



## **MX240™ Ethernet Services Router**

# **Hardware Guide**

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# About This Guide

This preface provides the following guidelines for using the *MX240 Ethernet Services Router Hardware Guide*:

- Objectives on page xvii
- Audience on page xvii
- Documentation Conventions on page xviii
- List of Technical Publications on page xix
- Obtaining Documentation on page xxvi
- Documentation Feedback on page xxvi
- Requesting Technical Support on page xxvii

## Objectives

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This manual describes hardware components, installation, basic configuration, and basic troubleshooting procedures for the Juniper Networks MX240 Ethernet Services Router. It explains how to prepare your site for router installation, unpack and install the hardware, power on the router, perform initial software configuration, and perform routine maintenance. After completing the installation and basic configuration procedures covered in this manual, see the JUNOS software configuration guides for information about further JUNOS software configuration.



**NOTE:** For additional information about Juniper Networks Ethernet Services routers and the Dense Port Concentrators (DPCs) they support—either corrections to or information that might have been omitted from this guide—see the hardware release notes at <http://www.juniper.net/>.

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## Audience

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This guide is designed for network administrators who are installing and maintaining a Juniper Networks router or preparing a site for router installation. To use this guide, you need a broad understanding of networks in general, the Internet in particular, networking principles, and network configuration. Any detailed discussion of these concepts is beyond the scope of this guide.

## Documentation Conventions

Table 1 on page xviii defines the 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.

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

**Table 2: Text and Syntax Conventions**

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the <code>configure</code> 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 important new terms.</li> <li>Identifies book 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 System Basics Configuration 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
Plain text like this	Represents names of configuration statements, commands, files, and directories; IP addresses; 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 [edit protocols ospf area area-id] hierarchy level.</li> <li>■ The console port is labeled <b>CONSOLE</b>.</li> </ul>
< > (angle brackets)	Enclose 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</b>   <b>multicast</b> ( <i>string1</i>   <i>string2</i>   <i>string3</i> )
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	<b>rsvp</b> { # Required for dynamic MPLS only
[ ] (square brackets)	Enclose a variable for which you can substitute one or more values.	<b>community name members</b> [ <i>community-ids</i> ]
Indentation and braces ( { } )	Identify a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop <i>address</i> ; retain; } } }
; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
<b>J-Web GUI Conventions</b>		
<b>Bold text like this</b>	Represents J-Web 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 J-Web selections.	In the configuration editor hierarchy, select <b>Protocols &gt; Ospf</b> .

## List of Technical Publications

Table 3 on page xx lists the software and hardware guides and release notes for Juniper Networks J-series, M-series, MX-series, and T-series routing platforms and describes the contents of each document. Table 4 on page xxiv lists the books included in the *Network Operations Guide* series. Table 5 on page xxiv lists the manuals and release notes supporting JUNOS software with enhanced services. All documents are available at <http://www.juniper.net/techpubs/>.

Table 6 on page xxv lists additional books on Juniper Networks solutions that you can order through your bookstore. A complete list of such books is available at <http://www.juniper.net/books>.

**Table 3: Technical Documentation for Supported Routing Platforms**

Book	Description
<b>JUNOS Software for Supported Routing Platforms</b>	
<i>Access Privilege</i>	Explains how to configure access privileges in user classes by using permission flags and regular expressions. Lists the permission flags along with their associated command-line interface (CLI) operational mode commands and configuration statements.
<i>Class of Service</i>	Provides an overview of the class-of-service (CoS) functions of the JUNOS software and describes how to configure CoS features, including configuring multiple forwarding classes for transmitting packets, defining which packets are placed into each output queue, scheduling the transmission service level for each queue, and managing congestion through the random early detection (RED) algorithm.
<i>CLI User Guide</i>	Describes how to use the JUNOS command-line interface (CLI) to configure, monitor, and manage Juniper Networks routing platforms. This material was formerly covered in the <i>JUNOS System Basics Configuration Guide</i> .
<i>Feature Guide</i>	Provides a detailed explanation and configuration examples for several of the most complex features in the JUNOS software.
<i>High Availability</i>	Provides an overview of hardware and software resources that ensure a high level of continuous routing platform operation and describes how to configure high availability (HA) features such as nonstop active routing (NSR) and graceful Routing Engine switchover (GRES).
<i>MPLS Applications</i>	Provides an overview of traffic engineering concepts and describes how to configure traffic engineering protocols.
<i>Multicast Protocols</i>	Provides an overview of multicast concepts and describes how to configure multicast routing protocols.
<i>Multiplay Solutions</i>	Describes how you can deploy IPTV and voice over IP (VoIP) services in your network.
<i>MX-series Solutions Guide</i>	Describes common configuration scenarios for the Layer 2 features supported on the MX-series routers, including basic bridged VLANs with normalized VLAN tags, aggregated Ethernet links, bridge domains, Multiple Spanning Tree Protocol (MSTP), and integrated routing and bridging (IRB).
<i>Network Interfaces</i>	Provides an overview of the network interface functions of the JUNOS software and describes how to configure the network interfaces on the routing platform.
<i>Network Management</i>	Provides an overview of network management concepts and describes how to configure various network management features, such as SNMP and accounting options.

**Table 3: Technical Documentation for Supported Routing Platforms** (*continued*)

Book	Description
<i>Policy Framework</i>	Provides an overview of policy concepts and describes how to configure routing policy, firewall filters, and forwarding options.
<i>Routing Protocols</i>	Provides an overview of routing concepts and describes how to configure routing, routing instances, and unicast routing protocols.
<i>Secure Configuration Guide for Common Criteria and JUNOS-FIPS</i>	Provides an overview of secure Common Criteria and JUNOS-FIPS protocols for the JUNOS software and describes how to install and configure secure Common Criteria and JUNOS-FIPS on a routing platform.
<i>Services Interfaces</i>	Provides an overview of the services interfaces functions of the JUNOS software and describes how to configure the services interfaces on the router.
<i>Software Installation and Upgrade Guide</i>	Describes the JUNOS software components and packaging and explains how to initially configure, reinstall, and upgrade the JUNOS system software. This material was formerly covered in the <i>JUNOS System Basics Configuration Guide</i> .
<i>System Basics</i>	Describes Juniper Networks routing platforms and explains how to configure basic system parameters, supported protocols and software processes, authentication, and a variety of utilities for managing your router on the network.
<i>VPNs</i>	Provides an overview and describes how to configure Layer 2 and Layer 3 virtual private networks (VPNs), virtual private LAN service (VPLS), and Layer 2 circuits. Provides configuration examples.
<b>JUNOS References</b>	
<i>Hierarchy and RFC Reference</i>	Describes the JUNOS configuration mode commands. Provides a hierarchy reference that displays each level of a configuration hierarchy, and includes all possible configuration statements that can be used at that level. This material was formerly covered in the <i>JUNOS System Basics Configuration Guide</i> .
<i>Interfaces Command Reference</i>	Describes the JUNOS software operational mode commands you use to monitor and troubleshoot interfaces.
<i>Routing Protocols and Policies Command Reference</i>	Describes the JUNOS software operational mode commands you use to monitor and troubleshoot routing policies and protocols, including firewall filters.
<i>System Basics and Services Command Reference</i>	Describes the JUNOS software operational mode commands you use to monitor and troubleshoot system basics, including commands for real-time monitoring and route (or path) tracing, system software management, and chassis management. Also describes commands for monitoring and troubleshooting services such as class of service (CoS), IP Security (IPSec), stateful firewalls, flow collection, and flow monitoring.
<i>System Log Messages Reference</i>	Describes how to access and interpret system log messages generated by JUNOS software modules and provides a reference page for each message.

**Table 3: Technical Documentation for Supported Routing Platforms** (continued)

Book	Description
<b>J-Web User Guide</b>	
<i>J-Web Interface User Guide</i>	Describes how to use the J-Web graphical user interface (GUI) to configure, monitor, and manage Juniper Networks routing platforms.
<b>JUNOS API and Scripting Documentation</b>	
<i>JUNOScript API Guide</i>	Describes how to use the JUNOScript application programming interface (API) to monitor and configure Juniper Networks routing platforms.
<i>JUNOS XML API Configuration Reference</i>	Provides reference pages for the configuration tag elements in the JUNOS XML API.
<i>JUNOS XML API Operational Reference</i>	Provides reference pages for the operational tag elements in the JUNOS XML API.
<i>NETCONF API Guide</i>	Describes how to use the NETCONF API to monitor and configure Juniper Networks routing platforms.
<i>JUNOS Configuration and Diagnostic Automation Guide</i>	Describes how to use the commit script and self-diagnosis features of the JUNOS software. This guide explains how to enforce custom configuration rules defined in scripts, how to use commit script macros to provide simplified aliases for frequently used configuration statements, and how to configure diagnostic event policies.
<b>Hardware Documentation</b>	
<i>Hardware Guide</i>	Describes how to install, maintain, and troubleshoot routing platforms and components. Each platform has its own hardware guide.
<i>PIC Guide</i>	Describes the routing platform's Physical Interface Cards (PICs). Each platform has its own PIC guide.
<i>DPC Guide</i>	Describes the Dense Port Concentrators (DPCs) for all MX-series routers.
<b>JUNOScope Documentation</b>	
<i>JUNOScope Software User Guide</i>	Describes the JUNOScope software graphical user interface (GUI), how to install and administer the software, and how to use the software to manage routing platform configuration files and monitor routing platform operations.
<b>Advanced Insight Solutions (AIS) Documentation</b>	
<i>Advanced Insight Solutions Guide</i>	Describes the Advanced Insight Manager (AIM) application, which provides a gateway between JUNOS devices and Juniper Support Systems (JSS) for case management and intelligence updates. Explains how to run AI scripts on Juniper Networks devices.
<b>J-series Routing Platform Documentation</b>	

**Table 3: Technical Documentation for Supported Routing Platforms** (continued)

Book	Description
<i>Getting Started Guide</i>	Provides an overview, basic instructions, and specifications for J-series routing platforms. The guide explains how to prepare your site for installation, unpack and install the router and its components, install licenses, and establish basic connectivity. Use the <i>Getting Started Guide</i> for your router model.
<i>Basic LAN and WAN Access Configuration Guide</i>	Explains how to configure the interfaces on J-series Services Routers for basic IP routing with standard routing protocols, ISDN backup, and digital subscriber line (DSL) connections.
<i>Advanced WAN Access Configuration Guide</i>	Explains how to configure J-series Services Routers in virtual private networks (VPNs) and multicast networks, configure data link switching (DLSw) services, and apply routing techniques such as policies, stateless and stateful firewall filters, IP Security (IPSec) tunnels, and class-of-service (CoS) classification for safer, more efficient routing.
<i>Administration Guide</i>	Shows how to manage users and operations, monitor network performance, upgrade software, and diagnose common problems on J-series Services Routers.
<b>Release Notes</b>	
<i>JUNOS Release Notes</i>	Summarize new features and known problems for a particular software release, provide corrections and updates to published JUNOS, JUNOScript, and NETCONF manuals, provide information that might have been omitted from the manuals, and describe upgrade and downgrade procedures.
<i>Hardware Release Notes</i>	Describe the available documentation for the routing platform and summarize known problems with the hardware and accompanying software. Each platform has its own release notes.
<i>JUNOScope Release Notes</i>	Contain corrections and updates to the published JUNOScope manual, provide information that might have been omitted from the manual, and describe upgrade and downgrade procedures.
<i>AIS Release Notes</i>	Summarize AIS new features and guidelines, identify known and resolved problems, provide information that might have been omitted from the manuals, and provide initial setup, upgrade, and downgrade procedures.
<i>AIS AI Script Release Notes</i>	Summarize AI Scripts new features, identify known and resolved problems, provide information that might have been omitted from the manuals, and provide instructions for automatic and manual installation, including deleting and rolling back.
<i>J-series Services Router Release Notes</i>	Briefly describe Services Router features, identify known hardware problems, and provide upgrade and downgrade instructions.

**Table 4: JUNOS Software Network Operations Guides**

Book	Description
<i>Baseline</i>	Describes the most basic tasks for running a network using Juniper Networks products. Tasks include upgrading and reinstalling JUNOS software, gathering basic system management information, verifying your network topology, and searching log messages.
<i>Interfaces</i>	Describes tasks for monitoring interfaces. Tasks include using loopback testing and locating alarms.
<i>MPLS</i>	Describes tasks for configuring, monitoring, and troubleshooting an example MPLS network. Tasks include verifying the correct configuration of the MPLS and RSVP protocols, displaying the status and statistics of MPLS running on all routing platforms in the network, and using the layered MPLS troubleshooting model to investigate problems with an MPLS network.
<i>MPLS Log Reference</i>	Describes MPLS status and error messages that appear in the output of the <code>show mpls lsp extensive</code> command. The guide also describes how and when to configure Constrained Shortest Path First (CSPF) and RSVP trace options, and how to examine a CSPF or RSVP failure in a sample network.
<i>MPLS Fast Reroute</i>	Describes operational information helpful in monitoring and troubleshooting an MPLS network configured with fast reroute (FRR) and load balancing.
<i>Hardware</i>	Describes tasks for monitoring M-series and T-series routing platforms.

To configure and operate a J-series Services Router running JUNOS software with enhanced services, you must also use the configuration statements and operational mode commands documented in JUNOS configuration guides and command references. To configure and operate a WX Integrated Services Module, you must also use WX documentation.

**Table 5: JUNOS Software with Enhanced Services Documentation**

Book	Description
<i>JUNOS Software with Enhanced Services Design and Implementation Guide</i>	Provides guidelines and examples for designing and implementing IP Security (IPSec) virtual private networks (VPNs), firewalls, and routing on J-series routers running JUNOS software with enhanced services.
<i>JUNOS Software with Enhanced Services J-series Services Router Quick Start</i>	Explains how to quickly set up a J-series router. This document contains router declarations of conformity.
<i>JUNOS Software with Enhanced Services J-series Services Router Getting Started Guide</i>	Provides an overview, basic instructions, and specifications for J-series Services Routers. This guide explains how to prepare a site, unpack and install the router, replace router hardware, and establish basic router connectivity. This guide contains hardware descriptions and specifications.



**Table 5: JUNOS Software with Enhanced Services Documentation (continued)**

Book	Description
<i>JUNOS Software with Enhanced Services Migration Guide</i>	Provides instructions for migrating an SSG device running ScreenOS software or a J-series router running the JUNOS software to JUNOS software with enhanced services.
<i>JUNOS Software with Enhanced Services Interfaces and Routing Configuration Guide</i>	Explains how to configure J-series router interfaces for basic IP routing with standard routing protocols, ISDN service, firewall filters (access control lists), and class-of-service (CoS) traffic classification.
<i>JUNOS Software with Enhanced Services Security Configuration Guide</i>	Explains how to configure and manage security services such as stateful firewall policies, IPSec VPNs, firewall screens, Network Address translation (NAT) and Router interface modes, Public Key Cryptography, and Application Layer Gateways (ALGs).
<i>JUNOS Software with Enhanced Services Administration Guide</i>	Shows how to monitor the router and routing operations, firewall and security services, system alarms and events, and network performance. This guide also shows how to administer user authentication and access, upgrade software, and diagnose common problems.
<i>JUNOS Software with Enhanced Services CLI Reference</i>	Provides the complete JUNOS software with enhanced services configuration hierarchy and describes the configuration statements and operational mode commands not documented in the standard JUNOS manuals.
<i>WXC Integrated Services Module Installation and Configuration Guide</i>	Explains how to install and initially configure a WXC Integrated Services Module in a J-series router for application acceleration.
<i>JUNOS Software with Enhanced Services Release Notes</i>	Summarize new features and known problems for a particular release of JUNOS software with enhanced services on J-series routers, including J-Web interface features and problems. The release notes also contain corrections and updates to the manuals and software upgrade and downgrade instructions for JUNOS software with enhanced services.

**Table 6: Additional Books Available Through <http://www.juniper.net/books>**

Book	Description
<i>Interdomain Multicast Routing</i>	Provides background and in-depth analysis of multicast routing using Protocol Independent Multicast sparse mode (PIM SM) and Multicast Source Discovery Protocol (MSDP); details any-source and source-specific multicast delivery models; explores multiprotocol BGP (MBGP) and multicast IS-IS; explains Internet Gateway Management Protocol (IGMP) versions 1, 2, and 3; lists packet formats for IGMP, PIM, and MSDP; and provides a complete glossary of multicast terms.
<i>JUNOS Cookbook</i>	Provides detailed examples of common JUNOS software configuration tasks, such as basic router configuration and file management, security and access control, logging, routing policy, firewalls, routing protocols, MPLS, and VPNs.

**Table 6: Additional Books Available Through <http://www.juniper.net/books> (continued)**

Book	Description
<i>MPLS-Enabled Applications</i>	Provides an overview of Multiprotocol Label Switching (MPLS) applications (such as Layer 3 virtual private networks [VPNs], Layer 2 VPNs, virtual private LAN service [VPLS], and pseudowires), explains how to apply MPLS, examines the scaling requirements of equipment at different points in the network, and covers the following topics: point-to-multipoint label switched paths (LSPs), DiffServ-aware traffic engineering, class of service, interdomain traffic engineering, path computation, route target filtering, multicast support for Layer 3 VPNs, and management and troubleshooting of MPLS networks.
<i>OSPF and IS-IS: Choosing an IGP for Large-Scale Networks</i>	Explores the full range of characteristics and capabilities for the two major link-state routing protocols: Open Shortest Path First (OSPF) and IS-IS. Explains architecture, packet types, and addressing; demonstrates how to improve scalability; shows how to design large-scale networks for maximum security and reliability; details protocol extensions for MPLS-based traffic engineering, IPv6, and multipoint-to-multipoint routing; and covers troubleshooting for OSPF and IS-IS networks.
<i>Routing Policy and Protocols for Multivendor IP Networks</i>	Provides a brief history of the Internet, explains IP addressing and routing (Routing Information Protocol [RIP], OSPF, IS-IS, and Border Gateway Protocol [BGP]), explores ISP peering and routing policies, and displays configurations for both Juniper Networks and other vendors' routers.
<i>The Complete IS-IS Protocol</i>	Provides the insight and practical solutions necessary to understand the IS-IS protocol and how it works by using a multivendor, real-world approach.

## Obtaining Documentation

To obtain the most current version of all Juniper Networks technical documentation, see the products documentation page on the Juniper Networks Web site at <http://www.juniper.net/>.

To order printed copies of this guide and other Juniper Networks technical documents, or to order a documentation CD, which contains this guide, contact your sales representative.

Copies of the Management Information Bases (MIBs) available in a software release are included on the documentation CDs and at <http://www.juniper.net/>.

## Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can send your comments to [techpubs-comments@juniper.net](mailto:techpubs-comments@juniper.net), or fill out the documentation feedback form at <http://www.juniper.net/techpubs/docbug/docbugreport.html>. If you are using e-mail, be sure to include the following information with your comments:

- Document name
- Document part number
- Page number
- Software release version (not required for *Network Operations Guides [NOGs]*)

## 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 JNASC support contract, or are covered under warranty, and need postsales 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/customers/support/downloads/710059.pdf>.
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/>.
- JTAC Hours of Operation —The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

### Self-Help Online Tools and Resources

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

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

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool located at <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 Manager 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, visit us at <http://www.juniper.net/support/requesting-support.html>.



## **Part 1**

# **MX240 Router Overview**

- Router Overview on page 3
- Hardware Components on page 5



## Chapter 1

# Router Overview

This chapter provides an overview of the MX240 Ethernet Services Router, discussing the following topics:

- Router Description on page 3
- Component Redundancy on page 4

## Router Description

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The MX240 Ethernet Services Router is an Ethernet-optimized edge router that provides both switching and carrier-class Ethernet routing, with a capacity of up to 120 gigabits per second (Gbps), full duplex. The MX240 router enables a wide range of business and residential applications and services, including high-speed transport and VPN services, next-generation broadband multiplay services, and high-volume Internet data center internetworking.

The MX240 router is five rack units (U) tall. Several routers can be stacked in a single floor-to-ceiling rack, for increased port density per unit of floor space. Fully populated, the MX240 provides up to 120 Gigabit Ethernet or up to 12 10-Gigabit Ethernet ports.

The router provides two dedicated slots for Dense Port Concentrators (DPC), one dedicated slot for a Switch Control Board (SCB), and one multifunction slot for either one DPC or one SCB.

The Packet Forwarding Engines are combined with the Ethernet ports on a Dense Port Concentrator (DPC), which installs into the router chassis. Each Packet Forwarding Engine enables a throughput of 10 Gbps. The DPCs are connected to one or two SCBs. The connections between DPCs and SCBs are organized in three groups:

- Switch Fabric—Connects the DPCs and provides for packet transport between DPCs.
- Control plane—Gigabit Ethernet links between the combined SCBs/Routing Engines and each DPC. All board-to-board information is passed over Ethernet except for low-level status and commands.
- Management signals—Provide low-level status diagnostic support.

## Component Redundancy

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The MX240 chassis provides redundancy and resiliency. The hardware system is fully redundant, including power supplies, Routing Engines, and SCBs.

A fully configured router is designed so that no single point of failure can cause the entire system to fail. Only a fully configured router provides complete redundancy. All other configurations provide partial redundancy. The following major hardware components are redundant:

- **Host subsystem**—The host subsystem consists of a Routing Engine functioning together with an SCB. 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 directly into in an SCB.

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

- In the high-line (220 V) AC power configuration, the MX240 router contains one or two AC power supplies, located horizontally at the rear of the chassis in slots **PEM0** and **PEM2** (left to right) (see Figure 3 on page 7). The high-line configuration requires one power supply, with the second power supply providing redundancy. Each AC power supply provides power to all components in the router. When two power supplies are present, they share power almost equally within a fully populated system. If one power supply fails or is removed, the remaining power supply assumes the entire electrical load without interruption. One power supply can provide the maximum configuration with full power for as long as the router is operational.
- In the low-line (110 V) AC power configuration, the MX240 router contains either two AC power supplies (nonredundant), located horizontally at the rear of the chassis in slots **PEM0** and **PEM1** (left to right); or four AC power supplies (redundant), located in slots **PEM0** through **PEM3** (left to right) (see Figure 2 on page 6). The low-line configuration requires two power supplies, and the third and fourth power supplies provide redundancy. Each AC power supply provides power to all components in the router. When two power supplies are present, they share power almost equally within a fully populated system. If one power supply in a redundant configuration fails or is removed, the remaining power supplies assume the entire electrical load without interruption. Two power supplies provide the maximum configuration with full power for as long as the router is operational.
- **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.



## Chapter 2

# Hardware Components

This chapter provides an overview of the router's hardware components:

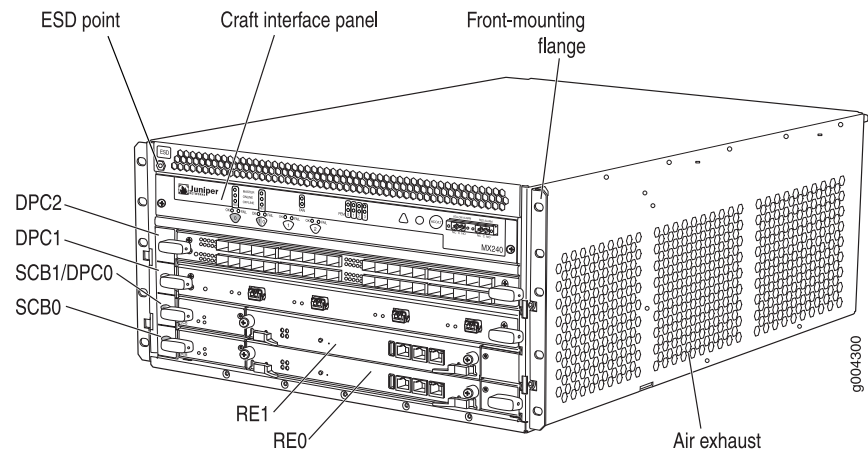
- Router Chassis on page 5
- Midplane on page 8
- Dense Port Concentrators (DPCs) on page 8
- Host Subsystem on page 11
- Cable Management System on page 17
- Craft Interface on page 17
- Power Supplies on page 21
- Cooling System on page 24

### Router Chassis

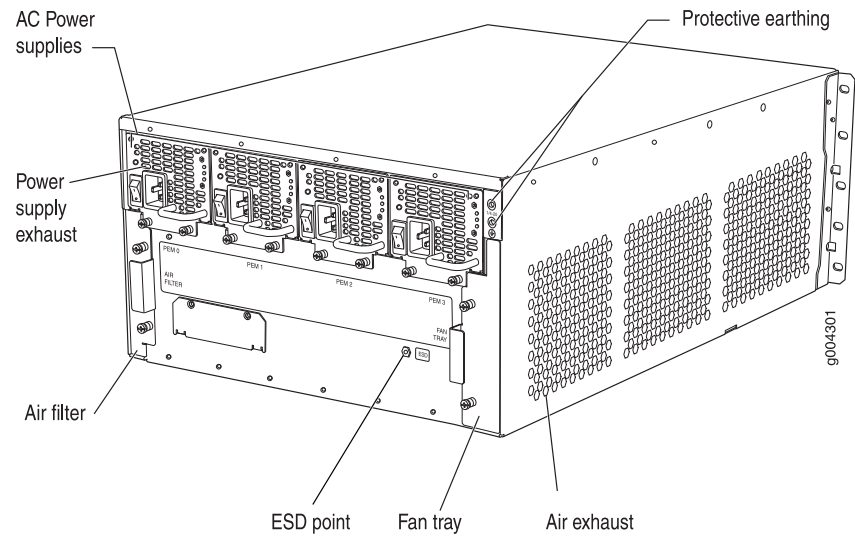
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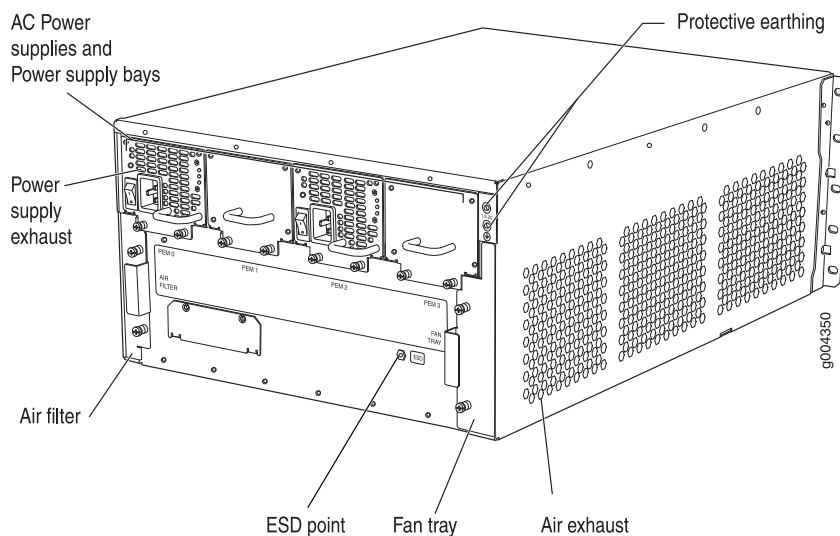
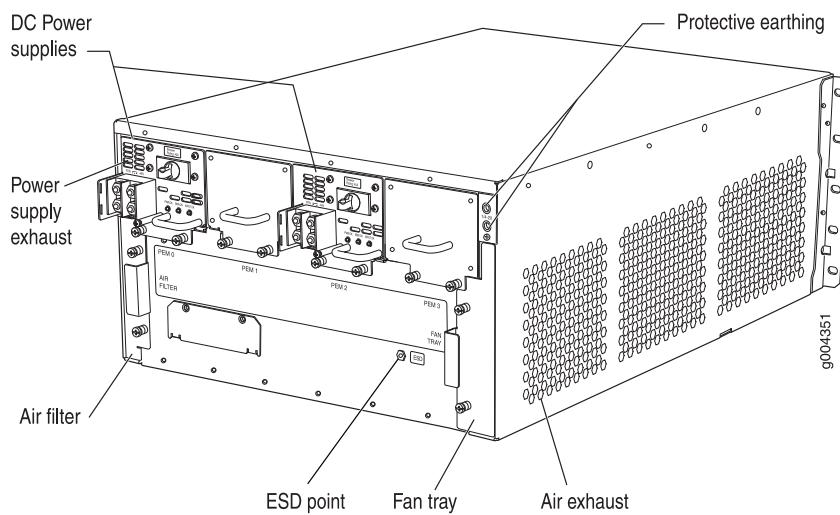
The router chassis is a rigid sheet metal structure that houses all the other router components (see Figure 1 on page 6, Figure 2 on page 6, Figure 3 on page 7, and Figure 4 on page 7). The chassis measures 8.71 in. (22.1 cm) high, 17.45 in. (44.3 cm) wide, and 24.5 in. (62.2 cm) deep (from the front-mounting brackets to the rear of the chassis). The chassis installs in standard 800-mm deep (or larger) enclosed cabinets, 19-in. equipment racks, or telco open-frame racks. See Table 25 on page 161.

