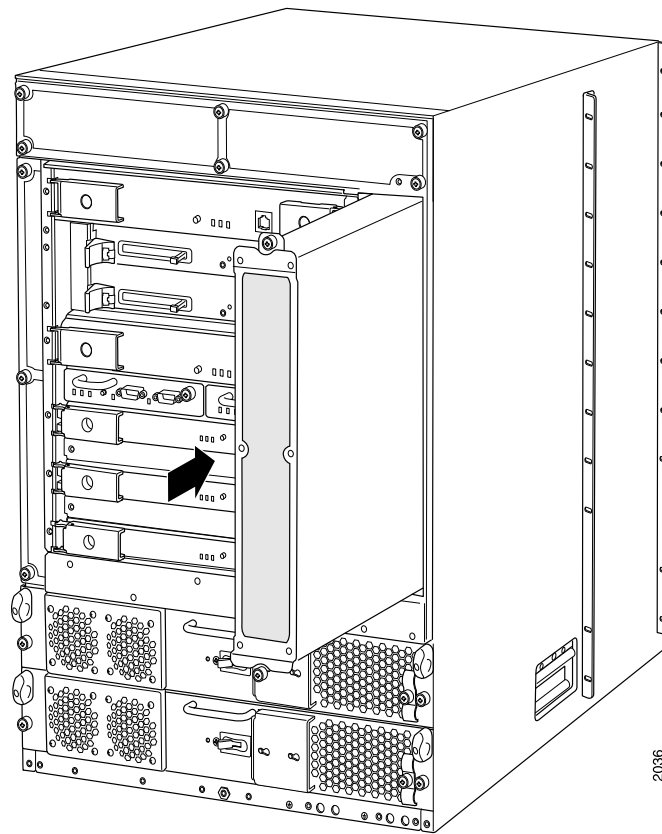
### Installing a T320 Rear Fan Tray

To install a replacement rear fan tray (see [Figure 82 on page 197](#)):

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
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 82: Installing a Rear T320 Fan Tray

**Related Documentation**

- [T320 Cooling System Description on page 25](#)
- [Maintaining the T320 Fan Trays on page 263](#)
- [Troubleshooting the T320 Cooling System on page 285](#)



# Replacing Host Subsystem Components

- [Replacing the T320 Host Subsystem Components on page 199](#)
- [Replacing a T320 Routing Engine on page 212](#)
- [Replacing a DIMM Module in T320 Routing Engines on page 216](#)
- [Replacing a T320 PC Card on page 217](#)
- [Replacing a T320 Standard Control Board or T-CB on page 219](#)

## Replacing the T320 Host Subsystem Components

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To replace a host subsystem, perform the following procedures:

- [Taking the T320 Host Subsystem Offline on page 199](#)
- [Replacing a T320 Standard Control Board or T-CB on page 202](#)
- [Replacing a T320 PC Card on page 204](#)
- [Replacing a DIMM Module in T320 Routing Engines on page 206](#)
- [Replacing a T320 Routing Engine on page 207](#)

## Taking the T320 Host Subsystem Offline

The host subsystem is taken offline and brought online as a unit. Before you replace a control board or Routing Engine, you must take the host subsystem offline.

Normally, if two host subsystems are installed in the router, **RE0** functions as the master and **RE1** functions as the backup. You can remove the backup host subsystem (or either of its components) without interrupting the functioning of the router. If you take the master host subsystem offline, the backup host subsystem becomes the master (the router might reboot, depending on your configuration). If the router has only one host subsystem, taking the host subsystem offline causes the router to shut down.

[Table 61 on page 199](#) explains the effect of taking the host subsystem offline.

**Table 61: Effect of Taking the T320 Host Subsystem Offline**

Type of Host Subsystem	Effect of taking the Host Subsystem Offline
Nonredundant host subsystem	The router shuts down.

Table 61: Effect of Taking the T320 Host Subsystem Offline (*continued*)

Type of Host Subsystem	Effect of taking the Host Subsystem Offline
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> <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> <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>



**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 configuring graceful Routing Engine switchover, graceful restart, and nonstop active routing, see the *Junos OS High Availability Library for Routing Devices*.



**NOTE:** The first supported release for graceful Routing Engine switchover and nonstop active routing on the T320 router is Junos OS Release 7.0 and Junos OS Release 8.4, respectively. Graceful restart software requirements are dependent on the routing protocols configured on the router. For the minimum software requirements for graceful restart, see the *Junos OS High Availability Library for Routing Devices*.

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.
- Issue the following CLI command. The master Routing Engine is designated **Master** in the **Current state** field:

```
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 using the CLI command:

```
user@host> request chassis routing-engine master switch
```

3. To halt the Routing Engine:

```
user@host> request system halt
```

The command shuts down the Routing Engine cleanly, so its state information is preserved. For more information about the command, see *request system halt*.



**NOTE:** The SIBs might continue forwarding traffic for approximately five minutes after the `request system halt` command has been issued.

4. On the console or other management device connected to the other Routing Engine, enter CLI operational mode and 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
```

## Replacing a T320 Standard Control Board or T-CB

The router can have up to two control boards. They are located in the upper rear of the chassis in the slots marked **CB0** and **CB1**. Each weighs approximately 5 lb (2.3 kg).

To replace a standard control board or T-CB, perform the following procedures:

1. [Removing a T320 Standard Control Board or T-CB on page 202](#)
2. [Installing a T320 Standard Control Board or T-CB on page 203](#)

### Removing a T320 Standard Control Board or T-CB

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**CAUTION:** Before you replace a control board, you must take the host subsystem offline. If there is only one host subsystem, taking the host subsystem offline shuts down the router. See [“Taking the T320 Host Subsystem Offline” on page 199](#).

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**CAUTION:** If the control board to be replaced is associated with the Routing Engine currently functioning as the master Routing engine, switch it to the backup before removing the T-CB. See [“Taking the T320 Host Subsystem Offline” on page 199](#).

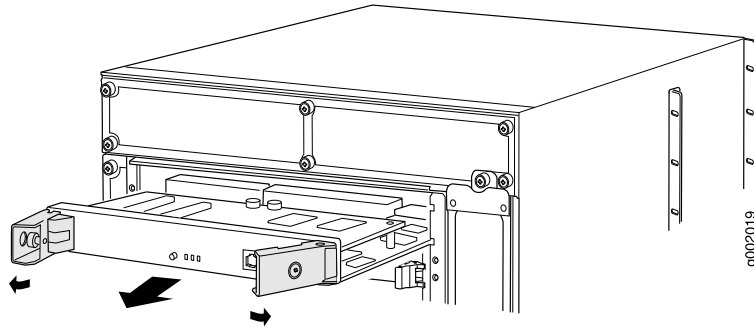
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To remove a standard control board or T-CB (see [Figure 83 on page 203](#)):

1. Take the host subsystem offline. See [“Taking the T320 Host Subsystem Offline” on page 199](#).
2. Place an electrostatic bag or antistatic mat on a flat, stable surface.
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. Loosen the captive screws (using a Phillips (+) screwdriver, number 2) on the ejector handles on both sides of the control board faceplate.
5. Flip the ejector handles outward to unseat the control board.
6. Grasp the ejector handles and slide the control board about halfway out of the chassis.
7. Place one hand underneath the control board to support it and slide it completely out of the chassis.

8. Place the control board on the antistatic mat.
9. If you are not replacing the control board now, install a blank panel over the empty slot.

**Figure 83: Removing a T320 Standard Control Board**



### Installing a T320 Standard Control Board or T-CB

To install a standard control board or T-CB (see [Figure 84 on page 204](#)):

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 control board with the guides inside the chassis.
3. Slide the control board 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.

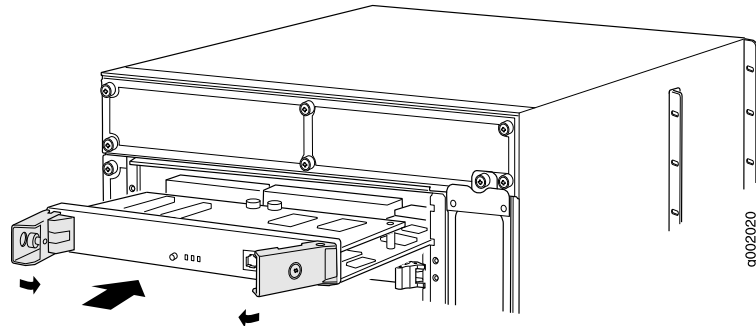


**NOTE:** If power is applied to the Routing Engine and its corresponding control board is functioning normally, the control board comes online automatically.

6. Verify that the control board is functioning normally,
  - Check the LEDs on the control board faceplate. The green **OK** LED should light steadily a few minutes after the control board is installed. If the **FAIL** LED is lit steadily, remove and install the control board again. If the **FAIL** LED still lights steadily, the control board is not functioning properly. Contact your customer support representative.

- Use the CLI command `show chassis environment cb` to check the status of the control board,

**Figure 84: Installing a Standard Control Board**



## Replacing a T320 PC Card

1. [Removing a T320 PC Card on page 204](#)
2. [Installing a T320 PC Card on page 205](#)

### Removing a T320 PC Card

The PC card is inserted into the slot labeled **PC CARD** on the RE-600 or RE-1600. To remove the PC card (see [Figure 85 on page 205](#)):

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 cover by loosening the captive screws on the corners of its faceplate.
4. On the Routing Engine faceplate, press the eject button on the right side of the PC card slot once to release the button. Press again to release the PC card.



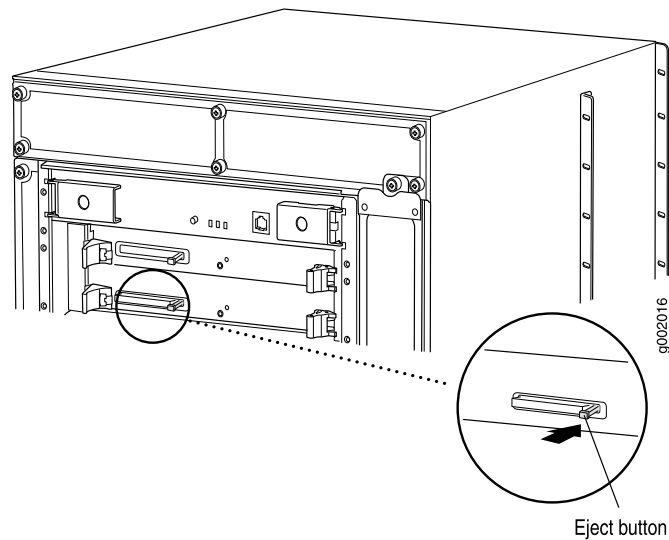
**NOTE:** The Routing Engine in your router might have two PC Card slots. In this case, use either slot. Do not install more than one PC card in the Routing Engine.

5. The PC card pops partially out of the slot. Grasp the card and pull it completely out of the slot.



6. Place the PC card on the antistatic mat.
7. If you are not replacing the PC card now, reinstall the Routing Engine cover and tighten the screws on the corners of the cover to secure it to the chassis.

**Figure 85: Removing a PC Card**



### Installing a T320 PC Card

To install a PC card (see [Figure 86 on page 206](#)):

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 Routing Engine cover is in place, remove the cover by loosening the captive screws on the corners of its faceplate.
3. Insert the PC card into the PC card slot on the Routing Engine, with the Juniper Networks logo facing downward.



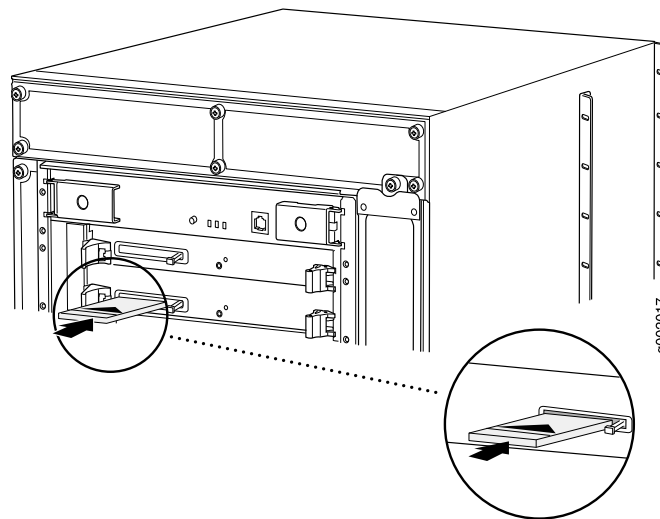
**CAUTION:** Be sure to insert the PC card with the label facing downward. Inserting the PC card incorrectly might damage the Routing Engine.



**NOTE:** The RE-1600 has two PC Card slots. In this case, use either slot. Do not install more than one PC card in the Routing Engine.

4. Press the card firmly all the way into the slot.
5. Reinstall the Routing Engine cover and tighten the screws on the corners of the cover to secure it to the chassis.

Figure 86: Installing a PC Card



## Replacing a DIMM Module in T320 Routing Engines

1. [Removing a T320 DIMM Module on page 206](#)
2. [Installing a T320 DIMM Module on page 207](#)

### Removing a T320 DIMM Module

The DIMM modules are located on the top of the 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.
4. Depending on which Routing Engine you are using, there are two different procedures for ejecting the DIMMs:
  - For Routing Engines with an ejector on one side of the DIMM, press the plastic ejector of the DIMM module. The edge of the module raises upward.
  - For Routing Engines with ejectors on each side of the DIMM, press 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.

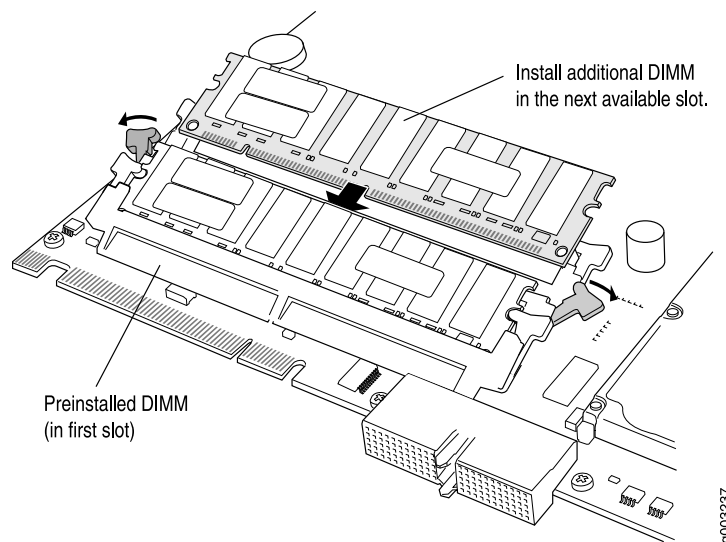
6. Place the DIMM module on the antistatic mat or in the electrostatic bag.
7. Push the plastic ejectors to close the empty DIMM module slot.

### Installing a T320 DIMM Module

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. Pressing firmly on both ends, push the module into the slot until the ejectors return completely to the closed position.
6. Install the Routing Engine.
7. You can view the SDRAM configuration and verify the DIMM was installed correctly by issuing the `show chassis routing-engine` command.

Figure 87: Installing the DIMM Module



### Replacing a T320 Routing Engine

To replace a Routing Engine, perform the following procedures:

1. [Removing a T320 Routing Engine on page 208](#)
2. [Installing a T320 Routing Engine on page 210](#)

## Removing a T320 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 1.9 lb (0.9 kg).



**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. .



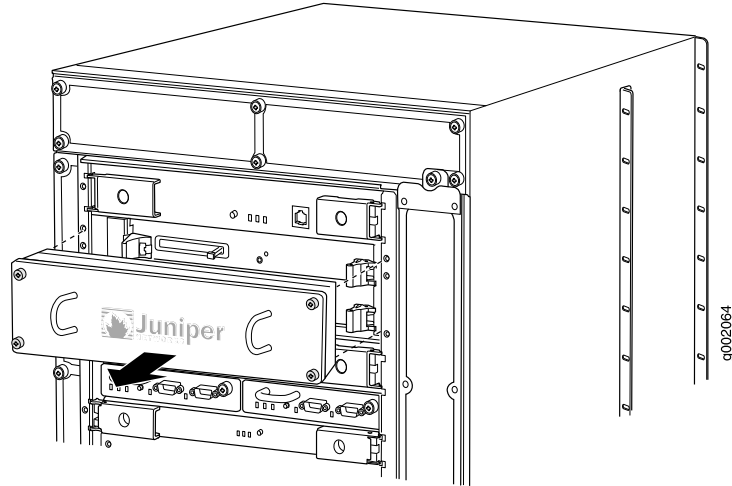
**CAUTION:** If the Routing Engine to be replaced is currently functioning as the master Routing engine, switch it to be the backup before removing it.

To remove a Routing Engine (see [Figure 89 on page 209](#)):

1. Take the host subsystem offline as described in [“Taking the T320 Host Subsystem Offline” on page 199](#).
2. Place an electrostatic bag or antistatic mat on a flat, stable surface.
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. If the Routing Engine cover is in place, remove the cover by loosening the captive screws on the corners of its faceplate (see [Figure 88 on page 209](#)).
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 (see [Figure 90 on page 210](#)).

**Figure 88: Removing the T320 Routing Engine Cover**



**Figure 89: Removing a T320 Routing Engine**

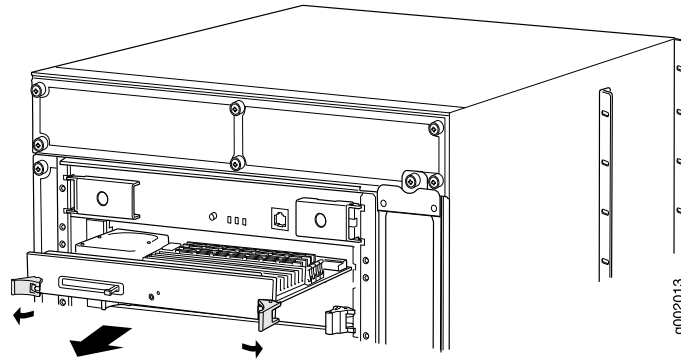
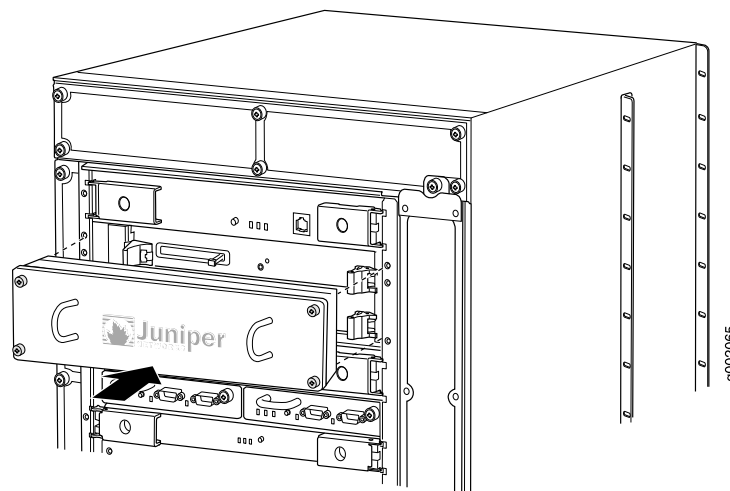


Figure 90: Reinstalling the T320 Routing Engine Cover



### Installing a T320 Routing Engine

To install a Routing Engine (see [Figure 91 on page 211](#)):

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, 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 92 on page 211](#)).
9. If the router is powered on and the Routing Engine's corresponding control board is functioning normally, the Routing Engine comes online automatically. To verify that

the Routing Engine is installed correctly, check the **HOST0** and **HOST1** LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **OK** LED lights steadily. If the red **FAIL** LED lights steadily instead, remove and install the Routing Engine again. If the red **FAIL** LED still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.

To check the status of the Routing Engine, use the CLI command:

```
user@host> show chassis routing-engine
```

For more information about using the CLI, see *show chassis routing-engine*.

Figure 91: Installing a T320 Routing Engine

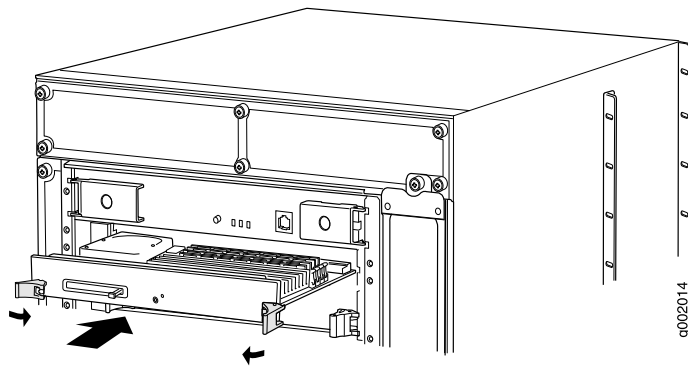
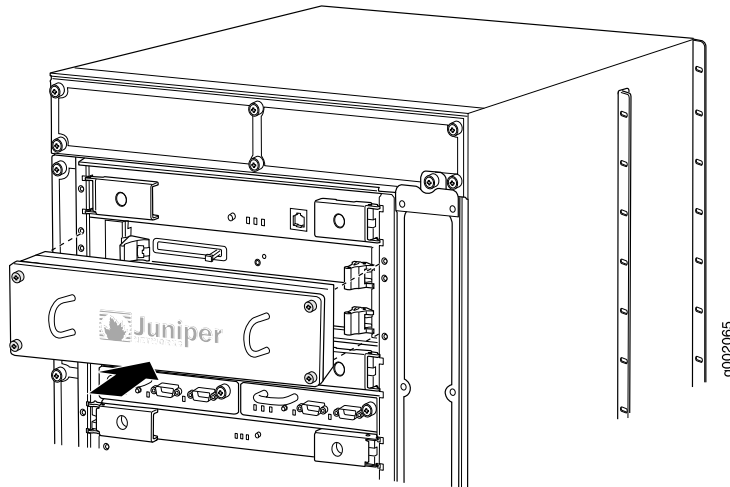


Figure 92: Reinstalling the T320 Routing Engine Cover



- Related Documentation**
- [T320 Host Subsystem Description on page 29](#)
  - [Maintaining the T320 Host Subsystem on page 263](#)

## Replacing a T320 Routing Engine

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To replace a Routing Engine, perform the following procedures:

1. [Removing a T320 Routing Engine on page 212](#)
2. [Installing a T320 Routing Engine on page 214](#)

### Removing a T320 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 1.9 lb (0.9 kg).



**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. .



**CAUTION:** If the Routing Engine to be replaced is currently functioning as the master Routing engine, switch it to be the backup before removing it.

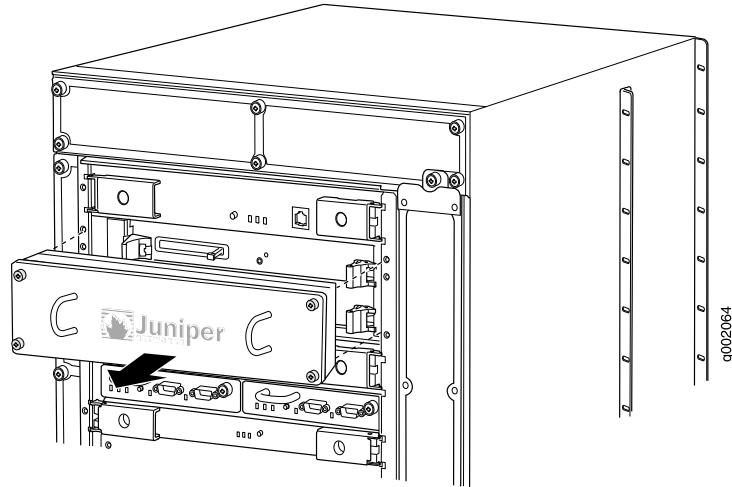
To remove a Routing Engine (see [Figure 89 on page 209](#)):

1. Take the host subsystem offline as described in [“Taking the T320 Host Subsystem Offline” on page 199](#).
2. Place an electrostatic bag or antistatic mat on a flat, stable surface.
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. If the Routing Engine cover is in place, remove the cover by loosening the captive screws on the corners of its faceplate (see [Figure 88 on page 209](#)).
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 (see [Figure 90 on page 210](#)).

**Figure 93: Removing the T320 Routing Engine Cover**



**Figure 94: Removing a T320 Routing Engine**

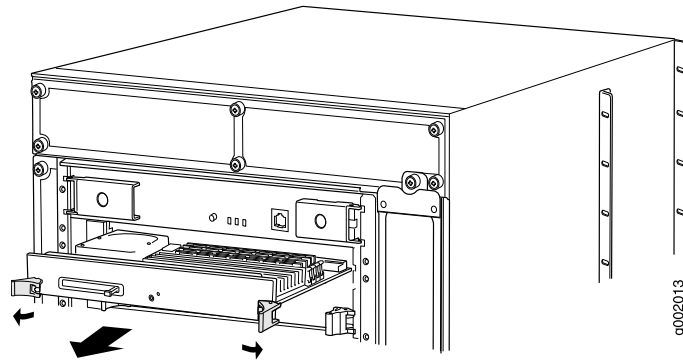
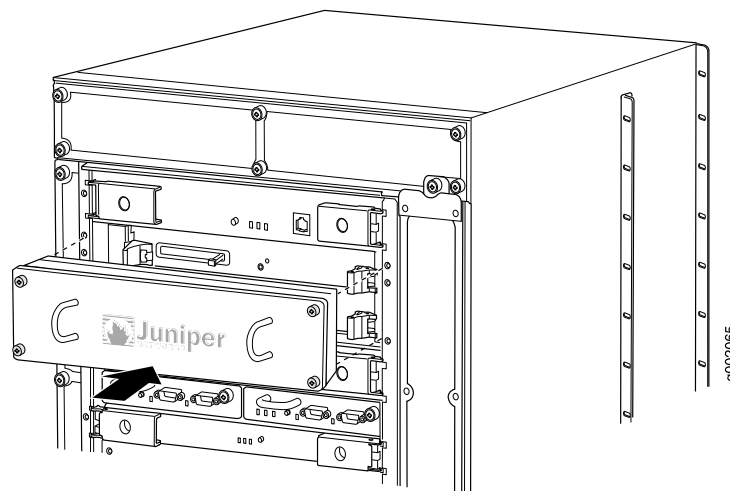


Figure 95: Reinstalling the T320 Routing Engine Cover



## Installing a T320 Routing Engine

To install a Routing Engine (see [Figure 91](#) on page 211):

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, 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 92](#) on page 211).
9. If the router is powered on and the Routing Engine's corresponding control board is functioning normally, the Routing Engine comes online automatically. To verify that

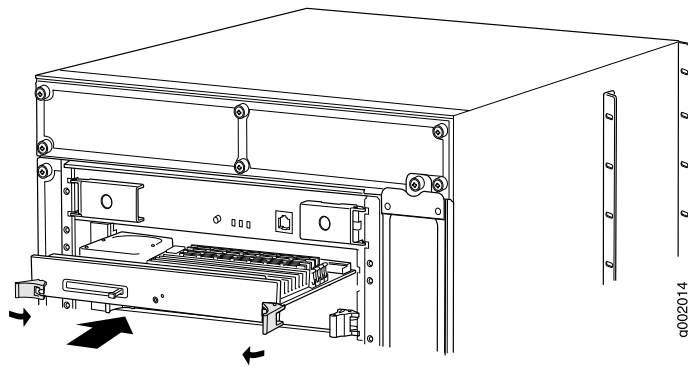
the Routing Engine is installed correctly, check the **HOST0** and **HOST1** LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **OK** LED lights steadily. If the red **FAIL** LED lights steadily instead, remove and install the Routing Engine again. If the red **FAIL** LED still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.

To check the status of the Routing Engine, use the CLI command:

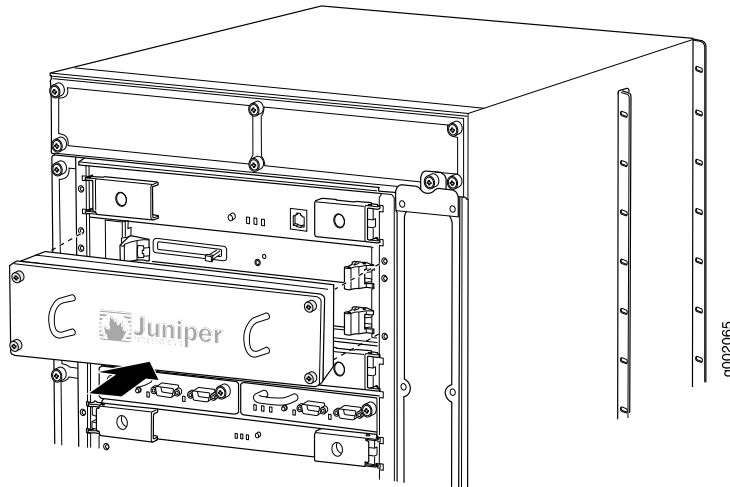
```
user@host> show chassis routing-engine
```

For more information about using the CLI, see *show chassis routing-engine*.

**Figure 96: Installing a T320 Routing Engine**



**Figure 97: Reinstalling the T320 Routing Engine Cover**



**Related Documentation**

- [T320 Routing Engine Description on page 33](#)
- [Maintaining the T320 Host Subsystem on page 263](#)
- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [Synchronizing Routing Engines](#)

## Replacing a DIMM Module in T320 Routing Engines

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1. [Removing a T320 DIMM Module on page 216](#)
2. [Installing a T320 DIMM Module on page 216](#)

### Removing a T320 DIMM Module

The DIMM modules are located on the top of the Routing Engine. To remove a DIMM module:

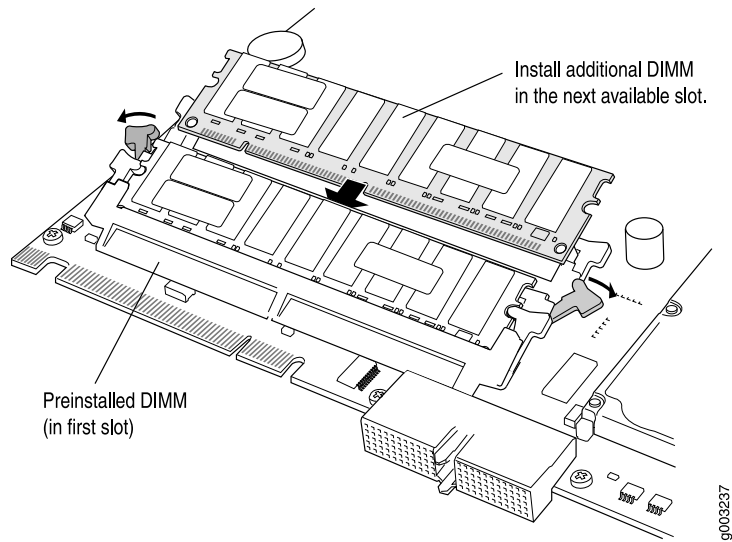
1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Remove the Routing Engine.
4. Depending on which Routing Engine you are using, there are two different procedures for ejecting the DIMMs:
  - For Routing Engines with an ejector on one side of the DIMM, press the plastic ejector of the DIMM module. The edge of the module raises upward.
  - For Routing Engines with ejectors on each side of the DIMM, press 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 T320 DIMM Module

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. Pressing firmly on both ends, push the module into the slot until the ejectors return completely to the closed position.
6. Install the Routing Engine.
7. You can view the SDRAM configuration and verify the DIMM was installed correctly by issuing the **show chassis routing-engine** command.

Figure 98: Installing the DIMM Module



- Related Documentation**
- [T320 Routing Engine Description on page 33](#)
  - [Replacing a T320 Routing Engine on page 207](#)

## Replacing a T320 PC Card

1. [Removing a T320 PC Card on page 217](#)
2. [Installing a T320 PC Card on page 218](#)

## Removing a T320 PC Card

The PC card is inserted into the slot labeled **PC CARD** on the RE-600 or RE-1600. To remove the PC card (see [Figure 85 on page 205](#)):

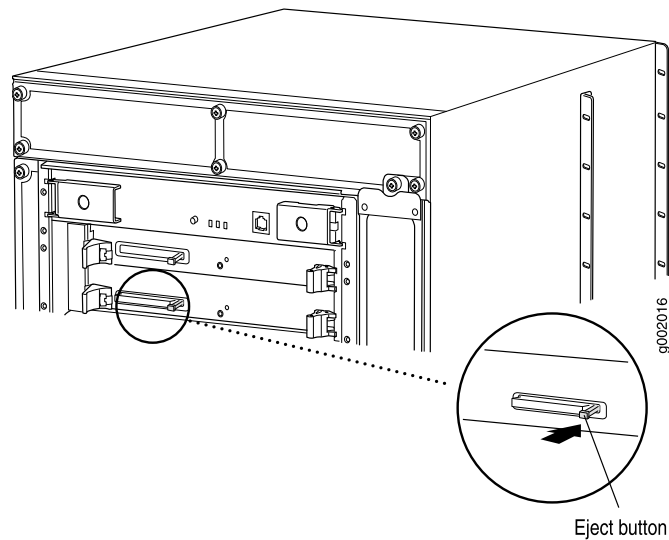
1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Remove the Routing Engine cover by loosening the captive screws on the corners of its faceplate.
4. On the Routing Engine faceplate, press the eject button on the right side of the PC card slot once to release the button. Press again to release the PC card.



**NOTE:** The Routing Engine in your router might have two PC Card slots. In this case, use either slot. Do not install more than one PC card in the Routing Engine.

5. The PC card pops partially out of the slot. Grasp the card and pull it completely out of the slot.
6. Place the PC card on the antistatic mat.
7. If you are not replacing the PC card now, reinstall the Routing Engine cover and tighten the screws on the corners of the cover to secure it to the chassis.

**Figure 99: Removing a PC Card**



### Installing a T320 PC Card

To install a PC card (see [Figure 86 on page 206](#)):

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 Routing Engine cover is in place, remove the cover by loosening the captive screws on the corners of its faceplate.
3. Insert the PC card into the PC card slot on the Routing Engine, with the Juniper Networks logo facing downward.



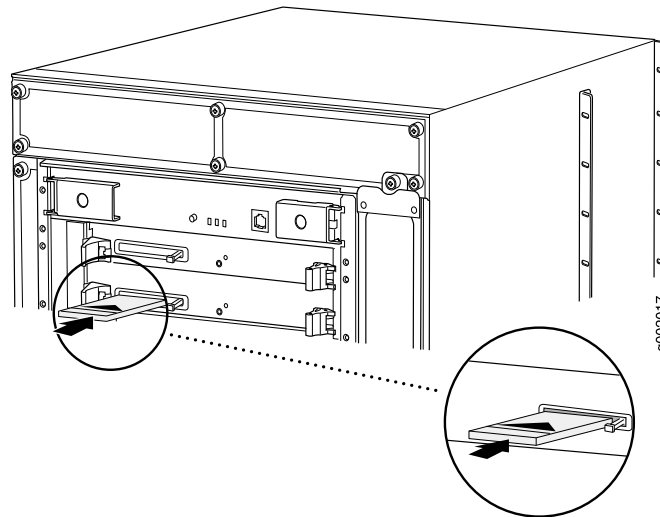
**CAUTION:** Be sure to insert the PC card with the label facing downward. Inserting the PC card incorrectly might damage the Routing Engine.



**NOTE:** The RE-1600 has two PC Card slots. In this case, use either slot. Do not install more than one PC card in the Routing Engine.

4. Press the card firmly all the way into the slot.
5. Reinstall the Routing Engine cover and tighten the screws on the corners of the cover to secure it to the chassis.

**Figure 100: Installing a PC Card**



**Related Documentation**

- [T320 RE-600 Description on page 34](#)
- [T320 RE-1600 Description on page 36](#)
- [Maintaining the T320 Host Subsystem on page 263](#)
- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)

## Replacing a T320 Standard Control Board or T-CB

The router can have up to two control boards. They are located in the upper rear of the chassis in the slots marked **CB0** and **CB1**. Each weighs approximately 5 lb (2.3 kg).

To replace a standard control board or T-CB, perform the following procedures:

1. [Removing a T320 Standard Control Board or T-CB on page 220](#)
2. [Installing a T320 Standard Control Board or T-CB on page 221](#)

## Removing a T320 Standard Control Board or T-CB



**CAUTION:** Before you replace a control board, you must take the host subsystem offline. If there is only one host subsystem, taking the host subsystem offline shuts down the router. See [“Taking the T320 Host Subsystem Offline” on page 199](#).



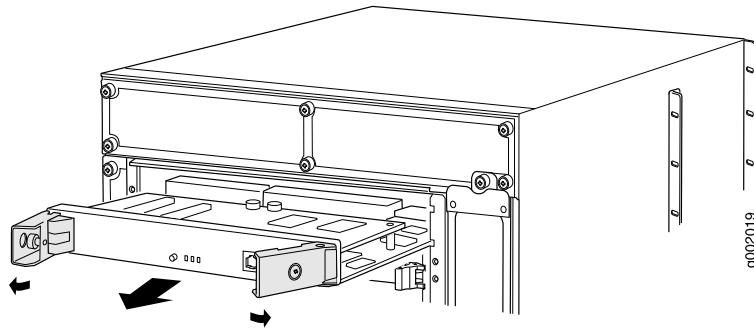
**CAUTION:** If the control board to be replaced is associated with the Routing Engine currently functioning as the master Routing engine, switch it to the backup before removing the T-CB. See [“Taking the T320 Host Subsystem Offline” on page 199](#).

To remove a standard control board or T-CB (see [Figure 83 on page 203](#)):

1. Take the host subsystem offline. See [“Taking the T320 Host Subsystem Offline” on page 199](#).
2. Place an electrostatic bag or antistatic mat on a flat, stable surface.
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. Loosen the captive screws (using a Phillips (+) screwdriver, number 2) on the ejector handles on both sides of the control board faceplate.
5. Flip the ejector handles outward to unseat the control board.
6. Grasp the ejector handles and slide the control board about halfway out of the chassis.
7. Place one hand underneath the control board to support it and slide it completely out of the chassis.
8. Place the control board on the antistatic mat.
9. If you are not replacing the control board now, install a blank panel over the empty slot.



Figure 101: Removing a T320 Standard Control Board



### Installing a T320 Standard Control Board or T-CB

To install a standard control board or T-CB (see [Figure 84 on page 204](#)):

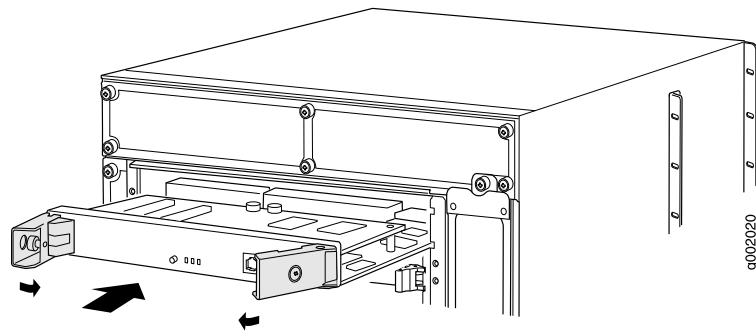
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Carefully align the sides of the control board with the guides inside the chassis.
3. Slide the control board into the chassis, carefully ensuring that it is 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.



**NOTE:** If power is applied to the Routing Engine and its corresponding control board is functioning normally, the control board comes online automatically.

6. Verify that the control board is functioning normally,
  - Check the LEDs on the control board faceplate. The green **OK** LED should light steadily a few minutes after the control board is installed. If the **FAIL** LED is lit steadily, remove and install the control board again. If the **FAIL** LED still lights steadily, the control board is not functioning properly. Contact your customer support representative.
  - Use the CLI command `show chassis environment cb` to check the status of the control board,

Figure 102: Installing a Standard Control Board



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 Control Board Description on page 30](#)
- [T320 Standard Control Board Description on page 31](#)
- [T320 T Series Control Board \(T-CB\) Description on page 31](#)
- [T320 Standard Control Board and T-CB LEDs on page 32](#)
- [Maintaining the T320 Control Boards on page 265](#)

# Replacing Line Card Components

- [Replacing a T320 FPC on page 223](#)
- [Replacing a T320 PIC on page 229](#)
- [Replacing T320 PIC Cables on page 235](#)

## Replacing a T320 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.

1. [Removing a T320 FPC on page 223](#)
2. [Installing a T320 FPC on page 226](#)

## Removing a T320 FPC

The router holds up to eight FPCs, which are installed vertically in the front of the router. An empty FPC weighs approximately 14.8 lb (6.7 kg) and a fully configured FPC can weigh up to 19 lb (8.6 kg).

Each FPC slot not occupied by an FPC must be covered by an FPC blank panel. An FPC blank panel weighs 6.3 lb (2.9 kg).

To remove an FPC (see [Figure 103 on page 225](#)):

1. Have ready a replacement FPC or FPC blank panel and an antistatic mat for the FPC. Also have ready rubber safety caps for each PIC using an optical interface on the FPC that you are removing.
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. Label the cables connected to each PIC on the FPC so that you can later reconnect the cables to the correct PICs.
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 CLI command:

```
user@host>request chassis fpc slot slot-number offline
```

For more information about the command, see *show chassis fpc*.

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 the ends of fiber-optic cables or into the transceivers on the PIC faceplate. Single-mode fiber-optic cable and the PICs that use it (such as ATM and SONET/SDH interfaces) 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 you are removing a Type 2 or a Type 3 FPC, loosen the screws inside the ejector handles at the top and bottom of the FPC faceplate.
7. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.
8. Grasp the handles and slide the FPC straight out of the card cage halfway.
9. 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 19 lb (8.6 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 or edge connectors. They cannot support its weight.