**Figure 1: Front View of a Fully Configured Router Chassis**



**Figure 2: Rear View of a Fully Configured AC-Powered Router Chassis (110 V)**



**Figure 3: Rear View of a Fully Configured AC-Powered Router Chassis (220V)****Figure 4: Rear View of a Fully Configured DC-Powered Router Chassis**

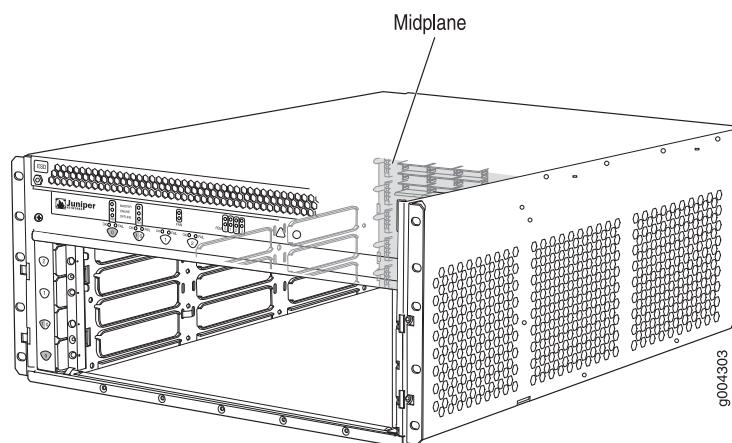
## Midplane

The midplane is located toward the rear of the chassis and forms the rear of the DPC card cage (see Figure 5 on page 8). The DPCs and SCBs install into the midplane from the front of the chassis, and the power supplies install into the midplane from the rear of the chassis. The cooling system components also connect to the midplane.

The midplane performs the following major functions:

- Data path—Data packets are transferred across the midplane between the DPCs through the fabric ASICs on the SCBs.
- Power distribution—The router power supplies connect to the midplane, which distributes power to all the router components.
- Signal path—The midplane provides the signal path to the DPCs, SCBs, Routing Engines, and other system components for monitoring and control of the system.

**Figure 5: Midplane**



## Dense Port Concentrators (DPCs)

A Dense Port Concentrator (DPC) is optimized for Ethernet density and supports up to 40 Gigabit Ethernet or four 10-Gigabit Ethernet ports (see Figure 6 on page 9). The DPC assembly combines packet forwarding and Ethernet interfaces on a single board, with four 10-Gbps Packet Forwarding Engines. Each Packet Forwarding Engine consists of one I-chip for Layer 3 processing and one Layer 2 network processor. The DPCs interface with the power supplies and Switch Control Boards (SCBs).

The router has two dedicated DPC slots. DPCs install horizontally in the front of the router (see Figure 6 on page 9). One multifunction slot numbered 1/0 supports either one DPC or one SCB. The DPC slots are numbered 1/0, 1, and 2 bottom to top. A DPC can be installed in any slot on the router that supports DPCs.

You can install any combination of DPC types in the router.

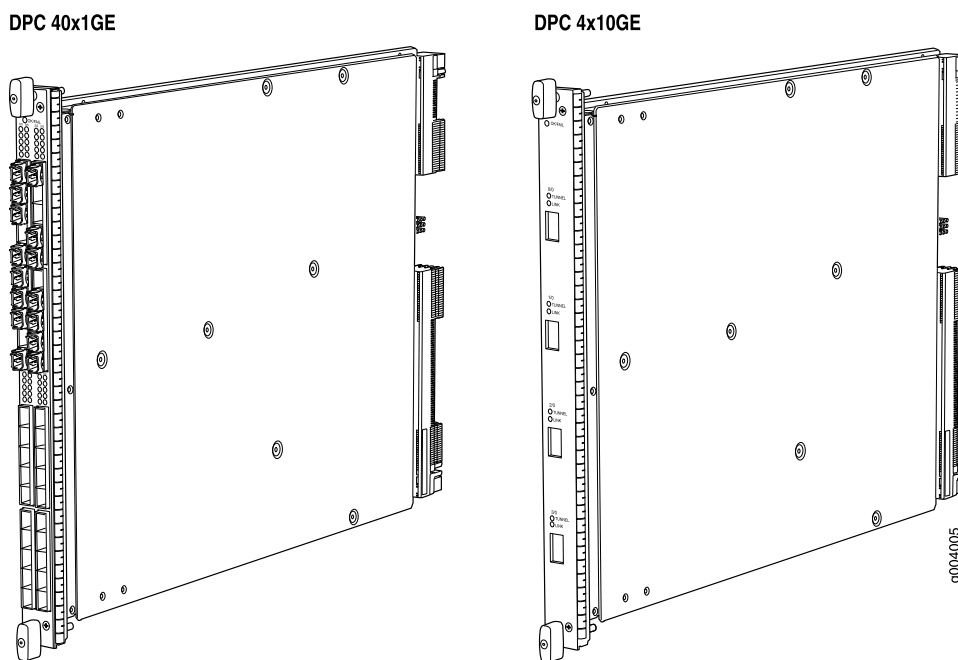
DPCs are hot-removable and hot-insertable, as described in “Field-Replaceable Units (FRUs)” on page 87. When you install a DPC in an operating router, the Routing

Engine downloads the DPC software, the DPC runs its diagnostics, and the Packet Forwarding Engines housed on the DPC are enabled. Forwarding on other DPCs continues uninterrupted during this process. For DPC replacement instructions, see “Replacing a DPC” on page 106.

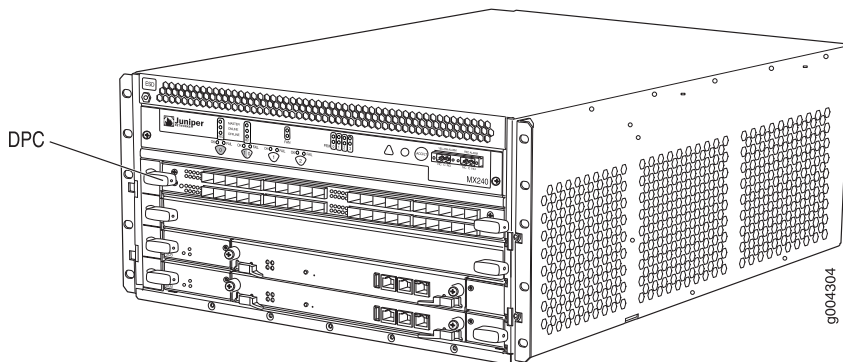
If a slot is not occupied by a DPC or SCB, a blank panel must be installed to shield the empty slot and to allow cooling air to circulate properly through the router.

Figure 6 on page 9 shows typical DPCs supported on the MX240 router. For more information about DPCs, see the *MX-series Ethernet Services Router DPC Guide*.

**Figure 6: Typical DPCs Supported on the MX240 Router**



**Figure 7: DPC Installed Horizontally in the MX240 Router**



## DPC Components

Each DPC consists of the following components:

- DPC cover, which functions as a ground plane and a stiffener.
- Fabric interfaces.
- Two Gigabit Ethernet interfaces that allow control information, route information, and statistics to be sent between the Routing Engine and the CPU on the DPCs.
- Two interfaces from the SCBs that enable the DPCs to be powered on and controlled.
- Physical DPC connectors.
- Four Packet Forwarding Engines.
- Midplane connectors and power circuitry.
- Processor subsystem, which includes a 1.2-GHz CPU, system controller, and 1 GB of SDRAM.
- Online button—Takes the DPC online or offline when pressed.
- LEDs on the 4-port 10-Gigabit Ethernet faceplate, which indicate the port status. LEDs are labeled top to bottom 0/0 through 0/3 (see Table 7 on page 10).
- LEDs on a 40-port Gigabit Ethernet faceplate indicate the port status. LEDs are labeled horizontally and left to right 0/0 through 0/5, 1/0 through 1/5, 2/0 through 2/5, and 3/0 through 3/5 (see Table 8 on page 10).

**Table 7: Four-Port 10-Gigabit Ethernet DPC LEDs**

Label	Color	State	Description
OK/FAIL	Green	On steadily	DPC is functioning normally.
	Red	On steadily	DPC has failed.
TUNNEL	Green	Off	Normal operating mode.
		On steadily	Port configured in tunnel mode.
LINK	Green	On steadily	Link is active.
		Off	No link.

**Table 8: 40-Port Gigabit Ethernet DPC LEDs**

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

**Table 8: 40-Port Gigabit Ethernet DPC LEDs** *(continued)*

Label	Color	State	Description
LINK	Green	On steadily	Link is active.
	Off		No link.

Two LEDs, located on the craft interface above the DPC, display the status of the DPC and are labeled **OK** and **FAIL**. For more information about the DPC LEDs located on the craft interface, see “DPC LEDs” on page 20.

## Host Subsystem

The host subsystem provides the routing and system management functions of the router. You can install one or two host subsystems on the router. Each host subsystem functions as a unit; the Routing Engine must be installed directly into the Switch Control Board.



**NOTE:** We recommend that you install two host subsystems for redundant protection. If you install only one host subsystem, we recommend that you install it in slot 0.

Each host subsystem has three LEDs that display its status. The host subsystem LEDs are located on the upper left of the craft interface. For more information about the host subsystem LEDs, see “Host Subsystem LEDs” on page 19.

The host subsystem consists of the following components:

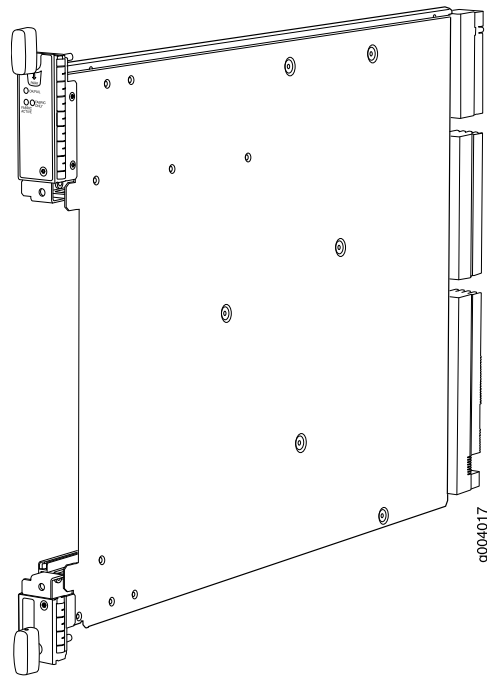
- Switch Control Board (SCB) on page 11
- Routing Engine on page 14

### Switch Control Board (SCB)

The Switch Control Board (SCB) provides the following functions:

- Powers on and powers off DPCs
- Controls clocking, system resets and booting
- Monitors and controls system functions, including fan speed, board power status, PDM status and control, and the craft interface
- Provides interconnections to all the DPCs within the chassis through the switch fabrics integrated into the SCB

The Routing Engine installs directly into a slot on the SCB (see Figure 8 on page 12).

**Figure 8: SCB**

### SCB Slots

You can install one or two SCBs. The SCBs install horizontally into the front of the chassis in the slots labeled 0 and 1/0 (the multifunction slot 1/0 can contain either SCB1 or DPC0). If any slots are empty, you must install a blank panel.

### SCB Redundancy

If two SCBs are installed, one SCB functions as the master SCB and the other as its backup. If the master fails or is removed, the backup becomes the master.



## SCB Components

Each SCB consists of the following components:

- Chassis management Ethernet switch.
- I2C bus logic, used for low-level communication with each component.
- Component redundancy circuitry.
- Control Board/Routing Engine mastership mechanism.
- Gigabit Ethernet switch that is connected to the embedded CPU complex on all components.
- Switch fabric—Provides the switching functions for the DPCs.
- Control FPGA—Provides the Peripheral Component Interconnect (PCI) interface to the Routing Engine.
- 1000Base-T Ethernet controller—Provides a 1-Gbps Ethernet link between the Routing Engines.
- Ethernet switch—Provides 1-Gbps link speeds between the Routing Engine and the DPCs.
- Circuits for chassis management and control.
- Power circuits for the Routing Engine and SCB.
- LEDs—Provide status (see “SCB LEDs” on page 13)

## SCB LEDs

Three LEDs on the SCB indicate the status of the SCB. The LEDs, labeled **FABRIC ACTIVE**, **FABRIC ONLY**, and **OK/FAIL**, are located directly on the SCB. Table 9 on page 13 describes the functions of the SCB LEDs.

**Table 9: Switch Control Board LEDs**

Label	Color	State	Description
FABRIC ACTIVE	Green	On steadily	Fabric is in active mode.
FABRIC ONLY	Green	On steadily	SCB operates in fabric-only mode.
		Off	SCB operates in fabric/control board mode.
OK/FAIL	Green	On steadily	SCB is online.
	Off		SCB is offline.
	Red	On steadily	SCB has failed.

## Routing Engine

The Routing Engine is an Intel-based PC platform that runs JUNOS software. 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 front of the chassis in horizontal slots in the SCBs labeled **0** and **1/0**. Each Routing Engine must be installed directly into an SCB. A USB port on the Routing Engine accepts a USB memory card that allows you to load JUNOS software.

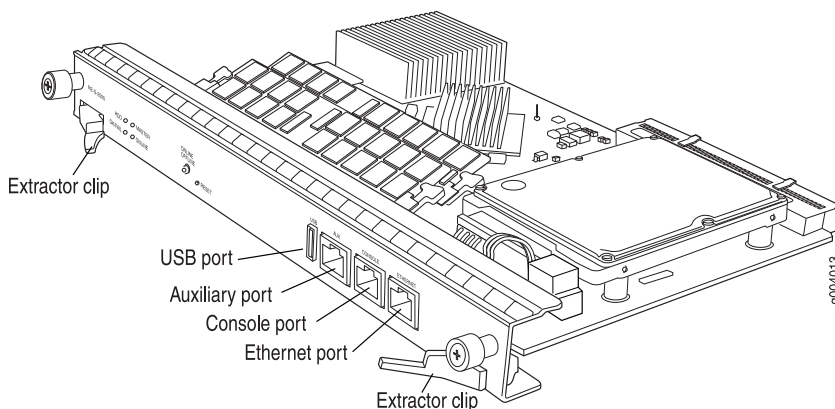
If two Routing Engines are installed, one functions as the master and the other acts as the backup. If the master Routing Engine fails or is removed and the backup is configured appropriately, the backup takes over as the master. The Backup Routing Engine is hot-insertable and hot-removable.

The MX240 router supports the RE-S-1300-2048 Routing Engine and the RE-S-2000-4096 Routing Engine. Both Routing Engines have the same ports and LEDs on the faceplate.



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

**Figure 9: Routing Engine**

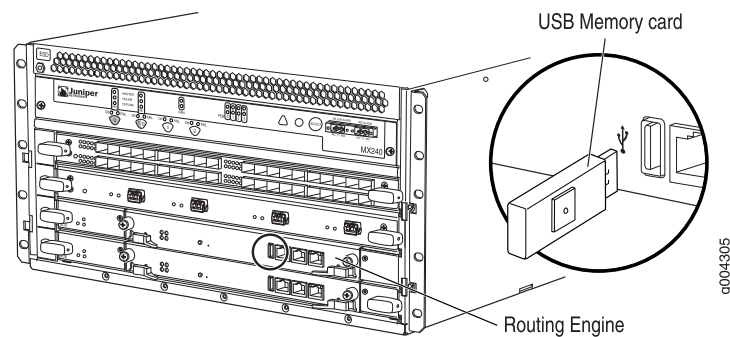


### Routing Engine Components

Each Routing Engine (shown in Figure 9 on page 14) consists of the following components:

- CPU—Runs JUNOS software to maintain the router's routing tables and routing protocols. It has a Pentium-class processor.
- DRAM—Provides storage for the routing and forwarding tables and for other Routing Engine processes.
- USB port—Provides a removable media interface through which you can install the JUNOS software manually. (See Figure 10 on page 15.) JUNOS supports USB version 1.0.

**Figure 10: USB Memory Device in a Routing Engine**



- CompactFlash card—Provides primary storage for software images, configuration files, and microcode. The CompactFlash card is fixed 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.
- Management ports—Each Routing Engine has one 10/100-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. The interface ports are labelled **AUX**, **CONSOLE**, and **ETHERNET**.
- EEPROM—Stores the serial number of the Routing Engine.
- Reset button—Reboots the Routing Engine when pressed.
- Online/Offline button—Takes the Routing Engine online or offline when pressed.
- Extractor clips—Used for inserting and extracting the Routing Engine.
- Captive screws—Secure the Routing Engine in place.



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

Each Routing Engine has four LEDs that indicate its status. The LEDs, labeled **MASTER**, **HDD**, **ONLINE**, and **FAIL**, are located directly on the faceplate of the Routing Engine. Table 10 on page 16 describes the functions of the Routing Engine LEDs.

**Table 10: Routing Engine LEDs**

Label	Color	State	Description
MASTER	Blue	On steadily	Routing Engine is the Master.
HDD	Green	Green blinking	Hard disk is functioning normally.
ONLINE	Green	Blinking	Routing Engine is transitioning online.
		On steadily	Routing Engine is functioning normally.
FAIL	Red	On steadily	Routing Engine has failed.

## Routing Engine Interface Ports

Three Routing Engine ports connect the Routing Engine to one or more external devices on which system administrators can issue JUNOS command-line interface (CLI) commands to manage the router (see Figure 9 on page 14).

The ports with the indicated labels function as follows:

- **AUX**—Connects the Routing Engine to a laptop, modem, or other auxiliary device through a serial cable with an RJ-45 connector.
- **CONSOLE**—Connects the Routing Engine to a system console through a serial cable with an RJ-45 connector.
- **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 10-Mbps or 100-Mbps connections. Two small LEDs on the top of the port indicate the connection in use: the LED flashes yellow or green for a 10-Mbps or 100-Mbps connection, and the LED is light green when traffic is passing through the port.

For information about the pinouts for the connectors, see “Cable Connector Pinouts” on page 185.

## Routing Engine Boot Sequence

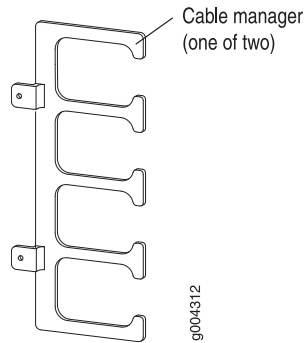
The Routing Engine boots from the storage media in this order: the USB device (if present), then the CompactFlash card, then the hard disk, then the LAN.

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

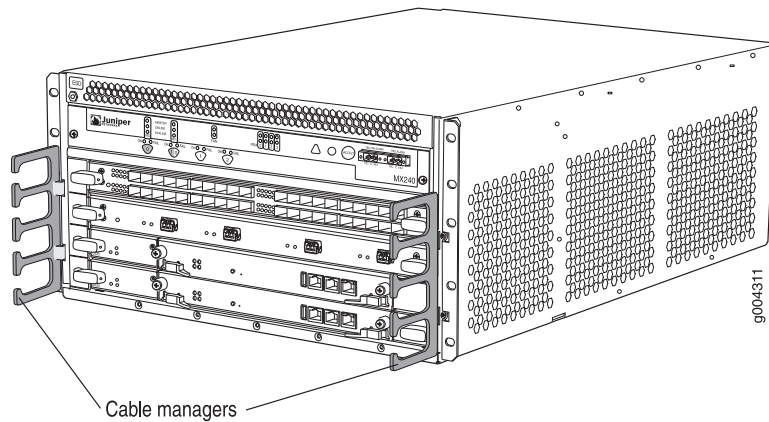
## Cable Management System

The cable management system (see Figure 11 on page 17 and Figure 12 on page 17) consists of plastic dividers located on the left and right sides of each DPC, SCB, and multifunction slot. The cable management system allows you to route the cables outside the router and away from the DPCs, SCBs, and Routing Engines.

**Figure 11: Cable Management System**



**Figure 12: Cable Management System Installed on the Router**

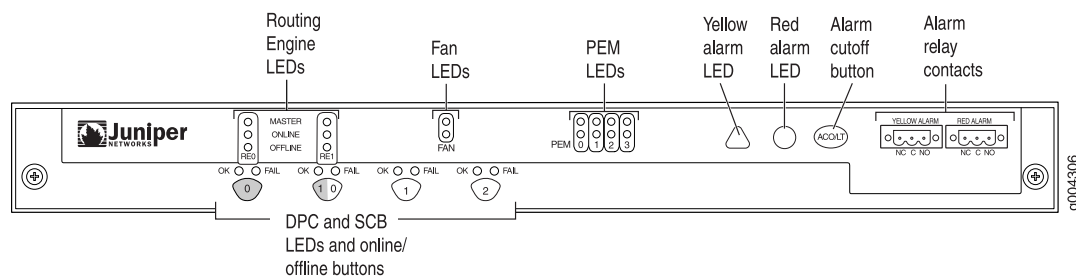


## Craft Interface

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 DPC card cage and contains the following components:

- Alarm LEDs and Alarm Cutoff/Lamp Test Button on page 18
- Host Subsystem LEDs on page 19
- Power Supply LEDs on page 19
- DPC LEDs on page 20

- SCB LEDs on page 20
- Fan LEDs on page 20
- Alarm Relay Contacts on page 21

**Figure 13: Front Panel of the Craft Interface**

**NOTE:** At least one SCB must be installed in the router for the craft interface to obtain power.

### Alarm LEDs and Alarm Cutoff/Lamp Test Button




Two large alarm LEDs are located at the upper right of the craft interface (see Figure 13 on page 18). 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 craft interface, as described in “Alarm Relay Contacts” on page 21.

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 craft interface.

Table 11 on page 19 describes the alarm LEDs and alarm cutoff button in more detail.

**Table 11: 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.

## Host Subsystem LEDs

Each host subsystem has three LEDs, located on the upper left of the craft interface, that indicate its status. The LEDs labeled **RE0** show the status of the Routing Engine in slot 0 and the SCB in slot 0. The LEDs labeled **RE1** show the status of the Routing Engine and SCB in slot 1. Table 12 on page 19 describes the functions of the host subsystem LEDs.

**Table 12: Host Subsystem LEDs**

Label	Color	State	Description
MASTER	Green	On steadily	Host is functioning as the master.
ONLINE	Green	On steadily	Host is online and is functioning normally.
OFFLINE	Red	On steadily	Host is installed but the Routing Engine is offline.
		Off	Host is not installed.

## Power Supply LEDs

Each power supply has two LEDs on the craft interface that indicate its status. The LEDs, labeled 0 through 3, are located on the upper left of the craft interface next to the **PEM** label. Table 13 on page 19 describes the functions of the power supply LEDs on the craft interface.

**Table 13: Power Supply LEDs on the Craft Interface**

Label	Color	State	Description
PEM	Green	On steadily	Power supply is functioning normally.
	Red	On steadily	Power supply has failed or power input has failed.

## DPC LEDs

Each DPC has LEDs on the craft interface that indicate its status. The DPC LEDs, labeled 1/0, 1, and 2, (1/0 shows status of either SCB1 or DPC0, depending on which component is installed in the slot), are located along the bottom of the craft interface.

**Table 14: DPC LEDs**

Label	Color	State	Description
OK	Green	On steadily	DPC is functioning normally.
		Blinking	DPC is transitioning online or offline.
		Off	The slot is not online.
FAIL	Red	On steadily	DPC has failed.

## SCB LEDs

Each SCB has two LEDs on the craft interface that indicates its status. The SCB LEDs, labeled 0 and 1/0 (the multifunction slot 1/0 can contain either SCB1 or DPC0), are located along the bottom of the craft interface. Table 15 on page 20 describes the functions of the SCB LEDs.

**Table 15: SCB LEDs**

Label	Color	State	Description
OK	Green	On steadily	SCB: Fabric and control board functioning normally.
		Blinking	SCB is transitioning online or offline.
		Off	The slot is not online.
FAIL	Red	On steadily	SCB has failed.

## Fan LEDs

The fan LED is located on the top left of the craft interface. Table 16 on page 20 describes the functions of the fan LEDs.

**Table 16: Fan LEDs**

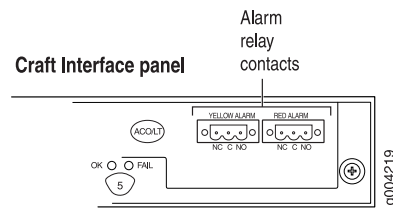
Label	Color	State	Description
FAN	Green	On steadily	Fan is functioning normally.
	Red	On steadily	Fan has failed.



## Alarm Relay Contacts

The craft interface has two alarm relay contacts for connecting the router to external alarm devices (see Figure 14 on page 21). 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 on the upper right of the craft interface.

**Figure 14: Alarm Relay Contacts**



## Power Supplies

The MX240 router uses either AC or DC power supplies. You can configure the MX240 router with either one or two high-line (220 V) AC power supplies, two or four low-line (110 V) AC power supplies, or one or two DC power supplies. 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. Each power supply is cooled by its own internal cooling system.

Redundant power supplies are hot-removable and hot-insertable. When you remove a power supply from a router that uses a nonredundant power supply configuration, the router might shut down depending on your configuration.



**CAUTION:** The router cannot be powered from AC and DC power supplies simultaneously.

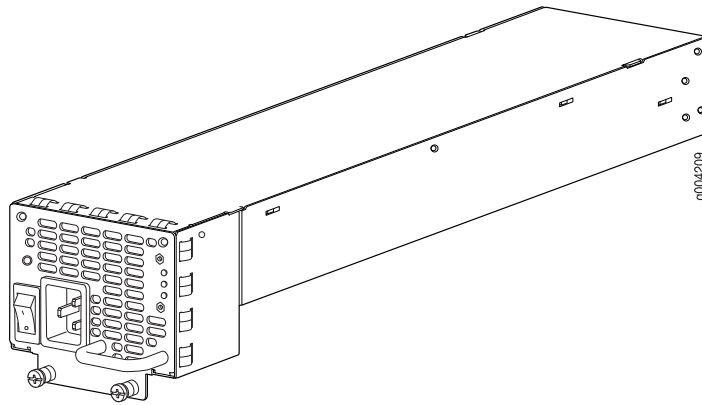


**NOTE:** Routers configured with only one or two power supplies are shipped with a blank panel installed over the power supply slots that are not populated.

## AC Power Supply

Each AC power supply weighs approximately 5.0 lb (2.3 kg) and consists of one AC appliance inlet, one AC switch, a fan, and LEDs to monitor the status of the power supply. Figure 15 on page 22 shows the power supply.

Each inlet requires a dedicated AC power feed and a dedicated facility circuit breaker. We recommend that you use a minimum 15 A (250 VAC) facility circuit breaker, or as required by local code. For information about connecting the router to power, see “Connecting Power to an AC-Powered Router” on page 54.

**Figure 15: AC Power Supply**

**WARNING:** The router is pluggable type A equipment installed in a restricted-access location. It has a separate protective earthing terminal (sized for UNC 1/4-20 ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earthing terminal must be permanently connected to earth.

In the high-line (220 V) AC power configuration, the MX240 router contains one or two AC power supplies, located horizontally at the rear of the chassis in slots **PEM0** and **PEM2** (left to right) (see Figure 3 on page 7). The high-line configuration requires one power supply, with the second power supply providing redundancy. Each AC power supply provides power to all components in the router. When two power supplies are present, they share power almost equally within a fully populated system. If one power supply fails or is removed, the remaining power supply assumes the entire electrical load without interruption. One power supply can provide the maximum configuration with full power for as long as the router is operational.

In the low-line (110 V) AC power configuration, the MX240 router contains either two AC power supplies (nonredundant), located horizontally at the rear of the chassis in slots **PEM0** and **PEM1** (left to right); or four AC power supplies (redundant), located in slots **PEM0** through **PEM3** (left to right) (see Figure 2 on page 6). The low-line configuration requires two power supplies, and the third and fourth power supplies provide redundancy. Each AC power supply provides power to all components in the router. When two power supplies are present, they share power almost equally within a fully populated system. If one power supply in a redundant configuration fails or is removed, the remaining power supplies assume the entire electrical load without interruption. Two power supplies provide the maximum configuration with full power for as long as the router is operational.

### AC Power Supply LEDs

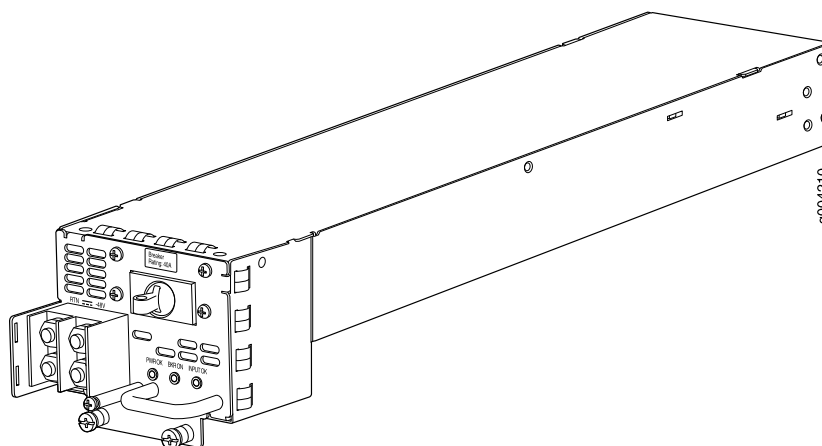
Each AC power supply faceplate contains three LEDs that indicate the status of the power supply (see Table 17 on page 23). The power supply status is also reflected in two LEDs on the craft interface (see Table 13 on page 19). In addition, a power supply failure triggers the red alarm LED on the craft interface.