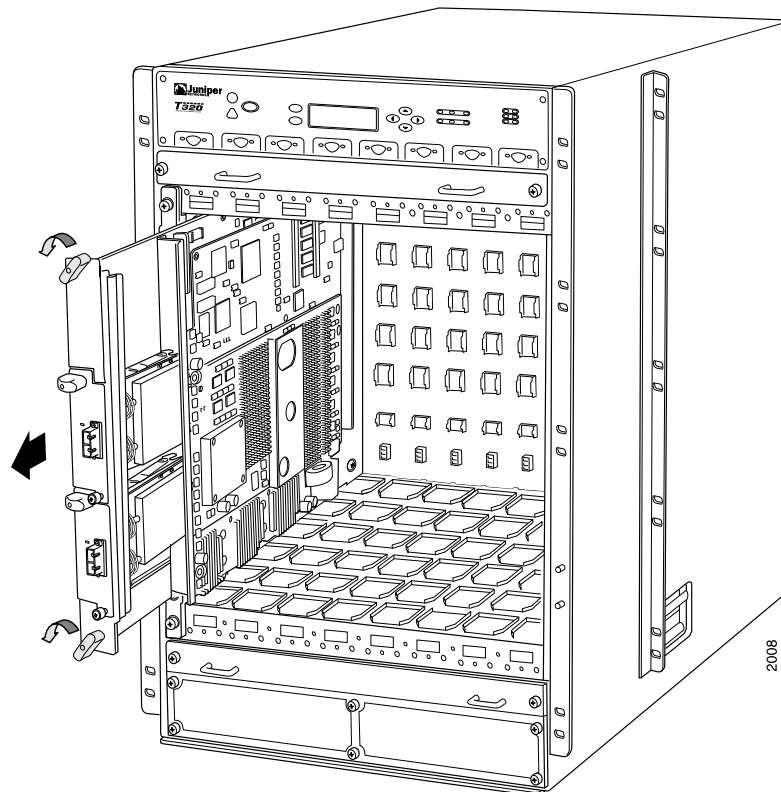
Do not stack FPCs on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

10. If necessary, remove each installed PIC from the FPC.
11. After you remove each PIC, immediately place it on an antistatic mat or in an electrostatic bag.
12. If you are not reinstalling a 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 103: Removing a T320 FPC



## Installing a T320 FPC

To install an FPC (see [Figure 104 on page 228](#) and [Figure 105 on page 229](#)):

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
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 on installing a PIC, see [“Installing a T320 PIC” on page 232](#).
6. Locate the slot in the FPC card cage in which you plan to install the FPC.
7. 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 or edge connectors. They cannot support its weight.

8. Slide the FPC all the way into the card cage until you feel resistance.
9. Starting with the ejector handles on the FPC faceplate nearly horizontal, simultaneously turn both ejector handles clockwise to seat the FPC.
10. If you are installing a Type 2 FPC or Type 3 FPC, tighten the screws inside the ejector handles to secure the FPC. Do not overtighten them.
11. 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 the ends of fiber-optic cables or into the transceivers on the PIC faceplate. Single-mode fiber-optic cable and the PICs that use it (such as ATM and SONET/SDH interfaces) emit laser light that can damage your eyes.

12. 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.

13. 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 CLI command:

```
user@host>request chassis fpc slot slot-number online
```

For more information about the command, see *request chassis fpc*.



**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 described in [“Maintaining T320 FPCs” on page 265](#) and [“Maintaining T320 PICs and PIC Cables” on page 270](#).

Figure 104: Installing a T320 FPC

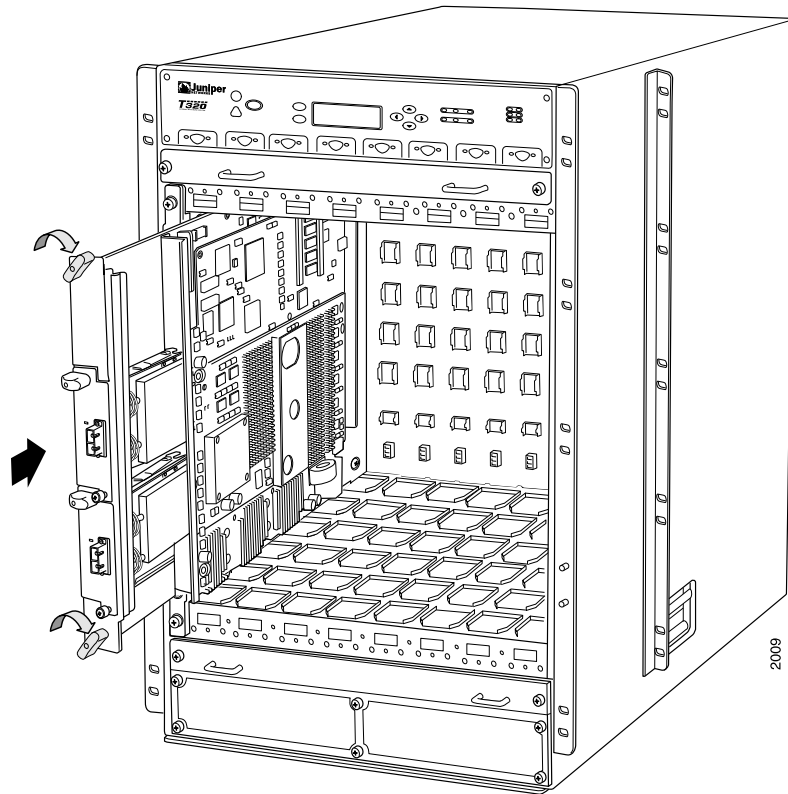
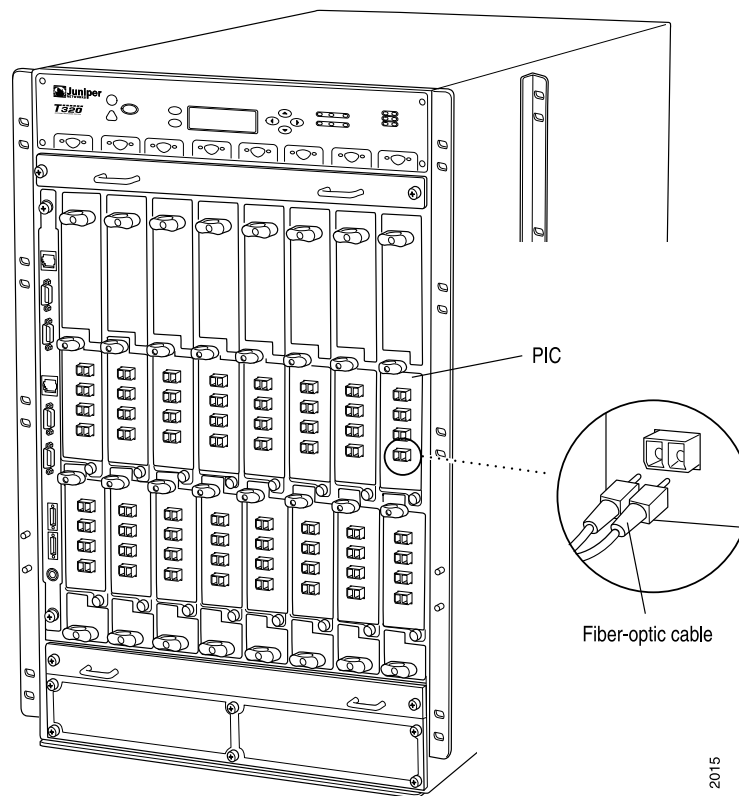




Figure 105: Connecting Fiber-Optic Cable to a T320 PIC

**Related Documentation**

- [T320 Flexible PIC Concentrators \(FPCs\) Description on page 57](#)
- [Troubleshooting the T320 FPCs on page 289](#)

## Replacing a T320 PIC

1. [Removing a T320 PIC on page 230](#)
2. [Installing a T320 PIC on page 232](#)

## Removing a T320 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 less than 2 lb (0.9 kg).

To remove a PIC (see [Figure 106 on page 232](#)):

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:

- Press and hold the online/offline button until the PIC LED goes out (about 5 seconds).

For a PIC installed in a Type 1 FPC, use a tool—such as a flat-blade screwdriver—to press the button slightly beneath the faceplate of the PIC. For a PIC installed in a Type 2 FPC or Type 3 FPC, use a narrow-ended tool that fits inside the opening that leads to the button.

- Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot offline
```

For more information about the command, see *request chassis pic*.

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.

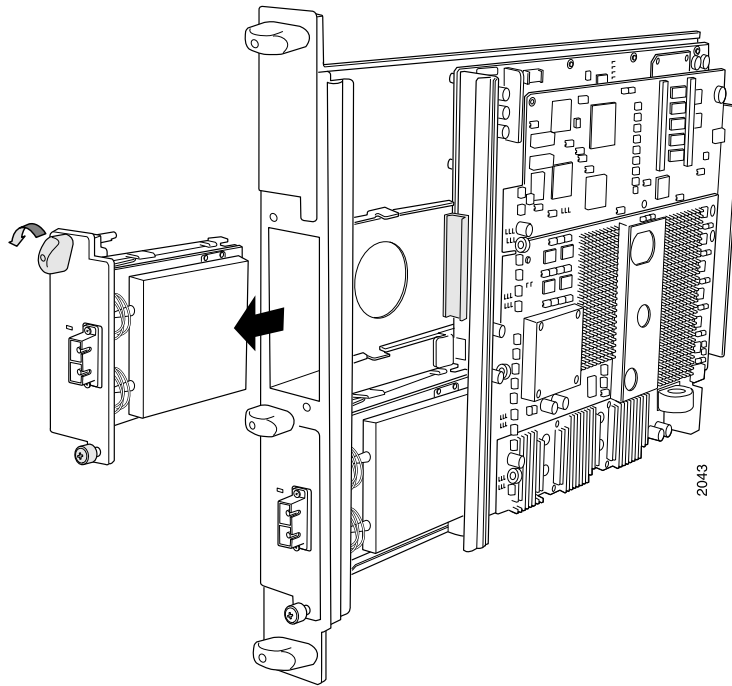
6. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop in the cable management system. Placing fasteners 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. Unseat the PIC:
  - Type 1 or Type 2 PIC—Loosen the captive screws at the top and bottom of the PIC faceplate.
  - Type 3 PIC—Loosen the captive screw at the bottom of the PIC faceplate, then twist the ejector handle at the top of the faceplate and counterclockwise to unseat the PIC.
  - Type 4 PIC—Twist the ejector handle at the bottom of the PIC faceplate, then twist the ejector handle at the top of the faceplate and 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 106: Removing a PIC



## Installing a T320 PIC

To install a PIC (see [Figure 107 on page 234](#)):

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. Secure the PIC to the FPC faceplate:
  - Type 1 or Type 2 PICs—Tighten the captive screws at the top and bottom of the faceplate.
  - Type 3 PICs—Turn the ejector handle at the top of the PIC faceplate clockwise, then tighten the captive screw at the bottom of the faceplate.
  - Type 4 PIC—Twist the ejector handle at the bottom of the PIC faceplate, then twist the ejector handle at the top of the faceplate and 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 PIC LED lights green. For a PIC installed in a Type 1 FPC, use a tool—such as a flat-blade screwdriver—to press the button

slightly beneath the faceplate of the PIC. For a PIC installed in a Type 2 FPC or Type 3 FPC, use a narrow-ended tool that fits inside the opening that leads to the button.

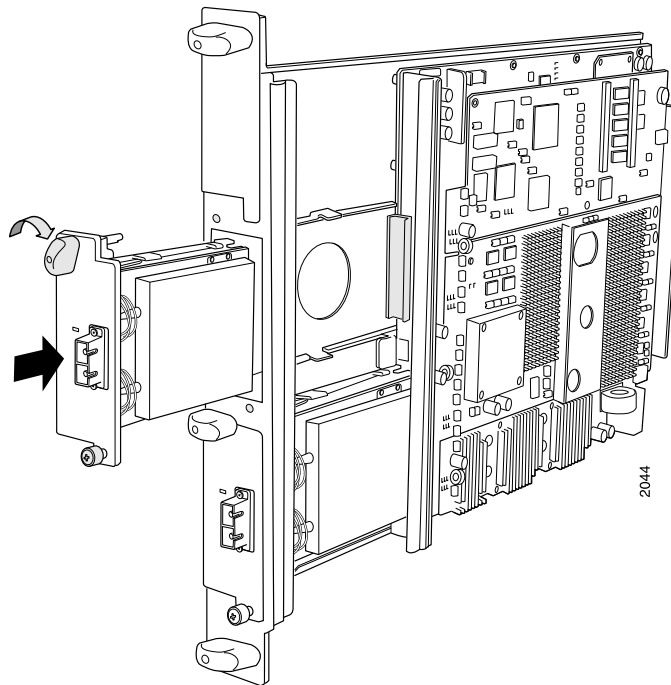
- Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see *request chassis pic*.

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 107: Installing a PIC



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 PIC Description on page 63](#)
- [Maintaining T320 PICs and PIC Cables on page 270](#)
- [Troubleshooting the T320 PICs on page 290](#)

## Replacing T320 PIC Cables

Removing and installing PIC cables do not affect router function, except that a PIC does not receive or transmit data while its cable is disconnected. To replace a PIC cable, perform the following procedures:

1. [Removing a T320 PIC Cable on page 235](#)
2. [Installing a T320 PIC Cable on page 236](#)

### Removing a T320 PIC Cable

To remove a PIC cable:

1. If the PIC connects to fiber-optic cable, have ready a rubber safety cap for each cable and transceiver.
2. If removing all cables connected to the PIC, use one of the following methods to take the PIC offline:
  - Press its online/offline button. For a PIC installed in a Type 1 FPC, use a tool—such as a flat-blade screwdriver—to press the button slightly beneath the faceplate of the PIC. For a PIC installed in a Type 2 FPC or a Type 3 FPC, use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the PIC LED goes out (about 5 seconds).
  - Issue the CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot offline
```

For more information about the command, see *request chassis fpc*.

3. Unplug the cable from the cable connector port. 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 the ends of fiber-optic cables or into the transceivers on the PIC faceplate. Single-mode fiber-optic cable and the PICs that use it (such as ATM and SONET/SDH interfaces) 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.

4. Remove the cable from the cable management system and detach it from the destination port.

## Installing a T320 PIC Cable

To install a PIC cable (see [Figure 108 on page 237](#)):

1. Have ready a length of the type of cable used by the PIC. For cable specifications, see the *T320 Core Router PIC Guide*.

2. If the PIC cable connector port is covered by a rubber safety plug, remove the plug.



**WARNING:** Do not look directly into the ends of fiber-optic cables or into the transceivers on the PIC faceplate. Single-mode fiber-optic cable and the PICs that use it (such as ATM and SONET/SDH interfaces) 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 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.



**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.

5. Insert the other end of the cable into the destination port.
6. Repeat the previous steps for any additional cables.
7. If the PIC is offline (its failure indicator LED is lit), use one of the following methods to bring the PIC online:



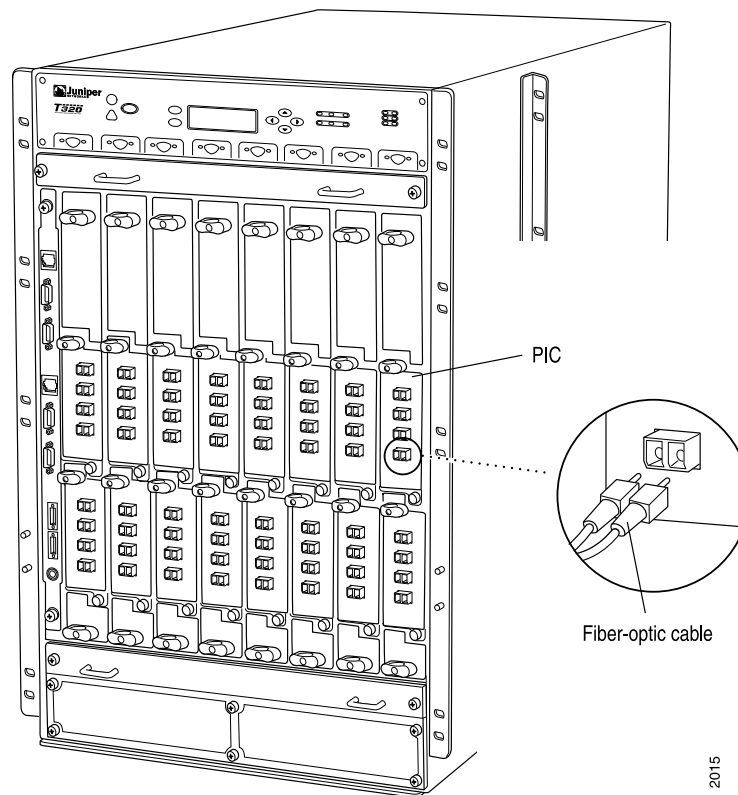
- Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in a Type 1 FPC, use a tool—such as a flat-blade screwdriver—to press the button slightly beneath the faceplate of the PIC. For a PIC installed in a Type 2 FPC or a Type 3 FPC, use a narrow-ended tool that fits inside the opening that leads to the button.
- Issue the CLI command:

```
user@host>request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see *request chassis fpc*.

The normal functioning indicator LED confirms that the PIC is online. You can also verify correct PIC functioning by issuing the `show chassis fpc pic-status` command described in “Maintaining T320 PICs and PIC Cables” on page 270.

Figure 108: Connecting Fiber-Optic Cable to a T320 PIC



#### Related Documentation

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 PIC Description on page 63](#)
- [Connecting PIC Cables to the T320 Router on page 150](#)
- [Maintaining T320 PICs and PIC Cables on page 270](#)



# Replacing Power System Components

- [Replacing a T320 DC Power Supply on page 239](#)
- [Replacing a T320 DC Power Supply Cable on page 244](#)

## Replacing a T320 DC Power Supply

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The router has two redundant, load-sharing DC power supplies. Each power supply is hot-insertable and hot-removable. When one power supply is powered down or removed, the other power supply automatically assumes the entire electrical load for the router.

1. [Removing a T320 DC Power Supply on page 239](#)
2. [Installing a T320 DC Power Supply on page 242](#)

## Removing a T320 DC Power Supply

The power supplies are located at the rear of the chassis below the SIBs. Each power supply weighs approximately 12 lb (5.4 kg).



**CAUTION:** Do not leave a power supply slot empty for more than 30 minutes while the router is operational. For proper airflow, the power supply must remain in the chassis, or a blank panel must be used in an empty slot.



**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on.

To remove a power supply:

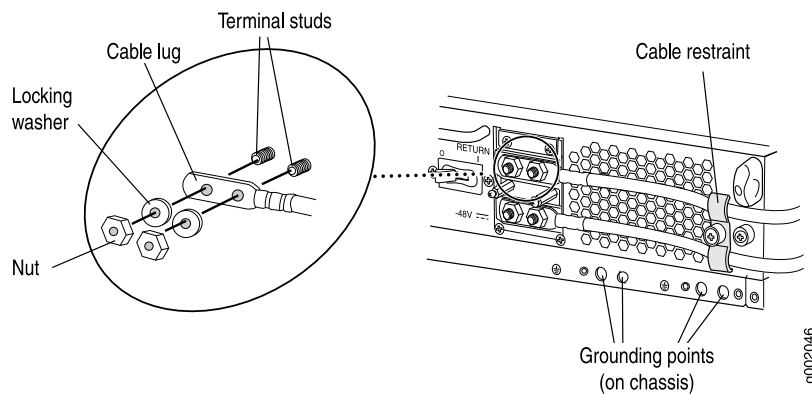
1. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during the removal process.



**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.

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
3. Switch the circuit breaker on the power supply faceplate to the off position (O).
4. Remove the clear plastic cover protecting the terminal studs on the faceplate.
5. Remove the nuts and washers from the terminal studs (see [Figure 109 on page 240](#)). (Use a 7/16–in. nut driver or pliers.)

**Figure 109: Disconnecting Power Cables from the DC Power Supply**



6. Remove the cable lugs from the terminal studs.
7. Loosen the captive screws on the cable restraint on the right edge of the power supply faceplate.
8. Carefully move the power cables out of the way.
9. Loosen the captive screws on the lower corners of the power supply faceplate completely. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.

10. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.
11. 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 110 on page 241](#)).



**WARNING:** Do not touch the power connectors on the rear of the power supply (see [Figure 111 on page 241](#)). They can contain dangerous voltages.

12. Place one hand underneath the power supply to support it and slide it completely out of the chassis.



**CAUTION:** Each power supply weighs approximately 12 lb (5.4 kg). Be prepared to support the full weight of the power supply as you remove it from the router.

Figure 110: Removing a T320 Power Supply

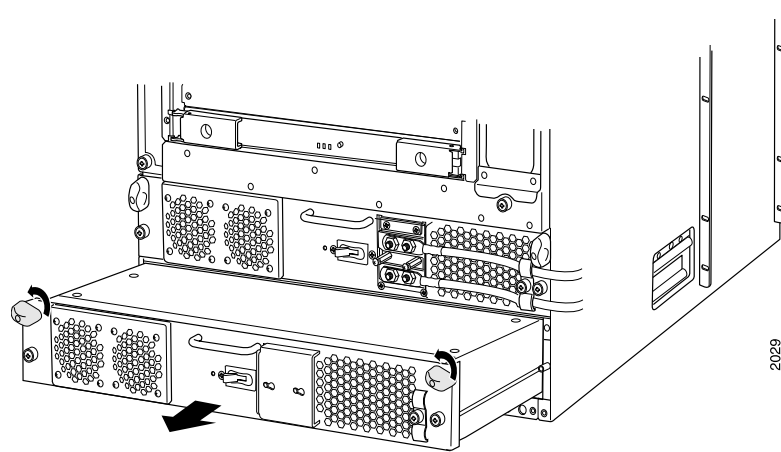
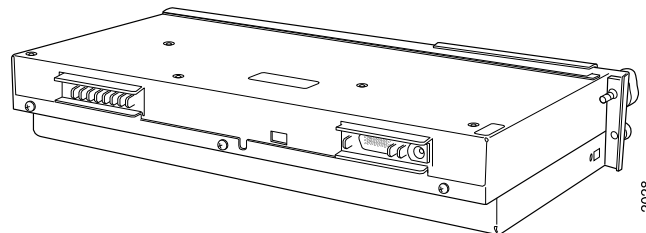


Figure 111: Rear of the Power Supply Showing Midplane Connectors



## Installing a T320 DC Power Supply



**CAUTION:** Each power supply must be connected to a dedicated DC power source.

To install a power supply (see [Figure 112 on page 244](#)):

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.



**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.

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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
3. Switch the circuit breaker on the power supply faceplate to the off position (O).
4. Using both hands, slide the power supply into the chassis until you feel resistance.
5. Twist the ejector handles at the upper corners of the power supply faceplate clockwise until they stop.
6. Tighten the captive screws at the lower corners of the power supply faceplate to secure the power supply in the chassis.
7. Remove the clear plastic cover protecting the terminal studs on the faceplate.
8. Remove the nuts and washers from the terminal studs.
9. Attach the lugs on the DC source power cables to the terminal studs.
  - a. Attach the positive (+) DC source power cable lugs to the **RETURN** (return) terminals.
  - b. Attach the negative (–) DC source power cable lugs to the **–48V** (input) terminals.

Secure the cable lugs to the terminal studs, first with the washers, then with the nuts. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

10. Verify that the power cables are not touching or in the way of any other components.
11. Loosen the captive screws on the cable restraint on the right edge of the power supply faceplate.
12. Route the positive and negative DC power cables through the top and bottom of each cable restraint.
13. Tighten the cable restraint captive screws to hold the power cables in place.
14. Verify that the ground and power cabling are correct, that they are not touching or blocking access to router components, and that they do not drape where people could trip on them.
15. Replace the clear plastic cover over the terminal studs on the faceplate.
16. Switch on the external circuit breakers to provide voltage to the DC power source cable leads.
17. Switch the circuit breaker on the power supply to the on position (I) and observe the LEDs on the power supply faceplate. If the power supply is correctly installed and is functioning properly, the **DC OK** LED lights steadily, and the **CB ON** LED blinks momentarily, then lights steadily.

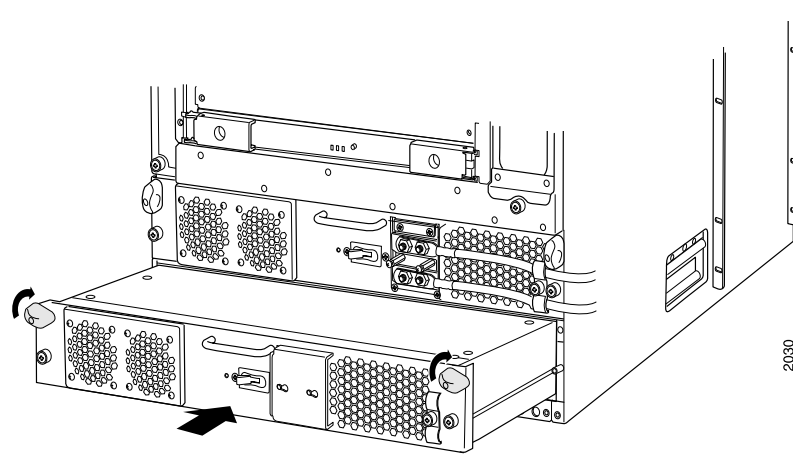


**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on. After powering on a power supply, wait at least 60 seconds before turning it off.

If the system is completely powered off when you power on the power supply, the Routing Engine boots as the power supply completes its startup sequence. If the Routing Engine finishes booting and you need to power off the system again, see [“Powering Off the T320 Router” on page 161](#).

After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the output status LEDs on the power supply, the command display output, and messages on the LCD on the craft interface—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

Figure 112: Installing a Replacement T320 Power Supply



#### Related Documentation

- [T320 Power System Description on page 77](#)
- [Maintaining the T320 Power Supplies on page 272](#)
- [T320 Power System Electrical Specifications on page 90](#)
- [Site Electrical Wiring Guidelines for Juniper Networks Devices on page 351](#)

## Replacing a T320 DC Power Supply Cable

1. [Removing a T320 DC Power Supply Cable on page 244](#)
2. [Installing a T320 DC Power Supply Cable on page 245](#)

### Removing a T320 DC Power Supply Cable

1. Locate a replacement power cable that meets the specifications defined in “[T320 DC Power Cable Specifications](#)” on page 89.



**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 (for example, by causing a short circuit).

2. 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.



**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.



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. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
4. Switch the circuit breaker on the power supply faceplate to the off position (O).
5. Remove the power cable from the DC power source.
6. Remove the clear plastic cover protecting the terminal studs on the faceplate.
7. Remove the nuts and washers from the terminal studs (see [“Disconnecting Power Cables From the DC Power Supply” on page 239](#)). (Use a 7/16-in. nut driver or pliers.)
8. Remove the cable lug from the terminal studs.
9. Loosen the captive screw on the cable restraint on the right edge of the power supply faceplate.
10. Carefully move the power cable out of the way.

### Installing a T320 DC Power Supply Cable

1. Attach the lug on the replacement power cable to the terminal studs, making sure the cable is not touching or in the way of any router components.
2. Secure the cable lug to the terminal studs, first with the washers, then with the nuts (see [“Connect Power Cables to the T320 Power Supply” on page 242](#)). Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.
3. Route the power cable through the cable restraint.
4. Tighten the cable restraint captive screw to hold the power cable in place.
5. Replace the clear plastic cover over the terminal studs on the faceplate.
6. Attach the power cable to the DC power source.
7. Verify that the DC source power cabling and grounding cabling are correct, that they are not touching or blocking access to router components, and that they do not drape where people could trip on them.
8. Switch the circuit breaker on the power supply to the on position (I) and observe the LEDs on the power supply faceplate. If the power supply is correctly installed and is

functioning properly, the **DC OK** LED lights steadily, and the **CB ON** LED blinks momentarily, then lights steadily.

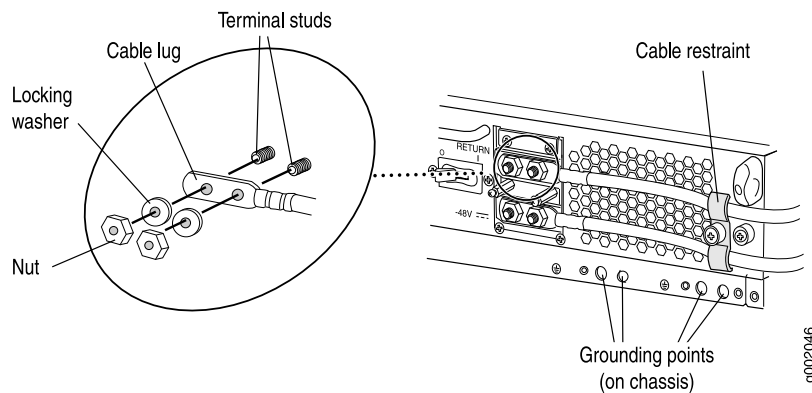


**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on. After powering on a power supply, wait at least 60 seconds before turning it off.

If the system is completely powered off when you power on the power supply, the Routing Engine boots as the power supply completes its startup sequence. If the Routing Engine finishes booting and you need to power off the system again, see [“Powering Off the T320 Router” on page 161](#).

After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the output status LEDs on the power supply, the command display output, and messages on the LCD on the craft interface—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

**Figure 113: Connecting Power Cables to the T320 Power Supply**



**Related Documentation**

- [T320 Power System Description on page 77](#)
- [Maintaining the T320 Power Supplies on page 272](#)
- [T320 Power System Electrical Specifications on page 90](#)
- [Site Electrical Wiring Guidelines for Juniper Networks Devices on page 351](#)

# Replacing Switch Fabric Components

- [Replacing a T320 SIB on page 247](#)
- [Replacing a T320 SFP on page 249](#)
- [Replacing a T320 XENPAK Module on page 252](#)

## Replacing a T320 SIB

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To replace a SIB, perform the following procedures:

1. [Removing a T320 SIB on page 247](#)
2. [Installing a T320 SIB on page 248](#)

## Removing a T320 SIB

Three SIBs are installed in the router. The SIBs are located in the rear of the chassis in the slots marked **SIB0** through **SIB2**. Each SIB weighs approximately 4.5 lb (2.0 kg).

To remove a SIB (see [Figure 114 on page 248](#)):

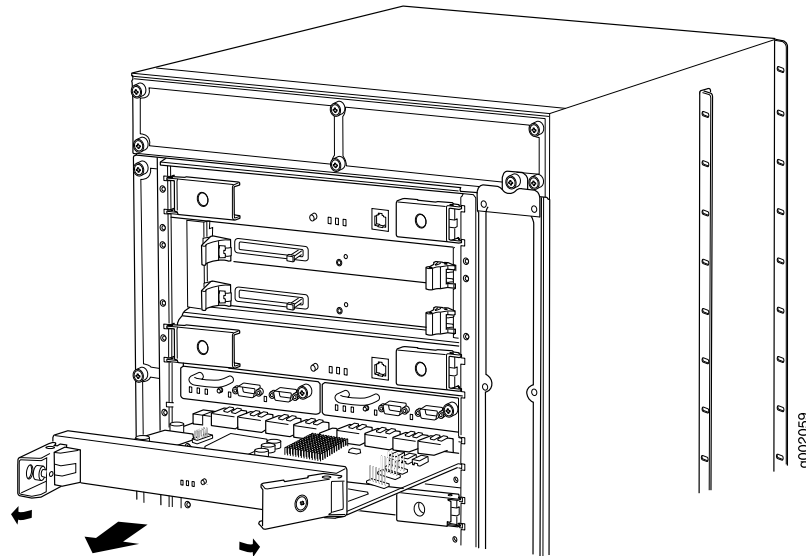
1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
3. Press the online/offline button on the SIB faceplate. Press and hold down the button until the green **OK** LED goes out (about 5 seconds).
4. Loosen the captive screws (using a Phillips (+) screwdriver, number 2) on the ejector handles on each side of the SIB faceplate.
5. Flip the ejector handles outward to unseat the SIB.

6. Grasp both ejector handles, pull firmly, and slide the SIB about three-quarters of the way out of the chassis.
7. 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 114: Removing a T320 SIB



### Installing a T320 SIB

To install a SIB into the rear of the chassis (see [Figure 115 on page 249](#)):

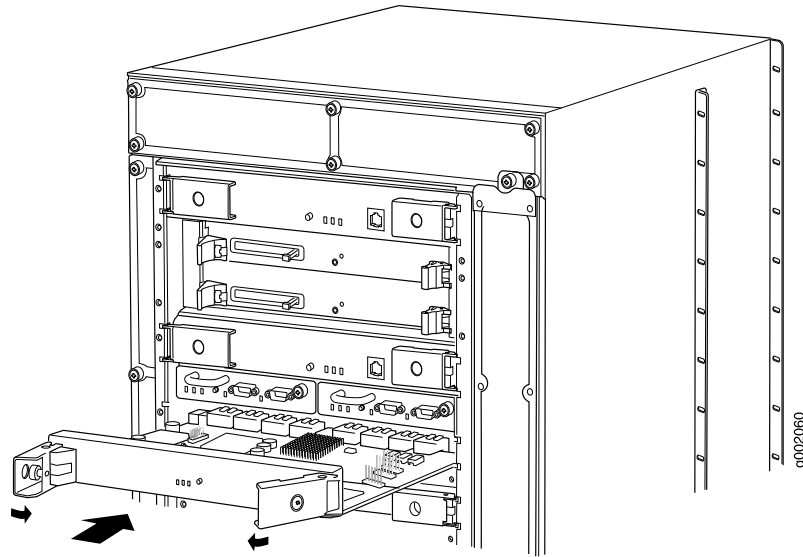
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis. For more information about ESD, see [“Preventing Electrostatic Discharge Damage to a T320 Router” on page 320](#).
2. Place one hand underneath the SIB to support 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. Press the offline/online button until the green **OK** LED blinks to bring the SIB online.
8. To verify that the SIB is functioning normally, check the LEDs on its 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. If the **FAIL** LED still lights steadily, the SIB is not functioning properly. Contact your customer support representative.

To check the status of the SIBs:

```
user@host> show chassis environment sib
```

Figure 115: Installing a T320 SIB



- Related Documentation**
- [T320 Switch Interface Boards \(SIBs\) Description on page 79](#)
  - [Maintaining the T320 SIBs on page 274](#)

## Replacing a T320 SFP

1. [Removing a T320 SFP on page 250](#)
2. [Installing a T320 SFP on page 251](#)

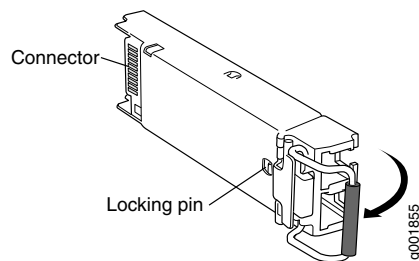
## Removing a T320 SFP

Small form-factor pluggables (SFPs) are transceivers that can be removed from a PIC. SFPs are hot-insertable and hot-removable. Removing an SFP does not interrupt PIC functioning, but the removed SFP no longer receives or transmits data.



**NOTE:** When you remove a PIC transceiver, the router continues to function, although the PIC interface being removed no longer functions.

**Figure 116: Small Form-Factor Pluggable (SFP)**



**NOTE:** This procedure applies to both SFP and SFP+ transceivers.

To remove an SFP transceiver (see [Figure 116 on page 250](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the SFP. Have ready a rubber safety cap for the SFP transceiver and the 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. Label the cable connected to the SFP so that you can later reconnect it to the correct SFP.
4. Disconnect the cable from the SFP. Immediately cover the transceiver and the end of the 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.

5. 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.

6. Pull the ejector handle away from the SFP faceplate to unseat the SFP from the PIC. Pull the SFP out of the PIC, and place it on the antistatic mat or in the electrostatic bag.



**CAUTION:** After removing a transceiver from the chassis, wait at least 30 seconds before reinserting it or inserting a transceiver into a different slot.

## Installing a T320 SFP

To install a replacement SFP:

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 a rubber safety cap covers the SFP transceiver, installing one if necessary.
3. Orient the SFP over the port in the PIC so that the connector end will enter the slot first and the SFP connector faces the appropriate direction:
  - If the PIC has ten SFP ports, the ports are arranged in two columns. The SFP connector faces to the right for ports in the left column, and to the left for ports in the right column.
  - If the PIC has one or two SFP ports, the SFP connector faces to the left.
4. Slide the SFP into the slot. If there is resistance, remove the SFP and flip it so that the connector faces the other direction.
5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.



**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 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.

7. Verify that the status LEDs on the PIC faceplate indicate that the SFP is functioning correctly (there is an LED for each SFP port). For more information about the PIC LEDs, see the interface module reference for your device. You can also verify PIC functioning by issuing the **show chassis fpc pic-status** command.

**Related Documentation**

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 PIC Description on page 63](#)

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## Replacing a T320 XENPAK Module

1. [Removing a T320 XENPAK Module on page 252](#)
2. [Installing a T320 XENPAK Module on page 254](#)

### Removing a T320 XENPAK Module

To remove a XENPAK module (see [Figure 117 on page 254](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the XENPAK module. Have ready a rubber safety cap for the XENPAK transceiver and the 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. Label the cable connected to the XENPAK module so that you can later reconnect it to the correct module.
4. Disconnect the cable from the XENPAK module. Immediately cover the transceiver and the end of the 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.

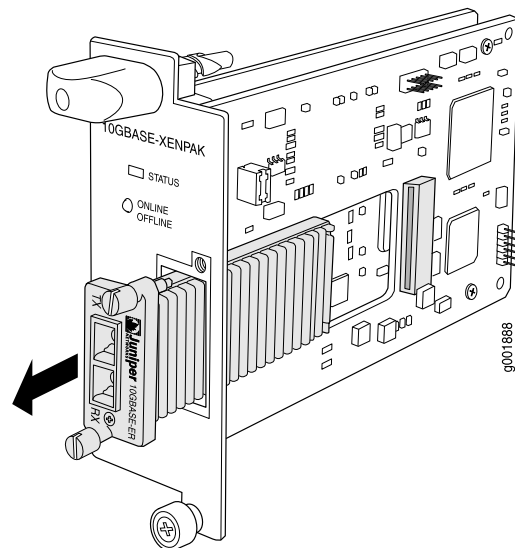
5. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop in the cable management system. Placing fasteners 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.

6. Unscrew the thumbscrews at the top and bottom of the XENPAK module.
7. Slide the module out of the PIC and place it in the electrostatic bag or on the antistatic mat.

Figure 117: Removing a XENPAK Module



### Installing a T320 XENPAK Module

To install a replacement XENPAK module (see [Figure 118 on page 255](#)):

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 a rubber safety cap covers the XENPAK transceiver. Install one if necessary.
3. Orient the XENPAK module so that the optical port faces out, and the transmit (TX) port is above the receive (RX) port (see [Figure 118 on page 255](#)).
4. Slide the XENPAK module into the slot.
5. Tighten the thumbscrews at the top and bottom of the XENPAK module. Verify that the module is seated properly.
6. Remove the rubber safety cap from the transceiver and the end of the cable. Insert the cable into the transceiver.



**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.

7. Arrange the 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.



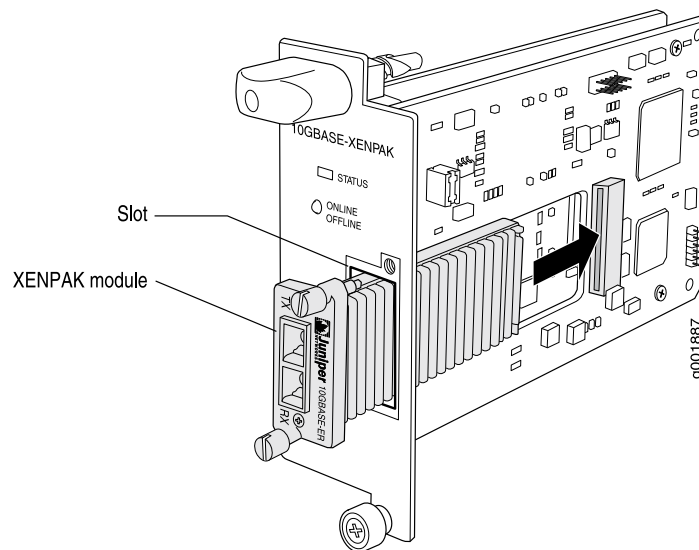
**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



**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. Verify that the status LEDs on the PIC faceplate indicate that the XENPAK module is functioning correctly. For more information about the PIC LEDs, see the interface module reference for your device. You can also verify PIC functioning by issuing the `show chassis fpc pic-status` command.

Figure 118: Installing a XENPAK Module



**NOTE:** Orient the XENPAK module in the slot so it does not touch the faceplate opening.

**Related Documentation**

- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)
- [T320 PIC Description on page 63](#)



## PART 5

# Maintaining the Chassis and Components

- [Routine Maintenance Procedures on page 259](#)
- [Maintaining Components on page 261](#)



# Routine Maintenance Procedures

- [Routine Maintenance Procedures for the T320 Router on page 259](#)

## Routine Maintenance Procedures for the T320 Router

---

**Purpose** For optimum router performance, perform preventive maintenance procedures.



**NOTE:** Some components, such as the Connector Interface Panel (CIP) and the craft interface, require no maintenance.

**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, replacing them every 6 months. Do not run the router for more than a few minutes without the air filters in place.

**Related Documentation**

- [T320 Chassis Description on page 13](#)
- [T320 Craft Interface Description on page 20](#)
- [Maintaining the T320 Air Filters on page 262](#)





## CHAPTER 31

# Maintaining Components

- [Tools and Parts Required to Maintain the T320 Hardware Components on page 261](#)
- [Maintaining the T320 SCGs on page 261](#)
- [Maintaining the T320 Air Filters on page 262](#)
- [Maintaining the T320 Fan Trays on page 263](#)
- [Maintaining the T320 Host Subsystem on page 263](#)
- [Maintaining the T320 Routing Engines on page 264](#)
- [Maintaining the T320 Control Boards on page 265](#)
- [Maintaining T320 FPCs on page 265](#)
- [Holding and Storing T320 FPCs on page 266](#)
- [Maintaining T320 PICs and PIC Cables on page 270](#)
- [Maintaining the T320 Power Supplies on page 272](#)
- [Maintaining the T320 SIBs on page 274](#)

## Tools and Parts Required to Maintain the T320 Hardware Components

---

To maintain the T320 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

- [T320 Router Description on page 3](#)
- [T320 Physical Specifications on page 86](#)
- [Contacting Customer Support on page 297](#)

## Maintaining the T320 SCGs

---

**Purpose** For optimum router performance, verify the condition of the SCGs.

**Action** On a regular basis:

- Check the SCG LEDs to observe the status of the SCGs. For more information, see [“T320 SCG LEDs” on page 20](#).
- Issue the `show chassis environment scg` command to display information about the SCGs. The output is similar to the following:

```
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
```

For further description of the output from the command, see *show chassis environment scg*.

**Related Documentation**

- [Replacing a T320 SCG on page 182](#)

## Maintaining the T320 Air Filters

**Purpose** For optimum cooling, verify the condition of the filters.

**Action** On a regular basis:

Check the air filters regularly for dust and debris. Replace the filter elements as needed. The filter elements degrade over time, so the filter elements in use, as well as spares, should be replaced every 6 months. For procedures to replace the air filters, see [“Replacing a T320 Air Filter” on page 187](#).

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 both 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**
- [T320 Cooling System Description on page 25](#)
  - [T320 Clearance Requirements for Airflow and Hardware Maintenance on page 85](#)
  - [Replacing a T320 Air Filter on page 187](#)

## Maintaining the T320 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. If one fan fails, the host subsystem adjusts the speed of the remaining fans to maintain proper cooling. A red alarm is triggered when a fan fails, and a yellow alarm is triggered when a fan tray is removed.
- To display the status of the fans, issue the **show chassis environment** command. The output is similar to the following:

```
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
      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
...
```

- Related Documentation**
- [T320 Cooling System Description on page 25](#)
  - [Troubleshooting the T320 Cooling System on page 285](#)
  - [Replacing a T320 Fan Tray on page 192](#)

## Maintaining the T320 Host Subsystem

**Purpose** For optimum router performance, verify the condition of the host subsystem. The router can have one or two host subsystems. Each host subsystem consists of a Routing Engine and an adjacent control board.

**Action** On a regular basis:

- Check the host subsystem LEDs (**HOST0** and **HOST1**) on the craft interface. If the red **HOST0** or **HOST1** LED is lit, look at the LCD to get more information about the cause of the problem. For more information about the LEDs and the display, see [“T320 Craft Interface Description” on page 20](#).
- Check the LCD on the craft interface to view information about the status of the Routing Engines and control boards.

**Related Documentation**

- [T320 Host Subsystem Description on page 29](#)
- [Maintaining the T320 Routing Engines on page 264](#)
- [Maintaining the T320 Control Boards on page 265](#)
- [Replacing the T320 Host Subsystem Components on page 199](#)
- [Taking the T320 Host Subsystem Offline on page 199](#)

## Maintaining the T320 Routing Engines

**Purpose** For optimum router performance, verify the condition of the Routing Engines.

**Action** On a regular basis:

- Check the host subsystem LEDs on the craft interface. For more information about the LEDs and the display, see [“T320 Craft Interface Description” on page 20](#).
- Check the LCD on the craft interface to view information about the router temperature and the status of the Routing Engines.