**Table 17: AC Power Supply LEDs**

Label	Color	State	Description
AC OK	Amber	Off	AC power input voltage is below 78 VAC.
	Green	On	AC power input voltage is within 78–264 VAC.
DC OK	Green	Off	DC power outputs generated by the power supply are not within the normal operating ranges.
		On	DC power outputs generated by the power supply are within the normal operating ranges.
PS FAIL	Red	Off	Power supply is functioning normally.
		On	Power supply is not functioning normally and its output voltage is out of regulation limits. Check AC OK and DC OK LEDs for more information.

## DC Power Supply

Each DC power supply has a single DC input (–48 VDC and return) that requires a dedicated circuit breaker. We recommend that you use a minimum 40 A facility circuit breaker, or as required by local code.

**Figure 16: DC Power Supply**

For information about site power preparations, see “Power Guidelines, Requirements, and Specifications” on page 165. For information about connecting the router to power, see “Connecting Power to a DC-Powered Router” on page 56. For DC power electrical specifications, see “DC Power System Electrical Specifications” on page 167.

## DC Power Supply Configurations for the MX240 Router

In the DC power configuration, the router contains either one or two DC power supplies (see Figure 16 on page 23) located at the rear of the chassis in slots PEMO

and PEM2 (left to right). You can upgrade your DC power system from one to two power supplies. A single DC power supply provides power to all components.

One DC power supply is required. A second DC power supply provides redundancy. If a DC power supply in a redundant configuration fails, the redundant power supply takes over without interruption.

### DC Power Supply LEDs

Each DC power supply faceplate contains three LEDs that indicate the status of the power supply (see Table 18 on page 24). The power supply status is also reflected in two LEDs on the craft interface (see Table 13 on page 19). In addition, a power supply failure triggers the red alarm LED on the craft interface.



**NOTE:** An SCB must be present for the PWR OK LED to go on.

**Table 18: DC Power Supply LEDs**

Label	Color	State	Description
PWR OK	Green	Off	Power supply is not functioning normally. Check the INPUT OK LED for more information.
		On	Power supply is functioning normally.
	Amber	On	The main output voltage is out of range (lower limit: 37.5 V to 39.5 V; upper limit: 72.5 V to 76 V).
BRKR ON	Green	Off	DC power supply circuit breaker is turned off.
	Green	On	DC power input is present and the DC power supply circuit breaker is turned on.
INPUT OK	Green	Off	DC input to the PEM is not present.
		On	DC input is present and is connected in correct polarity.
	Amber	On	DC input is present, but not in valid operating range or connected in reverse polarity.

### Cooling System

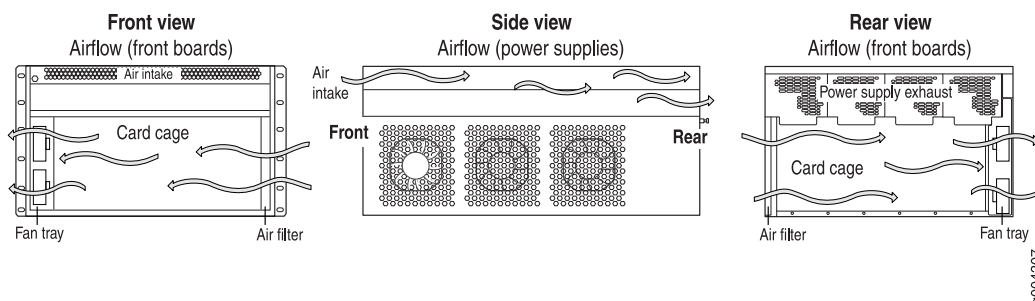
The cooling system consists of the following components:

- Fan tray
- Air filter

The cooling system components work together to keep all router components within the acceptable temperature range (see Figure 17 on page 25, Figure 18 on page 25, and Figure 19 on page 26). The router has one fan tray and one air filter that install vertically in the rear of the router. The fan tray contains three fans.

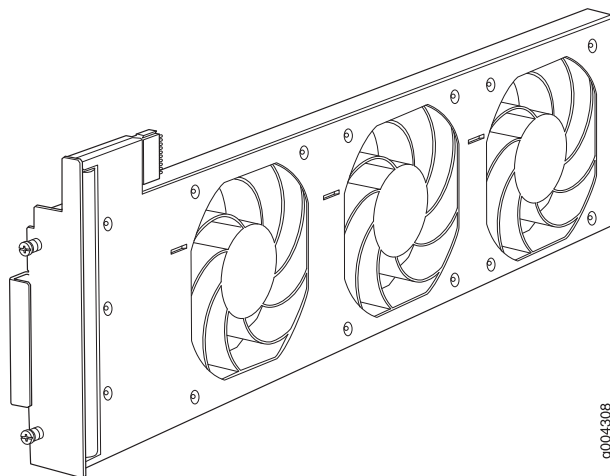
The air intake to cool the chassis is located on the side of the chassis next to the air filter. Air is pulled through the chassis toward the fan tray, where it is exhausted out the side of the system. The air intake to cool the power supplies is located in the front of the router above the craft interface. The exhaust for the power supplies is located on the rear bulkhead power supplies.

**Figure 17: Airflow Through Chassis**

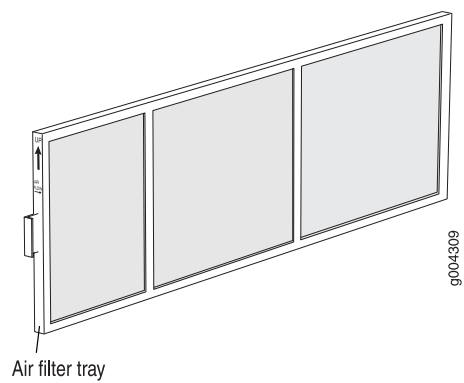


The host subsystem monitors the temperature of the router components. When the router is operating normally, the fans function at lower than full speed. If a fan fails or the ambient temperature rises above a threshold, the speed of the remaining fans is automatically adjusted to keep the temperature within the acceptable range. If the ambient maximum temperature specification is exceeded and the system cannot be adequately cooled, the Routing Engine shuts down the system by disabling output power from each power supply.

**Figure 18: Fan Tray**



**Figure 19: Air Filter**



## **Part 2**

# **Setting Up the Router**

- Preparing the Site for Router Installation on page 29
- Installation Overview on page 35
- Unpacking the Router on page 37
- Installing the Mounting Hardware on page 41
- Installing the Router on page 45
- Connecting the Router on page 49
- Grounding and Providing Power to the Router on page 53
- Configuring JUNOS Software on page 61





## Chapter 3

# Preparing the Site for Router Installation

This chapter describes how to prepare your site for installation of the MX240 router. It discusses the following topics:

- Site Preparation Checklist on page 29
- Cabinet Requirements on page 30
- Rack Requirements on page 31
- Clearance Requirements for Airflow and Hardware Maintenance on page 32

## Site Preparation Checklist

The checklist in Table 19 on page 29 summarizes the tasks you must perform when preparing a site for router installation.

**Table 19: Site Preparation Checklist**

Item or Task	For More Information	Performed By	Date
Verify that environmental factors such as temperature and humidity do not exceed router tolerances.	"Router Environmental Specifications" on page 163		
Select the type of rack or cabinet.	"Cabinet Requirements" on page 30, "Rack Requirements" on page 31		
Plan rack or cabinet location, including required space clearances.	"Cabinet Size and Clearance Requirements" on page 30, "Rack Size and Strength" on page 31, "Clearance Requirements for Airflow and Hardware Maintenance" on page 32		
If a rack is used, secure rack to floor and building structure.	"Connection to Building Structure" on page 32		
Acquire cables and connectors.			
Locate sites for connection of system grounding.	"Chassis Grounding Specifications" on page 165		
Measure distance between external power sources and router installation site.			

**Table 19: Site Preparation Checklist** *(continued)*

Item or Task	For More Information	Performed By	Date
Calculate the optical power budget and optical power margin.	“Calculating Power Budget for Fiber-Optic Cable” on page 181		

## Cabinet Requirements

The router can be installed in a standard 482-mm wide (or larger) enclosed cabinet. The following sections describe cabinet requirements:

- Cabinet Size and Clearance Requirements on page 30
- Cabinet Airflow Requirements on page 30

### Cabinet Size and Clearance Requirements

The minimum-sized cabinet that can accommodate the router is 482-mm wide and 800-mm deep. A cabinet larger than the minimum requirement provides better airflow and reduces the chance of overheating. To accommodate a single router, the cabinet must be at least 13 U high. If you provide adequate cooling air and airflow clearance, you can stack several routers in a cabinet that has sufficient usable vertical space. Each router requires 5 U.

The minimum total clearance inside the cabinet is 30.7 in. between the inside of the front door and the inside of the rear door.

### Cabinet Airflow Requirements

When you mount the router in a cabinet, you must ensure that ventilation through the cabinet is sufficient to prevent overheating. Consider the following requirements to when planning for chassis cooling:

- Ensure that the cool air supply you provide through the cabinet can adequately dissipate the thermal output of the router.
- Ensure that the cabinet allows the chassis hot exhaust air to exit from the cabinet without recirculating into the router. An open cabinet (without a top or doors) that employs hot air exhaust extraction from the top allows the best airflow through the chassis. If the cabinet contains a top or doors, perforations in these elements assist with removing the hot air exhaust. For an illustration of chassis airflow, see Figure 17 on page 25.
- Install the router as close as possible to the front of the cabinet so that the cable management system just clears the inside of the front door. This maximizes the clearance in the rear of the cabinet for critical airflow.
- Route and dress all cables to minimize the blockage of airflow to and from the chassis.

## Rack Requirements

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The router can be installed in a rack. Many types of racks are acceptable, including four-post (telco) racks and open-frame racks. An example of an open-frame rack appears in Figure 20 on page 32.

The following sections describe rack requirements:

- Rack Size and Strength on page 31
- Spacing of Mounting Bracket Holes on page 32
- Connection to Building Structure on page 32

### Rack Size and Strength

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 Industry Association (<http://www.eia.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.

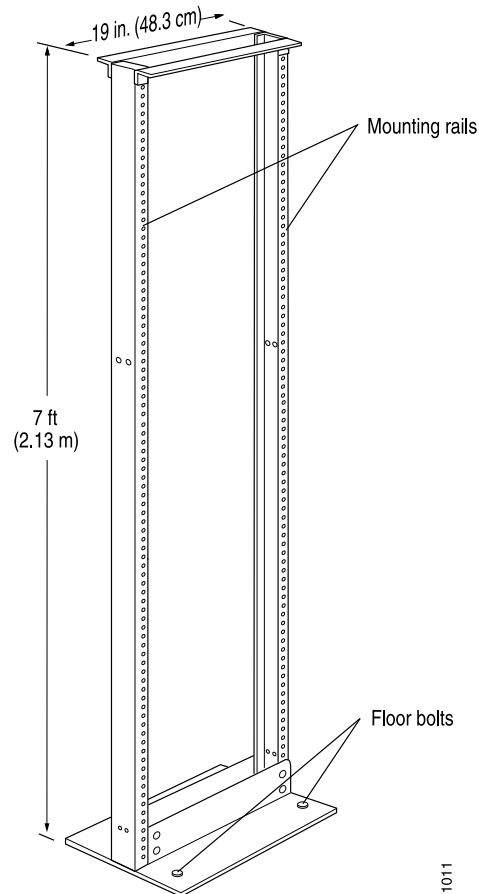
The rack rails must be spaced widely enough to accommodate the router chassis's external dimensions: 8.71 in. (22.1 cm) high, 24.5 in. (62.2 cm) deep, and 17.45 in. (44.3 cm) wide. The spacing of rails and adjacent racks must also allow for the clearances around the router and rack that are specified in “Clearance Requirements for Airflow and Hardware Maintenance” on page 32.

In an open-frame rack, center-mounting the chassis in the rack is preferable to front-mounting because the more even distribution of weight provides greater stability.

For instructions about installing the mounting hardware, see “Installing the Mounting Hardware” on page 41.

The chassis height of 8.71 in. (22.1 cm) is approximately 5 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 several MX240 routers in a rack that has sufficient usable vertical space.

The rack must be strong enough to support the weight of the fully configured router, up to 128 lb (58.1 kg). If you stack multiple fully configured routers in one rack, it must be capable of supporting the combined weight of the routers.

**Figure 20: Typical Open-Frame Rack**

### **Spacing of Mounting Bracket Holes**

The router can be mounted in any rack that provides holes or hole patterns spaced at 1 U (1.75 in.) increments. The mounting brackets used to attach the chassis to a rack are designed to fasten to holes spaced at those distances.

### **Connection to Building Structure**

Always secure the rack to the structure of the building. If your geographical area is subject to earthquakes, bolt the rack to the floor. For maximum stability, also secure the rack to ceiling brackets. For more information, see “Rack-Mounting Requirements and Warnings” on page 133.

### **Clearance Requirements for Airflow and Hardware Maintenance**

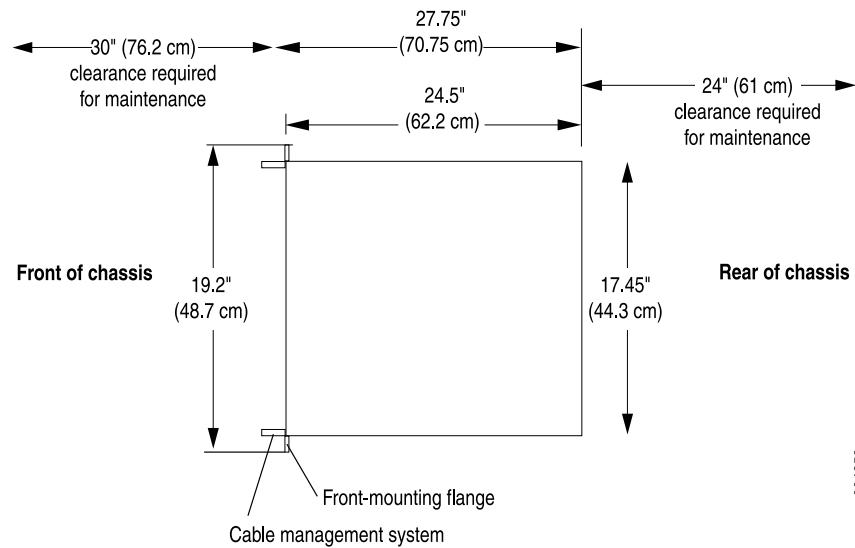
When planning the installation site, allow sufficient clearance around the rack (see Figure 21 on page 33):

- For the cooling system to function properly, the airflow around the chassis must be unrestricted. Allow at least 6 in. (15.2 cm) of clearance between side-cooled

routers. Allow 2.8 in. (7 cm) between the side of the chassis and any non-heat-producing surface such as a wall.

- 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. (76.2 cm) in front of the router.

**Figure 21: Chassis Dimensions and Clearance Requirements**





## Chapter 4

# Installation Overview

After you have prepared your installation site as described in “Preparing the Site for Router Installation” on page 29, you are ready to unpack and install the router. It is important to proceed through the installation process in the following order:

1. Review the safety guidelines explained in “Safety and Regulatory Compliance Information” on page 125.
2. Follow the instructions in this chapter to unpack the router and verify that the parts are received.
3. Install the mounting hardware as described in “Installing the Mounting Hardware” on page 41.
4. Install the router as described in “Installing the Router” on page 45 or “Installing the Router Without a Mechanical Lift” on page 187.
5. Connect cables to external devices as described in “Connecting the Router” on page 49.
6. Connect the grounding cable as described in “Grounding the Router” on page 54.
7. Connect the power cables as described in “Connecting Power to an AC-Powered Router” on page 54 or “Connecting Power to a DC-Powered Router” on page 56.
8. Power on the router as described in “Powering On an AC-Powered Router” on page 55 or “Powering On a DC-Powered Router” on page 58.
9. Perform the initial system startup as described in “Configuring JUNOS Software” on page 61.





## Chapter 5

# Unpacking the Router

This chapter describes how to prepare to install the router. It discusses the following topics:

- Tools and Parts Required on page 37
- Unpacking the Router on page 37
- Verifying Parts Received on page 38

### Tools and Parts Required

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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

### Unpacking the 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 container measures 21 in. (53.3 cm) high, 23.5 in. (60.0 cm) wide, and 32.5 in. (82.5 cm) deep. The total weight of the container containing the router and accessories can range from 93 lb (42.2 kg) to 169 lb (76.7 kg).



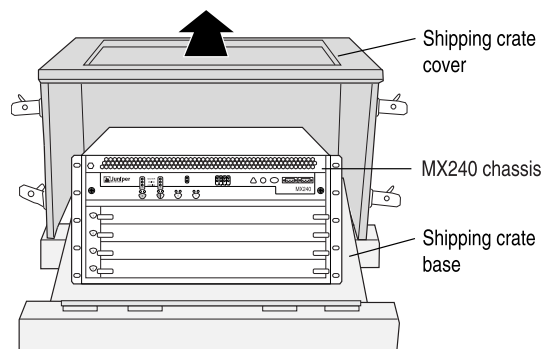
**NOTE:** The router is maximally protected inside the shipping crate. Do not unpack it until you are ready to begin installation.

---

To unpack the router (see Figure 22 on page 38):

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 installation instructions.
8. Verify the parts received against the lists in Table 20 on page 39 and Table 21 on page 39.
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. To proceed with the installation, see “Installing the Router Using a Lift” on page 46 or “Installing the Router Without a Mechanical Lift” on page 187.

**Figure 22: Contents of the Shipping Crate**



## Verifying 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.

A fully configured router contains the router chassis with installed components, listed in Table 20 on page 39, and an accessory box, which contains the parts listed in Table 21 on page 39. The parts shipped with your router can vary depending on the configuration you ordered.

**Table 20: Parts List for a Fully Configured Router**

Component	Quantity
Chassis, including midplane, craft interface, and rack-mounting brackets	1
DPCs	Up to 3
Routing Engines	1 or 2
SCBs	1 or 2
DC power supplies	1 or 2
AC power supplies (220 V)	1 or 2
AC power supplies (110 V)	2 or 4
Fan tray	1
Air filter	1
Air filter tray	1
Quick start installation instructions	1
Mounting shelf	1
Blank panels for slots without components installed	One blank panel for each slot not occupied by a component

**Table 21: Accessory Box Parts List**

Part	Quantity
Screws to mount chassis and small shelf	22
DC power terminal Lugs, 6-AWG	5
RJ-45-to-DB-9 serial cable to connect the router through the serial port	1
Cable manager brackets	2
Terminal block plug, 3-pole, 5.08 mm spacing, 12A, to connect the router alarms	2

**Table 21: Accessory Box Parts List** *(continued)*

Part	Quantity
Label, accessories contents, MX240	1
USB flash drive with JUNOS software	1
Read me first document	1
Affidavit for T1 connection	1
Juniper Networks Product Warranty	1
End User License Agreement	1
Document sleeve	1
3 in. x 5 in. pink bag	2
9 in. x 12 in. pink bag, ESD	2
Accessory box, 19 in. x 12 in. x 3 in.	1
Ethernet cable, RJ-45/RJ-45, 4-pair stranded UTP, Category 5E, 15'	1
ESD wrist strap with cable	1

## Chapter 6

# Installing the Mounting Hardware

The router can be installed in a four-post rack or cabinet or an open-frame rack. Install the mounting hardware on the rack before installing the router.

After the mounting hardware is installed, proceed to “Installing the Router” on page 45 or “Installing the Router Without a Mechanical Lift” on page 187, depending on your type of installation.

This chapter describes the procedures for installing the mounting hardware:

- Installing the Mounting Hardware for a Rack or Cabinet on page 41
- Moving the Mounting Brackets for Center-Mounting the Router on page 43

## Installing the Mounting Hardware for a Rack or Cabinet

Install the mounting shelf, which is included in the shipping container, before installing the router. We recommend that you install the mounting shelf because the weight of a fully loaded chassis can be up to 128 lb (58.1 kg).

Table 22 on page 41 specifies the holes in which you insert cage nuts and screws to install the mounting hardware required (an X indicates a mounting hole location). The hole distances are relative to one of the standard U divisions on the rack. The bottom of all mounting shelves is at 0.02 in. above a U division.

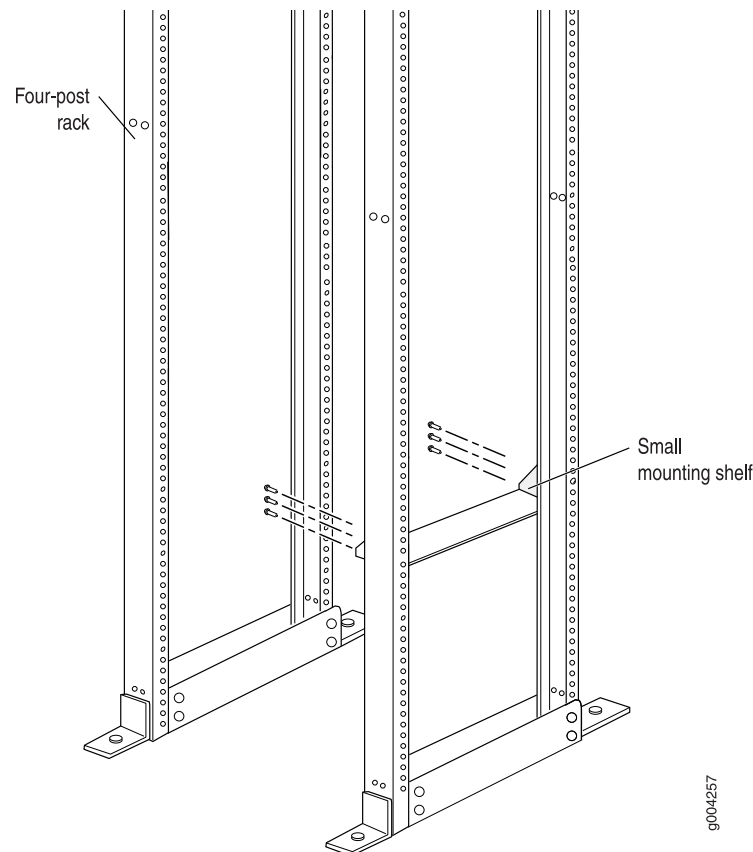
**Table 22: Four-Post Rack or Cabinet Mounting Hole Locations**

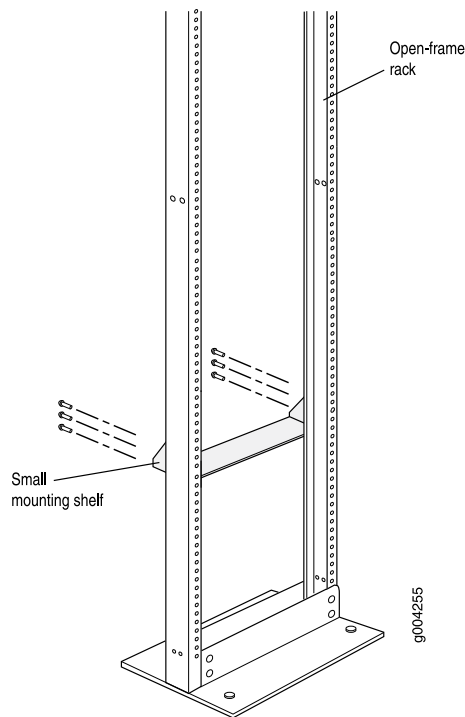
Hole	Distance Above U Division		Mounting Shelf
4	2.00 in. (5.1 cm)	1.14 U	X
3	1.51 in. (3.8 cm)	0.86 U	X
2	0.88 in. (2.2 cm)	0.50 U	X
1	0.25 in. (0.6 cm)	0.14 U	X

To install the mounting shelf on the front rails of a four-post rack or cabinet, or the rails of an open-frame rack:

1. If needed, install cage nuts in the holes specified in Table 22 on page 41.
2. On the back of each rack rail, partially insert a mounting screw into the lowest hole specified in Table 22 on page 41.
3. Install the mounting shelf on the back of the rack rails. Rest the bottom slot of each flange on a mounting screw.
4. Partially insert the remaining screws into the open holes in each flange of the mounting shelf (see Figure 23 on page 42 or Figure 24 on page 43).
5. Tighten all the screws completely.

**Figure 23: Installing the Front Mounting Hardware for a Four-Post Rack or Cabinet**



**Figure 24: Installing the Mounting Hardware for an Open-Frame Rack**

## Moving the Mounting Brackets for Center-Mounting the Router

Two removable mounting brackets are attached to the mounting holes closest to the front of the chassis. You can move the pair of brackets to another position on the side of the chassis for center-mounting the router.

To move the mounting brackets from the front of the chassis toward the center of the chassis:

1. Remove the three screws at the top and center of the bracket.
2. Pull the top of the bracket slightly away from the chassis. The bottom of the bracket contains a tab that inserts into a slot in the chassis.
3. Pull the bracket away from the chassis so that the tab is removed from the chassis slot.
4. Insert the bracket tab into the slot in the bottom center of the chassis.
5. Align the bracket with the two mounting holes located toward the top center of the chassis.

There is no mounting hole in the center of the chassis that corresponds to the hole in the center of the bracket.

6. Insert the two screws at the top of the bracket and tighten each partially.

Two screws are needed for mounting the bracket on the center of the chassis. You do not need the third screw.

7. Tighten the two screws completely.
8. Repeat the procedure for the other bracket.



## Chapter 7

# Installing the Router

This chapter discusses the following router installation topics:

- Safety Requirements, Warnings, and Guidelines on page 45
- Installing the Router Using a Mechanical Lift on page 45

### **Safety Requirements, Warnings, and Guidelines**

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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 Internet routers. For a discussion of how to make the installation site a safe environment, see “Preparing the Site for Router Installation” on page 29. For a list of safety warnings, see “Safety and Regulatory Compliance Information” on page 125 and particularly “Electrical Safety Guidelines and Warnings” on page 144. However, providing an exhaustive set of guidelines for working with electrical equipment is beyond the scope of this manual.

### **Installing the Router Using a Mechanical Lift**

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Because of the router's size and weight—up to 128 lb (58.1 kg) depending on the configuration—we strongly recommend that you install the router using a mechanical lift as described in “Installing the Router Using a Lift” on page 46. If you do not use a lift to install the router, see “Installing the Router Without a Mechanical Lift” on page 187 for complete instructions to install the router safely.

Before installing the router, prepare your site and review the guidelines in “Preparing the Site for Router Installation” on page 29. The “Site Preparation Checklist” on page 29 summarizes the tasks you must perform when preparing a site for router installation. You also need to unpack the router from the shipping container, as described in “Unpacking the Router” on page 37.

This section is divided into the following topics:

- Tools Required on page 46
- Installing the Router Using a Lift on page 46

## Tools Required

To install the router, you need the following tools:

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

## Installing the Router Using a Lift

Before installing the router in the rack, read the safety information in “Chassis-Lifting Guidelines” on page 132. Remove the router from the shipping container as described in “Unpacking the Router” on page 37. Install the mounting hardware as described in “Installing the Mounting Hardware” on page 41.

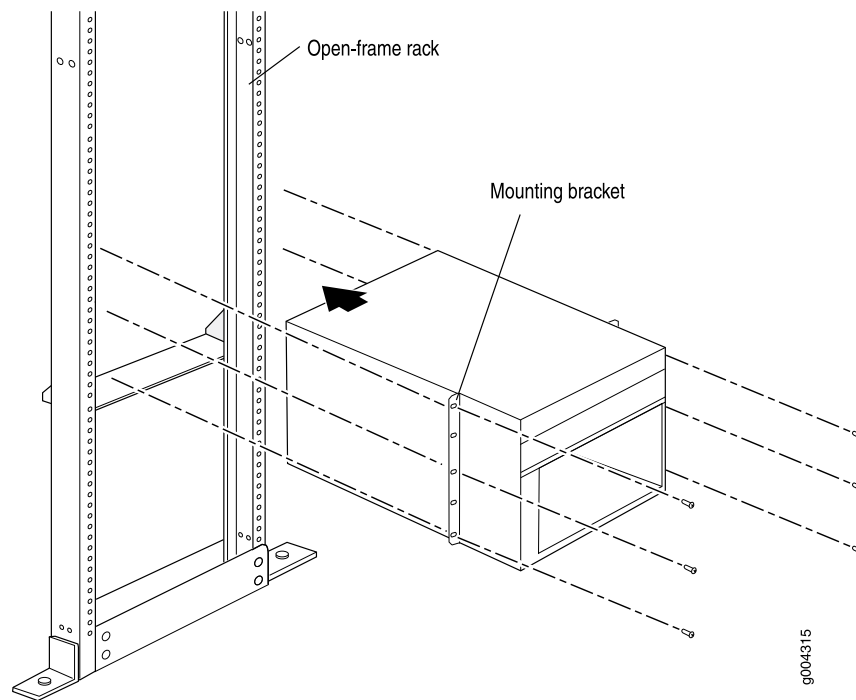


**CAUTION:** Before front mounting the router in a rack, have a qualified technician verify that the rack is strong enough to support the router's weight and is adequately supported at the installation site.