```

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

```

For further description of the output from the commands, see *show chassis routing-engine*.

- Related Documentation**
- [T320 Routing Engine Description on page 33](#)

## Maintaining the T320 Control Boards

---

**Purpose** For optimum router performance, verify the condition of the router's control boards.

**Action** On a regular basis:

- Check the LEDs on the control board faceplate. For more information, see *T-CB LEDs*.
- Issue the **show chassis environment cb** command to check the status of the control boards. The output is similar to the following:

```
user@host> show chassis environment cb
CB 0 status:
State                               Online Master
Temperature                          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
BUS Revision                          40
FPGA Revision                         7
```

For further description of the output from the command, see *show chassis environment cb*.

- Related Documentation**
- [T320 Control Board Description on page 30](#)
  - [T320 Standard Control Board Description on page 31](#)
  - [T320 T Series Control Board \(T-CB\) Description on page 31](#)

## Maintaining T320 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 LCD on the craft interface and 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.
- Issue the CLI **show chassis fpc** command to check the status of installed FPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the FPC is functioning normally:

```
user@host> show chassis fpc
```

Slot	State	Temp (C)	CPU Utilization (%)		Memory Utilization (%)		
			Total	Interrupt	DRAM (MB)	Heap	Buffer
0	Online	25	3	0	256	14	41
1	Online	25	2	0	256	7	41
2	Empty	0	0	0	0	0	0
3	Empty	0	0	0	0	0	0
4	Empty	0	0	0	0	0	0
5	Empty	0	0	0	0	0	0
6	Empty	0	0	0	0	0	0
7	Empty	0	0	0	0	0	0

For more detailed output, add the **detail** option. The following example also specifies a slot number (**0**), which is optional:

```
user@host> show chassis fpc detail 0
```

```
Slot 0 information:
```

```
State                               Online
Temperature                          25 degrees C / 77 degrees F
Total CPU DRAM                       256 MB
Total SRAM                            56 MB
Total SDRAM                          1280 MB
Start time:                          2003-10-01 04:19:30 PDT
Uptime:                               10 days, 7 hours, 16 minutes, 48 seconds
```

For further description of the output from the commands, see *show chassis fpc*.

- Related Documentation**
- [T320 Chassis Description on page 13](#)
  - [T320 Flexible PIC Concentrators \(FPCs\) Description on page 57](#)
  - [T320 Craft Interface FPC LEDs on page 23](#)

## Holding and Storing T320 FPCs

1. [Holding T320 FPCs on page 266](#)
2. [Storing T320 FPCs on page 270](#)

### Holding T320 FPCs



**CAUTION:** Many components on the FPC are fragile. Failure to handle FPCs as specified in this document can cause irreparable damage.

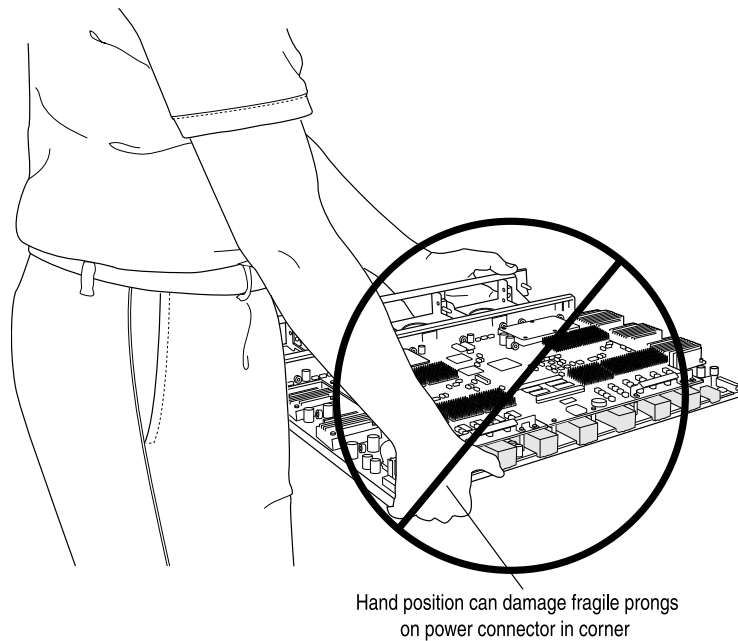


**NOTE:** An FPC configured with PICs installed can weigh as much as 29 lb (13.2 kg). Be prepared to accept the full weight of the FPC as you lift it.

To prevent damage when handling or carrying FPCs:

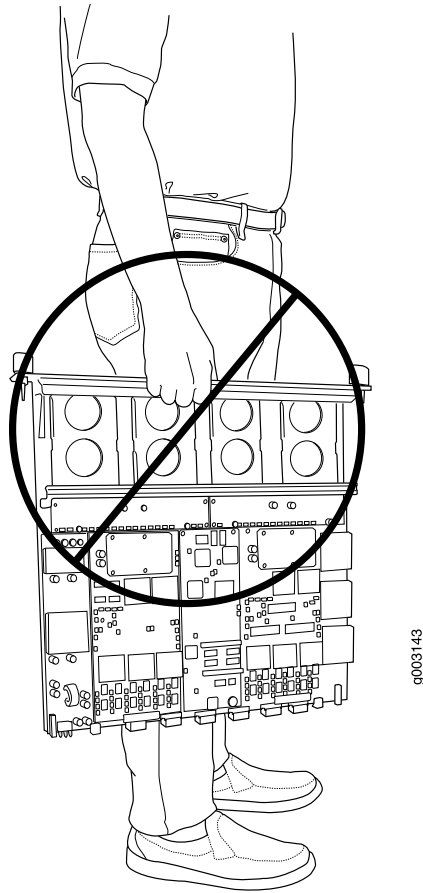
- As you carry the FPC, do not bump it against anything. FPC components are fragile.
- Do not grasp the FPC anywhere except places that this document indicates. In particular, never grasp the connector edge, especially at the power connector in the corner where the connector and bottom edges meet (see [Figure 119 on page 267](#)).

**Figure 119: Do Not Grasp the Connector Edge**



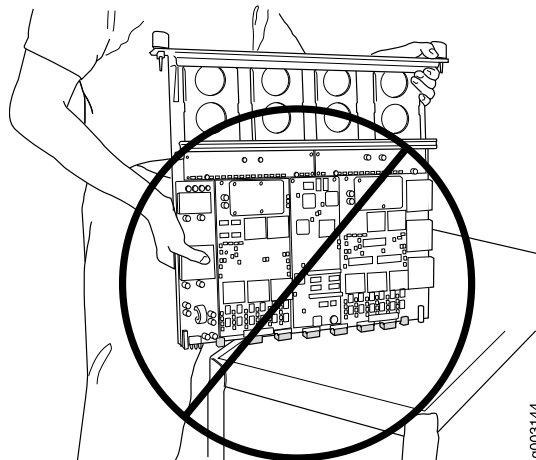
- Do not carry the FPC by the faceplate with only one hand (see [Figure 120 on page 268](#)).

Figure 120: Do Not Carry an FPC with Only One Hand



- Do not rest any edge of an FPC directly against a hard surface (see [Figure 121 on page 268](#)). If you must rest the FPC temporarily on an edge while changing its orientation between vertical and horizontal, use your hand as a cushion between the edge and the surface.

Figure 121: Do Not Rest the FPC on an Edge

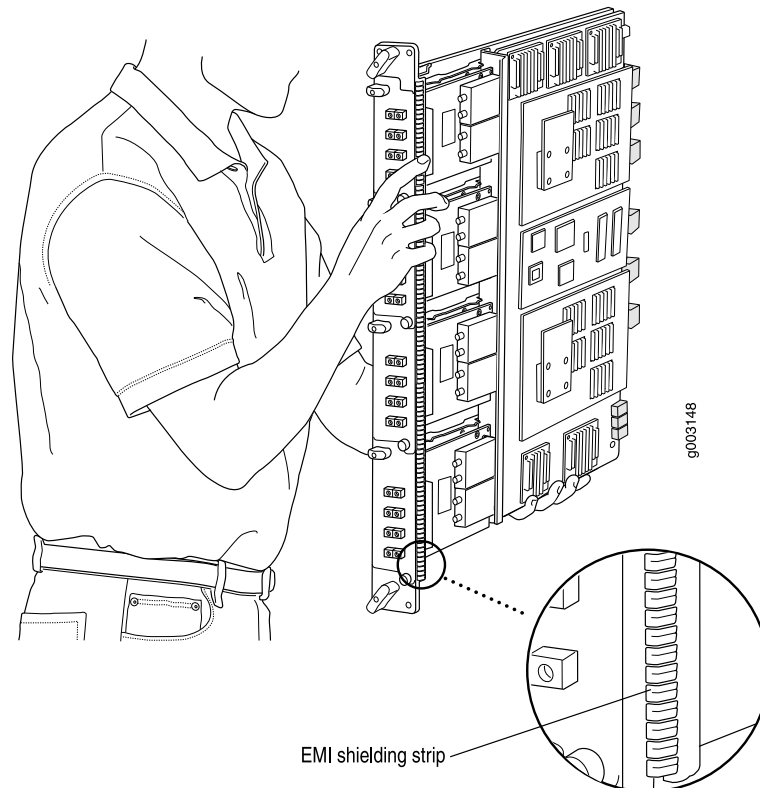




You hold an FPC vertically when installing it into the chassis or an equipment rack. To hold an FPC vertically (see [Figure 122 on page 269](#)):

1. Orient the FPC so that the faceplate faces you.
2. Place one hand around the FPC faceplate about a quarter of the way down from the top edge. To avoid deforming the electromagnetic interference (EMI) shielding strip, do not press hard on it.
3. Place your other hand at the bottom edge of the FPC. If the FPC has heat sinks about midway between the faceplate and connector edge, place your other hand against the heat sinks.

**Figure 122: Holding an FPC Vertically**



## Storing T320 FPCs

When an FPC is not installed in a router, the FPC must be either stored in the container in which a spare FPC is shipped or stored horizontally with the component-side up on a flat, stable surface. When you store an FPC on a horizontal surface or in the shipping container, always place it inside an antistatic bag. Because the FPC is heavy and because antistatic bags are fragile, inserting the FPC into the bag is easier with two people. The storage procedures are as follows:

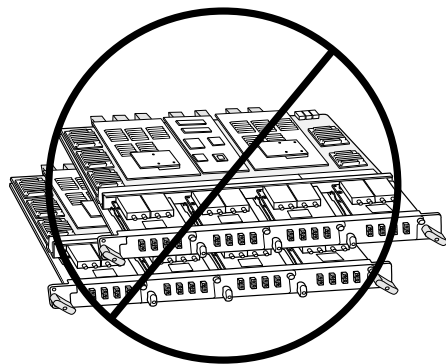
- When storing an FPC with two people, one person holds the FPC in the horizontal position with the faceplate facing their body, the other person slides the opening of the bag over the FPC connector edge.
- When storing an FPC with one person, you must insert the FPC into a bag by yourself. First lay the FPC horizontally on a flat, stable surface, component-side up. Orient the FPC with the faceplate facing you. Carefully insert the FPC connector edge into the opening of the bag, and pull the bag toward you to cover the FPC.



**CAUTION:** To prevent damage when storing FPCs:

- Never lay an FPC component-side down.

**Figure 123: Do Not Stack FPCs**



- Never stack an FPC under or on top of any other component (see [Figure 123 on page 270](#)).

### Related Documentation

- [T320 Flexible PIC Concentrators \(FPCs\) Description on page 57](#)
- [Troubleshooting the T320 FPCs on page 289](#)

## Maintaining T320 PICs and PIC Cables

**Purpose** For optimum router performance, verify the condition of the PICs and PIC cables.

**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 interface module reference for your device. If the FPC that houses the PIC detects a PIC failure, the FPC generates an alarm message to be sent to the Routing Engine.
- Issue the CLI **show chassis fpc pic-status** command. The PIC slots in an FPC are numbered from 0 through 3, top to bottom:

```
user@host> show chassis fpc pic-status
Slot 0  Online      E-FPC Type 3
  PIC 0  Online      1x 10GE(LAN),DWDM
  PIC 2  Present     1x OC-192 SONET XFP- Hardware Error
  PIC 3  Online      1x 10GE(LAN),XENPAK
Slot 2  Online      E2-FPC Type 2
  PIC 0  Online      1x OC-48 SONET, SMIR
  PIC 1  Online      2x OC-12 ATM-II IQ, MM
  PIC 2  Online      8x 1GE(LAN), IQ2
Slot 3  Online      FPC Type 3
  PIC 0  Online      1x 10GE(LAN),XENPAK
  PIC 1  Online      1x 10GE(LAN),XENPAK
  PIC 2  Online      8x 1GE(TYPE3), IQ2
  PIC 3  Online      8x 1GE(TYPE3), IQ2
Slot 4  Online      FPC Type 4
  PIC 0  Online      4x OC-192 SONET XFP
Slot 6  Online      FPC Type 3
  PIC 0  Online      4x OC-48 SONET
  PIC 1  Online      1x Tunnel
Slot 7  Online      FPC Type 4
  PIC 0  Online      1x OC-768 SONET SR
```

For further description of the output from the command, see *show chassis fpc*.

- Use the cable management system to support cables and prevent cables from dislodging or developing stress points.
- Place excess cable out of the way in the cable management system. Do not allow fastened loops of cable to dangle from the connector or cable management system, because this stresses the cable at the fastening point. Putting fasteners on the loops helps to maintain their shape.
- Keep the cable connections clean and free of dust and other particles, which can cause drops in the received power level. Always inspect cables and clean them if necessary before connecting an interface.
- Label both ends of PIC cables to identify them.

The following guidelines apply specifically to fiber-optic cable:

- When you unplug a fiber-optic cable from a PIC, always place a rubber safety plug over the transceiver on the PIC faceplate and on the end of the cable.
- Anchor fiber-optic cable to avoid stress on the connectors. When attaching fiber to a PIC, be sure to secure the fiber so it is not supporting its own weight as it hangs to the floor. Never let fiber-optic cable hang free from the connector.

- Avoid bending fiber-optic cable beyond its bend radius. An arc smaller than a few inches can damage the cable and cause problems that are difficult to diagnose.
- Frequent plugging and unplugging of fiber-optic cable into and out of optical instruments, such as ATM or SONET/SDH analyzers, can cause damage to the instruments that is expensive to repair. Instead, attach a short fiber extension to the optical equipment. Any wear and tear due to frequent plugging and unplugging is then absorbed by the short fiber extension, which is easy and inexpensive to replace.
- Keep fiber-optic cable connections clean. Small microdeposits of oil and dust in the canal of the transceiver or cable connector could cause loss of light, reducing signal power and possibly causing intermittent problems with the optical connection.

To clean the transceivers, use an appropriate fiber-cleaning device, such as RIFOCS Fiber Optic Adaptor Cleaning Wands (part number 946). Follow the directions for the cleaning kit you use.

After you have cleaned the transceiver on the fiber-optic PIC, make sure that the connector tip of the fiber-optic cable is clean. Use only an approved alcohol-free fiber-optic cable cleaning kit, such as the Optex Cletop-S<sup>®</sup> Fiber Cleaner. Follow the directions for the cleaning kit you use.

**Related  
Documentation**

- [T320 Chassis Description on page 13](#)
- [T320 PIC Description on page 63](#)
- [Connecting PIC Cables to the T320 Router on page 150](#)
- [Replacing T320 PIC Cables on page 235](#)

---

## Maintaining the T320 Power Supplies

---

**Purpose** For optimum router performance, verify the condition of the power supplies.

**Action** On a regular basis:

- To check the status of the power supplies, issue the **show chassis environment pem** command. The output is similar to the following:

```
user@host> show chassis environment pem
PEM 0 status:
  State           Online
  Temperature     OK
  DC input:       OK
```

- Check that the voltages in each load zone are equal.



**NOTE:** The current sharing between PEMs relies on equal voltages at the input terminals of the PEMs. The T320 Internet Router system power is divided into two load zones. (INPUT 0 of PEM0 should be matched with INPUT 0 of PEM1; INPUT 1 of PEM0 should be matched with INPUT 1 of PEM1) Therefore, those two PEMs voltages should be equal for current sharing. However, if the voltages do not match, the router operates normally as long as the DC input voltages are within the operating range provided in [“T320 Power System Electrical Specifications” on page 90](#). See [Figure 35 on page 92](#) for a typical DC source cabling arrangement.

- Make sure that the power and grounding cables are arranged so that they do not obstruct access to other router components.
- Routinely check the LEDs on the power supply faceplates. If the **CB ON** LEDs are lit, the power supplies are functioning normally. For more information about the power supply LEDs, see [“T320 Power System Description” on page 77](#).
- 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 CLI command:

```
user@host> show chassis alarms
```

- 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 there is no moisture accumulating near the router. To review grounding and site wiring requirements for the router, see [“T320 Chassis Grounding Cable and Lug Specifications” on page 87](#) and [“Site Electrical Wiring Guidelines for Juniper Networks Devices” on page 351](#).
- Regularly inspect the air filter on each power supply for dust and debris, and replace the filter element every 6 months. To replace a power supply filter element:
  1. Grasp the filter cover on the power supply faceplate and pull it straight off the power supply.
  2. Remove the filter element.
  3. Install a new filter element.
  4. Press the filter cover straight onto the power supply faceplate until all four sides click into place.

- Related Documentation**
- [Powering On the T320 Router on page 159](#)
  - [Powering Off the T320 Router on page 161](#)
  - [Troubleshooting the T320 Power System on page 291](#)
  - [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)

## Maintaining the T320 SIBs

**Purpose** For optimum router performance, verify the condition of the SIBs.

**Action** On a regular basis:

- Observe the status of the SIBs by checking the LEDs on the SIB faceplate. During normal operations:
  - The green **OK** LED on the SIB faceplate is lit.
  - The yellow **FAIL** LED on the SIB faceplate is not lit.
- To check the status of the SIBs using the CLI, issue the **show chassis environment sib** command. The output is similar to the following:

```
user@host> show chassis environment sib
SIB 0 status:
State                Spare
Temperature          45 degrees C / 113 degrees F
Power:
  GROUND              0 mV
  1.8 V               1794 mV
  2.5 V               2446 mV
  3.3 V               3291 mV
  1.8 V bias         1780 mV
  3.3 V bias         3284 mV
  5.0 V bias         5003 mV
  8.0 V bias         6910 mV
SIB 1 status:
State                Online
Temperature          45 degrees C / 113 degrees F
Power:
  GROUND              0 mV
  1.8 V               1802 mV
  2.5 V               2461 mV
  3.3 V               3294 mV
  1.8 V bias         1782 mV
  3.3 V bias         3294 mV
  5.0 V bias         5013 mV
  8.0 V bias         7057 mV
SIB 2 status:
State                Online
Temperature          47 degrees C / 116 degrees F
Power:
  GROUND              0 mV
  1.8 V               1794 mV
  2.5 V               2461 mV
  3.3 V               3301 mV
```

1.8 V bias	1785 mV
3.3 V bias	3296 mV
5.0 V bias	4998 mV
8.0 V bias	7050 mV

For more information about using the command, see *show chassis environment sib*.

- Related Documentation**
- [T320 Switch Interface Boards \(SIBs\) Description on page 79](#)
  - [T320 Craft Interface SIB LEDs on page 24](#)
  - [Replacing a T320 SIB on page 247](#)





## PART 6

# Troubleshooting Hardware

- [Troubleshooting Components on page 279](#)



# Troubleshooting Components

- Overview of Troubleshooting Resources for the T320 Router on page 279
- T320 LED Overview on page 280
- T320 Alarm Messages Overview on page 281
- Troubleshooting the T320 Craft Interface on page 283
- Troubleshooting the T320 SONET Clock Generators on page 284
- Troubleshooting the T320 Cooling System on page 285
- Troubleshooting the T320 Host Subsystem on page 287
- Troubleshooting the T320 Control Board on page 288
- Troubleshooting the T320 FPCs on page 289
- Troubleshooting the T320 PICs on page 290
- Troubleshooting the T320 Power System on page 291
- Troubleshooting the T320 SIBs on page 292

## Overview of Troubleshooting Resources for the T320 Router

---

To troubleshoot a router, you use the Junos OS command-line interface (CLI), LCD, alarms, devices connected to the alarm relay contacts on the CIP, 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.
- Alarm devices connected to the alarm relay contact on the CIP—When a red or yellow alarm occurs, it trips the corresponding alarm relay contact on the CIP.
- CLI—The CLI is the primary tool for controlling and troubleshooting hardware, Junos OS, routing protocols, and network connectivity. Use the CLI to display more information about alarms. 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 the 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**

- [T320 LED Overview on page 280](#)
- [T320 Connector Interface Panel \(CIP\) Description on page 16](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)

---

## T320 LED Overview

- [Craft Interface LEDs on page 280](#)
- [T320 Component LEDs on page 281](#)

### Craft Interface LEDs

The craft interface is the panel on the front of the router that displays system status messages and allows you to troubleshoot the router. The craft interface is located at the top of the chassis above the FPC card cage. It contains LEDs, buttons, and an LCD showing status messages for the router.

For more information about using the craft interface, see [“T320 Craft Interface Description” on page 20](#).

LEDs on the T320 craft interface include:

- Host subsystem LEDs—Three LEDs (one green **MASTER**, one green **OK**, and one red **FAIL**) indicate the status of each host subsystem. The host subsystem LEDs are located on the upper right of the craft interface, and are labeled **HOST0** and **HOST1**.

See [“T320 Craft Interface Host Subsystem LEDs” on page 23](#).

- SIB LEDs—Two LEDs (one red **FAIL** and one green **OK**) indicate the status of each SIB. The SIB LEDs are located on the upper right of the craft interface, and are labeled **SIB0** through **SIB2**.

See [“T320 Craft Interface SIB LEDs” on page 24](#)

- FPC LEDs—Two LEDs (one red **FAIL** and one green **OK**) indicate the status of each FPC. The FPC LEDs are located along the bottom edge of the craft interface, and are labeled **FPC0** through **FPC7**.

See [“T320 Craft Interface FPC LEDs” on page 23](#).

- Alarm LEDs—One large red circular LED and one large yellow triangular LED, located on the upper left of the craft interface, indicate two levels of alarm conditions. You can determine the cause of the alarm condition by looking at the LCD on the craft interface.

See [“T320 Craft Interface Alarm LEDs and ACO/LT Button” on page 21](#).

## T320 Component LEDs

The following LEDs are located on various router components and display the status of those components:

- SIB LEDs—Three LEDs on each SIB faceplate—**ACTIVE**, **OK**, and **FAIL**—indicate the status of that SIB.  
See [“T320 SIB LEDs” on page 80](#).
- Control board LEDs—Three LEDs on each control board faceplate indicate the status of that control board. If no LEDs are lit, the control board is not receiving power.  
See [“T320 Standard Control Board and T-CB LEDs” on page 32](#).
- PIC LEDs—Each port on each PIC has an LED that indicates the status of the port.  
See the *T320 Core Router PIC Guide*.
- SCG LEDs—Three LEDs on each SCG faceplate indicate the status of that SCG.  
See [“T320 SCG LEDs” on page 20](#).
- Power supply LEDs—One LED on each power supply faceplate indicates the status of that power supply.  
See [“T320 Power Supply LEDs” on page 78](#).
- Routing Engine LEDs—One or more LED on each Routing Engine faceplate indicates the status of that Routing Engine or disk activity.
  - [T320 RE-600 LEDs on page 35](#)
  - [T320 RE-1600 LEDs on page 37](#)
  - [T320 RE-2000 LEDs on page 39](#)

### Related Documentation

- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)

## T320 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 on the CIP, 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
```

There are two classes of alarm messages:

- [T320 Chassis Alarm Messages on page 282](#)
- [T320 SONET/SDH Alarm Messages on page 282](#)

## T320 Chassis Alarm Messages

Chassis alarms indicate a problem with a chassis component such as the cooling system or power supplies. For more information, see the following topics:

- [Troubleshooting the T320 Control Board on page 288](#)
- [Troubleshooting the T320 Cooling System on page 285](#)
- [Troubleshooting the T320 Craft Interface on page 283](#)
- [Troubleshooting the T320 FPCs on page 289](#)
- [Troubleshooting the T320 Host Subsystem on page 287](#)
- [Troubleshooting the T320 PICs on page 290](#)
- [Troubleshooting the T320 Power System on page 291](#)
- [Troubleshooting the T320 SIBs on page 292](#)
- [Troubleshooting the T320 SONET Clock Generators on page 284](#)

## T320 SONET/SDH Alarm Messages

Interface alarms indicate a problem with a specific network interface, as described in [Table 62 on page 282](#).

**Table 62: 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>

Table 62: SONET/SDH Interface Alarm Messages (*continued*)

LCD Message	CLI Message
<i>interface-name</i> so-x/x/x PRDI	<i>interface-name</i> so-x/x/x - SONET path remote defect indicator
<i>interface-name</i> so-x/x/x REI	<i>interface-name</i> so-x/x/x - SONET remote error indicator
<i>interface-name</i> so-x/x/x SEF	<i>interface-name</i> so-x/x/x - SONET severely errored frame
<i>interface-name</i> so-x/x/x UNEQ	<i>interface-name</i> so-x/x/x - SONET unequipped

**Related Documentation**

- [T320 Craft Interface Description on page 20](#)
- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 LED Overview on page 280](#)

## Troubleshooting the T320 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.

**Solution** To troubleshoot the craft interface:

1. Check the LEDs on the craft interface.
2. Use the CLI to check for alarms—Issue the **show chassis alarms** command to view the alarms.

In [Table 63 on page 283](#), 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 63: T320 Chassis Alarm Messages

Alarm Type	LCD Display Message	CLI Message
Yellow	Craft Failure	Craft Failure

- Related Documentation**
- [T320 Craft Interface Description on page 20](#)
  - [T320 Craft Interface Alarm LEDs and ACO/LT Button on page 21](#)
  - [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
  - [T320 Alarm Messages Overview on page 281](#)
  - [Contacting Customer Support on page 297](#)

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## Troubleshooting the T320 SONET Clock Generators

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**Problem Description:**

During normal operations:

- The green **OK** LED on the SCG faceplate is lit.
- The yellow **FAIL** LED on the SCG faceplate is not lit.
- The blue **MASTER** LED on the SCG faceplate indicates which SCG is the master.

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 an SCG, SCG voltage sensor, or the internal clock has failed.
- A red alarm indicates that there are no SCGs online.
- A yellow alarm indicates that an SCG is not online in a router with redundant SCGs or that an SCG has been removed..
- A yellow alarm indicates that a temperature sensor has failed.

**Solution** To troubleshoot the T320 SCGs:

1. Check the LEDs on the faceplate of each SCG and on the craft interface.
2. Use the CLI to check for alarms—Issue the **show chassis alarms** command to view the alarms..

In [Table 64 on page 285](#), 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 64: T320 SCG Alarm Messages

Alarm Type	LCD Display Message	CLI Message
Red	RED ALARM—SCG <i>SCG-number</i> Failure	RED ALARM—SCG <i>SCG-number</i> Failure
	RED ALARM—No SCG Online	RED ALARM—No SCG Online
	RED ALARM—SCG <i>SCG-number</i> Volt Snsr Fail	RED ALARM—SCG <i>SCG-number</i> Volt Sensor Fail
	RED ALARM—SCG <i>SCG-number</i> INT CLK Fail	RED ALARM—SCG <i>SCG-number</i> Internal Clock Failure
Yellow	YELLOW ALARM—SCG <i>SCG-number</i> Not Online	YELLOW ALARM—SCG <i>SCG-number</i> Not Online
	YELLOW ALARM—SCG <i>SCG-number</i> Removed	YELLOW ALARM—SCG <i>SCG-number</i> Removed
	YELLOW ALARM—SCG <i>SCG-number</i> TrmpSnsr Fail	YELLOW ALARM—SCG <i>SCG-number</i> Temp Sensor Fail

**Related Documentation**

- [T320 SONET Clock Generator \(SCG\) Description on page 19](#)
- [T320 SCG LEDs on page 20](#)
- [Maintaining the T320 SCGs on page 261](#)
- [Replacing a T320 SCG on page 182](#)
- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)

## Troubleshooting the T320 Cooling System

- Problem Description:** During normal operation:
- Fans in both front and rear fan trays function at less than 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.



**NOTE:** If the router temperature exceeds the acceptable maximum, the control board turns off the power supplies.

The following alarms and LEDs indicate a problem when:

- A fan fails (red alarm).
- One of the fan trays is removed (yellow alarm).
- The router temperature exceeds the “temperature warm” threshold (yellow alarm).
- The temperature of the router exceeds the maximum (“temperature hot”) threshold (red alarm and automatic shutdown of the power supplies).

**Solution** To troubleshoot the fans, follow these guidelines:

- If the red alarm LED on the craft interface lights, find the source of the problem by looking at the display on the craft interface. The number of alarm conditions, as well as the source of each alarm, appears on the screen.
- Use the CLI to check the status of the fans. For example, you can issue the following command to get information about the source of an alarm condition:

```
user@host> show chassis alarms
```

- 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.
- If the **DC OK** LED on one or both of the power supplies is not lit, check the power supply fans to see if they are operating.
- If all power supplies have failed, the system temperature might have exceeded the threshold, causing the system to shut down.
- If the display on the craft interface 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, as described in [“Replacing a T320 Fan Tray” on page 192](#).

Component	Alarm Type	LCD Display Message	CLI Message
Fans	Red	Fan Failure	<i>fan-name</i> Failure
		Fans Missing	Too many fans missing or failing
	Yellow	Fan Removed	<i>fan-name</i> Removed
Temperature sensors	Red	Temperature Hot	Temperature Hot
		Sensor Failure	Temperature sensor failure
	Yellow	Temperature Warm	Temperature Warm

**Related Documentation**

- [Maintaining the T320 Air Filters on page 262](#)
- [Maintaining the T320 Fan Trays on page 263](#)
- [Replacing a T320 Fan Tray on page 192](#)
- [Replacing a T320 Air Filter on page 187](#)
- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)

## Troubleshooting the T320 Host Subsystem

---

**Problem Description:**

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.

The following alarms and LEDs indicate a problem with a host subsystem control board or 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.

**Solution** To troubleshoot the T640 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. Use the CLI to check for alarms—Issue the **show chassis alarms** command to view the alarms.

In [Table 65 on page 287](#), 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 65: T320 Host Subsystem Alarm Messages**

Alarm Type	LCD Display Message	CLI Message
Red	Host <i>host-number</i> Removed	Host <i>host-number</i> Removed

Table 65: T320 Host Subsystem Alarm Messages (*continued*)

Alarm Type	LCD Display Message	CLI Message
Yellow	Host <i>host-number</i> Failure	Host <i>host-number</i> Failure

**Related Documentation**

- [T320 Host Subsystem Description on page 29](#)
- [T320 Craft Interface Host Subsystem LEDs on page 23](#)
- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)

## Troubleshooting the T320 Control Board

**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.
- The green **OK** LED on the control board faceplate is not lit.
- 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 control board has failed or has been removed.
- A yellow alarm indicates that the Ethernet switch in the control board has failed.

In [Table 66 on page 288](#), 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 66: Control Board Alarm Messages

Alarm Type	LCD Message	CLI Message
Red	CB <i>cb-number</i> Removed	CB <i>cb-number</i> Removed
	CB <i>cb-number</i> Failure	CB <i>cb-number</i> Failure
Yellow	CB <i>cb-number</i> Ethernet Switch Failure	CB <i>cb-number</i> Ethernet Switch Failure

**Solution**

To troubleshoot the control boards:

1. Check the LEDs on the faceplate of each control board and on the craft interface.

2. Use the CLI to check for alarms—Issue the **show chassis alarms** command to view the alarms.

**Related Documentation**

- [T320 Control Board Description on page 30](#)
- [T320 Standard Control Board and T-CB LEDs on page 32](#)
- [Maintaining the T320 SCGs on page 261](#)
- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)

## Troubleshooting the T320 FPCs

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**Problem Description:**

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 on the craft interface above the FPC indicates a problem.

**Solution** To troubleshoot the FPCs:

1. If the red **FAIL** LED above the FPC is on, 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 following CLI commands to check the status of an FPC:

```
user@host> show chassis fpc
```

To display more detailed information, use the following option:

```
user@host> show chassis fpc detail
```

3. Make sure 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.

**Related Documentation**

- [T320 Flexible PIC Concentrators \(FPCs\) Description on page 57](#)
- [T320 Craft Interface Description on page 20](#)
- [Replacing a T320 FPC on page 223](#)

- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)

## Troubleshooting the T320 PICs

**Problem**    **Description:** The PICs are not functioning normally.

**Solution**    To troubleshoot the PICs:

- To check the status of each port on a PIC, look at the LED located on the PIC faceplate. For information about the meaning of LED states on different PICs, see the *T320 Core Router Interface Module Reference*.
- To check the status of a PIC, issue 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      E-FPC Type 3
  PIC 0  Online      1x 10GE(LAN),DWDM
  PIC 2  Present     1x OC-192 SONET XFP- Hardware Error
  PIC 3  Online      1x 10GE(LAN),XENPAK
Slot 2  Online      E2-FPC Type 2
  PIC 0  Online      1x OC-48 SONET, SMIR
  PIC 1  Online      2x OC-12 ATM-II IQ, MM
  PIC 2  Online      8x 1GE(LAN), IQ2
Slot 3  Online      FPC Type 3
  PIC 0  Online      1x 10GE(LAN),XENPAK
  PIC 1  Online      1x 10GE(LAN),XENPAK
  PIC 2  Online      8x 1GE(TYPE3), IQ2
  PIC 3  Online      8x 1GE(TYPE3), IQ2
Slot 4  Online      FPC Type 4
  PIC 0  Online      4x OC-192 SONET XFP
Slot 6  Online      FPC Type 3
  PIC 0  Online      4x OC-48 SONET
  PIC 1  Online      1x Tunnel
Slot 7  Online      FPC Type 4
  PIC 0  Online      1x OC-768 SONET SR
```

For further description of the output from the command, see *show chassis fpc*.

### Related Documentation

- [T320 PIC Description on page 63](#)
- [Maintaining T320 PICs and PIC Cables on page 270](#)
- [Replacing a T320 PIC on page 229](#)
- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)

## Troubleshooting the T320 Power System

**Problem**    **Description:** The power system is not functioning normally.

- Solution**
- Check the **OUTPUT OK** LED on each power supply faceplate (or the corresponding **POWER OK** LED on the craft interface). If this LED is on, the power source is good and the power supply is functional.
  - Check the display on the craft interface. The Junos OS constantly updates the screen with status information for each component. For more information about the display, see [“T320 Craft Interface Description”](#) on page 20.



**NOTE:** On the display and in the CLI, the power supplies are referred to as **PEM0** through **PEM3**, from top to bottom.

If a power supply is not functioning normally, perform the following steps to diagnose and correct the problem:

- If the **OUTPUT OK** power supply LED is off, check the red alarm LED on the craft interface. The Junos OS monitors the system temperature, and if it exceeds a certain limit, the software triggers a red alarm, a condition that shuts down the power supplies.
- If a red alarm condition occurs, check the display on the craft interface to determine the source of the problem.



**NOTE:** If the system temperature exceeds the threshold, the Junos OS shuts down all power supplies so that no status is displayed.

The Junos OS also can shut down one of the power supplies for other reasons. In this case, the remaining power supply assumes the load, and you can still view the system status through the CLI or display.

- If the **OUTPUT OK** power supply LED is off and no red alarm condition exists, check that the circuit breaker is switched to the on position (I).
- Verify that the source circuit breaker has the proper current rating. Each power supply must be connected to a separate source circuit breaker.
- 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 cord or cable.
- Connect the power supply to a different power source with a new DC power cable. If the power supply **OUTPUT OK** LED still does not light, the power supply is the source of the problem. Replace the power supply with a spare, as described in [“Replacing a T320 DC Power Supply”](#) on page 239.

- If the **OUTPUT OK** LED on the installed spare lights, the replaced power supply is faulty. Return it for replacement, as described in [“Returning a Hardware Component to Juniper Networks, Inc.”](#) on page 307.
- If you cannot determine the cause of the problem or need additional assistance, see [“Contacting Customer Support”](#) on page 297.

Component	Alarm Type	LCD Display Message	CLI Message
Power supplies	Red	PEM <i>pem-number</i> Over Temp	PEM <i>pem-number</i> Over Temperature
		PEM <i>pem-number</i> Output Fail	PEM <i>pem-number</i> Output Failure
		PEM <i>pem-number</i> Input Fail	PEM <i>pem-number</i> Input Failure
	Yellow	PEM <i>pem-number</i> Removed	PEM <i>pem-number</i> Removed

#### Related Documentation

- [T320 Power System Description on page 77](#)
- [T320 Power Supply LEDs on page 78](#)
- [Maintaining the T320 Power Supplies on page 272](#)
- [Replacing a T320 DC Power Supply Cable on page 244](#)
- [Replacing a T320 DC Power Supply on page 239](#)
- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)

## Troubleshooting the T320 SIBs

### Problem Description:

During normal operations:

- The green **OK** LED on the SIB faceplate is lit.
- The yellow **FAIL** LED on the SIB faceplate is not lit.

The following alarms and LEDs indicate a problem with a SIB:

- The yellow **FAIL** LED on the SIB faceplate is lit.
- The green **OK** LED on the SIB faceplate is not lit.
- A red alarm indicates that the SIB failed or has been removed.
- A yellow alarm indicates that a spare SIB has failed or has been removed.



**Solution** To troubleshoot the 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..

In [Table 67 on page 293](#), 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 67: SIB Alarm Messages**

Alarm Type	LCD Display 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
Yellow	Spare SIB Failure	Spare SIB Fault
	Spare SIB Removed	Spare SIB Absent
	Check SIB	Check SIB

**Related Documentation**

- [T320 Switch Interface Boards \(SIBs\) Description on page 79](#)
- [T320 SIB LEDs on page 80](#)
- [Maintaining the T320 SIBs on page 274](#)
- [Overview of Troubleshooting Resources for the T320 Router on page 279](#)
- [T320 Alarm Messages Overview on page 281](#)
- [Contacting Customer Support on page 297](#)



## PART 7

# Contacting Customer Support and Returning the Chassis or Components

- [Contacting Customer Support on page 297](#)
- [Locating Component Serial Numbers on page 299](#)
- [Packing and Returning Components on page 307](#)



## CHAPTER 33

# Contacting Customer Support

- [Contacting Customer Support on page 297](#)

## 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:

<http://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 11-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

### Related Documentation

- [Returning a Hardware Component to Juniper Networks, Inc. on page 307](#)



# Locating Component Serial Numbers

- [Locating T320 Component Serial Numbers Using the CLI on page 299](#)
- [T320 Component Serial Number Label Locations on page 300](#)

## Locating T320 Component Serial Numbers Using the CLI

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			51766	T320
Midplane	REV 07	710-004339	HJ1249	T320 Backplane
FPM GBUS	REV 04	710-004461	HJ1142	T320 FPM Board
FPM Display	REV 05	710-002897	HK8861	FPM Display
CIP	REV 06	710-002895	HJ1002	T-series CIP
PEM 1	Rev 04	740-004359	PB15990	Power Entry Module
SCG 0	REV 09	710-004455	HJ1568	T320 Sonet Clock Gen.
SCG 1	REV 09	710-004455	HN1604	T320 Sonet Clock Gen.
Routing Engine 0	REV 07	740-014082	9009010618	RE-A-2000
Routing Engine 1	REV 07	740-014082	9009003642	RE-A-2000
CB 0	REV 02	710-007655	HS5914	Control Board (CB-T)
CB 1	REV 16	710-002728	JG0451	T-series Control Board
FPC 0	REV 02	710-010160	HV9173	E-FPC Type 3
CPU	REV 02	710-010169	HW9186	FPC CPU-Enhanced
PIC 0	REV 01	750-004695	HD5985	1x Tunnel
PIC 1	REV 01	750-003336	HG6072	4x OC-48 SONET, SMSR
MMB 1	REV 02	710-010171	HR0877	MMB-288mbit
FPC 1	REV 06	710-005860	BE6882	FPC Type 1
CPU	REV 14	710-001726	BF9669	FPC CPU
PIC 0	REV 07	750-021652	DN4167	1x CHOC12 IQE SONET
Xcvr 0	REV 01	740-016066	AC0934V0009	SFP-IR
PIC 1	REV 21	750-005634	WC2095	1x CHOC12 IQ SONET, SMIR
MMB 1	REV 02	710-005555	BF4970	MMB-288mbit
PPB 0	REV 04	710-003758	BF2045	PPB Type 2
FPC 3	REV 04	710-007532	HL6278	FPC Type 3
CPU	REV 14	710-001726	HJ1277	FPC CPU
PIC 0	REV 05	750-015217	DA2065	8x 1GE(TYPE3), IQ2
Xcvr 0		NON-JNPR	AVAGCNA100KN1	SFP-SX
Xcvr 1	REV 01	740-011613	AM0812S8WQ7	SFP-SX

Xcvr 5	REV 01	740-011613	PFA6K4W	SFP-SX
Xcvr 7	REV 01	740-011613	AM0812S8X71	SFP-SX
MMB 1	REV 02	710-005555	HK7503	MMB-288mbit
PPB 0	REV 04	710-002845	HH8855	PPB Type 3
FPC 4	REV 04	710-007531	HL4427	FPC Type 2
CPU	REV 14	710-001726	HJ1349	FPC CPU
PIC 0	REV 03	750-001900	AA9622	1x OC-48 SONET, SMIR
MMB 1	REV 02	710-005555	HH5687	MMB-288mbit
PPB 0	REV 04	710-003758	HK8684	PPB Type 2
FPC 5	REV 01	710-013566	JD6188	E2-FPC Type 2
CPU	REV 05	710-010169	JE4410	FPC CPU-Enhanced
PIC 0	REV 05	750-001901	AD3837	4x OC-12 SONET, SMIR
PIC 1	REV 12	750-014897	DW0043	MultiServices 400
MMB 1	REV 04	710-010171	JF8986	MMB-5M3-288mbit
FPC 7	REV 01	710-007531	AZ5731	FPC Type 2
CPU	REV 12	710-001726	BC1543	FPC CPU
PIC 0	REV 04	750-003737	BC1103	4x G/E, 1000 BASE-SX
PIC 1	REV 01	750-001901	AD3611	4x OC-12 SONET, SMIR
MMB 1	REV 01	710-005555	AZ2180	MMB-288mbit
PPB 0	REV 02	710-003758	HC0908	PPB Type 2
SPMB 0	REV 09	710-003229	HT4322	T-series Switch CPU
SPMB 1	REV 10	710-003229	JG0022	T-series Switch CPU
SIB 0	REV 03	750-016019	JS5003	SIB-I8-F16
SIB 1	REV 03	750-016019	JS4840	SIB-I8-F16
SIB 2	REV 03	750-016019	JS5043	SIB-I8-F16
Fan Tray 0				Front Top Fan Tray
Fan Tray 1				Front Bottom Fan Tray
Fan Tray 2				Rear Fan Tray

Most components also have a small rectangular serial number ID label (see [Figure 124 on page 300](#)) attached to the component body.

**Figure 124: Serial Number ID Label**



- Related Documentation**
- [T320 Component Serial Number Label Locations on page 300](#)
  - [Contacting Customer Support on page 297](#)

## T320 Component Serial Number Label Locations

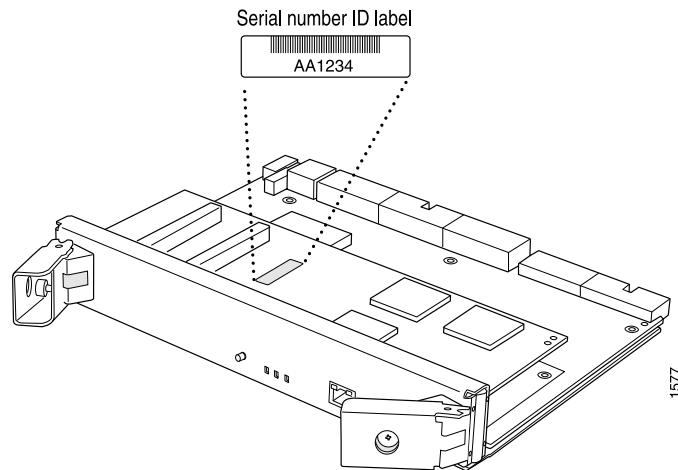
- [Locating the T320 Control Board Serial Number Label on page 301](#)
- [T320 CIP Serial Number Label on page 301](#)
- [T320 Craft Interface Serial Number Label on page 302](#)
- [T320 FPC Serial Number Label on page 302](#)
- [T320 PIC Serial Number Label on page 303](#)
- [T320 Power Supply Serial Number Label on page 303](#)
- [T320 Routing Engine Serial Number Label on page 304](#)
- [T320 SCG Serial Number Label on page 304](#)
- [T320 SIB Serial Number Label on page 304](#)



## Locating the T320 Control Board Serial Number Label

The serial number is located on the top of the standard control board (see [Figure 125 on page 301](#)).

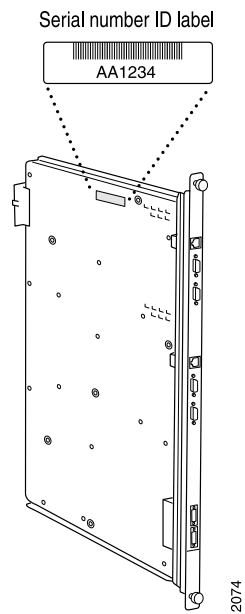
**Figure 125: Control Board Serial Number Label**



## T320 CIP Serial Number Label

The serial number label is located at the middle of the left side of the CIP (see [Figure 126 on page 301](#)).

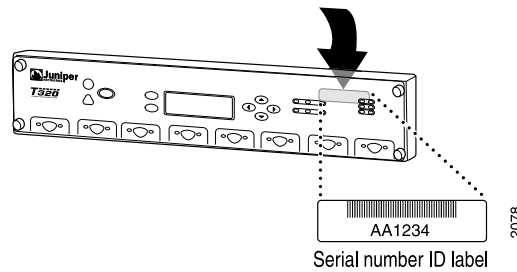
**Figure 126: CIP Serial Number Label**



## T320 Craft Interface Serial Number Label

The serial number is located on the back of the craft interface panel, behind the alarm LEDs (see [Figure 127 on page 302](#)).

Figure 127: Craft Interface Serial Number Label

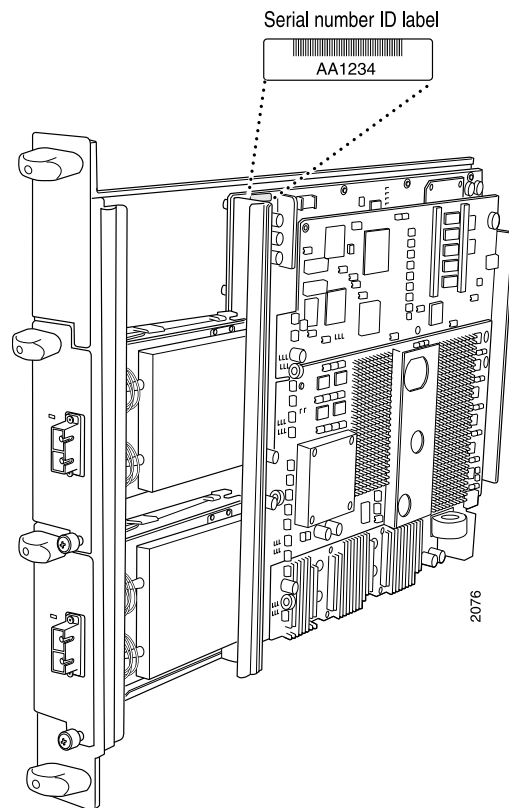


## T320 FPC Serial Number Label

The location of the serial number label varies depending on the FPC:

- Type 2 FPC: located near the top PIC slot.
- Type 3 FPC: located on the center of the right side (see [Figure 128 on page 302](#))

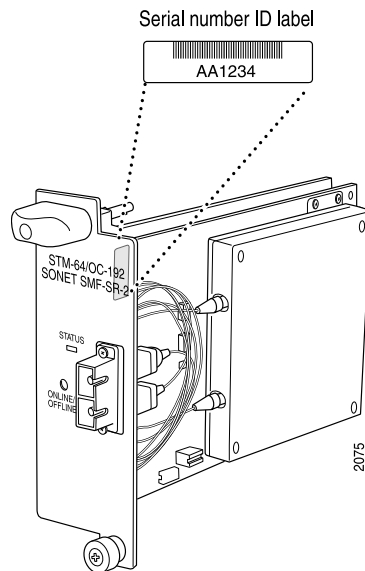
Figure 128: Serial Number Label on FPC



## T320 PIC Serial Number Label

The exact location of the 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 129 on page 303](#)), when the PIC is vertically oriented (as it would be installed in the router).

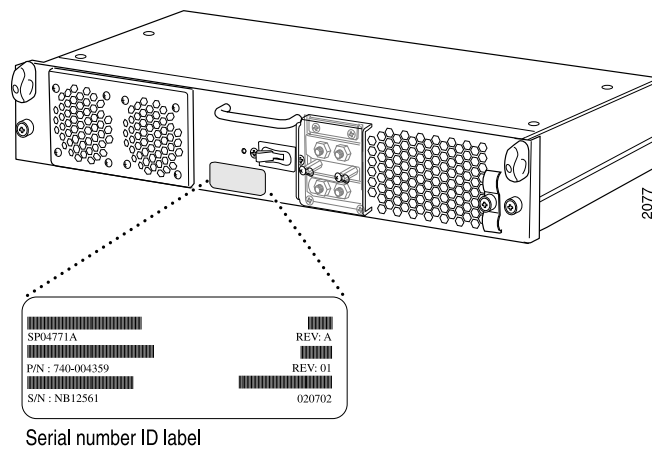
**Figure 129: PIC Serial Number Label**



## T320 Power Supply Serial Number Label

The serial number label is located on the left side of the power supply faceplate (see [Figure 130 on page 303](#)).

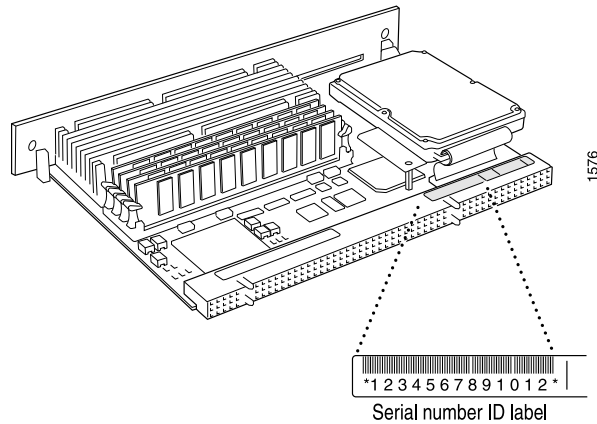
**Figure 130: Power Supply Serial Number Label**



## T320 Routing Engine Serial Number Label

The serial number label is located on the right side of the top of the Routing Engine (see [Figure 131 on page 304](#)).

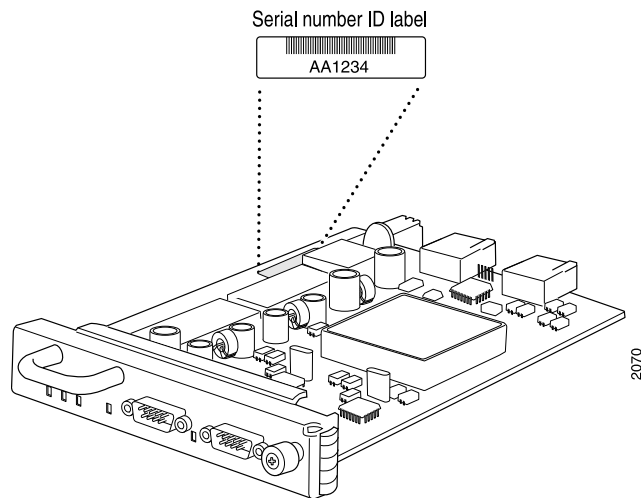
**Figure 131: Routing Engine Serial Number Label**



## T320 SCG Serial Number Label

The serial number is located on the top of the SCG, close to the midplane connector (see [Figure 132 on page 304](#)).

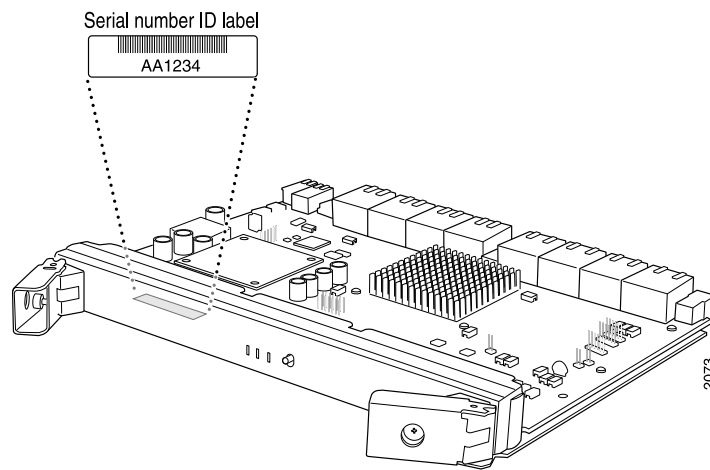
**Figure 132: SCG Serial Number Label**



## T320 SIB Serial Number Label

The serial number label is located on the left side of the SIB (see [Figure 133 on page 305](#)).

Figure 133: SIB Serial Number Label

**Related Documentation**

- [Locating T320 Component Serial Numbers Using the CLI on page 299](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 307](#)
- [Contacting Customer Support on page 297](#)



# Packing and Returning Components

- [Returning a Hardware Component to Juniper Networks, Inc. on page 307](#)
- [Tools and Parts Required to Remove Components From a T320 Router on page 308](#)
- [Packing the T320 Router for Shipment on page 309](#)
- [Packing Router Components for Shipment on page 310](#)

## Returning a Hardware Component to Juniper Networks, Inc.

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If a problem cannot be resolved by the JTAC technician, a Return Materials Authorization (RMA) is issued. 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 <http://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 <http://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 hardware component:

1. Determine the part number and serial number of the 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.

**Related Documentation**

- [Contacting Customer Support on page 297](#)
- [Guidelines for Packing Hardware Components for Shipment](#)

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## Tools and Parts Required to Remove Components From a T320 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 cap for fiber-optic interfaces or cable
- Wire cutters

**Related Documentation**

- [Packing the T320 Router for Shipment on page 309](#)
- [Locating T320 Component Serial Numbers Using the CLI on page 299](#)
- [Contacting Customer Support on page 297](#)
- [Packing Router Components for Shipment on page 310](#)



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## Packing the T320 Router for Shipment

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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. On the console or other management device connected to the master Routing Engine, enter CLI operational mode and issue the following command to shut down the router software. (If two Routing Engines are installed, also issue the command on the backup Routing Engine.)