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To install the router using a lift (see Figure 25 on page 47):

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 “Preparing the Site for Router Installation” on page 29.
2. Load the router onto the lift, making sure it rests securely on the lift platform.
3. Using the lift, position the router in front of the rack or cabinet, centering it in front of the mounting shelf.
4. Lift the chassis approximately 0.75 in. above the surface of the mounting shelf and position it as close as possible to the shelf.
5. Carefully slide the router onto the mounting shelf so that the bottom of the chassis and the mounting shelf overlap by approximately two inches.
6. Slide the router onto the mounting shelf until the mounting brackets contact the rack rails. The shelf ensures that the holes in the mounting brackets of the chassis align with the holes in the rack rails.
7. Move the lift away from the rack.
8. 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 25: Installing the Router in the Rack**

**NOTE:** This illustration depicts the router being installed in an open-frame rack. For an illustration of the mounting hardware required for a four-post rack or cabinet, see Figure 23 on page 42.



## Chapter 8

# Connecting the Router

- Tools and Parts Required on page 49
- Connecting the Router to Management and Alarm Devices on page 49
- Connecting DPC Cables on page 51

### Tools and Parts Required

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

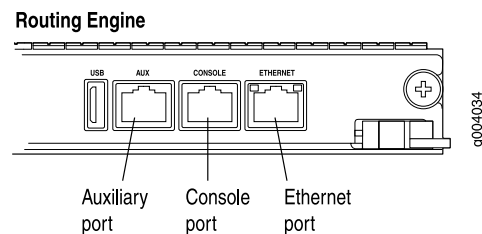
- Phillips (+) screwdrivers, numbers 1 and 2
- 2.5-mm flat-blade (–) screwdriver
- 2.5-mm Phillips (+) screwdriver
- Wire cutters
- Electrostatic discharge (ESD) grounding wrist strap

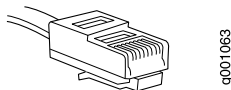
### Connecting the Router to Management and Alarm Devices

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After you have installed the router into the rack, connect one or more external devices to the Routing Engine ports for management and service operations (see Figure 26 on page 49). For specifications for the cable accepted by the Routing Engine management ports, see “Routing Engine Interface Cable and Wire Specifications” on page 183.

**Figure 26: Routing Engine Management Ports**



**Figure 27: RJ-45 Cable Connector**

To connect external devices to the Routing Engine management ports, perform the procedures described in the following sections:

- Connecting to a Network for Out-of-Band Management on page 50
- Connecting to a Management Console or Auxiliary Device on page 50
- Connecting to an External Alarm-Reporting Device on page 50

### **Connecting to a Network for Out-of-Band Management**

To connect the Routing Engine to a network for out-of-band management, connect an Ethernet cable with RJ-45 connectors to the **ETHERNET** port on the Routing Engine. One such cable is provided with the router. For cable specifications, see “Routing Engine Interface Cable and Wire Specifications” on page 183. Follow this procedure:

1. Turn off the power to the management device.
2. Plug one end of the Ethernet cable (Figure 27 on page 50 shows the connector) into the **ETHERNET** port on the Routing Engine. Figure 26 on page 49 shows the external device ports on the Routing Engine.
3. Plug the other end of the cable into the network device.

### **Connecting 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 Routing Engine. To use a laptop, modem, or other auxiliary device, connect it to the **AUX** port on the Routing Engine. Both ports accept a cable with an RJ-45 connector. One serial cable with an RJ-45 connector and a DB-9 connector is provided with the router. If you want to connect a device to the **CONSOLE** port and another device to the **AUX** port, you must supply an additional cable. For cable specifications, see “Routing Engine Interface Cable and Wire Specifications” on page 183.

To connect a management console or auxiliary device:

1. Turn off the power to the console or auxiliary device.
2. Plug the RJ-45 end of the serial cable (Figure 27 on page 50 shows the connector) into the **AUX** port or **CONSOLE** port on the Routing Engine. Figure 26 on page 49 shows the external device ports on the Routing Engine.
3. Plug the female DB-9 end into the device's serial port.

### **Connecting to an External Alarm-Reporting Device**

To connect the router to external alarm-reporting devices, attach wires to the **RED** and **YELLOW** relay contacts on the craft interface. (See Figure 28 on page 51.) A

system condition that triggers the red or yellow alarm LED on the craft interface also activates the corresponding alarm relay contact.

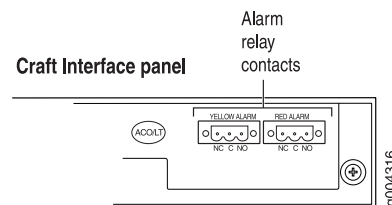
The terminal blocks that plug into the alarm relay contacts are supplied with the router. They accept wire of any gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>), which is not provided. Use the gauge of wire appropriate for the external device you are connecting.

To connect an external device to an alarm relay contact (see Figure 28 on page 51):

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. 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.
3. 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.
4. Attach the other end of the wires to the external device.

To attach a reporting device for the other kind of alarm, repeat the procedure.

**Figure 28: Alarm Relay Contacts**



## Connecting DPC Cables

Connect the DPCs to the network by plugging in network cables. Follow this procedure (see Figure 29 on page 52, which shows a fiber-optic DPC):

1. Have ready a length of the type of cable used by the DPC. For cable specifications, see the *MX-series Ethernet Services Router DPC Guide*.
2. If the 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 DPC faceplate.



**NOTE:** The XFP cages and optics on the DPC are industry standard parts that have limited tactile feedback for insertion of optics and fiber. You need to insert the optics and fiber firmly until the latch is securely in place.

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.

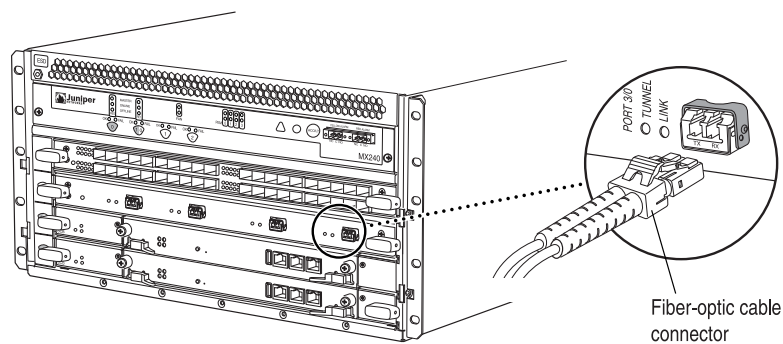


**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.



**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 29: Attaching a Cable to a DPC**





## Chapter 9

# Grounding and Providing Power to the Router

- Tools and Parts Required on page 53
- Grounding the Router on page 54
- Connecting Power to an AC-Powered Router on page 54
- Powering On an AC-Powered Router on page 55
- Connecting Power to a DC-Powered Router on page 56
- Powering On a DC-Powered Router on page 58
- Powering Off the Router on page 59

## Tools and Parts Required

---

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

- Phillips (+) screwdrivers, numbers 1 and 2
- 2.5-mm flat-blade (–) screwdriver
- 3/8-in. nut driver or hexagonal-head external drive socket wrench, with a torque range between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) tightening torque, for tightening nuts to terminal studs on each power supply (on a DC-powered router)



**CAUTION:** Do not substitute a metric nut driver or wrench. A tool that does not fit the nuts exactly can damage them. You must use a 3/8-in. tool.

---

- Wire cutters
- Electrostatic discharge (ESD) grounding wrist strap

## Grounding the Router

---

You ground the router by connecting a grounding cable to earth ground and then attaching it to the chassis grounding points using UNC 1/4-20 two screws. You must provide the grounding cables (the cable lugs are supplied with the router). For grounding cable specifications, see “Chassis Grounding Specifications” on page 165.

1. Verify that a licensed electrician has attached the cable lug provided with the router to the grounding cable.
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. Ensure that all grounding surfaces are clean and brought to a bright finish before grounding connections are made.
4. Connect the grounding cable to a proper earth ground.
5. Detach the ESD grounding strap from the site ESD grounding point.
6. 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” on page 130.
7. Place the grounding cable lug over the grounding points on the upper rear of the chassis. The bolts are sized for UNC 1/4-20 bolts.
8. Secure the grounding cable lug to the grounding points, first with the washers, then with the screws.
9. Dress the grounding cable and verify that it does not touch or block access to router components, and that it does not drape where people could trip on it.

## Connecting Power to an AC-Powered Router

---



**CAUTION:** Do not mix AC and DC power supplies within the same router. Damage to the router might occur.

---

You connect AC power to the router by attaching power cords from the AC power sources to the AC appliance inlets located on the power supplies. The power cords are provided. For power cord specifications, see “AC Power Cord Specifications” on page 174.

To connect the AC power cords to the router for each power supply (see Figure 30 on page 55):

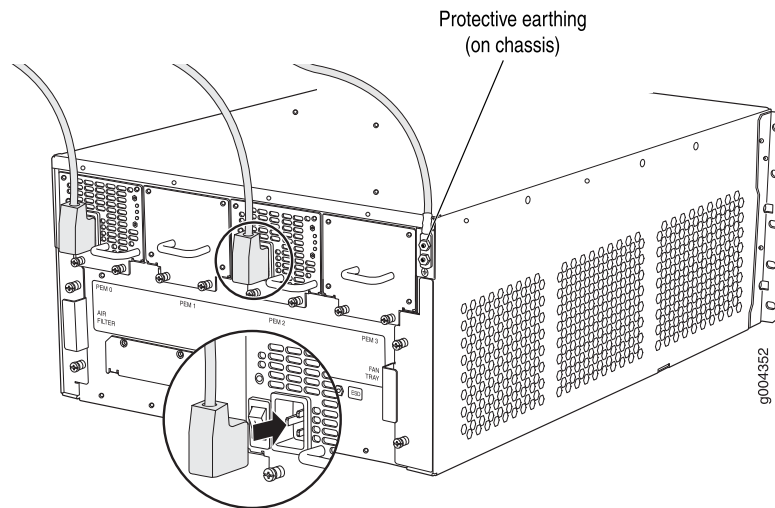
1. Locate the power cords shipped with the router, which should have a plug appropriate for your geographical location (see “AC Power Cord Specifications” on page 174).
2. Move the AC switch next to the appliance inlet on the power supply to the off position (O).
3. Insert the power cord plug into an external AC power source receptacle.



**NOTE:** Each power supply must be connected to a dedicated AC power feed and a dedicated external circuit breaker. We recommend that you use a 15 A (250 VAC) minimum, or as permitted by local code.

4. Dress the power cord appropriately. Verify that the power cord does not block the air exhaust and access to router components, or drape where people could trip on it.
5. Repeat Step 1 through Step 4 for the remaining power supplies.

**Figure 30: Connecting AC Power to the Router**



## Powering On an AC-Powered Router

To power on an AC-powered 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. For more information about ESD, see “Preventing Electrostatic Discharge Damage” on page 130.
2. Verify that the power supplies are fully inserted in the chassis.
3. Verify that the AC power cord is securely inserted into the appliance inlet.
4. Verify that an external management device is connected to one of the Routing Engine ports (AUX, CONSOLE, or ETHERNET). For more information about connecting management devices, see “Connecting the Router to Management and Alarm Devices” on page 49.
5. Turn on the power to the external management device.
6. Switch the AC switch on each power supply to the on position (I) and observe the status LEDs on each power supply faceplate. If an AC power supply is correctly installed and functioning normally, the AC OK and DC OK LEDs light steadily, and the PS FAIL LED is not lit.

If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures described in “Replacing Power System Components” on page 112.



**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, first issue the CLI `request system halt` command.

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

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

## Connecting Power to a DC-Powered Router



**CAUTION:** Do not mix AC and DC power supplies within the same router. Damage to the router might occur.



**WARNING:** Before performing the following procedure, 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.

You connect DC power to the router by attaching power cables from the external DC power sources to the terminal studs on the power supply faceplates. You must provide the power cables (the cable lugs are supplied with the router). For power cable specifications, see “DC Power Cable Specifications” on page 170.

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

1. Switch off the dedicated facility circuit breakers. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.
2. Switch the circuit breaker on the power supply faceplate to the **OFF** position.
3. Remove the clear plastic cover protecting the terminal studs on the faceplate.
4. Verify that the DC power cables are correctly labeled before making connections to the power supply. In a typical power distribution scheme where the return is

connected to chassis ground at the battery plant, you can use a multimeter to verify that the ohm output of the **–48V** and **RTN** DC cables to chassis ground. . The cable with very large resistance (indicating an open circuit) to chassis ground will be **–48V** and the cable with very low resistance (indicating a closed circuit) to chassis ground will be **RTN**.



**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.

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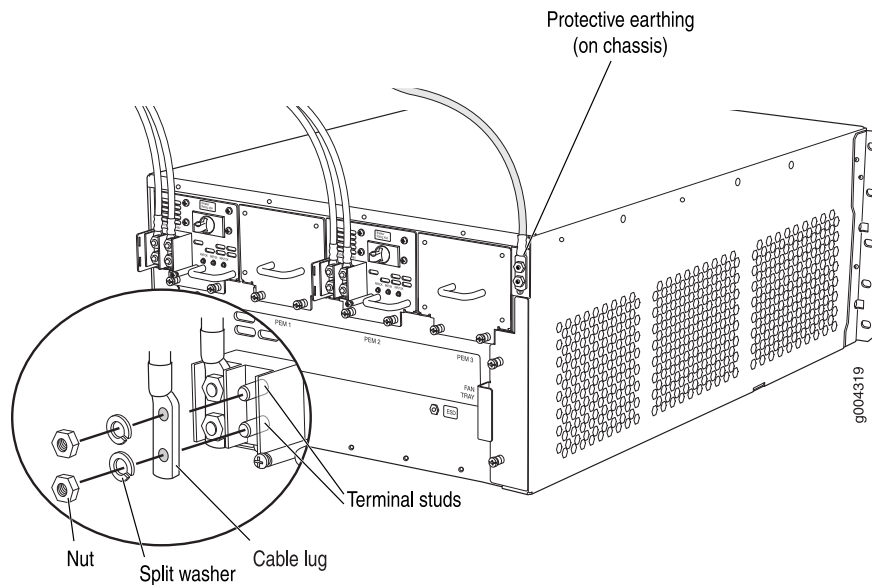
5. Remove the nuts and washers from the terminal studs. (Use a 3/8-in. nut driver or socket wrench.)
  6. Secure each power cable lug to the terminal studs, first with the flat washer, then with the nut (see Figure 31 on page 58). Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut. .(Use a 3/8-in. nut driver or socket wrench.)
    - Secure the positive (+) DC source power cable lug to the **RTN** (return) terminal.
    - Secure the negative (–) DC source power cable lug to the **–48V** (input) terminal.
- 



**NOTE:** The DC power supply in **PEM0** must be powered by dedicated power feeds derived from feed **A**, and the DC power supply in **PEM2** must be powered by dedicated power feeds derived from feed **B**. This configuration provides the commonly deployed A/B feed redundancy for the system.

---

7. Replace the clear plastic cover over the terminal studs on the faceplate.
8. Verify that the power cables are connected correctly, that they are not touching or blocking access to router components, and that they do not drape where people could trip on them.
9. If you are installing two power supplies, repeat Steps 2 through 8 for the other power supply.

**Figure 31: Connecting DC Power to the Router**

## Powering On a DC-Powered Router



**WARNING:** Before performing the following procedure, 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.



**CAUTION:** Do not mix AC and DC power supplies within the same router. Damage to the router might occur.

To power on a DC-powered router:

1. Verify that an external management device is connected to one of the Routing Engine ports (AUX, CONSOLE, or ETHERNET). For more information about connecting management devices, see “Connecting the Router to Management and Alarm Devices” on page 49.
2. Turn on the power to the external management device.
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” on page 130.
4. Verify that the power supplies are fully inserted in the chassis.
5. Verify that the source power cables are connected to the appropriate terminal: the positive (+) source cable to the return terminal (labeled RTN) and the negative (–) source cable to the input terminal (labeled –48V).

6. Switch on the dedicated facility circuit breakers to provide power to the DC power cables.
7. Check the **INPUT OK** LED is lit steadily green to verify that power is present.
8. If power is not present:
  - Verify that the fuse is installed correctly and turn on the breaker at the battery distribution fuse board or fuse bay.
  - Check the voltage with a meter at the terminals of the power supply for correct voltage level and polarity.
9. Switch the circuit breaker on each of the power supplies to the **ON** position — and observe the status LEDs on each power supply faceplate. If a DC power supply is correctly installed and functioning normally, the **PWR OK**, **BRKR ON**, and **INPUT OK** LEDs light green steadily.

If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures described in “Replacing Power System Components” on page 112.



**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, first issue the CLI **request system halt** command.

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

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

## Powering Off the Router

If you need to power off the 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 the 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
```

Wait until a message appears on the console confirming that the operating system has halted. For more information about the command, see the *JUNOS System Basics and Services Command Reference*.

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” on page 130.
3. On an AC-powered router, switch the AC switch on each power supply to the off position (O). On a DC-powered router, switch the circuit breaker on each power supply to the off position (OFF).



## Chapter 10

# Configuring JUNOS Software

- Configuring the JUNOS Software on page 61

### Configuring the JUNOS Software

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The router is shipped with the JUNOS software preinstalled and ready to be configured when the router is powered on. There are three copies of the software: one on a CompactFlash card in the Routing Engine, one on a hard disk in the Routing Engine, and one on a USB flash drive that can be inserted into the slot in the Routing Engine faceplate.

When the router boots, it first attempts to start the image on the USB flash drive. If a USB flash drive is not inserted into the Routing Engine or the attempt otherwise fails, the router next tries the CompactFlash card (if installed), and finally the hard disk.

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

Gather the following information before configuring the router:

- Name that the router will use on the network
- Domain name that 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

This procedure connects the router to the network but does not enable it to forward traffic. For complete information about enabling the router to forward traffic, including examples, see the JUNOS software configuration guides.

To configure the software:

1. Verify that the router is powered on, as described in “Powering On an AC-Powered Router” on page 55 or “Powering On a DC-Powered Router” on page 58.
2. Log in as the root user. There is no password.

3. Start the CLI.

```
root# cli
root@>
```

4. Enter configuration mode.

```
cli> configure
[edit]
root@#
```

5. 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
```

6. Configure the router's domain name.

```
[edit]
root@# set system domain-name domain-name
```

7. Configure the IP address and prefix length for the router's Ethernet interface.

```
[edit]
root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
```

8. Configure the IP address of a backup router, which is used only while the routing protocol is not running.

```
[edit]
root@# set system backup-router address
```

9. Configure the IP address of a DNS server.

```
[edit]
root@# set system name-server address
```

10. Set the root authentication password by entering either a clear-text password, an encrypted password, or an SSH public key string (DSA or RSA).

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

or

```
[edit]
root@# set system root-authentication encrypted-password encrypted-password
```

or

```
[edit]
root@# set system root-authentication ssh-dsa public-key
```

or

```
[edit]
root@# set system root-authentication ssh-rsa public-key
```

11. Optionally, 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;
      }
    }
  }
}
```

12. Commit the configuration to activate it on the router.

```
[edit]
root@# commit
```

13. Optionally, configure additional properties by adding the necessary configuration statements. Then commit the changes to activate them on the router.

```
[edit]
root@host# commit
```

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

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



## **Part 3**

# **Hardware Maintenance, Troubleshooting, and Replacement Procedures**

- Maintaining Hardware Components on page 67
- Troubleshooting Hardware Components on page 79
- Replacing Hardware Components on page 87



## Chapter 11

# Maintaining Hardware Components

This chapter describes how to maintain hardware components installed in the router. Some components, such as the craft interface, require no maintenance.

For information about returning a part to Juniper Networks for repair or replacement, see “Contacting Customer Support and Returning Hardware” on page 197.

- Tools and Parts Required on page 67
- Routine Maintenance Procedures on page 67
- Maintaining Cooling System Components on page 68
- Maintaining the Host Subsystem on page 70
- Maintaining Packet Forwarding Engine Components on page 72
- Maintaining the Power Supplies on page 78

### Tools and Parts Required

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To maintain hardware components, you need the following tools and parts:

- ESD grounding wrist strap
- Flat-blade (–) screwdriver
- Phillips (+) screwdriver, number 1
- Phillips (+) screwdriver, number 2

### Routine Maintenance Procedures

---

For optimum router performance, perform the following preventive maintenance procedures regularly:

- 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 and LEDs.
- Inspect the air filter at the left rear of the router, replacing it every 6 months for optimum cooling system performance. Do not run the router for more than a

few minutes without the air filter in place. For maintenance instructions, see “Maintaining the Air Filter” on page 68.

## Maintaining Cooling System Components

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This section discusses the following topics:

- Maintaining the Air Filter on page 68
- Maintaining the Fan Tray on page 68

### Maintaining the Air Filter

A dirty air filter restricts airflow in the unit, producing a negative effect on the ventilation of the chassis. The filter degrades over time. Periodically replace the filter in use, as well as spares. We recommend that you replace the filter every 6 months. For procedures to replace the air filter, see “Replacing the Air Filter” on page 94.



**CAUTION:** Always keep the air filter 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.

---

Use spare filters within one year of manufacture. Check the date of manufacture printed on the filter. Store spare air filters in a dark, cool, and dry place. Storing air filters at higher temperatures, or where they can be exposed to ultraviolet (UV) radiation, hydrocarbon emissions, or vapors from solvents, can significantly reduce their life.

### Maintaining the Fan Tray

The fan tray contains 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 and red alarm is triggered when a fan tray is removed.

To display the status of the cooling system, issue the **show chassis environment** command. The output is similar to the following:

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

Class	Item	Status	Measurement
Temp	PEM 0	OK	45 degrees C / 113 degrees F
	PEM 1	OK	45 degrees C / 113 degrees F
	PEM 2	Absent	
	PEM 3	Absent	



Routing Engine 0	OK	42 degrees C / 107 degrees F
Routing Engine 1	Present	
CB 0 Intake	OK	40 degrees C / 104 degrees F
CB 0 Exhaust A	OK	37 degrees C / 98 degrees F
CB 0 Exhaust B	OK	42 degrees C / 107 degrees F
CB 0 ACBC	OK	41 degrees C / 105 degrees F
CB 0 SF A	OK	49 degrees C / 120 degrees F
CB 0 SF B	OK	44 degrees C / 111 degrees F
CB 1 Intake	OK	39 degrees C / 102 degrees F
CB 1 Exhaust A	OK	37 degrees C / 98 degrees F
CB 1 Exhaust B	OK	42 degrees C / 107 degrees F
CB 1 ACBC	OK	40 degrees C / 104 degrees F
CB 1 SF A	OK	49 degrees C / 120 degrees F
CB 1 SF B	OK	43 degrees C / 109 degrees F
FPC 1 Intake	OK	33 degrees C / 91 degrees F
FPC 1 Exhaust A	OK	39 degrees C / 102 degrees F
FPC 1 Exhaust B	OK	52 degrees C / 125 degrees F
FPC 1 I3 0 TSensor	OK	50 degrees C / 122 degrees F
FPC 1 I3 0 Chip	OK	54 degrees C / 129 degrees F
FPC 1 I3 1 TSensor	OK	47 degrees C / 116 degrees F
FPC 1 I3 1 Chip	OK	50 degrees C / 122 degrees F
FPC 1 I3 2 TSensor	OK	46 degrees C / 114 degrees F
FPC 1 I3 2 Chip	OK	49 degrees C / 120 degrees F
FPC 1 I3 3 TSensor	OK	43 degrees C / 109 degrees F
FPC 1 I3 3 Chip	OK	48 degrees C / 118 degrees F
FPC 1 IA 0 TSensor	OK	48 degrees C / 118 degrees F
FPC 1 IA 0 Chip	OK	49 degrees C / 120 degrees F
FPC 1 IA 1 TSensor	OK	45 degrees C / 113 degrees F
FPC 1 IA 1 Chip	OK	50 degrees C / 122 degrees F
FPC 2 Intake	OK	33 degrees C / 91 degrees F
FPC 2 Exhaust A	OK	40 degrees C / 104 degrees F
FPC 2 Exhaust B	OK	54 degrees C / 129 degrees F
FPC 2 I3 0 TSensor	OK	52 degrees C / 125 degrees F
FPC 2 I3 0 Chip	OK	54 degrees C / 129 degrees F
FPC 2 I3 1 TSensor	OK	49 degrees C / 120 degrees F
FPC 2 I3 1 Chip	OK	50 degrees C / 122 degrees F
FPC 2 I3 2 TSensor	OK	48 degrees C / 118 degrees F
FPC 2 I3 2 Chip	OK	51 degrees C / 123 degrees F
FPC 2 I3 3 TSensor	OK	44 degrees C / 111 degrees F
FPC 2 I3 3 Chip	OK	46 degrees C / 114 degrees F
FPC 2 IA 0 TSensor	OK	49 degrees C / 120 degrees F
FPC 2 IA 0 Chip	OK	50 degrees C / 122 degrees F
FPC 2 IA 1 TSensor	OK	48 degrees C / 118 degrees F
FPC 2 IA 1 Chip	OK	52 degrees C / 125 degrees F
Fans Front Fan	OK	Spinning at intermediate-speed
Middle Fan	OK	Spinning at intermediate-speed
Rear Fan	OK	Spinning at intermediate-speed

## Maintaining the Host Subsystem

The host subsystem comprises an SCB and a Routing Engine installed into a slot in the SCB. To maintain the host subsystem components, follow these guidelines:

- Check the LEDs on the craft interface to view information about the status of the Routing Engines. For more information about the LEDs, see “Craft Interface” on page 17.
- Check the LEDs on the SCB faceplate (see Table 9 on page 13).
- Check the LEDs on the Routing Engine faceplate (see Table 10 on page 16).
- To check the status of the Routing Engines, issue the `show chassis routing-engine` command. The output is similar to the following:

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

```
Routing Engine status:
```

```
Slot 0:
```

```
Current state           Master
Election priority       Master (default)
Temperature             45 degrees C / 113 degrees F
CPU temperature         43 degrees C / 109 degrees F
DRAM                   2048 MB
Memory utilization      15 percent
CPU utilization:
  User                  0 percent
  Background            0 percent
  Kernel                8 percent
  Interrupt             0 percent
  Idle                  92 percent
Model                  RE-S-1300
Serial ID               1000694968
Start time              2007-07-10 12:27:39 PDT
Uptime                  1 hour, 40 minutes, 37 seconds
Load averages:         1 minute   5 minute   15 minute
                       0.11       0.06       0.01
```

```
Routing Engine status:
```

```
Slot 1:
```

```
Current state           Backup
Election priority       Backup (default)
Temperature             46 degrees C / 114 degrees F
CPU temperature         42 degrees C / 107 degrees F
DRAM                   2048 MB
Memory utilization      13 percent
CPU utilization:
  User                  0 percent
  Background            0 percent
  Kernel                0 percent
  Interrupt             0 percent
  Idle                  100 percent
Model                  RE-S-1300
Serial ID               1000694976
Start time              2007-06-19 14:17:00 PDT
Uptime                  20 days, 23 hours, 51 minutes, 4 seconds
```

- To check the status of the SCBs, issue the **show chassis environment cb** command. The output is similar to the following:

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

```
CB 0 status:
State                Online Master
Temperature          40 degrees C / 104 degrees F
Power 1
  1.2 V              1208 mV
  1.5 V              1521 mV
  1.8 V              1807 mV
  2.5 V              2507 mV
  3.3 V              3319 mV
  5.0 V              5033 mV
  12.0 V             12142 mV
  1.25 V             1243 mV
  3.3 V SM3          3312 mV
  5 V RE             5059 mV
  12 V RE            11968 mV
Power 2
  11.3 V bias PEM    11253 mV
  4.6 V bias MidPlane 4814 mV
  11.3 V bias FPD    11234 mV
  11.3 V bias POE 0  11176 mV
  11.3 V bias POE 1  11292 mV
Bus Revision         42
FPGA Revision        1

CB 1 status:
State                Online Standby
Temperature          40 degrees C / 104 degrees F
Power 1
  1.2 V              1202 mV
  1.5 V              1514 mV
  1.8 V              1807 mV
  2.5 V              2500 mV
  3.3 V              3293 mV
  5.0 V              5053 mV
  12.0 V             12200 mV
  1.25 V             1260 mV
  3.3 V SM3          3319 mV
  5 V RE             5059 mV
  12 V RE            12007 mV
Power 2
  11.3 V bias PEM    11311 mV
  4.6 V bias MidPlane 4827 mV
  11.3 V bias FPD    11330 mV
  11.3 V bias POE 0  11292 mV
  11.3 V bias POE 1  11311 mV
Bus Revision         42
FPGA Revision        1
```

To check the status of a specific SCB, issue the **show chassis environment cb** command and include the slot number of the SCB. The output is similar to the following:

```

user@host> show chassis environment cb 0
CB 0 status:
  State                Online
  Temperature Intake    66 degrees C / 150 degrees F
  Temperature Exhaust A 67 degrees C / 152 degrees F
  Temperature Exhaust B 73 degrees C / 163 degrees F
  Power
    1.2 V                1153 mV
    1.5 V                1417 mV
    1.8 V                1704 mV
    2.5 V                2375 mV
    3.3 V                3138 mV
    5.0 V                4763 mV
    1.2 V Rocket IO     1160 mV
    1.5 V Rocket IO     1408 mV
    1.8 V RLDRAM        1717 mV
  I2C Slave Revision    15

```

For more information about using the CLI, see the JUNOS software manuals.

## Maintaining Packet Forwarding Engine Components

For instructions on maintaining Packet Forwarding Engine components, see the following sections:

- Maintaining DPCs on page 72
- Maintaining DPC Cables on page 74
- Handling and Storing DPCs on page 74

### Maintaining DPCs

The router can have up to three Dense Port Concentrators (DPCs) mounted horizontally in the DPC card cage at the front of the chassis, as shown in Figure 1 on page 6. To maintain DPCs, perform the following procedures regularly:

- Check the LEDs on the craft interface directly above each DPC slot. The green LED labeled **OK** lights steadily when a DPC is functioning normally. For more information, see “DPC LEDs” on page 20.
- Check the **OK/FAIL** LED on the DPC. For more information, see Table 7 on page 10 and Table 8 on page 10. If the DPC detects a failure, the DPC sends an alarm message to the Routing Engine.
- Issue the CLI **show chassis fpc** command to check the status of installed DPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the DPC is functioning normally:

```

user@host> show chassis fpc

```

Slot	Temp	CPU Utilization (%)	Memory	Utilization (%)			
State	(C)	Total	Interrupt	DRAM (MB)	Heap	Buffer	
0 Online	41	9	0	1024	15	57	
1 Online	43	5	0	1024	16	57	
2 Online	43	11	0	1024	16	57	

```

3 Empty
4 Empty
5 Online      42      6      0      1024      16      57

```

For more detailed output, add the **detail** option. The following example does not specify a slot number, which is optional:

```

user@host> show chassis fpc detail

Slot 1 information:
  State                Online
  Temperature          33 degrees C / 91 degrees F
  Total CPU DRAM       1024 MB
  Total RDRAM          256 MB
  Total DDR DRAM       4096 MB
  Start time:          2007-12-06 11:33:01 PST
  Uptime:              4 hours, 34 minutes, 48 seconds

Slot 2 information:
  State                Online
  Temperature          33 degrees C / 91 degrees F
  Total CPU DRAM       1024 MB
  Total RDRAM          256 MB
  Total DDR DRAM       4096 MB
  Start time:          2007-12-06 11:33:05 PST
  Uptime:              4 hours, 34 minutes, 44 seconds

```

- Issue the CLI **show chassis fpc pic-status** command. The DPC slots are numbered 1/0, 1, and 2, left to right:

```

user@host> show chassis fpc pic-status

Slot 0  Online      DPCE 4x 10GE R
  PIC 0  Online      1x 10GE(LAN/WAN)
  PIC 1  Online      1x 10GE(LAN/WAN)
  PIC 2  Online      1x 10GE(LAN/WAN)
  PIC 3  Online      1x 10GE(LAN/WAN)
Slot 1  Online      DPCE 40x 1GE R
  PIC 0  Online      10x 1GE(LAN)
  PIC 1  Online      10x 1GE(LAN)
  PIC 2  Online      10x 1GE(LAN)
  PIC 3  Online      10x 1GE(LAN)
Slot 2  Online      DPCE 40x 1GE R
  PIC 0  Online      10x 1GE(LAN)
  PIC 1  Online      10x 1GE(LAN)
  PIC 2  Online      10x 1GE(LAN)
  PIC 3  Online      10x 1GE(LAN)

```

For further description of the output from the command, see the *JUNOS System Basics and Services Command Reference*.

## **Maintaining DPC Cables**

To maintain DPCs and DPC cables, follow these guidelines:

- Use the cable management system (shown in Figure 11 on page 17) 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 DPC cables to identify them.

The following guidelines apply specifically to fiber-optic cable:

- When you unplug a fiber-optic cable from a DPC, always place a rubber safety plug over the transceiver on the DPC faceplate and on the end of the cable.
- Anchor fiber-optic cable to avoid stress on the connectors. When attaching fiber to a DPC, 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 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 DPC interface or port, 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 Opptex Cletop-S Fiber Cleaner. Follow the directions for the cleaning kit you use.

## **Handling and Storing DPCs**

This section explains how to avoid damaging the DPCs that you install into the router. Many components on the DPC are fragile.



**CAUTION:** Failure to handle DPCs as specified in this document can cause irreparable damage.

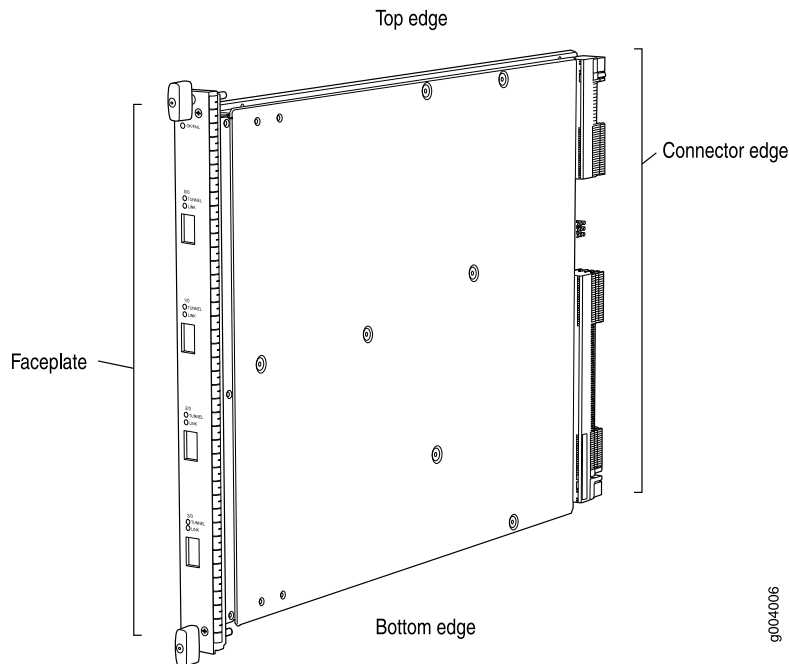
This section discusses how to hold DPCs in both the vertical and horizontal positions. Regardless of orientation, this section uses the same terms for all four edges of the DPC (see Figure 32 on page 75):

- Faceplate—Edge of the DPC that has connectors into which you insert the SFP or XFP transceivers
- Connector edge—Edge opposite the faceplate; this edge has the connectors that attach to the midplane
- Top edge—Edge at the top of the DPC when it is vertical
- Bottom edge—Edge at the bottom of the DPC when it is vertical



**NOTE:** The instructions in this section apply to all DPC types.

**Figure 32: DPC Edges**



### Holding a DPC

You hold a DPC horizontally when installing it into the chassis or an equipment rack. When carrying a DPC, you can hold it either vertically or horizontally.



**NOTE:** A DPC weighs 13.1 lb (5.9 kg). Be prepared to accept the full weight of the DPC as you lift it.

To hold a DPC vertically:

1. Orient the DPC so that the faceplate faces you. To verify orientation, confirm that the text on the DPC is right-side up and the electromagnetic interference (EMI) strip is on the right-hand side.
2. Place one hand around the DPC faceplate about a quarter of the way down from the top edge. To avoid deforming the EMI shielding strip, do not press hard on it.
3. Place your other hand at the bottom edge of the DPC.

If the DPC is horizontal before you grasp it, place your left hand around the faceplate and your right hand along the bottom edge.

To hold a DPC horizontally:

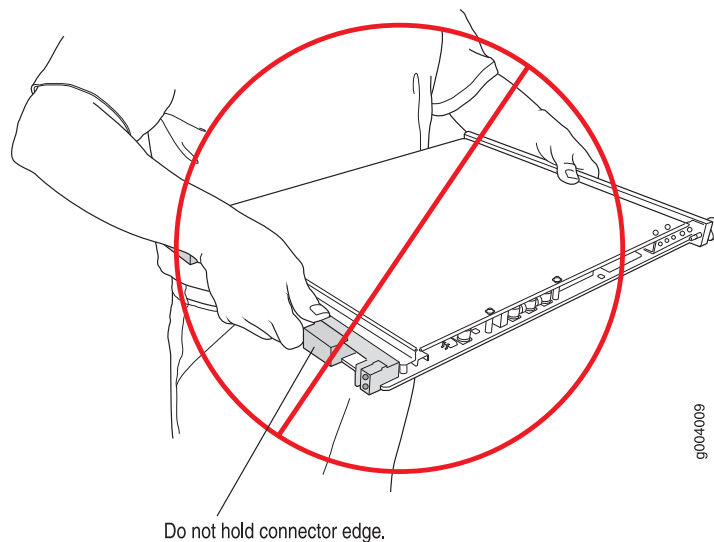
1. Orient the DPC so that the faceplate faces you.
2. Grasp the top edge with your left hand and the bottom edge with your right hand.

You can rest the faceplate of the DPC against your body as you carry it.

As you carry the DPC, do not bump it against anything. DPC components are fragile.

Never hold or grasp the DPC 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 33 on page 76).

**Figure 33: Do Not Grasp the Connector Edge**



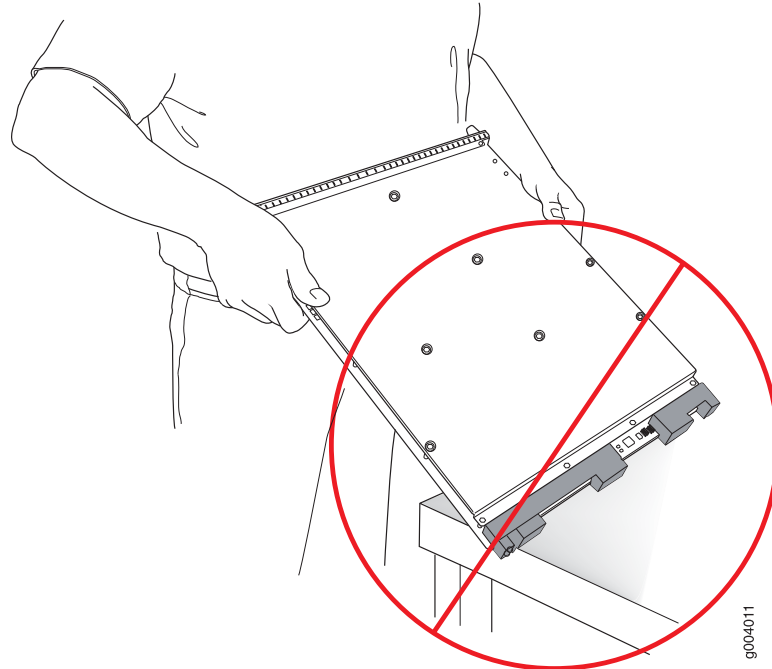


Never carry the DPC by the faceplate with only one hand.

Do not rest any edge of a DPC directly against a hard surface (see Figure 34 on page 77).

Do not stack DPCs.

**Figure 34: Do Not Rest the DPC on an Edge**



Do not rest connectors on any surface.

If you must rest the DPC temporarily on an edge while changing its orientation between vertical and horizontal, use your hand as a cushion between the edge and the surface.

### Storing a DPC

You must store a DPC as follows:

- In the routing platform
- In the container in which a spare DPC is shipped
- Horizontally and sheet metal side down

When you store a DPC on a horizontal surface or in the shipping container, always place it inside an antistatic bag. Because the DPC is heavy, and because antistatic bags are fragile, inserting the DPC into the bag is easier with two people. To do this, one person holds the DPC in the horizontal position with the faceplate facing the body, and the other person slides the opening of the bag over the DPC connector edge.

If you must insert the DPC into a bag by yourself, first lay the DPC horizontally on a flat, stable surface, sheet metal side down. Orient the DPC with the faceplate facing you. Carefully insert the DPC connector edge into the opening of the bag, and pull the bag toward you to cover the DPC.

Never stack a DPC under or on top of any other component.

## Maintaining the Power Supplies

---

To maintain the power supplies, follow these guidelines:

- 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 output        OK
PEM 2 status:
  State           Online
  Temperature      OK
  DC output        OK

```

- Make sure that the power and grounding cables are arranged so that they do not obstruct access to other router components.
- Routinely check the status LEDs on the power supply faceplates and the craft interface to determine whether the power supplies are functioning normally. For more information about the power supply LEDs, see “Power Supply LEDs” on page 19 and “AC Power Supply LEDs” on page 22 or “DC Power Supply LEDs” on page 24.
- Check the red and yellow alarm LEDs on the craft interface. Power supply failure or removal triggers an alarm that causes one or both of the LEDs to light. You can display the associated error messages by issuing the following command:

```
user@host> show chassis alarms
```

For a list of possible alarm messages, see “Chassis and Interface Alarm Messages” on page 80.

- 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 “Preparing the Site for Router Installation” on page 29.

## Chapter 12

# Troubleshooting Hardware Components

This chapter describes how to troubleshoot problems with hardware components installed in the router. If you encounter software problems, or problems with hardware components not discussed here, contact the Juniper Networks Technical Assistance Center (JTAC) as described in “Requesting Technical Support” on page xxvii.

- Overview of Troubleshooting Resources on page 79
- Troubleshooting the Cooling System on page 82
- Troubleshooting DPCs on page 83
- Troubleshooting the Power System on page 84

### Overview of Troubleshooting Resources

---

This section provides an overview of the resources you can use while troubleshooting problems with the router:

- Juniper Networks Technical Assistance Center on page 79
- Command-Line Interface on page 79
- Chassis and Interface Alarm Messages on page 80
- Alarm Relay Contacts on page 80
- LEDs on page 80

### *Juniper Networks Technical Assistance Center*

If you need assistance during troubleshooting, you can contact the Juniper Networks Technical Assistance Center (JTAC) by using the Web or by telephone. See “Requesting Technical Support” on page xxvii.

### *Command-Line Interface*

The JUNOS software command-line interface (CLI) is the primary tool for controlling and troubleshooting router hardware, the JUNOS software, routing protocols, and network connectivity. CLI commands display information from routing tables, information specific to routing protocols, and information about network connectivity derived from the `ping` and `traceroute` utilities.

You enter CLI commands on one or more external management devices connected to ports on the Routing Engine. For more information about the Routing Engine ports, see “Routing Engine Interface Ports” on page 16.

For information about using the CLI to display details about alarms generated by interfaces and hardware components, see “Chassis and Interface Alarm Messages” on page 80. For information about using the CLI to troubleshoot the JUNOS software, see the appropriate JUNOS software configuration guide.

## **Chassis and Interface Alarm Messages**

When the Routing Engine detects an alarm condition, it lights the red or yellow alarm LED on the craft interface as appropriate. To view a more detailed description of the alarm cause, issue the `show chassis alarms` command:

```
user@host> show chassis alarms
```

There are two classes of alarm messages:

- Chassis alarms—Indicate a problem with a chassis component such as the cooling system or power supplies.
- Interface alarms—Indicate a problem with a specific network interface.

## **Alarm Relay Contacts**

The craft interface has two alarm relay contacts for connecting the router to external alarm devices (see Figure 14 on page 21). 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 on the upper right of the craft interface.

## **LEDs**

LEDs on the router display the status of various components. This section describes the following types of LEDs:

- Craft Interface LEDs on page 80
- Component LEDs on page 81

### **Craft Interface LEDs**

The craft interface is the panel on the front of the router located above the DPC cards that contains LEDs and buttons that allow you to troubleshoot the router (see Figure 13 on page 18). For more information about the craft interface, see “Craft Interface” on page 17.

LEDs on the craft interface include the following:

- **Alarm LEDs**—One large red circular LED and one large yellow triangular LED, located on the upper right of the craft interface, indicate two levels of alarm conditions. 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 alarm LED to light also activates the corresponding alarm relay contact on the craft interface.
- **Host subsystem LEDs**—Three LEDs, **MASTER**, **ONLINE**, and **OFFLINE**, indicate the status of the host subsystem. A green **MASTER** LED indicates that the host is functioning as the master. The **ONLINE** LED indicates that the host is online. The **OFFLINE** LED indicates that the host is installed but the routing engine is offline. The host subsystem LEDs are located on the left of the craft interface and are labeled **RE0** and **RE1**. For more information, see “Host Subsystem LEDs” on page 19.
- **Power supply LED**—Two LEDs (**PEM**) indicate the status of each power supply. Green indicates that the power supply is functioning normally. Red indicates that the power supply is not functioning normally. The power supply LEDs are located in the center craft interface, and are labeled **0** through **3**. For more information, see “Power Supply LEDs” on page 19.
- **DPC LEDs**—Two LEDs, **OK** and **FAIL**, indicate the status of each DPC. Green indicates OK and red indicates a failure. The DPC LEDs are located along the bottom of the craft interface, and are labeled **0/1**, **1**, and **2**. For more information, see “DPC LEDs” on page 20.
- **SCB LEDs**—Two LEDs, **OK** and **FAIL**, indicate the status of each SCB. Green indicates OK and red indicates a failure. The SCB LEDs are located on the left of the craft interface along the bottom, and are labeled **0** and **1/0**. For more information, see “SCB LEDs” on page 20.
- **Fan LEDs**—Two LEDs indicate the status of the fans. Green indicates **OK** and red indicates **FAIL**. The fan LEDs are located on the upper left of the craft interface. For more information, see “Host Subsystem LEDs” on page 19.

### Component LEDs

The following LEDs are located on various router components and display the status of those components:

- **DPC LED**—One LED labeled **OK/FAIL** on each DPC faceplate indicates the DPC's status. For more information, see Table 7 on page 10, Table 8 on page 10, and Table 14 on page 20.
- **SCB LEDs**—Three LEDs, labeled **FABRIC ACTIVE**, **FABRIC ONLY**, and **OK/FAIL**, on each SCB faceplate indicate the status of the SCB. If no LEDs are lit, the master

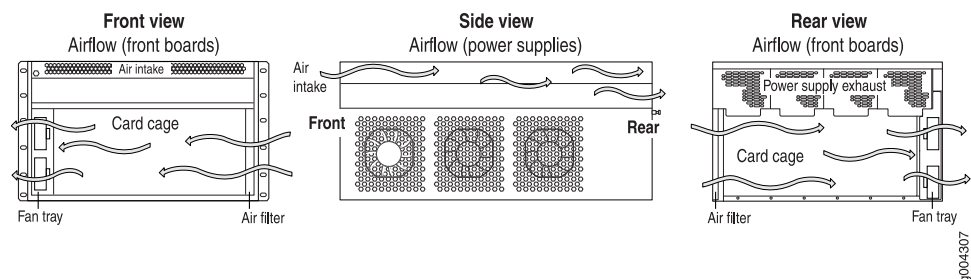
RE might still be booting or the SCB is not receiving power. For more information, see “SCB Components” on page 13.

- RE LEDs—Four LEDs, labeled MASTER, HDD, ONLINE, and FAIL on each Routing Engine faceplate indicate the status of the Routing Engine and hard disk drive. For more information, see Table 10 on page 16.
- Power supply LEDs—Two LEDs on each power supply faceplate indicate the status of that power supply. For more information, see Table 17 on page 23 and Table 18 on page 24.

## Troubleshooting the Cooling System

The router cooling system is a fan tray and an air filter, both of which are located vertically in the rear of the chassis (see Figure 1 on page 6). Figure 35 on page 82 shows the airflow through the router. To function properly, the entire cooling system requires an unobstructed airflow and proper clearance around the site, as described in “Preparing the Site for Router Installation” on page 29.

**Figure 35: Airflow Through the Chassis**



- An air filter installed in the rear of the chassis helps keep dust and other particles from entering the cooling system.
- The fan tray contains three fans. The fan tray provides cooling to the components installed in the router. During normal operation, the fans in the fan tray function at less than full speed. The SCB constantly monitors the temperatures detected by sensors and router components, adjusting the speed of the fans as necessary. The following conditions automatically cause the fans to run at full speed and also trigger the indicated alarm:
  - A fan fails (red alarm).
  - The fan tray is removed (yellow alarm and red 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).

To verify that the cooling system is functioning normally:

- Check the fan LEDs and alarm LEDs on the craft interface.

- See “Maintaining Cooling System Components” on page 68.

If the fans are not functioning normally, follow these guidelines to troubleshoot the fans:

- If the red alarm LED on the craft interface lights, use the CLI to get information about the source of an alarm condition: `user@host> show chassis alarms`. For information about alarms, see “Alarm LEDs and Alarm Cutoff/Lamp Test Button” on page 18.

If the CLI output lists only one fan failure, and the other fans are functioning normally, the fan is most likely faulty and you must replace the fan tray, as described in “Replacing the Fan Tray” on page 92.

- Place your hand near the exhaust vents at the side of the chassis to determine whether the fans are pushing air out of the chassis.

## Troubleshooting DPCs



**NOTE:** The `show chassis fpc` command, shows status of the DPCs.

To verify that the DPCs are operating normally:

- Check the **OK/FAIL** LED on the DPC and **OK** and **FAIL** DPC LEDs on the craft interface. When the DPC is online and functioning normally, the **OK** LED lights green steadily.
- Issue the `show chassis fpc` command to check the status of installed DPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the DPC is functioning normally:

```
user@host> show chassis fpc
```

Slot	State	Temp (C)	CPU Utilization (%)		Memory	Utilization (%)	
			Total	Interrupt	DRAM (MB)	Heap	Buffer
0	Online	33	9		0	1024	15
57							
1	Online	33	5		0	1024	16
57							
2	Online	33	11		0	1024	16
57							

For more detailed output, add the `detail` option. The following example does not specify a slot number, which is optional:

```
user@host> show chassis fpc detail
```

```
Slot 1 information:
```

State	Online
Temperature	33 degrees C / 91 degrees F
Total CPU DRAM	1024 MB

```

Total RLD RAM      256 MB
Total DDR DRAM     4096 MB
Start time:        2007-12-06 11:33:01 PST
Uptime:            4 hours, 34 minutes, 48 seconds
Slot 2 information:
State              Online
Temperature        33 degrees C / 91 degrees F
Total CPU DRAM     1024 MB
Total RLD RAM      256 MB
Total DDR DRAM     4096 MB
Start time:        2007-12-06 11:33:05 PST
Uptime:            4 hours, 34 minutes, 44 seconds

```

For further description of the output from the commands, see the *JUNOS System Basics and Services Command Reference*.

If a DPC is not functioning normally, follow these guidelines to troubleshoot the DPC:

- Make sure the DPC is properly seated in the midplane. Check that each ejector handle has been turned clockwise and is tight.

## Troubleshooting the Power System

To verify that a power supply is functioning normally, perform the following steps:

- Check the LEDs on each power supply faceplate.
  - If an AC power supply is correctly installed and functioning normally, the AC OK and DC OK LEDs light steadily, and the PS FAIL LED is not lit. For more information about the LEDs, see “AC Power Supply LEDs” on page 22.
  - If a DC power supply is correctly installed and functioning normally, the PWR OK, BRKR ON, and INPUT OK LEDs light green steadily. For more information about the LEDs, see “DC Power Supply LEDs” on page 24.
- Issue the CLI `show chassis environment pem` command to check the status of installed power supplies. As shown in the sample output, the value **Online** in the rows labeled **State** indicates that the power supplies in slots 0 and 1 are functioning normally:

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

```

PEM 0 status:
State          Online
Temperature    OK
DC output      OK
PEM 2 status:
State          Online

```



Temperature	OK
DC output	OK

If a power supply is not functioning normally, perform the following steps to diagnose and correct the problem:

- If a red alarm condition occurs, issue the **show chassis alarms** command to determine the source of the problem.
- If all power supplies have failed, the system temperature might have exceeded the threshold, causing the system to shut down.



**NOTE:** If the system temperature exceeds the threshold, the JUNOS software shuts down all power supplies so that no status is displayed.

The JUNOS software also can shut down one of the power supplies for other reasons. In this case, the remaining power supplies provide power to the router, and you can still view the system status through the CLI or display.

---

- Check that the DC circuit breaker or AC switch is in the on position and is receiving power.
- 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 AC power cord or 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 power cord or power cables. If the power supply status LEDs indicate that the power supply is not functioning normally, the power supply is the source of the problem. Replace the power supply with a spare, as described in “Replacing Power System Components” on page 112.
- If you cannot determine the cause of the problem or need additional assistance, see “Juniper Networks Technical Assistance Center” on page 79.



## Chapter 13

# Replacing Hardware Components

This chapter explains how to replace hardware components on the router. It discusses the following topics:

- Field-Replaceable Units (FRUs) on page 87
- Tools and Parts Required on page 88
- Replacing the Craft Interface on page 89
- Replacing Cooling System Components on page 92
- Replacing Host Subsystem Components on page 96
- Replacing a Routing Engine on page 102
- Replacing Connections to Routing Engine Interface Ports on page 104
- Replacing DPCs and Transceivers on page 106
- Replacing Power System Components on page 112
- Replacing the Cable Management System on page 121

### Field-Replaceable Units (FRUs)

---

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 off the router, but the routing functions of the system are interrupted when the component is removed.

Table 23 on page 88 lists the FRUs for the MX240 router. Before you replace an SCB or a Routing Engine, you must take the host subsystem offline (see “Taking the Host Subsystem Offline” on page 96).

**Table 23: Field-Replaceable Units**

Hot-Removable and Hot-Insertable FRUs	Hot-Pluggable FRUs
Air filter	Master Switch Control Board (SCB) (if redundant)
Craft interface	Master Routing Engine (if redundant)
Backup Switch Control Board (SCB) (if redundant)	Switch Control Board (SCB) (nonredundant)
Backup Routing Engine (if redundant)	Routing Engine (nonredundant)
Dense Port Concentrators (DPCs)	
AC and DC power supplies (if redundant)	
Fan tray	

## Tools and Parts Required

To replace hardware components, you need the tools and parts listed in Table 24 on page 88.

**Table 24: Tools and Parts Required**

Tool or part	Components
3/8-in. nut driver or socket wrench	Cables and connectors DC power supply
Blank panels (if component is not reinstalled)	SCB DPC Power supply Routing Engine
Electrostatic bag or antistatic mat	Craft Interface SCB DPC Routing Engine
Electrostatic discharge (ESD) grounding wrist strap	All
Flat-blade (–) screwdriver	Cables and connectors DPC

**Table 24: Tools and Parts Required** *(continued)*

Tool or part	Components
Phillips ( + ) screwdrivers, numbers 1 and 2	Air filter
	Routing Engine
	Craft interface
	SCB
	Cables and connectors
	Fan tray
Rubber safety cap	DPC
Wire cutters	Cables and connectors
	DC power supply

## Replacing the Craft Interface

The craft interface is located above the DPC card cage, as shown in Figure 1 on page 6. It houses the alarm relay interface ports and indicates status of router components.

The craft interface is hot-insertable and hot-removable. It weighs approximately 1.1 lb (0.50 kg). When you install the craft interface, allow several minutes for the display to reflect the current state of the router.

To replace the craft interface, use the following procedures:

- Removing the Craft Interface on page 89
- Installing the Craft Interface on page 90
- Replacing Alarm Relay Wires on page 91

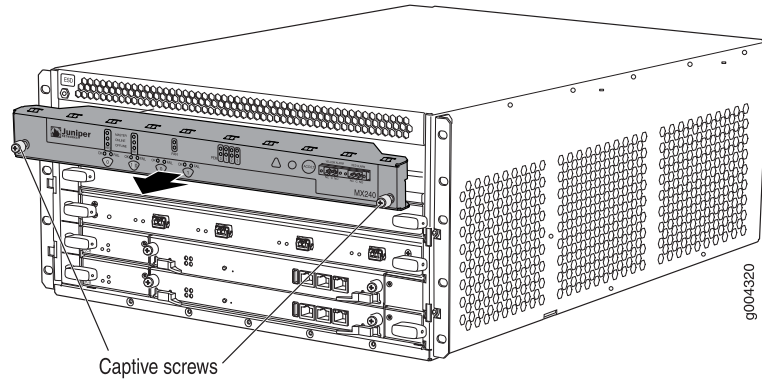
## Removing the Craft Interface

To remove the craft interface (see Figure 36 on page 90):

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” on page 130.
2. Detach any external devices connected to the craft interface.
3. Loosen the captive screws at the top left and right corners of the craft interface faceplate.

4. Grasp the craft interface faceplate and carefully tilt it toward you until it is horizontal.
5. Disconnect the ribbon cable from the back of the faceplate by gently pressing on both sides of the latch with your thumb and forefinger. Remove the craft interface from the chassis.

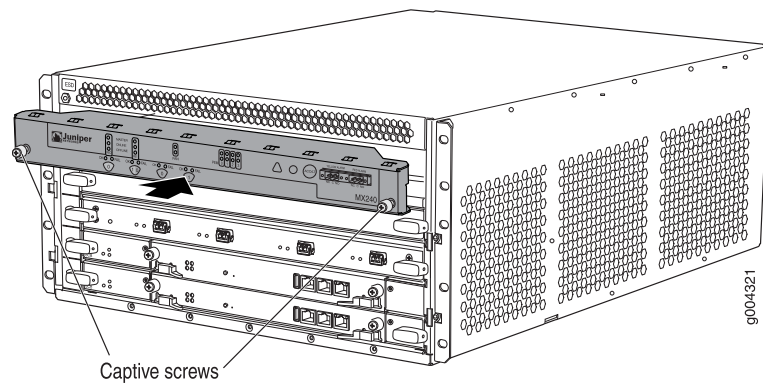
**Figure 36: Removing the Craft Interface**



## Installing the Craft Interface

To install the craft interface (see Figure 37 on page 91):

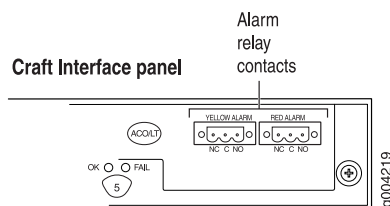
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. For more information about ESD, see “Preventing Electrostatic Discharge Damage” on page 130.
2. Grasp the craft interface with one hand and hold the bottom edge of the craft interface with the other hand to support its weight.
3. Orient the ribbon cable so that it plugs into the connector socket. The connector is keyed and can be inserted only one way.
4. Align the bottom of the craft interface with the sheet metal above the DPC card cage and press it into place.
5. Tighten the screws on the left and right corners of the craft interface faceplate.
6. Reattach any external devices connected to the craft interface.