```
user@host> request system halt
```

Wait until a message appears on the console confirming that the operating system has halted.

For more information about the command, see *request system halt*.

3. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
4. Shut down power to the router by pressing the AC input switch or DC circuit breaker for all power supplies to the off (O) position.
5. Disconnect power from the router.
6. Remove the cables that connect to all external devices.
7. Remove all field replaceable units (FRUs) from the router.
8. 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 and the router weight is fully supported by a shelf or another router, unscrew and remove the mounting screws from the rack. Three people can then lift the router and move it to the shipping crate.
  - If you are not using a mechanical lift and the router weight is not fully supported by a shelf or another router, three people should grasp the router while a fourth person unscrews and removes the mounting screws from the rack. The three lifters can then move the router to the shipping container.

9. Place the router in the shipping crate or onto the pallet. If on a pallet, bolt the router to the pallet.
10. Cover the router with an ESD bag and place the packing foam on top of and around the router.
11. Replace the accessory box on top of the packing foam.
12. Securely tape the box closed or place the crate cover over the router.
13. Write the RMA number on the exterior of the box to ensure proper tracking.

**Related Documentation**

- [Tools and Parts Required to Replace the T320 Hardware Components on page 172](#)
- [Locating T320 Component Serial Numbers Using the CLI on page 299](#)
- [Contacting Customer Support on page 297](#)
- [Packing Router Components for Shipment on page 310](#)

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## Packing Router Components for Shipment

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If the problem cannot be resolved by the JTAC technician, an RMA is issued. 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 will be returned to the customer via collect freight.

For more information about return and repair policies, see the customer support Web page at <http://www.juniper.net/support/guidelines.html>.

For product problems or technical support issues, contact the Juniper Networks Technical Assistance Center (JTAC) using the Case Manager link at <http://www.juniper.net/support/>, or at 1-888-314-JTAC (within the United States) or 1-408-745-9500 (from outside the United States).

When you need to return a component:

1. Determine the part number and serial number of the component.
2. Obtain a Return Materials Authorization (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 router or component for shipment.

**Related  
Documentation**

- [Packing the T320 Router for Shipment on page 309](#)
- [Locating T320 Component Serial Numbers Using the CLI on page 299](#)
- [Contacting Customer Support on page 297](#)



## PART 8

# Safety and Compliance Information

- [General Safety Guidelines and Warnings on page 315](#)
- [Fire Safety Requirements on page 323](#)
- [Installation Safety Guidelines and Warnings on page 325](#)
- [Laser and LED Safety Guidelines and Warnings on page 333](#)
- [Maintenance and Operational Safety Guidelines and Warnings on page 337](#)
- [Electrical Safety Guidelines and Warnings on page 343](#)
- [Agency Approvals and Compliance Statements on page 353](#)



# General Safety Guidelines and Warnings

- [Definition of Safety Warning Levels on page 315](#)
- [General Safety Guidelines for Juniper Networks Devices on page 317](#)
- [General Safety Warnings for Juniper Networks Devices on page 318](#)
- [Preventing Electrostatic Discharge Damage to a T320 Router on page 320](#)

## Definition of Safety Warning Levels

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The documentation uses the following levels of safety warnings:



**NOTE:** You might find this information helpful in a particular situation, or might otherwise overlook it.



**CAUTION:** You must observe the specified guidelines to avoid minor injury or discomfort to you, or severe damage to the hardware 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 Warnings for Juniper Networks Devices on page 318](#)
- [Installation Safety Warnings for Juniper Networks Devices on page 326](#)
- [Maintenance and Operational Safety Warnings for Juniper Networks Devices on page 337](#)
- [General Electrical Safety Warnings for Juniper Networks Devices on page 344](#)
- [DC Power Electrical Safety Warnings for Juniper Networks Devices on page 348](#)



## General Safety Guidelines for Juniper Networks Devices

The following guidelines help ensure your safety and protect the hardware equipment 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 this documentation. Make sure that only authorized service personnel perform other system services.
- Keep the area around the chassis 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, that could become caught in the chassis.
- 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 hardware equipment only when the chassis is properly grounded.
- Do not open or remove chassis covers or sheet metal parts unless instructions are provided in this documentation. 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 hardware component. Such an action could cause electrical shock or damage the hardware equipment.
- 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 router might become hot. The following label provides the warning of the hot surfaces on the router:



### Related Documentation

- [General Safety Warnings for Juniper Networks Devices on page 318](#)

## General Safety Warnings for Juniper Networks Devices

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- [Qualified Personnel Warning on page 318](#)
- [Restricted-Access Area Warning on page 318](#)

### Qualified Personnel Warning

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**WARNING:** Only trained and qualified personnel should install or replace the hardware equipment.

**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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### Restricted-Access Area Warning

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**WARNING:** The hardware equipment 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.

- Related Documentation**
- [Installation Safety Warnings for Juniper Networks Devices on page 326](#)
  - [Maintenance and Operational Safety Warnings for Juniper Networks Devices on page 337](#)
  - [General Electrical Safety Warnings for Juniper Networks Devices on page 344](#)
  - [DC Power Electrical Safety Warnings for Juniper Networks Devices on page 348](#)

## Preventing Electrostatic Discharge Damage to a T320 Router

Many router hardware components 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:

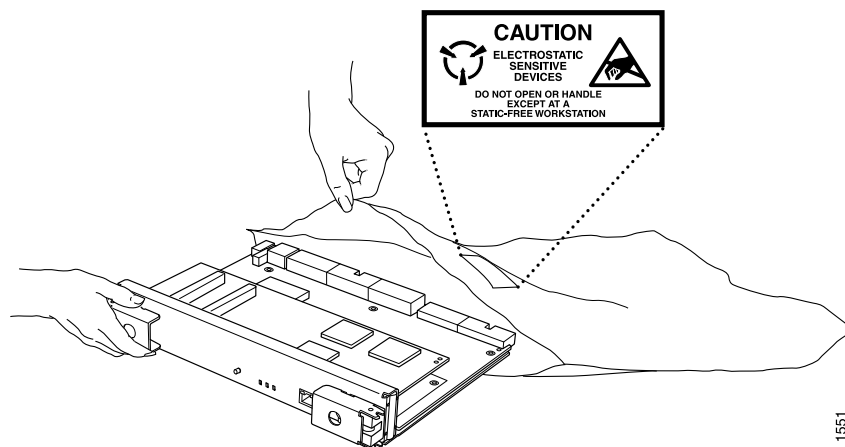
- Always use an ESD wrist strap or ankle strap, and make sure that it is in direct contact with your skin.



**CAUTION:** For safety, periodically check the resistance value of the ESD strap. The measurement should be in the range of 1 through 10 Mohms.

- When handling any component that is removed from the chassis, make sure the equipment end of your ESD strap is attached to one of the ESD points on the chassis.
- Avoid contact between the component and your clothing. ESD voltages emitted from clothing can still damage components.
- When removing or installing a component, always place it component-side up on an antistatic surface, in an antistatic card rack, or in an electrostatic bag (see [Figure 134 on page 320](#)). If you are returning a component, place it in an electrostatic bag before packing it.

**Figure 134: Placing a Component into an Electrostatic Bag**



**Related  
Documentation**

- [T320 Router Description on page 3](#)
- [Site Electrical Wiring Guidelines for Juniper Networks Devices on page 351](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)



## CHAPTER 37

# Fire Safety Requirements

- [Fire Safety Requirements for Juniper Networks Devices on page 323](#)

## Fire Safety Requirements for Juniper Networks Devices

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- [General Fire Safety Requirements on page 323](#)
- [Fire Suppression on page 323](#)
- [Fire Suppression Equipment on page 323](#)

### General Fire Safety Requirements

In the event of a fire emergency involving network devices, the safety of people is the primary concern. Establish procedures for protecting people in a fire emergency, provide safety training, and properly provision fire-control equipment and fire extinguishers.

In addition, establish procedures to protect your equipment in a fire emergency. Juniper Networks products must 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 you observe all local fire, safety, and electrical codes and ordinances when installing and operating your equipment.

### Fire Suppression

In the event of an electrical hazard or an electrical fire, first turn off power 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 (CO<sub>2</sub>) and Halotron, are most effective for suppressing electrical fires. Type C fire extinguishers displace the 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, use this type of inert oxygen displacement extinguisher instead of an extinguisher that leave residues on equipment.

Do not use multipurpose Type ABC chemical fire extinguishers (dry chemical fire extinguishers) near Juniper Networks devices. The primary ingredient in these fire extinguishers is monoammonium phosphate, which is very sticky and difficult to clean.

In addition, in 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.



**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 for Juniper Networks Devices on page 317](#)
- [General Safety Warnings for Juniper Networks Devices on page 318](#)
- [General Electrical Safety Warnings for Juniper Networks Devices on page 344](#)
- [DC Power Electrical Safety Warnings for Juniper Networks Devices on page 348](#)



## CHAPTER 38

# Installation Safety Guidelines and Warnings

- [T320 Installation Safety Guidelines on page 325](#)
- [Installation Safety Warnings for Juniper Networks Devices on page 326](#)

## T320 Installation Safety Guidelines

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- [General Installation Safety Guidelines on page 325](#)
- [Chassis Lifting Guidelines on page 325](#)

## General Installation Safety Guidelines

Before installing the router, verify that the intended site meets the specified power, environmental, and clearance requirements.

- [T320 Clearance Requirements for Airflow and Hardware Maintenance on page 85](#)
- [T320 Rack Requirements on page 84](#)
- [T320 Environmental Specifications on page 87](#)
- [T320 DC Power Distribution on page 92](#)
- [T320 Power Requirements on page 90](#)
- [T320 Power System Electrical Specifications on page 90](#)

## Chassis Lifting Guidelines

The weight of a fully configured T320 chassis is up to 370 lb (168 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 mechanical lift cannot be used, a minimum of three 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**

- [T320 Site Preparation Checklist Requirements on page 83](#)
- [Installation Safety Warnings for Juniper Networks Devices on page 326](#)
- [Overview of Installing the T320 Router Without a Mechanical Lift on page 125](#)

## Installation Safety Warnings for Juniper Networks Devices

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Observe the following warnings before and during hardware equipment installation:

- [Intrabuilding Ports Warning on page 326](#)
- [Installation Instructions Warning on page 326](#)
- [Rack-Mounting Requirements and Warnings on page 327](#)
- [Ramp Warning on page 330](#)

### Intrabuilding Ports Warning



**WARNING:** The intrabuilding ports of the equipment or subassembly are suitable for connection to intrabuilding or unexposed wiring or cabling only. The intrabuilding ports of the equipment or subassembly **MUST NOT** be metallically connected to interfaces that connect to the Outside Plant (OSP) or its wiring. These interfaces are designed for use as intrabuilding interfaces only (Type 2 or Type 4 ports as described in GR-1089) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

### Installation Instructions Warning



**WARNING:** Read the installation instructions before you connect the hardware equipment to a power source.

**Waarschuwing** Raadpleeg de installatie-aanwijzingen voordat u het systeem met de voeding verbindt.

**Varoitus** Lue asennusohjeet ennen järjestelmän yhdistämistä virtalähteeseen.

**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.

## Rack-Mounting Requirements and Warnings

Ensure that the equipment rack into which the chassis is installed is evenly and securely supported, to avoid the hazardous condition that could result from uneven mechanical loading.



**WARNING:** To prevent bodily injury when mounting or servicing the chassis in a rack, take the following precautions to ensure that the system remains stable. The following directives help maintain your safety:

- The chassis must be installed into a rack that is secured to the building structure.
- The chassis should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting the chassis in 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 devices, install the stabilizers before mounting the chassis in the rack or servicing the hardware equipment.

**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 router moet in een stellage worden geïnstalleerd die aan een bouwsel 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:

- Router 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 router 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 router 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 router 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:

- Router 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 router 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, o posteriormente 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 router 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:

- Router 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.

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## Ramp Warning



**WARNING:** When installing the hardware equipment, 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 for Juniper Networks Devices on page 317](#)
- [General Safety Warnings for Juniper Networks Devices on page 318](#)
- [Maintenance and Operational Safety Warnings for Juniper Networks Devices on page 337](#)





# Laser and LED Safety Guidelines and Warnings

- [T320 General Laser Safety Guidelines on page 333](#)
- [Laser Safety Warnings for Juniper Networks Devices on page 333](#)

## T320 General Laser Safety Guidelines

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Physical Interface Cards (PICs) with single-mode optical interfaces 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 +A11 +A2 requirements.

When working around PICs, 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.

### Related Documentation

- [General Safety Guidelines for Juniper Networks Devices on page 317](#)
- [Maintenance and Operational Safety Warnings for Juniper Networks Devices on page 337](#)

## Laser Safety Warnings for Juniper Networks Devices

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- [Class 1 Laser Product Warning on page 334](#)
- [Class 1 LED Product Warning on page 334](#)

- [Laser Beam Warning on page 335](#)
- [Radiation from Open Port Apertures Warning on page 335](#)

### Class 1 Laser Product Warning

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**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.

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### Class 1 LED Product Warning

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**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.

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## 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.

**iAtención!** 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.

## Radiation from Open Port Apertures Warning



**WARNING:** Because invisible radiation might be emitted from the aperture of the port when no fiber-optic 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 for Juniper Networks Devices on page 317](#)
- [General Safety Warnings for Juniper Networks Devices on page 318](#)
- [Installation Safety Warnings for Juniper Networks Devices on page 326](#)

# Maintenance and Operational Safety Guidelines and Warnings

- [Maintenance and Operational Safety Warnings for Juniper Networks Devices on page 337](#)

## Maintenance and Operational Safety Warnings for Juniper Networks Devices

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As you maintain the hardware equipment, observe the following warnings:

- [Battery Handling Warning on page 337](#)
- [Jewelry Removal Warning on page 338](#)
- [Lightning Activity Warning on page 339](#)
- [Operating Temperature Warning on page 340](#)
- [Product Disposal Warning on page 341](#)

### Battery Handling Warning



**WARNING:** Replacing the battery incorrectly might result in an explosion. Replace the 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 ontploffingsgevaar 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 vastaaventyyppistä 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.

**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.

**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.

**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

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**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 weld the metal object 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 kuumentuvat, 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.

## Lightning Activity Warning



**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 hardware equipment from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature of 104° F (40° C). To prevent airflow restriction, allow at least 6 inches (15.2 cm) of clearance around the ventilation openings.

**Waarschuwing** Om te voorkomen dat welke router van de 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.

**Varoitus** Ettei router-sarjan reititin ylikuumentuusi, 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 router, 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 router 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 router, 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 router 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 router, 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 router 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 router 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 product 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.

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**Related  
Documentation**

- [General Safety Guidelines for Juniper Networks Devices on page 317](#)
- [General Safety Warnings for Juniper Networks Devices on page 318](#)

## CHAPTER 41

# Electrical Safety Guidelines and Warnings

- [In Case of an Electrical Accident on page 343](#)
- [T320 General Electrical Safety Guidelines and Electrical Codes on page 343](#)
- [General Electrical Safety Warnings for Juniper Networks Devices on page 344](#)
- [DC Power Electrical Safety Warnings for Juniper Networks Devices on page 348](#)
- [Site Electrical Wiring Guidelines for Juniper Networks Devices on page 351](#)

## In Case of 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 router.
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 for Juniper Networks Devices on page 317](#)
- [General Safety Warnings for Juniper Networks Devices on page 318](#)

## T320 General Electrical Safety Guidelines and Electrical Codes

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- Install the router in compliance with the following local, national, or international electrical codes:
  - United States—National Fire Protection Association (NFPA 70), United States National Electrical Code.
  - Canada—Canadian Electrical Code, Part 1, CSA C22.1.

- Other countries—International Electromechanical Commission (IEC) 60364, Part 1 through Part 7.
- 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.
- 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 router within marked electrical ratings and product usage instructions.
- For the router and peripheral equipment to function safely and correctly, use the cables and connectors specified for the attached peripheral equipment, and make certain they are in good condition.

Many router components can be removed and replaced without powering off or disconnecting power to the router. Never install equipment if it appears damaged.

- Related Documentation**
- [T320 Site Preparation Checklist Requirements on page 83](#)
  - [T320 Field-Replaceable Units on page 171](#)

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## General Electrical Safety Warnings for Juniper Networks Devices

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- [Grounded Equipment Warning on page 344](#)
- [Grounding Requirements and Warning on page 345](#)
- [Midplane Energy Hazard Warning on page 346](#)
- [Multiple Power Supplies Disconnection Warning on page 346](#)
- [Power Disconnection Warning on page 347](#)

### Grounded Equipment Warning



**WARNING:** The network device is intended to be grounded. Ensure that the network device is connected to earth ground during normal use.

**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.

## 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 unit. The grounding conductor is a separately derived system at the supply transformer or motor generator set.



**WARNING:** When installing the network device, you must always make the ground connection first and disconnect it 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.

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### Midplane Energy Hazard Warning

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**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.

**Warning!** Denna enhet har mer än en strömförsörjningsanslutning; alla anslutningar måste vara helt avlägsnade innan strömtillförseln till enheten är fullständigt bruten.

## Power Disconnection Warning



**WARNING:** Before working on the chassis or near power supplies, switch off the power at the DC circuit breaker.

**Waarschuwing** Voordat u aan een frame of in de nabijheid van voedingen werkt, dient u bij wisselstroom toestellen de stekker van het netsnoer uit het stopcontact te halen; voor gelijkstroom toestellen dient u de stroom uit te schakelen bij de stroomverbreker.

**Varoitus** Kytke irti vaihtovirtalaitteiden virtajohto ja katkaise tasavirtalaitteiden virta suojakytkimellä, ennen kuin teet mitään asennuspohjalle tai työskentelet virtalähteiden läheisyydessä.

**Attention** Avant de travailler sur un châssis ou à proximité d'une alimentation électrique, débrancher le cordon d'alimentation des unités en courant alternatif; couper l'alimentation des unités en courant continu au niveau du disjoncteur.

**Warnung** Bevor Sie an einem Chassis oder in der Nähe von Netzgeräten arbeiten, ziehen Sie bei Wechselstromeinheiten das Netzkabel ab bzw. schalten Sie bei Gleichstromeinheiten den Strom am Unterbrecher ab.

**Avvertenza** Prima di lavorare su un telaio o intorno ad alimentatori, scollegare il cavo di alimentazione sulle unità CA; scollegare l'alimentazione all'interruttore automatico sulle unità CC.

**Advarsel** Før det utføres arbeid på kabinettet eller det arbeides i nærheten av strømforsyningsenheter, skal strømledningen trekkes ut p vekselstrømsenheter og strømmen kobles fra ved strømbryteren på likestrømsenheter.

**Aviso** Antes de trabalhar num chassis, ou antes de trabalhar perto de unidades de fornecimento de energia, desligue o cabo de alimentação nas unidades de corrente alternada; desligue a corrente no disjuntor nas unidades de corrente contínua.

**¡Atención!** Antes de manipular el chasis de un equipo o trabajar cerca de una fuente de alimentación, desenchufar el cable de alimentación en los equipos de corriente alterna (CA); cortar la alimentación desde el interruptor automático en los equipos de corriente continua (CC).

**Warning!** Innan du arbetar med ett chassi eller nära strömförsörjningsenheter skall du för växelströmsenheter dra ur nätsladden och för likströmsenheter bryta strømmen vid överspänningsskyddet.

- Related Documentation**
- [DC Power Electrical Safety Warnings for Juniper Networks Devices on page 348](#)

## DC Power Electrical Safety Warnings for Juniper Networks Devices

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When working with DC-powered equipment, observe the following warnings:

- [DC Power Copper Conductors Warning on page 348](#)
- [DC Power Disconnection Warning on page 348](#)
- [DC Power Wiring Terminations Warning on page 350](#)

### 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



**WARNING:** Before performing any procedures on power supplies, 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 switch 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 schakelaarhendel 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.

## DC Power Wiring Terminations Warning



**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 johdinliitäntää, esimerkiksi suljettua silmukkaa tai kourumaista liitäntää, 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. Ringoesen oder gabelförmige Kabelschuhe mit nach oben gerichteten Enden 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 lederen.

**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.

- Related Documentation**
- [General Safety Warnings for Juniper Networks Devices on page 318](#)
  - [General Electrical Safety Warnings for Juniper Networks Devices on page 344](#)

## Site Electrical Wiring Guidelines for Juniper Networks Devices

- [Distance Limitations for Signaling on page 351](#)
- [Radio Frequency Interference on page 351](#)
- [Electromagnetic Compatibility on page 351](#)

### Distance Limitations for Signaling

Improperly installed wires can emit radio interference. In addition, the potential for damage from lightning strikes increases if wires exceed recommended distances or if wires pass between buildings. The electromagnetic pulse (EMP) caused by lightning can damage unshielded conductors and destroy electronic devices. If your site has previously experienced such problems, you might want to consult experts in electrical surge suppression and shielding.

### Radio Frequency Interference

You can reduce or eliminate the emission of radio frequency interference (RFI) from your site wiring by using twisted-pair cable with a good distribution of grounding conductors. If you must exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

### Electromagnetic Compatibility

If your site is susceptible to problems with electromagnetic compatibility (EMC), particularly from lightning or radio transmitters, you might want to seek expert advice. Strong sources of electromagnetic interference (EMI) can destroy the signal drivers and receivers in the network device and conduct power surges over the lines into the equipment, resulting in an electrical hazard. It is particularly important to provide a properly grounded and shielded environment and to use electrical surge-suppression devices.



**CAUTION:** To comply with intrabuilding lightning and surge requirements, intrabuilding wiring must be shielded, and the shield for the wiring must be grounded at both ends.



**WARNING:** The intrabuilding ports of the equipment or subassembly are suitable for connection to intrabuilding or unexposed wiring or cabling only. The intrabuilding ports of the equipment or subassembly **MUST NOT** be metallically connected to interfaces that connect to the Outside Plant (OSP) or its wiring. These interfaces are designed for use as intrabuilding interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE, Issue 4) and require isolation from the exposed OSP cabling. The addition of primary protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

**Related  
Documentation**

- *General Electrical Safety Guidelines and Electrical Codes for Juniper Networks Devices*

## CHAPTER 42

# Agency Approvals and Compliance Statements

- T320 Agency Approvals on page 353
- Compliance Statements for EMC Requirements for Juniper Networks Devices (Canada) on page 354
- T320 Compliance Statements for EMC Requirements (European Community) on page 355
- Compliance Statements for EMC Requirements for Juniper Networks Devices (Israel) on page 355
- Compliance Statements for EMC Requirements for Juniper Networks Devices (Japan) on page 355
- Compliance Statements for EMC Requirements for Juniper Networks Devices (United States) on page 356
- Compliance Statements for Environmental Requirements for Juniper Networks Devices on page 356
- T320 Compliance Statements for NEBS on page 356
- T320 Compliance Statements for Acoustic Noise on page 356

## T320 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 Safety of Laser Products - Part 1: Equipment Classification, Requirements and User's Guide
- 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
- 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**

- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Canada\) on page 354](#)
- [T320 Compliance Statements for EMC Requirements \(European Community\) on page 355](#)
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Japan\) on page 355](#)
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(United States\) on page 356](#)
- [Compliance Statements for Environmental Requirements for Juniper Networks Devices on page 356](#)

## Compliance Statements for EMC Requirements for Juniper Networks Devices (Canada)

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

**Related Documentation**

- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Israel\) on page 355](#)
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Japan\) on page 355](#)

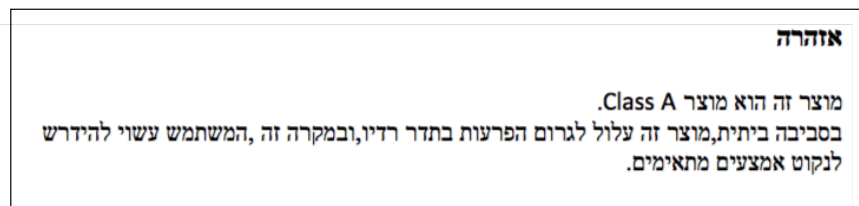
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(United States\)](#) on page 356

## T320 Compliance Statements for EMC Requirements (European Community)

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

- Related Documentation**
- [T320 Agency Approvals](#) on page 353

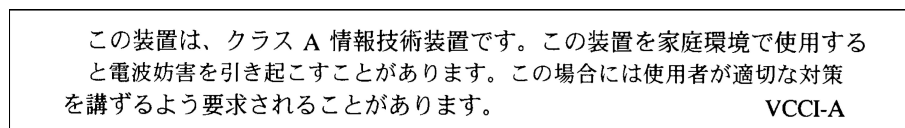
## Compliance Statements for EMC Requirements for Juniper Networks Devices (Israel)



Translation from Hebrew—Warning: This product is Class A. In residential environments, the product may cause radio interference, and in such a situation, the user may be required to take adequate measures.

- Related Documentation**
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Canada\)](#) on page 354
  - [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Japan\)](#) on page 355
  - [Compliance Statements for EMC Requirements for Juniper Networks Devices \(United States\)](#) on page 356

## Compliance Statements for EMC Requirements for Juniper Networks Devices (Japan)



Translation from Japanese—This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures. VCCI-A

- Related Documentation**

## Compliance Statements for EMC Requirements for Juniper Networks Devices (United States)

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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, may 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.

**Related  
Documentation**

## Compliance Statements for Environmental Requirements for Juniper Networks Devices

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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.

## T320 Compliance Statements for NEBS

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- 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**

- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Canada\) on page 354](#)
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Japan\) on page 355](#)
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(United States\) on page 356](#)
- [Compliance Statements for Environmental Requirements for Juniper Networks Devices on page 356](#)

## T320 Compliance Statements for Acoustic Noise

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- Maschinenlärminformations-Verordnung - 3. GPSGV, der höchste Schalldruckpegel beträgt 74 dB(A) oder weniger gemäss EN ISO 7779



- Translation—The emitted sound pressure resulted in 74 dB(A) per EN ISO 7779.

**Related  
Documentation**

- [T320 Compliance Statements for EMC Requirements \(European Community\) on page 355](#)
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(Japan\) on page 355](#)
- [Compliance Statements for EMC Requirements for Juniper Networks Devices \(United States\) on page 356](#)