**Figure 37: Installing a Craft Interface**

## Replacing Alarm Relay Wires

The alarm relay wires connect external alarm-reporting devices to the RED and YELLOW relay contacts on the craft interface.

The terminal blocks that plug into the alarm relay contacts are supplied with the router. The terminal blocks accept wire of any gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>). Use the wire gauge appropriate for the external device you are connecting.

**Figure 38: Alarm Relay Contacts**

## Disconnecting the Alarm Relay Wires

To disconnect the alarm relay wires from the router and an alarm-reporting device (see Figure 38 on page 91):

1. Disconnect the existing wire at the external device.
2. Using a 2.5-mm flat-blade screwdriver, loosen the small screws on the face of the terminal block and remove the block from the relay contact.
3. Using the 2.5-mm flat-blade screwdriver, loosen the small screws on the side of the terminal block. Remove existing wires from the slots in the front of the block.

## Connecting the Alarm Relay Wires

To connect the alarm relay wires between a router and an alarm-reporting device (see Figure 38 on page 91):

1. Prepare the required length of replacement wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>).
2. Insert the replacement wires into the slots in the front of the block. Use a 2.5-mm flat-blade screwdriver to tighten the screws and secure the wire.
3. 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.
4. Attach the other end of the wires to the external device.

## Replacing Cooling System Components

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- Replacing the Fan Tray on page 92
- Replacing the Air Filter on page 94

### Replacing the Fan Tray

The router has one fan tray that installs vertically in the rear of the chassis. The fan tray contains three fans. The fan tray is hot-removable and hot-insertable.

The fan tray is located in the rear of the chassis on the right side. The fan tray weighs about 4.2 lb (1.9 kg).



**NOTE:** To prevent overheating, install the replacement fan tray immediately after removing the existing fan tray.

---

To replace the fan tray, use the following procedures:

- Removing the Fan Tray on page 92
- Installing the Fan Tray on page 93

### Removing the Fan Tray

To remove the fan tray (see Figure 39 on page 93):

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” on page 130.
2. Loosen the captive screws on the fan tray faceplate.
3. Grasp the fan tray handle and pull it out approximately 1 to 3 inches.

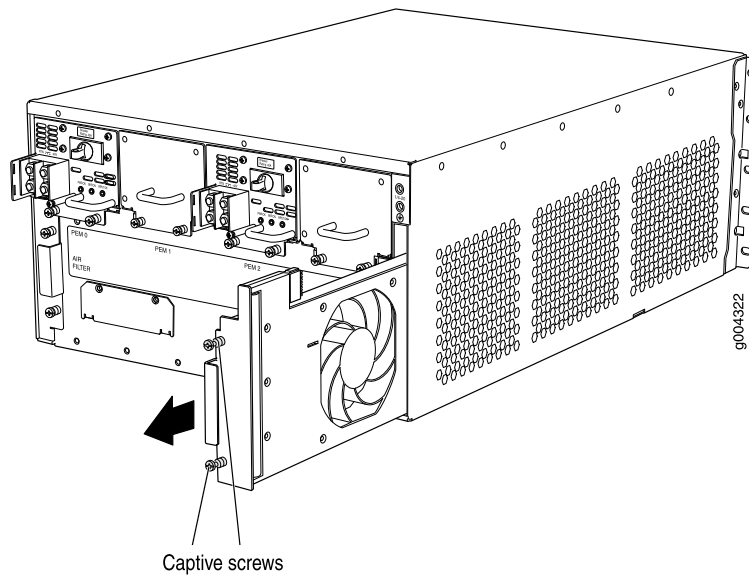




**WARNING:** To avoid injury, keep tools and your fingers away from the fans as you slide the fan tray out of the chassis. The fans might still be spinning.

4. Press the latch located on the inside of the fan tray to release it from the chassis.
5. Place one hand under the fan tray to support it and pull the fan tray completely out of the chassis.

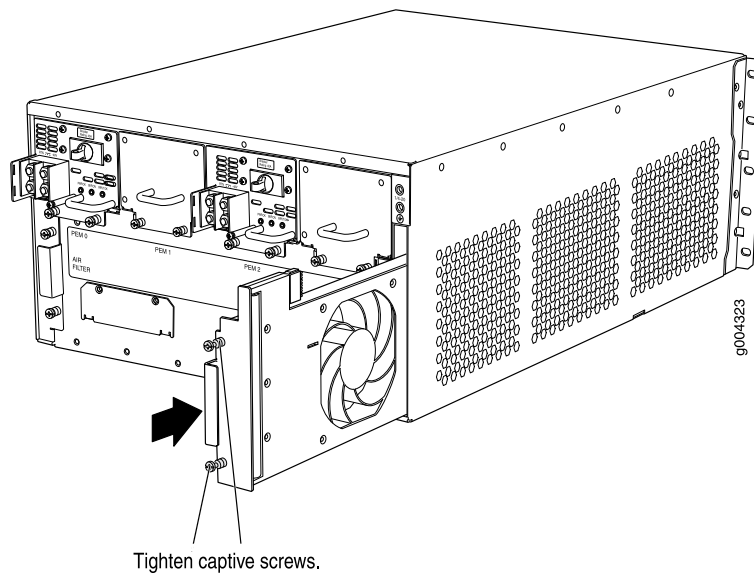
**Figure 39: Removing the Fan Tray from an MX240 Router**



### Installing the Fan Tray

To install the fan tray (see Figure 40 on page 94):

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” on page 130.
2. Grasp the fan tray handle and insert it straight into the chassis. Note the correct orientation by the **this side up** label on the top surface of the fan tray.
3. Tighten the captive screws on the fan tray faceplate to secure it in the chassis.

**Figure 40: Installing the Fan Tray in an MX240 Router**

## Replacing the Air Filter

The router has one air filter that installs vertically in the rear of the chassis. The air filter is hot-insertable and hot-removable.

The air filter is located in the rear of the chassis on the left side. The air filter weighs approximately 1 lb (0.5 kg).

To replace an air filter, use the following procedure:

- Removing an Air Filter on page 94
- Installing the Air Filter on page 95

### Removing an Air Filter



**CAUTION:** Do not run the router for more than a few minutes without the air filter in place.

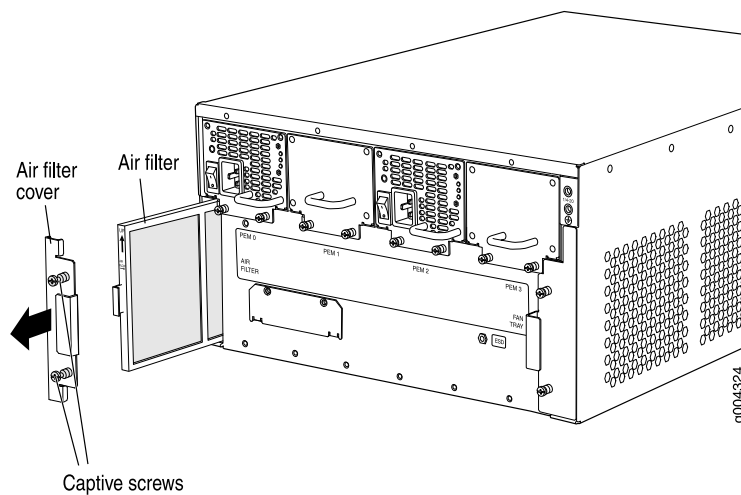


**CAUTION:** Always keep the air filter in place while the router is operating, except during replacement. Because the fans are very powerful, they could pull small bits of wire or other materials into the router through the unfiltered air intake. This could damage the router components.

To remove the air filter (see Figure 41 on page 95):

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” on page 130.
2. Loosen the captive screws on the air filter cover.
3. Remove the air filter cover.
4. Slide the air filter out of the chassis.

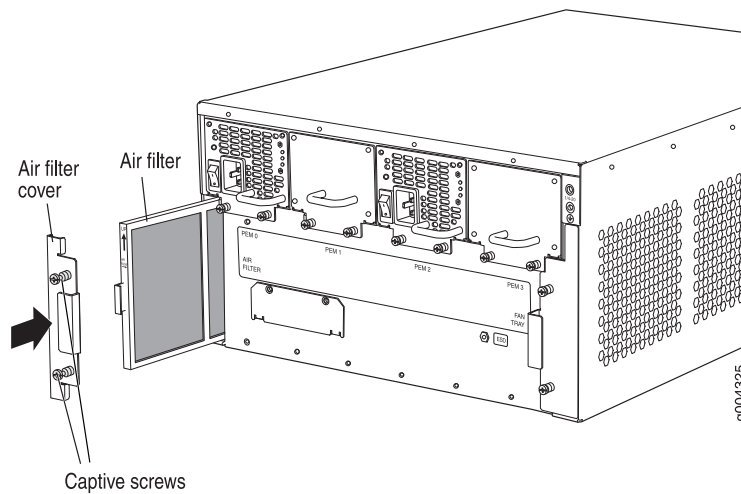
**Figure 41: Removing the Air Filter from an MX240 Router**



### Installing the Air Filter

To install the air filter (see Figure 42 on page 96):

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” on page 130.
2. Locate the up arrow and ensure that the air filter is right side up.
3. Slide the air filter straight into the chassis until it stops.
4. Align the captive screws of the air filter cover with the mounting holes on the chassis.
5. Tighten the captive screws on the air filter cover.

**Figure 42: Installing the Air Filter in an MX240 Router**

## Replacing Host Subsystem Components

To replace a host subsystem, use the following procedures:

- Taking the Host Subsystem Offline on page 96
- Replacing an SCB on page 97

### Taking the Host Subsystem Offline

The host subsystem is taken offline and brought online as a unit. Before you replace an SCB or a Routing Engine, you must take the host subsystem offline. The host subsystem is hot-pluggable.

If the router has only one host subsystem, taking the host subsystem offline causes the router to shut down.

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). The effect of taking the master host subsystem varies depending on your configuration of high availability features.

High availability features include Routing Engine redundancy, graceful Routing Engine switchover (GRES), nonstop bridging, nonstop active routing, graceful restart for routing protocols, Virtual Router Redundancy Protocol (VRRP), and unified in-service software upgrade (ISSU). Some high availability features are not supported by all platforms and all PICs. For information about the first supported JUNOS release for these features by PIC and platform, see the *JUNOS High Availability Configuration Guide*.

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 RE MASTER LED is lit, the corresponding host subsystem is functioning as the master.
  - Issue the following 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 command:

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

3. On the console or other management device connected to the Routing Engine that is paired with the SCB you are removing, enter CLI operational mode and issue the following command. The command shuts down the Routing Engine cleanly, so its state information is preserved:

```
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 the *JUNOS System Basics and Services Command Reference*.



**NOTE:** The SCB might continue forwarding traffic for approximately 5 minutes after the `request system halt` command has been issued.

---

## Replacing an SCB

The router can have up to two SCBs. They are located in the front of the chassis in the slots marked **0** and **1/0** (the multifunction slot **1/0** can contain either SCB1 or DPC0). With a Routing Engine installed, each SCB weighs approximately 9.6 lb (4.4 kg).

The SCBs are hot-pluggable. If the router contains a redundant host subsystem, the backup SCB and Routing Engine are hot-removable and hot-insertable. Before you replace an SCB or a Routing Engine, you must take the host subsystem offline (see

“Taking the Host Subsystem Offline” on page 96). To replace an SCB, use the following procedures:

- Operating and Positioning the SCB Ejectors on page 98
- Removing an SCB on page 99
- Installing an SCB on page 100

### **Operating and Positioning the SCB Ejectors**

- When removing or inserting an SCB, ensure that the SCBs or blank panels in adjacent slots are fully inserted to avoid hitting them with the ejector handles. The ejector handles require that all adjacent components be completely inserted so the ejector handles do not hit them, which could result in damage.
- The ejector handles rotate. After you install the SCBs in the router, ensure that the ejectors are positioned horizontally and do not block any other components or the LEDs. To avoid blocking the visibility of the LEDs, position the ejectors over the **PARK** icon.
- To insert or remove the SCB, slide the ejector across the SCB horizontally, rotate it, and slide it again another quarter of a turn. Turn the ejector again and repeat as necessary. Utilize the indexing feature to maximize leverage and to avoid hitting any adjacent components.
- Operate both ejector handles simultaneously. The insertion force on an SCB is too great for one ejector.

## Removing an SCB

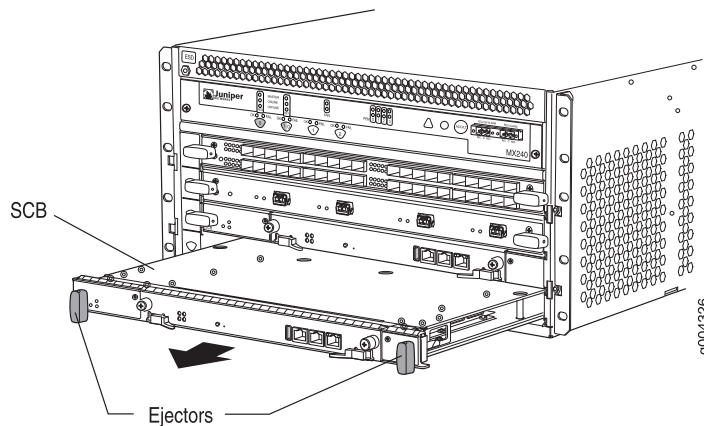
To remove an SCB (see Figure 43 on page 99):



**NOTE:** You can remove the SCB and Routing Engine as a unit, or remove the Routing Engine separately.

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” on page 130.
3. Check whether the SCB is functioning as the backup or as the master. If necessary, take the host subsystem offline, as described in “Taking the Host Subsystem Offline” on page 96.
4. Press the **ONLINE** button on the craft interface until the light turns from green to red.
5. Rotate the ejector handles simultaneously counterclockwise to unseat the SCB.
6. Grasp the ejector handles and slide the SCB about halfway out of the chassis.
7. Place one hand underneath the SCB to support it and slide it completely out of the chassis.
8. Place the SCB on the antistatic mat.
9. If you are not replacing the SCB now, install a blank panel over the empty slot.

**Figure 43: Removing an SCB**



## Installing an SCB

To install an SCB (see Figure 44 on page 102):

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” on page 130.
2. Carefully align the sides of the SCB with the guides inside the chassis.
3. Slide the SCB into the chassis until you feel resistance, carefully ensuring that it is correctly aligned.
4. Grasp both ejector handles and rotate them simultaneously clockwise until the SCB is fully seated.
5. Place the ejector handles in the proper position, horizontally and toward the center of the board.
6. To verify that the SCB is functioning normally, check the LEDs on its faceplate. The green **OK/FAIL** LED should light steadily a few minutes after the SCB is installed. If the **OK/FAIL** LED is red, remove and install the SCB again (see “Removing an SCB” on page 99 and “Installing an SCB” on page 100). If the **OK/FAIL** LED still lights steadily, the SCB is not functioning properly. Contact your customer support representative.



To check the status of the SCB, use the CLI command:

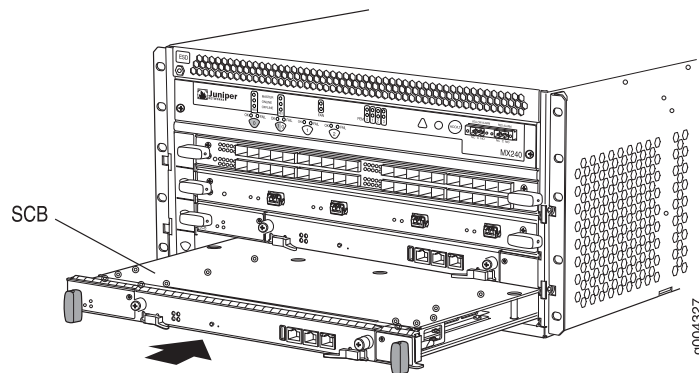
```
user@host> show chassis environment cb
```

CB 0 status:

State	Online Master
Temperature	25 degrees C / 77 degrees F
Power 1	
1.2 V	1198 mV
1.5 V	1508 mV
1.8 V	1830 mV
2.5 V	5059 mV
3.3 V	6593 mV
5.0 V	5111 mV
12.0 V	12181 mV
1.25 V	1250 mV
3.3 V SM3	6587 mV
5 V RE	5078 mV
12 V RE	12026 mV
Power 2	
11.3 V bias PEM	11253 mV
4.6 V bias MidPlane	4827 mV
11.3 V bias FPD	11408 mV
11.3 V bias POE 0	11446 mV
11.3 V bias POE 1	11408 mV
Bus Revision	6
FPGA Revision	0

CB 1 status:

State	Online Standby
Temperature	26 degrees C / 78 degrees F
Power 1	
1.2 V	1211 mV
1.5 V	1517 mV
1.8 V	1817 mV
2.5 V	2507 mV
3.3 V	3312 mV
5.0 V	5136 mV
12.0 V	12142 mV
1.25 V	1260 mV
3.3 V SM3	3306 mV
5 V RE	5085 mV
12 V RE	11968 mV
Power 2	
11.3 V bias PEM	11369 mV
4.6 V bias MidPlane	4814 mV
11.3 V bias FPD	11427 mV
11.3 V bias POE 0	11350 mV
11.3 V bias POE 1	11330 mV
Bus Revision	39
FPGA Revision	1

**Figure 44: Installing an SCB**

## Replacing a Routing Engine

The router can have one or two Routing Engines. They are located in the front of the chassis within the SCBs in the horizontally along the bottom of the chassis in the slots marked 0 and 1. Each Routing Engine weighs approximately 2.4 lb (1.1 kg).

The Routing Engine is hot-pluggable. If the router contains a redundant host subsystem, the backup Routing Engine and SCB are hot-removable and hot-insertable. Before you replace an SCB or a Routing Engine, you must take the host subsystem offline (see “Taking the Host Subsystem Offline” on page 96).

## Removing a Routing Engine

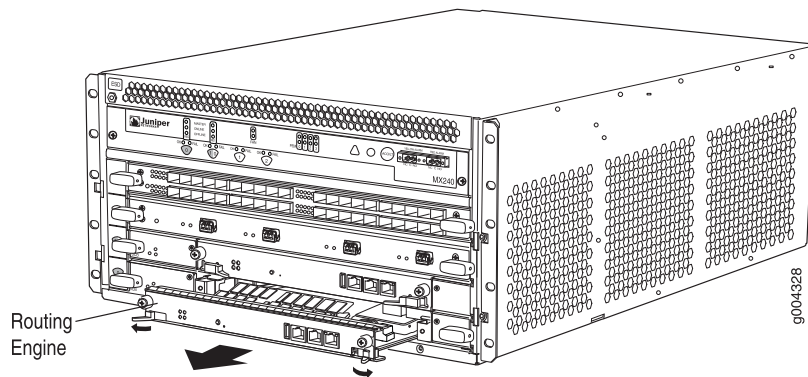
To remove a Routing Engine from an SCB (see Figure 45 on page 103):

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” on page 130.
3. Check whether the Routing Engine is functioning as the backup or as the master. If necessary, take the host subsystem offline, as described in “Taking the Host Subsystem Offline” on page 96.
4. Verify that the Routing Engine LEDs are off.
5. Loosen the captive screws on the left and right of the Routing Engine.
6. Flip the ejector handles outward to unseat the Routing Engine.
7. Grasp the Routing Engine by the ejector handles and slide it about halfway out of the chassis.
8. Place one hand underneath the Routing Engine to support it and slide it completely out of the chassis.
9. Place the Routing Engine on the antistatic mat.



**NOTE:** To maintain proper airflow through the chassis, do not leave an SCB installed in the chassis without a Routing Engine for extended periods of time. If a Routing Engine is removed, a replacement Routing Engine should be installed as soon as possible.

**Figure 45: Removing a Routing Engine**



### Installing a Routing Engine

To install a Routing Engine into an SCB (see Figure 46 on page 104):

1. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.
2. Place one hand underneath the Routing Engine to support it.
3. Carefully align the sides of the Routing Engine with the guides inside the opening on the SCB.
4. Slide the Routing Engine into the SCB until you feel resistance, and then press the Routing Engine's faceplate until it engages the connectors.
5. Press both of the ejector handles inward to seat the Routing Engine.
6. Tighten the captive screws on the left and right of the Routing Engine.

The Routing Engine might require several minutes to boot.

After the Routing Engine boots, verify that it is installed correctly by checking the RE0 and RE1 LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **ONLINE** LED lights steadily. If the red **FAIL** LED lights steadily instead, remove and install the Routing Engine again (see “Removing a Routing Engine” on page 102 and “Installing a Routing Engine” on page 103). 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:

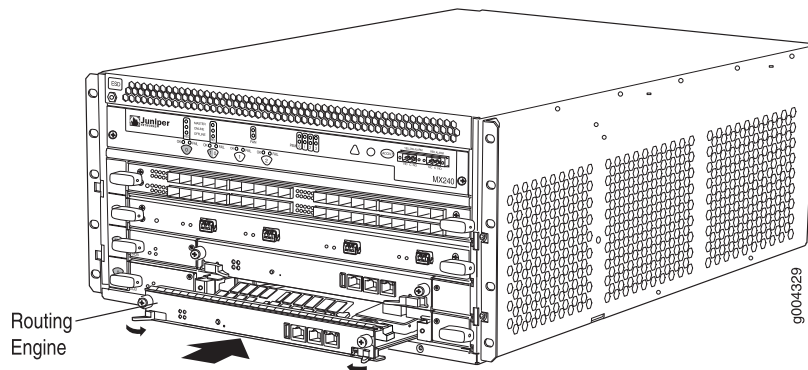
```

user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state           Master
...

```

For more information about using the CLI, see the JUNOS software manuals.

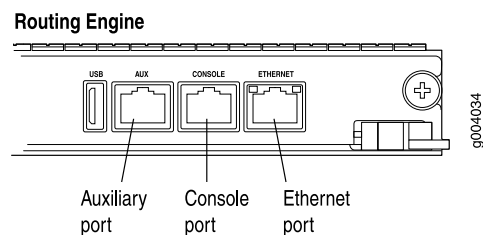
**Figure 46: Installing a Routing Engine**



## Replacing Connections to Routing Engine Interface Ports

You can connect the router to external management devices (see Figure 47 on page 104).

**Figure 47: Routing Engine Interface Ports**



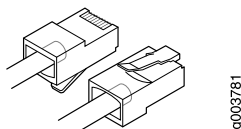
To replace the cables that connect to the ports, perform the procedures described in the following sections:

- Replacing the Management Ethernet Cable on page 105
- Replacing the Console or Auxiliary Cable on page 105

## Replacing the Management Ethernet Cable

To connect the Routing Engine to a network for out-of-band management, connect an Ethernet cable with RJ-45 connectors to the **ETHERNET** port on the Routing Engine. One such cable is provided with the router. For cable specifications, see “Routing Engine Interface Cable and Wire Specifications” on page 183.

**Figure 48: Cable Connectors**



## Removing the Management Ethernet Cable

To remove the management Ethernet cable:

1. Press the tab on the connector and pull the connector straight out of the port. Figure 48 on page 105 shows the connector.
2. Disconnect the cable from the network device.

## Installing the Management Ethernet Cable

To install the management Ethernet cable:

1. Plug one end of the replacement cable into the **ETHERNET** port. Figure 47 on page 104 shows the external device ports on the Routing Engine.
2. Plug the other end of the cable into the network device.

## Replacing the Console or Auxiliary Cable

To use a system console to configure and manage the Routing Engine, connect it to the **CONSOLE** port on the Routing Engine. To use a laptop, modem, or other auxiliary device, connect it to the **AUX** port on the Routing Engine. Both ports accept a cable with an RJ-45 connector. One serial cable with an RJ-45 connector and a DB-9 connector is provided with the router. If you want to connect a device to both ports, you must supply another cable. For cable specifications, see “Routing Engine Interface Cable and Wire Specifications” on page 183.

## Disconnecting the Cable from a Management Console or Auxiliary Device

To disconnect a serial cable from a management console or auxiliary device:

1. Turn off the power to the console or auxiliary device.
2. Press the tab on the connector and pull the connector straight out of the **CONSOLE** or **AUX** port.
3. Disconnect the cable from the console or auxiliary device.

## Connecting the Cable to a Management Console or Auxiliary Device

To connect a serial cable to a management console or auxiliary device:

1. Plug the RJ-45 end of the replacement serial cable into the **CONSOLE** or **AUX** port. Figure 47 on page 104 shows the external device ports on the Routing Engine.
2. Plug the female DB-9 end into the console or auxiliary device's serial port.
3. Turn on the power to the console or auxiliary device.

## Replacing DPCs and Transceivers

---

For instructions on replacing DPCs and SFP and XFP transceivers, see the following sections:

- Replacing a DPC on page 106
- Removing an SFP or XFP Transceiver on page 110
- Installing an SFP or XFP Transceiver on page 112

### Replacing a DPC

DPCs are installed horizontally in the front of the router. The DPCs are hot-insertable and hot-removable. When you remove a DPC, the router continues to function, although the DPC being removed no longer functions. Before replacing a DPC, review the information in “Holding a DPC” on page 75. A DPC weighs up to 13.1 lb (5.9 kg). Be prepared to accept its full weight. To replace a DPC:

- Removing a DPC on page 106
- Installing a DPC on page 108

### Removing a DPC

To remove a DPC (see Figure 49 on page 108):

1. Have ready a replacement DPC or DPC blank panel and an antistatic mat for the DPC. Also have ready rubber safety caps for each DPC you are removing that uses an optical interface.
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” on page 130.
3. Label the cables connected to each port on the DPC so that you can later reconnect the cables to the correct ports.
4. Use one of the following methods to take the DPC offline:
  - Press and hold the corresponding DPC online button on the craft interface. The green **OK** LED next to the button begins to blink. Hold the button down until the LED goes off.
  - Issue the following CLI command:

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

For more information about the command, see the *JUNOS System Basics and Services Command Reference*.

5. Disconnect the cables from the DPC. If the DPC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap. Arrange the disconnected cables in the cable management system to prevent the cables from developing stress points.



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

---



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

---



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

---

6. Simultaneously turn both of the ejector handles counterclockwise to unseat the DPC.
  7. Grasp the handles and slide the DPC straight out of the card cage halfway.
  8. Place one hand around the front of the DPC and the other hand under it to support it. Slide the DPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.
- 



**CAUTION:** The weight of the DPC is concentrated in the back end. Be prepared to accept the full weight—up to 13.1 lb (5.9 kg)—as you slide the DPC out of the chassis.

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

Do not stack DPCs 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.

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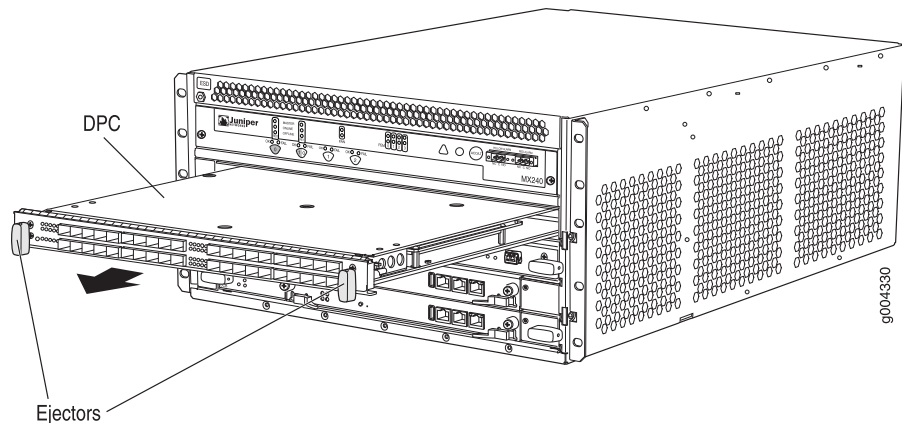
9. If you are not reinstalling a DPC into the emptied DPC slot within a short time, install a blank DPC panel over the slot to maintain proper airflow in the DPC card cage.



**CAUTION:** After removing a DPC from the chassis, wait at least 30 seconds before reinserting it, removing a DPC from a different slot, or inserting a DPC into a different slot.

---

**Figure 49: Removing a DPC**



### Installing a DPC

To install a DPC (see Figure 50 on page 110):

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” on page 130.
2. Place the DPC on an antistatic mat or remove it from its electrostatic bag.
3. Identify the slot on the router where it will be installed.
4. Verify that each fiber-optic transceiver is covered with a rubber safety cap. If it does not, cover the transceiver with a safety cap.
5. Orient the DPC so that the faceplate faces you.
6. Lift the DPC into place and carefully align the sides of the DPC with the guides inside the card cage.
7. Slide the DPC all the way into the card cage until you feel resistance.
8. Grasp both ejector handles and rotate them clockwise simultaneously until the DPC is fully seated.
9. If the DPC uses fiber-optic cable, remove the rubber safety cap from each transceiver and cable.



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

---



10. Insert the appropriate cables into the cable connector ports on each DPC (see Figure 51 on page 110). 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.

---

11. Use one of the following methods to bring the DPC online:

- Press and hold the corresponding DPC online button on the craft interface until the green OK LED next to the button lights steadily, in about 5 seconds.
- Issue the following CLI command:

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

For more information about the command, see the *JUNOS System Basics and Services Command Reference*.

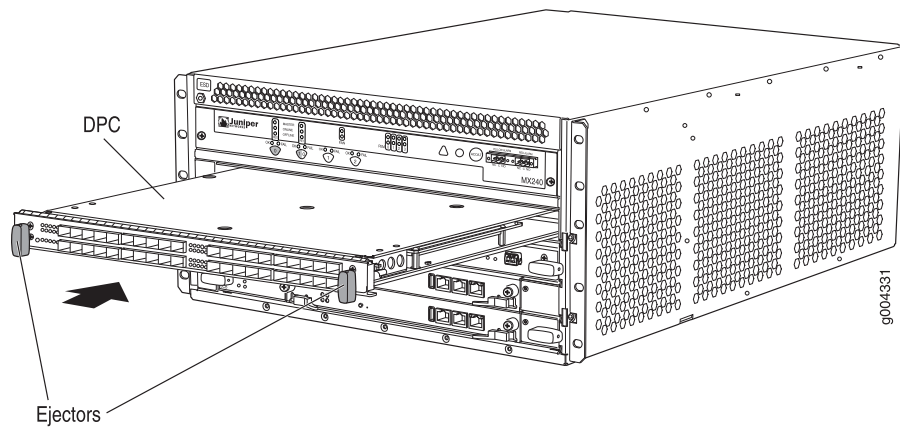
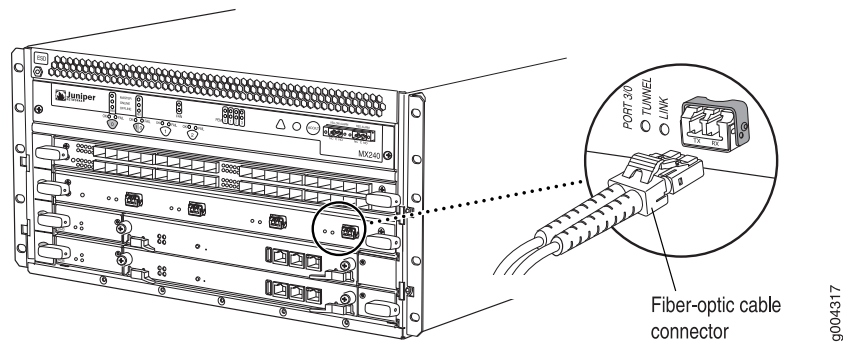
---



**CAUTION:** After the OK LED turns green, wait at least 30 seconds before removing the DPC again, removing a DPC from a different slot, or inserting a DPC in a different slot.

---

You can also verify that the DPC is functioning correctly by issuing the `show chassis fpc` and `show chassis fpc pic-status` commands, as described in “Maintaining DPCs” on page 72 and “Maintaining DPC Cables” on page 74.

**Figure 50: Installing a DPC****Figure 51: Attaching a Cable to a DPC**

## Removing an SFP or XFP Transceiver

Small form-factor pluggable (SFPs) and XFPs are optical transceivers that are installed in a DPC.

SFPs and XFPs are hot-insertable and hot-removable. Removing an SFP or XFP does not interrupt DPC functioning, but the removed SFP or XFP no longer receives or transmits data.

To remove an SFP or XFP transceiver (see Figure 52 on page 111):

1. Have ready a replacement transceiver or a transceiver slot plug, an antistatic mat, and a rubber safety cap for the transceiver.
2. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the ESD points on the chassis.
3. Label the cables connected to the transceiver so that you can reconnect them correctly later.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the end of a fiber-optic cable. Fiber-optic transceivers contain laser light sources that can damage your eyes.

4. Remove the cable connector plugged into the transceiver.
5. Carefully drape the disconnected cable over the bobbins in the cable management system to prevent the cable from developing stress points.



**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 out from the transceiver to unlock the transceiver.

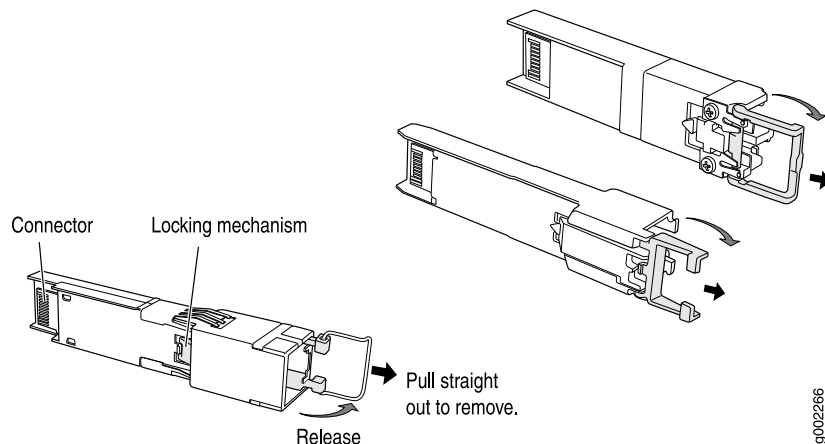


**CAUTION:** Make sure that you open the ejector handle completely until you hear it click. This prevents damage to the transceiver.

Use needlenose pliers to pull the ejector handle out from the SFP.

7. Grasp the transceiver ejector handle and pull the transceiver approximately 0.5 in. (1.3 cm) out of the DPC.
8. Using your fingers, grasp the body of the transceiver and pull it the rest of the way out of the DPC.

**Figure 52: Removing SFPs or XFPs**



9. Place a rubber safety cap over the transceiver.
10. Place the removed transceiver on an antistatic mat or in an electrostatic bag.

## Installing an SFP or XFP Transceiver

To install an SFP or XFP:

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the ESD points on the chassis.
2. Take each transceiver to be installed out of its electrostatic bag and identify the slot on the DPC where it will be installed.
3. Verify that each transceiver is covered by a rubber safety cap. If it is not, cover the transceiver with a safety cap.
4. Carefully align the transceiver with the slots in the DPC. The connectors should face the DPC.
5. Slide the transceiver until the connector is seated in the DPC slot. If you are unable to fully insert the transceiver, make sure the connector is facing the right way.
6. Close the ejector handle of the transceiver.
7. Remove the rubber safety cap from the transceiver and the end of the cable. Insert the cable into the transceiver.
8. Verify that the status LEDs on the DPC faceplate indicate that the SFP or XFP is functioning correctly. For more information about the DPC LEDs, see the *MX-series Ethernet Services Router DPC Guide*. You can also verify that the DPC is functioning by issuing the `show chassis fpc pic-status` command described in “Maintaining DPC Cables” on page 74.

## Replacing Power System Components

Redundant power supplies (AC or DC) are hot-insertable and hot-removable.



**NOTE:** The minimum number of power supplies must be present in the router at all times.



**NOTE:** To maintain proper cooling and prevent thermal shutdown of the operating power supply unit, each power supply slot must contain either a power supply or a blank panel. If you remove a power supply, you must install a replacement power supply or a blank panel shortly after the removal.

To replace a power system component, use the following procedures:

- Removing an AC Power Supply on page 113
- Installing an AC Power Supply on page 114
- Removing a DC Power Supply on page 114
- Installing a DC Power Supply on page 116

- Replacing an AC Power Cord on page 118
- Replacing a DC Power Supply Cable on page 119

## Removing an AC Power Supply

The power supplies are located at the rear of the chassis. Each AC power supply weighs approximately 5.0 lb (2.3 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.

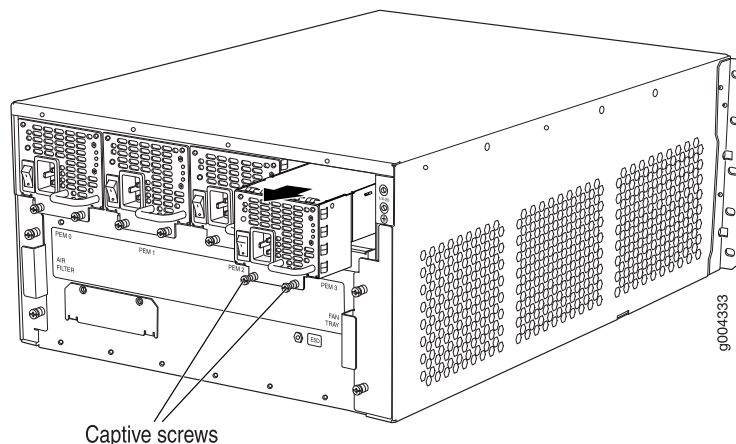


**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on.

To remove an AC power supply (see Figure 53 on page 113):

1. Switch off the dedicated facility circuit breaker for the power supply, and remove the power cord from the AC power source. Follow the ESD and disconnection instructions for your site.
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” on page 130.
3. Move the AC switch next to the appliance inlet on the power supply to the off position (O).
4. Unscrew the captive screws on the bottom edge of the power supply.
5. Remove the power cord from the power supply.
6. Pull the power supply straight out of the chassis.

**Figure 53: Removing an AC Power Supply**

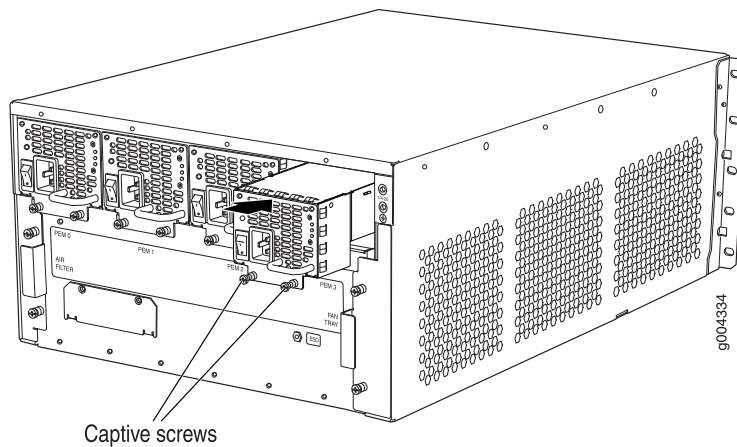


## Installing an AC Power Supply

To install an AC power supply (see Figure 54 on page 114):

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” on page 130.
2. Move the AC switch next to the appliance inlet on the power supply to the off position (O).
3. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplate or blank installed in the power supply slot.
4. Tighten both captive screws at the bottom of the power supply.
5. Attach the power cord to the power supply.
6. Attach the power cord to the AC power source, and switch on the dedicated facility circuit breaker for the power supply. Follow the ESD and connection instructions for your site.
7. Move the AC switch next to the appliance inlet on the power supply to the on position (|) and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the AC OK and DC OK LEDs light steadily, and the PS FAIL LED is not lit.

**Figure 54: Installing an AC Power Supply**



## Removing a DC Power Supply



**WARNING:** Before performing the following procedure, 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.

The power supplies are located at the rear of the chassis. Each DC power supply weighs approximately 3.8 lb (1.7 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.

---

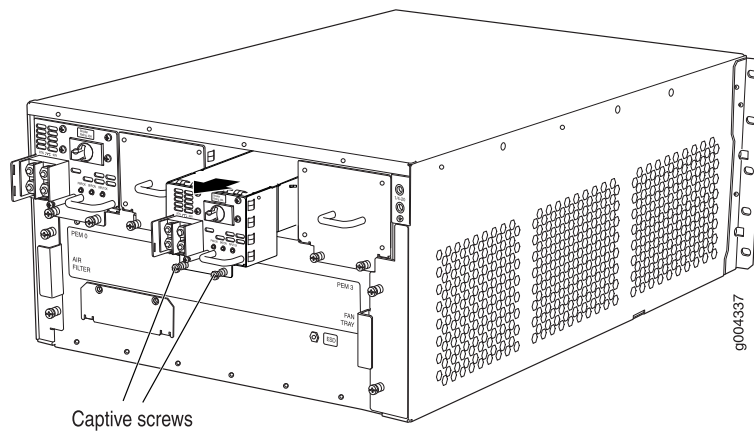


**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on.

---

To remove a DC power supply (see Figure 55 on page 116):

1. Switch off the dedicated facility circuit breaker for the power supply being removed. Follow your site's procedures for ESD.
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.
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” on page 130.
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. (Use a 3/8-in. nut driver or socket wrench.)
7. Remove the cable lugs from the terminal studs.
8. Loosen the captive screws on the bottom edge of the power supply faceplate.
9. Carefully move the power cables out of the way.
10. Pull the power supply straight out of the chassis.

**Figure 55: Removing a DC Power Supply from an MX240 Router**

## Installing a DC Power Supply



**WARNING:** Before performing the following procedure, 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.

To install a DC power supply (see Figure 56 on page 118 ):

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.
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” on page 130.
3. Switch the circuit breaker on the power supply faceplate to the **OFF** position **O**.
4. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplate or blank installed in the power supply slot.
5. Tighten the captive screws on the lower edge of the power supply faceplate.
6. Remove the clear plastic cover protecting the terminal studs on the faceplate.
7. Remove the nuts and washers from the terminal studs.
8. Secure each power cable lug to the terminal studs, first with the washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut. (see Figure 57 on page 118).
  - a. Secure the positive (+) DC source power cable lug to the RTN (return) terminal.
  - b. Secure the negative (–) DC source power cable lug to the –48V (input) terminal.





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



**NOTE:** For the MX240 router, the DC power supply in PEM0 must be powered by dedicated power feeds derived from feed A, and the DC power supply in PEM2 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.



**NOTE:** For information about connecting to DC power sources, see “DC Power System Electrical Specifications” on page 167.

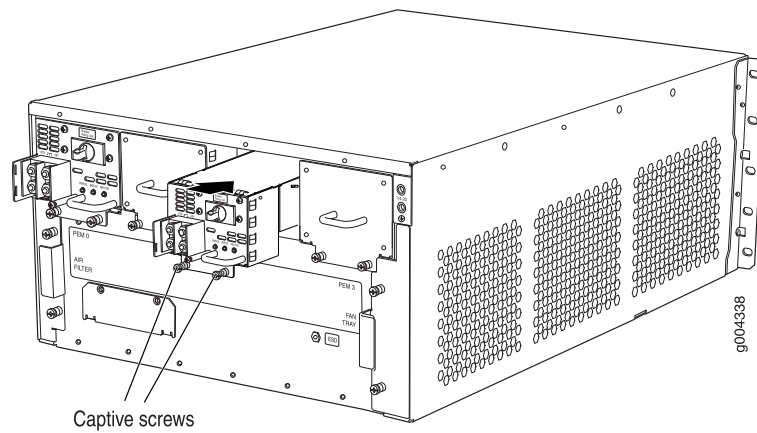
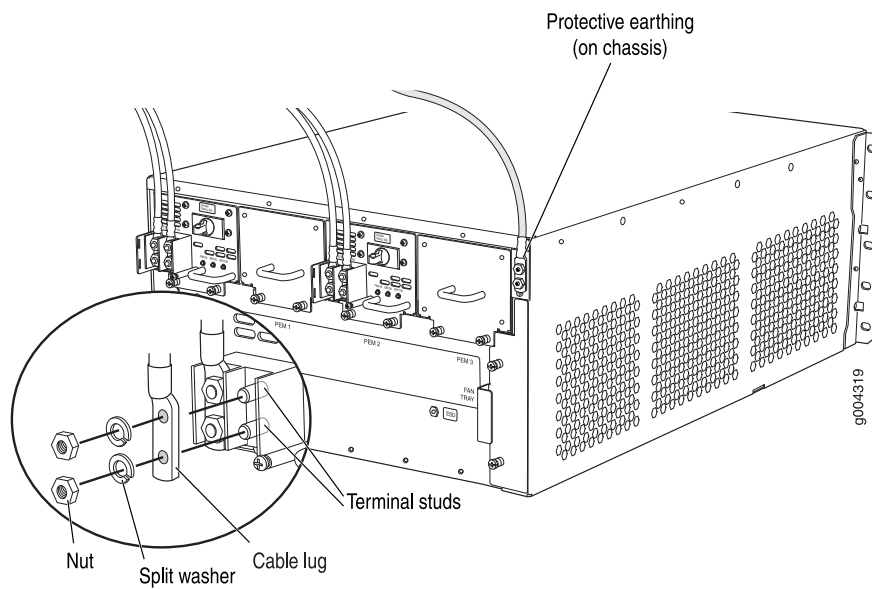
9. Replace the clear plastic cover over the terminal studs on the faceplate.
10. Verify that the power cabling is correct, that the cables are not touching or blocking access to router components, and that they do not drape where people could trip on them.
11. Verify that the **INPUT OK** LED on the power supply is lit green.
12. Switch the circuit breaker on the power supply to the **ON** position — and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **PWR OK**, **BRKR ON**, and **INPUT OK** LEDs light green steadily.



**NOTE:** If more than one power supply is being installed, turn on all power supplies at the same time.



**NOTE:** An SCB must be present for the **PWR OK** LED to go on.

**Figure 56: Installing a DC Power Supply in an MX240 Router****Figure 57: Connecting DC Power to the Router**

## Replacing an AC Power Cord

To replace an AC power cord:

- Disconnecting an AC Power Cord on page 119
- Connecting an AC Power Supply Cord on page 119

## Disconnecting an AC Power Cord



**WARNING:** Before working on the router or near power supplies, unplug the power cord from an AC router.

To disconnect the AC power cord:

1. Unplug the power cord from the power source receptacle.
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” on page 130.
3. Move the AC switch next to the appliance inlet on the power supply to the off position (O).
4. Unplug the power cord from the appliance inlet on the power supply.

## Connecting an AC Power Supply Cord

To connect the AC power cord:

1. Locate a replacement power cord with the type of plug appropriate for your geographical location (see “AC Power Cord Specifications” on page 174).
2. Insert the power cord plug into an external AC power source receptacle.
3. Dress the power cord appropriately. Verify that the power cord does not block the air exhaust and access to router components, or drape where people could trip on it.
4. Switch the AC switch on the each power supply to the on position (—) and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

## Replacing a DC Power Supply Cable



**WARNING:** Before performing the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the **OFF** position, and tape the switch handle of the circuit breaker in the **OFF** position.

To replace a power cable for a DC power supply:

- Disconnecting a DC Power Supply Cable on page 120
- Connecting a DC Power Supply Cable on page 120

### Disconnecting a DC Power Supply Cable

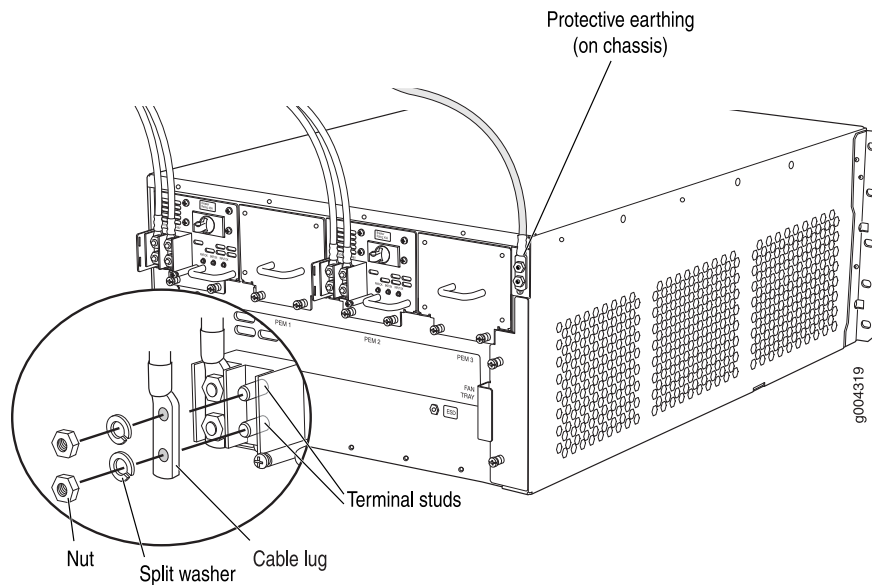
To disconnect a power cable for a DC power supply:

1. Switch the dedicated facility circuit breaker to the off position. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during the removal process.
2. Remove the power cable from the external DC power source.
3. 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” on page 130.
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 nut and washer from the terminal studs. (Use a 3/8-in. nut driver or socket wrench.)
7. Remove the cable lug from the terminal studs.
8. Loosen the captive screws on the bottom edge of the power supply faceplate.
9. Carefully move the power cable out of the way.

### Connecting a DC Power Supply Cable

To connect a power cable for a DC power supply (see Figure 58 on page 121):

1. Locate a replacement power cable that meets the specifications defined in Table 32 on page 171.
2. Verify that a licensed electrician has attached a cable lug to the replacement power cable.
3. Secure the power cable lug to the terminal studs, first with the flat washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut, (see Figure 58 on page 121).

**Figure 58: Connecting Power Cables to the DC Power Supply**

4. Replace the clear plastic cover over the terminal studs on the faceplate.
5. Verify that the DC power cable is connected correctly, that it does not touch or block access to router components, and that it does not drape where people could trip on it.
6. Attach the power cable to the DC power source.
7. Turn on the dedicated facility circuit breaker to the power supply.
8. Verify that the **INPUT OK** LED on the power supply is lit green steadily.
9. Switch the circuit breaker on the power supply to the **ON** position — and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **PWR OK**, **BRKR ON**, and **INPUT OK** LEDs light green steadily.

## Replacing the Cable Management System

- Removing the Cable Management System on page 121
- Installing the Cable Management System on page 122

### Removing the Cable Management System

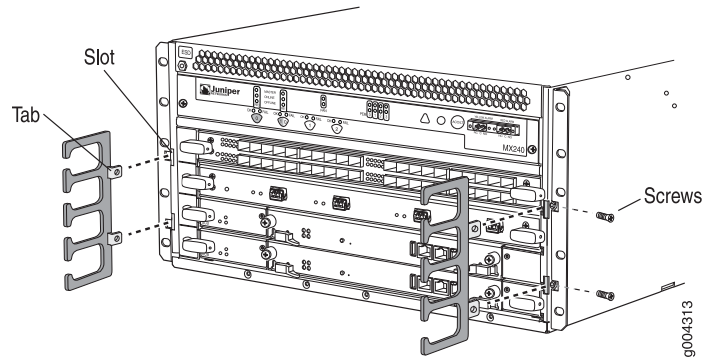
The cable management system is located on both sides of the DPC card cage. The cable management system weighs approximately 0.3 lb (0.14 kg).

To remove the cable management system (see Figure 59 on page 122):

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” on page 130.

2. Loosen the captive screws on either side of the chassis.
3. Remove the cable manager.

**Figure 59: Removing or Installing the Cable Management System**



Insert the Cable Manager tabs into the slots and secure with screws.

### ***Installing the Cable Management System***

To install the cable management system (see Figure 59 on page 122):

1. Position the cable management system on the front sides of the chassis.
2. Insert the tabs into the slots.
3. Tighten the screws completely.

## **Part 4**

# **Appendixes**

- Safety and Regulatory Compliance Information on page 125
- Physical Specifications on page 161
- Router Environmental Specifications on page 163
- Power Guidelines, Requirements, and Specifications on page 165
- Cable and Wire Guidelines and Specifications on page 179
- Cable Connector Pinouts on page 185
- Installing the Router Without a Mechanical Lift on page 187
- Contacting Customer Support and Returning Hardware on page 197





## Appendix A

# Safety and Regulatory Compliance Information

To install and use the router safely, follow proper safety procedures. This appendix discusses the following safety and regulatory compliance information:

- Definition of Safety Warning Levels on page 125
- Safety Guidelines and Warnings on page 126
- Agency Approvals and Compliance on page 155

## Definition of Safety Warning Levels

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This manual uses the following three levels of safety warnings:



**NOTE:** You might find this information helpful in a particular situation, or might otherwise overlook it.

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**CAUTION:** Observe the specified guidelines to avoid minor injury or discomfort to you, or severe damage to the router.

---



**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.

**Warning!** 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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## Safety Guidelines and Warnings

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This section lists safety guidelines and warnings for installing, operating, and maintaining the router:

- General Safety Guidelines and Warnings on page 127
- Fire Safety Requirements on page 130
- Installation Safety Guidelines and Warnings on page 131
- Laser and LED Safety Guidelines and Warnings on page 136
- Maintenance and Operational Safety Guidelines and Warnings on page 139
- Electrical Safety Guidelines and Warnings on page 144

## General Safety Guidelines and Warnings

The following guidelines help ensure your safety and protect the router 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 manual. 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, which 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 router only when it is properly grounded.
- Do not open or remove chassis covers or sheet metal parts unless instructions are provided in this manual. 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 router chassis or onto any router component. Such an action could cause electrical shock or damage the router.
- Avoid touching uninsulated electrical wires or terminals that have not been disconnected from their power source. Such an action could cause electrical shock.

In addition, observe the following warnings and guidelines:

- Qualified Personnel Warning on page 127
- Restricted Access Area Warning on page 128
- Preventing Electrostatic Discharge Damage on page 130

### Qualified Personnel Warning



**WARNING:** Only trained and qualified personnel should install or replace the router.

**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.

**Warning!** 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 router 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 erikoistyyökalun, 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.

## Preventing Electrostatic Discharge Damage

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:

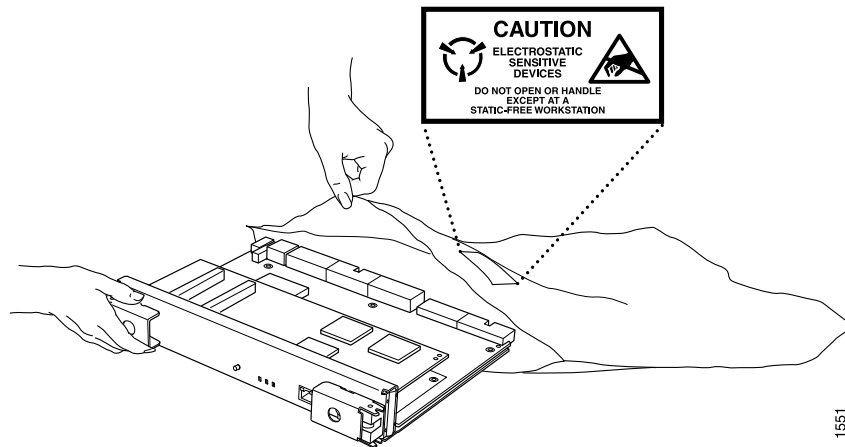
- Always use an ESD wrist strap or ankle strap, and make sure that it is in direct contact with your skin.



**CAUTION:** For safety, periodically check the resistance value of the ESD strap. The measurement should be in the range of 1 to 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, which are shown in Figure 1 on page 6, Figure 2 on page 6, and Figure 3 on page 7.
- 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 60 on page 130). If you are returning a component, place it in an electrostatic bag before packing it.

**Figure 60: Placing a Component into an Electrostatic Bag**



## Fire Safety Requirements

In the event of a fire emergency involving routers and other network equipment, the safety of people is the primary concern. Establish procedures for protecting people in the event of a fire emergency, provide safety training, and properly provision fire-control equipment and fire extinguishers.

In addition, establish procedures to protect your equipment in the event of a fire emergency. Juniper Networks products should be installed in an environment suitable for electronic equipment. We recommend that fire suppression equipment be available in the event of a fire in the vicinity of the equipment, and that all local fire, safety, and electrical codes and ordinances be observed when installing and operating your equipment.

## Fire Suppression

In the event of an electrical hazard or an electrical fire, first turn power off to the equipment at the source. Then use a Type C fire extinguisher, which uses noncorrosive fire retardants, to extinguish the fire. For more information about fire extinguishers, see “Fire Suppression Equipment” on page 131.

## 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 equipment. 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 router. 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.

## Installation Safety Guidelines and Warnings

Observe the following guidelines and warnings before and during router installation:

- Chassis-Lifting Guidelines on page 132
- Installation Instructions Warning on page 132
- Rack-Mounting Requirements and Warnings on page 133
- Ramp Warning on page 136

## Chassis-Lifting Guidelines

The weight of a fully configured chassis is about 128 lb (58.1 kg). Observe the following guidelines for lifting and moving the router:

- Before moving the router, read the guidelines in “Preparing the Site for Router Installation” on page 29 to verify that the intended site meets the specified power, environmental, and clearance requirements.
- Do not attempt to lift a fully configured router by yourself. Using a mechanical lift to maneuver the router into a rack is recommended. If a lift cannot be used, a minimum of two people must lift the router, and you must remove components from the chassis before lifting. For lifting and component removal instructions, see “Setting Up the Router” on page 27.
- 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.

## Installation Instructions Warning



**WARNING:** Read the installation instructions before you connect the router to a power source.

**Waarschuwing** Raadpleeg de installatie-aanwijzingen voordat u het systeem met de voeding verbindt.

**Varoituis** Lue asennusohjeet ennen järjestelmän yhdistämistä virtälähteeseen.

**Attention** Avant de brancher le système sur la source d'alimentation, consulter les directives d'installation.

**Warnung** Lesen Sie die Installationsanweisungen, bevor Sie das System an die Stromquelle anschließen.

**Avvertenza** Consultare le istruzioni di installazione prima di collegare il sistema all'alimentatore.

**Advarsel** Les installasjonsinstruksjonene før systemet kobles til strømkilden.

**Aviso** Leia as instruções de instalação antes de ligar o sistema à sua fonte de energia.

**¡Atención!** Ver las instrucciones de instalación antes de conectar el sistema a la red de alimentación.

**Varning!** Läs installationsanvisningarna innan du kopplar systemet till dess strömförsörjningsenhet.



## Rack-Mounting Requirements and Warnings

Ensure that the equipment rack into which the router 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 router in a rack, take the following precautions to ensure that the system remains stable. The following directives help maintain your safety:

- The router must be installed into a rack that is secured to the building structure.
- The router should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting the router 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 or servicing the router in the rack.

**Waarschuwing** Om lichamelijk letsel te voorkomen wanneer u dit toestel in een rek monteert of het daar een servicebeurt geeft, moet u speciale voorzorgsmaatregelen nemen om ervoor te zorgen dat het toestel stabiel blijft. De onderstaande richtlijnen worden verstrekt om uw veiligheid te verzekeren:

- De Juniper Networks 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:

- Juniper Networks 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 Juniper Networks 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 Juniper Networks 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 Juniper Networks 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:

- Juniper Networks 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 Juniper Networks 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 Juniper Networks 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:

- Juniper Networks 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

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**WARNING:** When installing the router, 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 käyttää 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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### Laser and LED Safety Guidelines and Warnings

Single-mode Physical Interface Cards (PICs) 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.

Observe the following guidelines and warnings:

- General Laser Safety Guidelines on page 137
- Class 1 Laser Product Warning on page 137
- Class 1 LED Product Warning on page 137

- Laser Beam Warning on page 138
- Radiation from Open Port Apertures Warning on page 139

### General Laser Safety Guidelines

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.

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### Class 1 Laser Product Warning



**WARNING:** Class 1 laser product.

**Waarschuwing** Klasse-1 laser produkt.

**Varoitus** Luokan 1 lasertuote.

**Attention** Produit laser de classe I.

**Warnung** Laserprodukt der Klasse 1.

**Avvertenza** Prodotto laser di Classe 1.

**Advarsel** Laserprodukt av klasse 1.

**Aviso** Produto laser de classe 1.

**¡Atención!** Producto láser Clase I.

**Varning!** Laserprodukt av klass 1.

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### Class 1 LED Product Warning



**WARNING:** Class 1 LED product.

**Waarschuwing** Klasse 1 LED-product.

**Varoitus** Luokan 1 valodiodituote.

**Attention** Alarme de produit LED Class I.

**Warnung** Class 1 LED-Produktwarnung.

**Avvertenza** Avvertenza prodotto LED di Classe 1.

**Advarsel** LED-produkt i klasse 1.

**Aviso** Produto de classe 1 com LED.

**¡Atención!** Aviso sobre producto LED de Clase 1.

**Varning!** Lysdiodprodukt av klass 1.

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### Laser Beam Warning

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**WARNING:** Do not stare into the laser beam or view it directly with optical instruments.

**Waarschuwing** Niet in de straal staren of hem rechtstreeks bekijken met optische instrumenten.

**Varoitus** Älä katso säteeseen äläkä tarkastele sitä suoraan optisen laitteen avulla.

**Attention** Ne pas fixer le faisceau des yeux, ni l'observer directement à l'aide d'instruments optiques.

**Warnung** Nicht direkt in den Strahl blicken und ihn nicht direkt mit optischen Geräten prüfen.

**Avvertenza** Non fissare il raggio con gli occhi né usare strumenti ottici per osservarlo direttamente.

**Advarsel** Stirr eller se ikke direkte p strlen med optiske instrumenter.

**Aviso** Não olhe fixamente para o raio, nem olhe para ele directamente com instrumentos ópticos.

**¡Atención!** No mirar fijamente el haz ni observarlo directamente con instrumentos ópticos.

**Varning!** Rikta inte blicken in mot strålen och titta inte direkt på den genom optiska instrument.

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## Radiation from Open Port Apertures Warning

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**WARNING:** Because invisible radiation might be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures.

**Waarschuwing** Aangezien onzichtbare straling vanuit de opening van de poort kan komen als er geen fiberkabel aangesloten is, dient blootstelling aan straling en het kijken in open openingen vermeden te worden.

**Varoitus** Koska portin aukosta voi emittoitua näkymätöntä säteilyä, kun kuitukaapelia ei ole kytkettynä, vältä säteilylle altistumista äläkä katso avoimiin aukkoihin.

**Attention** Des radiations invisibles à l'il nu pouvant traverser l'ouverture du port lorsqu'aucun câble en fibre optique n'y est connecté, il est recommandé de ne pas regarder fixement l'intérieur de ces ouvertures.

**Warnung** Aus der Port-Öffnung können unsichtbare Strahlen emittieren, wenn kein Glasfaserkabel angeschlossen ist. Vermeiden Sie es, sich den Strahlungen auszusetzen, und starren Sie nicht in die Öffnungen!

**Avvertenza** Quando i cavi in fibra non sono inseriti, radiazioni invisibili possono essere emesse attraverso l'apertura della porta. Evitate di esporvi alle radiazioni e non guardate direttamente nelle aperture.

**Advarsel** Unngå utsettelse for stråling, og stirr ikke inn i åpninger som er åpne, fordi usynlig stråling kan emitteres fra portens åpning når det ikke er tilkoblet en fiberkabel.

**Aviso** Dada a possibilidade de emissão de radiação invisível através do orifício da via de acesso, quando esta não tiver nenhum cabo de fibra conectado, deverá evitar a exposição à radiação e não deverá olhar fixamente para orifícios que se encontrarem a descoberto.

**¡Atención!** Debido a que la apertura del puerto puede emitir radiación invisible cuando no existe un cable de fibra conectado, evite mirar directamente a las aperturas para no exponerse a la radiación.

**Varning!** Osynlig strålning kan avges från en portöppning utan ansluten fiberkabel och du bör därför undvika att bli utsatt för strålning genom att inte stirra in i oskyddade öppningar.

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## Maintenance and Operational Safety Guidelines and Warnings

As you maintain the router, observe the following guidelines and warnings:

- Battery Handling Warning on page 140
- Jewelry Removal Warning on page 141
- Lightning Activity Warning on page 142

- Operating Temperature Warning on page 142
- Product Disposal Warning on page 143

### 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 ontplofingsgevaar als de batterij verkeerd vervangen wordt. Vervang de batterij slechts met hetzelfde of een equivalent type dat door de fabrikant aanbevolen is. Gebruikte batterijen dienen overeenkomstig fabrieksvoorschriften weggeworpen te worden.

**Varoitus** Räjähdyksen vaara, jos akku on vaihdettu väärään akkuun. Käytä vaihtamiseen ainoastaan saman- tai vastaavantyyppistä akkua, joka on valmistajan suosittelema. Hävitä käytetyt akut valmistajan ohjeiden mukaan.

**Attention** Danger d'explosion si la pile n'est pas remplacée correctement. Ne la remplacer que par une pile de type semblable ou équivalent, recommandée par le fabricant. Jeter les piles usagées conformément aux instructions du fabricant.

**Warnung** Bei Einsetzen einer falschen Batterie besteht Explosionsgefahr. Ersetzen Sie die Batterie nur durch den gleichen oder vom Hersteller empfohlenen Batterietyp. Entsorgen Sie die benutzten Batterien nach den Anweisungen des Herstellers.

**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.



## Jewelry Removal Warning



**WARNING:** Before working on equipment that is connected to power lines, remove jewelry, including rings, necklaces, and watches. Metal objects heat up when connected to power and ground and can cause serious burns or 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 kuumenevat, kun ne ovat yhteydessä sähkövirran ja maan kanssa, ja ne voivat aiheuttaa vakavia palovammoja tai hitsata metalliesineet kiinni liitäntänapoihin.

**Attention** Avant d'accéder à cet équipement connecté aux lignes électriques, ôter tout bijou (anneaux, colliers et montres compris). Lorsqu'ils sont branchés à l'alimentation et reliés à la terre, les objets métalliques chauffent, ce qui peut provoquer des blessures graves ou souder l'objet métallique aux bornes.

**Warnung** Vor der Arbeit an Geräten, die an das Netz angeschlossen sind, jeglichen Schmuck (einschließlich Ringe, Ketten und Uhren) abnehmen. Metallgegenstände erhitzen sich, wenn sie an das Netz und die Erde angeschlossen werden, und können schwere Verbrennungen verursachen oder an die Anschlußklemmen angeschweißt werden.

**Avvertenza** Prima di intervenire su apparecchiature collegate alle linee di alimentazione, togliersi qualsiasi monile (inclusi anelli, collane, braccialetti ed orologi). Gli oggetti metallici si riscaldano quando sono collegati tra punti di alimentazione e massa: possono causare ustioni gravi oppure il metallo può saldarsi ai terminali.

**Advarsel** Fjern alle smykker (inkludert ringer, halskjeder og klokker) før du skal arbeide på utstyr som er koblet til kraftledninger. Metallgjenstander som er koblet til kraftledninger og jord blir svært varme og kan forårsake alvorlige brannskader eller smelte fast til polene.

**Aviso** Antes de trabalhar em equipamento que esteja ligado a linhas de corrente, retire todas as jóias que estiver a usar (incluindo anéis, fios e relógios). Os objectos metálicos aquecerão em contacto com a corrente e em contacto com a ligação à terra, podendo causar queimaduras graves ou ficarem soldados aos terminais.

**¡Atención!** Antes de operar sobre equipos conectados a líneas de alimentación, quitarse las joyas (incluidos anillos, collares y relojes). Los objetos de metal se calientan cuando se conectan a la alimentación y a tierra, lo que puede ocasionar quemaduras graves o que los objetos metálicos queden soldados a los bornes.

**Varning!** Tag av alla smycken (inklusive ringar, halsband och armbandsur) innan du arbetar på utrustning som är kopplad till kraftledningar. Metallobjekt hettas upp när

de kopplas ihop med ström och jord och kan förorsaka allvarliga brännskador; metallobjekt kan också sammansvetsas med kontakterna.

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### Lightning Activity Warning

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**WARNING:** Do not work on the system or connect or disconnect cables during periods of lightning activity.

**Waarschuwing** Tijdens onweer dat gepaard gaat met bliksem, dient u niet aan het systeem te werken of kabels aan te sluiten of te ontkoppelen.

**Varoitus** Älä työskentele järjestelmän parissa äläkä yhdistä tai irrota kaapeleita ukkosilmalla.

**Attention** Ne pas travailler sur le système ni brancher ou débrancher les câbles pendant un orage.

**Warnung** Arbeiten Sie nicht am System und schließen Sie keine Kabel an bzw. trennen Sie keine ab, wenn es gewittert.

**Avvertenza** Non lavorare sul sistema o collegare oppure scollegare i cavi durante un temporale con fulmini.

**Advarsel** Utfør aldri arbeid på systemet, eller koble kabler til eller fra systemet når det tordner eller lyner.

**Aviso** Não trabalhe no sistema ou ligue e desligue cabos durante períodos de mau tempo (trovoada).

**¡Atención!** No operar el sistema ni conectar o desconectar cables durante el transcurso de descargas eléctricas en la atmósfera.

**Varning!** Vid åska skall du aldrig utföra arbete på systemet eller ansluta eller koppla loss kablar.

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### Operating Temperature Warning

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**WARNING:** To prevent the router 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 Juniper Networks router dan ook oververhit raakt, dient u deze niet te bedienen op een plaats waar de maximale aanbevolen omgevingstemperatuur van 40°C wordt overschreden. Om

te voorkomen dat de luchtstroom wordt beperkt, dient er minstens 15,2 cm speling rond de ventilatie-openingen te zijn.

**Varoitus** Ettei Juniper Networks 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 Juniper Networks 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 Juniper Networks 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 Juniper Networks 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 Juniper Networks 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.

**Warning!** Förhindra att en Juniper Networks 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.

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## Product Disposal Warning

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**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.

## **Electrical Safety Guidelines and Warnings**

When working on equipment powered by electricity, follow the guidelines described in the following sections:

- In Case of Electrical Accident on page 144
- General Electrical Safety Guidelines and Warnings on page 145
- AC Power Electrical Safety Guidelines on page 148
- DC Power Electrical Safety Guidelines and Warnings on page 149

### **In Case of Electrical Accident**

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.

## General Electrical Safety Guidelines and Warnings

- 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.
  - Evaluated to the TN power system.
- 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, as detailed in “Field-Replaceable Units (FRUs)” on page 87. Never install equipment if it appears damaged.

### ***Grounded Equipment Warning***



**WARNING:** The router is intended to be grounded. Ensure that the router 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.

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### **Midplane Energy Hazard Warning**

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**WARNING:** High levels of electrical energy are distributed across the router midplane. Be careful not to contact the midplane connectors, or any component connected to the midplane, with any metallic object while servicing components installed in the router.

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### **Multiple Power Supplies Disconnection Warning**

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**WARNING:** The router 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.

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### **Power Disconnection Warning**

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**WARNING:** Before working on the router or near power supplies, unplug the power cord from an AC router; switch off the power at the circuit breaker on a DC router.

**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 strø姆ledningen 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 strömmen vid överspänningsskyddet.

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### ***TN Power Warning***

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**WARNING:** The router is designed to work with TN power systems.

**Waarschuwing** Het apparaat is ontworpen om te functioneren met TN energiesystemen.

**Varoitus** Koje on suunniteltu toimimaan TN-sähkövoimajärjestelmien yhteydessä.

**Attention** Ce dispositif a été conçu pour fonctionner avec des systèmes d'alimentation TN.

**Warnung** Das Gerät ist für die Verwendung mit TN-Stromsystemen ausgelegt.

**Avvertenza** Il dispositivo è stato progettato per l'uso con sistemi di alimentazione TN.

**Advarsel** Utstyret er utfomet til bruk med TN-strømsystemer.

**Aviso** O dispositivo foi criado para operar com sistemas de corrente TN.

**¡Atención!** El equipo está diseñado para trabajar con sistemas de alimentación tipo TN.

**Warning!** Enheten är konstruerad för användning tillsammans med elkraftssystem av TN-typ.

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### **AC Power Electrical Safety Guidelines**

The following electrical safety guidelines apply to AC-powered routers:

- AC-powered routers are shipped with three-wire electrical cords with a grounding-type plug that fits only a grounding-type power outlet. Do not circumvent this safety feature. Equipment grounding should comply with local and national electrical codes.
- Each AC power supply has one AC appliance inlet. Each inlet requires a dedicated AC power feed and a dedicated circuit breaker. We recommend that you use a dedicated circuit breaker rated at 15 A (250 VAC) minimum, or as required by local code. For information about connecting the router to power, see “Connecting Power to an AC-Powered Router” on page 54.





**WARNING:** The router is pluggable type A equipment installed in a restricted-access location. It has a separate protective earthing terminal (sized for UNC 1/4-20 ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earthing terminal must be permanently connected to earth.

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- The cores in the mains lead are colored in accordance with the following code:
  - Green and yellow—Earth
  - Blue—Neutral
  - Brown—Live

### **DC Power Electrical Safety Guidelines and Warnings**

When working with DC-powered equipment, observe the following guidelines and warnings:

- DC Power Electrical Safety Guidelines on page 149
- Copper Conductors Warning on page 150
- DC Power Disconnection Warning on page 151
- DC Power Grounding Requirements and Warning on page 152
- DC Power Wiring Sequence Warning on page 153
- DC Power Wiring Terminations Warning on page 154

#### **DC Power Electrical Safety Guidelines**

The following electrical safety guidelines apply to a DC-powered router:

- A DC-powered router is equipped with a DC terminal block that is rated for the power requirements of a maximally configured router. To supply sufficient power, terminate the DC input wiring on a facility DC source capable of supplying at least 31 A @ –48 VDC per input for each power supply.
- Incorporate an easily accessible disconnect device into the facility wiring. We recommend that the 48 VDC facility DC source should be equipped with a circuit breaker rated at 40 A (–48 VDC) minimum, or as required by local code. In the United States and Canada, the 48 VDC facility should be equipped with a circuit breaker rated a minimum of 125 % of the power provisioned for the input in

accordance with the National Electrical Code in the US and the Canadian Electrical Code in Canada.

- Run two wires from the circuit breaker box to a source of 48 VDC. Use appropriate gauge wire to handle up to 50 A.
- Be sure to connect the ground wire or conduit to a solid office (earth) ground. A closed loop ring is recommended for terminating the ground conductor at the ground stud.
- A DC-powered router that is equipped with a DC terminal block is intended only for installation in a restricted access location. In the United States, a restricted access area is one in accordance with Articles 110-16, 110-17, and 110-18 of the National Electrical Code ANSI/NFPA 70.



**NOTE:** Primary overcurrent protection is provided by the building circuit breaker. This breaker should protect against excess currents, short circuits, and earth faults in accordance with NEC ANSI/NFPA70.

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- Ensure that the polarity of the DC input wiring is correct. Under certain conditions, connections with reversed polarity might trip the primary circuit breaker or damage the equipment.
- For personal safety, connect the green and yellow wire to safety (earth) ground at both the router and the supply side of the DC wiring.
- The marked input voltage of –48 VDC for a DC-powered router is the nominal voltage associated with the battery circuit, and any higher voltages are only to be associated with float voltages for the charging function.
- Because the router is a positive ground system, you must connect the positive lead to the terminal labeled **RTN**, the negative lead to the terminal labeled **–48V**, and the earth ground to the chassis grounding points.

### **Copper Conductors Warning**

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**WARNING:** Use copper conductors only.

**Waarschuwing** Gebruik alleen koperen geleiders.

**Varoitus** Käytä vain kuparijohtimia.

**Attention** Utilisez uniquement des conducteurs en cuivre.

**Warnung** Verwenden Sie ausschließlich Kupferleiter.

**Avvertenza** Usate unicamente dei conduttori di rame.

**Advarsel** Bruk bare kobberledninger.

**Aviso** Utilize apenas fios condutores de cobre.

**¡Atención!** Emplee sólo conductores de cobre.

**Varning!** Använd endast ledare av koppar.

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### **DC Power Disconnection Warning**

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**WARNING:** Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the **OFF** position, and tape the 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 schakelaarhandel van de stroomverbreker met plakband in de **UIT** positie vast.

**Varoitus** Varmista, että tasavirtapiirissä ei ole virtaa ennen seuraavien toimenpiteiden suorittamista. Varmistaaksesi, että virta on **KATKAISTU** täysin, paikanna tasavirrasta huolehtivassa kojetaulussa sijaitseva suojakytkin, käännä suojakytkin **KATKAISTU**-asentoon ja teippaa suojakytkimen varsi niin, että se pysyy **KATKAISTU**-asennossa.

**Attention** Avant de pratiquer l'une quelconque des procédures ci-dessous, vérifier 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.

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### **DC Power Grounding Requirements and Warning**

An insulated grounding conductor that is identical in size to the grounded and ungrounded branch circuit supply conductors, but is identifiable by green and yellow stripes, is installed as part of the branch circuit that supplies the unit. The grounding conductor is a separately derived system at the supply transformer or motor generator set.

For further information, see “Chassis Grounding Specifications” on page 165 and “DC Power Cable Specifications” on page 170.



**WARNING:** When installing the router, the ground connection must always be made first and disconnected last.

**Waarschuwing** Bij de installatie van het toestel moet de aardverbinding altijd het eerste worden gemaakt en het laatste worden losgemaakt.

**Varoitus** Laitetta asennettaessa on maahan yhdistäminen aina tehtävä ensiksi ja maadoituksen irti kytkeminen viimeiseksi.

**Attention** Lors de l'installation de l'appareil, la mise à la terre doit toujours être connectée en premier et déconnectée en dernier.

**Warnung** Der Erdanschluß muß bei der Installation der Einheit immer zuerst hergestellt und zuletzt abgetrennt werden.

**Avvertenza** In fase di installazione dell'unità, eseguire sempre per primo il collegamento a massa e disconnetterlo per ultimo.

**Advarsel** Når enheten installeres, må jordledningen alltid tilkobles først og frakobles sist.

**Aviso** Ao instalar a unidade, a ligação à terra deverá ser sempre a primeira a ser ligada, e a última a ser desligada.

**¡Atención!** Al instalar el equipo, conectar la tierra la primera y desconectarla la última.

**Varning!** Vid installation av enheten måste jordledningen alltid anslutas först och kopplas bort sist.

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### **DC Power Wiring Sequence Warning**

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**WARNING:** Wire the DC power supply using the appropriate lugs. When connecting power, the proper wiring sequence is ground to ground, + RTN to + RTN, then -48 V to -48 V. When disconnecting power, the proper wiring sequence is -48 V to -48 V, + RTN to + RTN, then ground to ground. Note that the ground wire should always be connected first and disconnected last.

**Waarschuwing** De juiste bedradingsvolgorde verbonden is aarde naar aarde, + RTN naar + RTN, en -48 V naar -48 V. De juiste bedradingsvolgorde losgemaakt is en -48 V naar -48 V, + RTN naar + RTN, aarde naar aarde.

**Varoitus** Oikea yhdistettävä kytkentäjäjestys on maajohto maajohtoon, + RTN varten + RTN, -48 V varten -48 V. Oikea irrotettava kytkentäjäjestys on -48 V varten -48 V, + RTN varten + RTN, maajohto maajohtoon.

**Attention** Câblez l'alimentation CC En utilisant les crochets appropriés à l'extrémité de câblage. En reliant la puissance, l'ordre approprié de câblage est rectifié pour rectifier, + RTN à + RTN, puis -48 V à -48 V. En débranchant la puissance, l'ordre approprié de câblage est -48 V à -48 V, + RTN à + RTN, a alors rectifié pour rectifier. Notez que le fil de masse devrait toujours être relié d'abord et débranché pour la dernière fois. Notez que le fil de masse devrait toujours être relié d'abord et débranché pour la dernière fois.

**Warnung** Die Stromzufuhr ist nur mit geeigneten Ringösen an das DC Netzteil anzuschliessen. Die richtige Anschlusssequenz ist: Erdanschluss zu Erdanschluss, + RTN zu + RTN und dann -48V zu -48V. Die richtige Sequenz zum Abtrennen der Stromversorgung ist -48V zu -48V, + RTN zu + RTN und dann Erdanschluss zu Erdanschluss. Es ist zu beachten dass der Erdanschluss immer zuerst angeschlossen und als letztes abgetrennt wird.

**Avvertenza** Mostra la morsettiera dell'alimentatore CC. Cablare l'alimentatore CC usando i connettori adatti all'estremità del cablaggio, come illustrato. La corretta sequenza di cablaggio è da massa a massa, da positivo a positivo (da linea ad L) e da negativo a negativo (da neutro a N). Tenere presente che il filo di massa deve sempre venire collegato per primo e scollegato per ultimo.

**Advarsel** Riktig tilkoples tilkoplingssekvens er jord til jord, + RTN til + RTN, -48 V til -48 V. Riktig frakoples tilkoplingssekvens er -48 V til -48 V, + RTN til + RTN, jord til jord.

**Aviso** Ate con alambre la fuente de potencia cc Usando los terminales apropiados en el extremo del cableado. Al conectar potencia, la secuencia apropiada del cableado se muele para moler, + RTN a + RTN, entonces -48 V a -48 V. Al desconectar potencia, la secuencia apropiada del cableado es -48 V a -48 V, + RTN a + RTN, entonces molió para moler. Observe que el alambre de tierra se debe conectar siempre primero y desconectar por último. Observe que el alambre de tierra se debe conectar siempre primero y desconectar por último.

**¡Atención!** Wire a fonte de alimentação de DC Usando os talões apropriados na extremidade da fiação. Ao conectar a potência, a seqüência apropriada da fiação é moída para moer, + RTN a + RTN, então -48 V a -48 V. Ao desconectar a potência, a seqüência apropriada da fiação é -48 V a -48 V, + RTN a + RTN, moeu então para moer. Anote que o fio à terra deve sempre ser conectado primeiramente e desconectado por último. Anote que o fio à terra deve sempre ser conectado primeiramente e desconectado por último.

**Warning!** Korrekt kopplingssekvens ar jord till jord, + RTN till + RTN, -48 V till - 48 V. Korrekt kopplas kopplingssekvens ar -48 V till -48 V, + RTN till + RTN, jord till jord.

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### **DC Power Wiring Terminations Warning**

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**WARNING:** When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations should be the appropriate size for the wires and should 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 johdinliitääntä, esimerkiksi suljettua silmukkaa tai kourumaista liitääntä, jossa on ylöspäin käännetyt kiinnityskorvat. Tällaisten liitääntöjen 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, sind zugelassene Verdrahtungsanschlüsse, 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 occhio o a forcella con linguette rivolte verso l'alto. I connettori devono avere la misura adatta per il cablaggio e devono serrare sia l'isolante che il conduttore.

**Advarsel** Hvis det er nødvendig med flertrådede ledninger, brukes godkjente ledningsavslutninger, som for eksempel lukket sløyfe eller spadetype med oppoverbøyde kabelsko. Disse avslutningene skal ha riktig størrelse i forhold til ledningene, og skal klemme sammen både isolasjonen og ledaren.

**Aviso** Quando forem requeridas montagens de instalação eléctrica de cabo torcido, use terminações de cabo aprovadas, tais como, terminações de cabo em circuito fechado e planas com terminais de orelha voltados para cima. Estas terminações de cabo deverão ser do tamanho apropriado para os respectivos cabos, e deverão prender simultaneamente o isolamento e o fio condutor.

**¡Atención!** Cuando se necesite hilo trenzado, utilizar terminales para cables homologados, tales como las de tipo "bucle cerrado" o "espada", con las lengüetas de conexión vueltas hacia arriba. Estos terminales deberán ser del tamaño apropiado para los cables que se utilicen, y tendrán que sujetar tanto el aislante como el conductor.

**Varning!** När flertrådiga ledningar krävs måste godkända ledningskontakter användas, t.ex. kabelsko av sluten eller öppen typ med uppåtvänd tapp. Storleken på dessa kontakter måste vara avpassad till ledningarna och måste kunna hålla både isoleringen och ledaren fastklämda.

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## Agency Approvals and Compliance

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- Agency Approvals on page 155
- Compliance Statements for NEBs Requirements on page 156
- Compliance Statements for EMC Requirements on page 157
- Compliance Statements for Environmental Requirements on page 159
- Compliance Statements for Acoustic Noise on page 159

### Agency Approvals

The router complies with the following standards:

- Safety
  - CAN/CSA-22.2 No. 60950-1-03/UL 60950-1, Third Edition, Safety of Information Technology Equipment
  - EN 60825-1 Safety of Laser Products - Part 1: Equipment Classification, Requirements and User's Guide

- EN 60950-1 Safety of Information Technology Equipment
- 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-61000-3-2 Power Line Harmonics
  - 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
  - EN-61000-4-11 Voltage Dips and Sags
- ETSI
  - ETSI EN-300386-2 Telecommunication Network Equipment. Electromagnetic Compatibility Requirements

The router is designed to comply with the following standards:

- NEBS
  - GR-1089-Core: EMC and Electrical Safety for Network Telecommunications Equipment
  - SR-3580 NEBS Criteria Levels (Level 3 Compliance)
  - GR-63-CORE: NEBS, Physical Protection

### ***Compliance Statements for NEBs Requirements***

- 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 a Common DC return (DC-C), as defined in GR-1089-CORE.



## ***Compliance Statements for EMC Requirements***

### **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.

### **European Community**

This is a Class A product. In a domestic environment this product might cause radio interference in which case the user might be required to take adequate measures.

**Declaration of Conformity****Declaration of Conformity**

Juniper Networks, Inc.  
1194 N. Mathilda Ave  
Sunnyvale, CA. 94089 USA

declares that under our sole responsibility the product(s)

**Internet Router**  
**Model MX240 DC , MX240 AC**

are in conformity with the provisions of the following EC Directives, including all amendments,  
and with national legislation implementing these directives:

**Low Voltage Directive 73/23/EEC**  
**EMC Directive 89/336/EEC**

and that the following harmonized standards have been applied

EN 60950-1:2001+A11  
EN 60825-1:1994+A1+A2

EN 300 386 V1.3.3:2005  
EN 55024:1998 +A1 + A2  
EN 61000-3-2, EN 61000-3-3  
EN 55022:2006 Class A  
EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-6,  
EN 61000-4-5, EN 61000-4-11 (-5 and -11 AC only)

Place  
Sunnyvale, CA

Signature  
John Lockwood

Date  
01/07/2008

**Japan**

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用する  
と電波妨害を引き起こすことがあります。この場合には使用者が適切な対策  
を講ずるよう要求されることがあります。 VCCI-A

Translation:

This is a Class A product. In a domestic environment this product might cause radio interference in which case the user might be required to take adequate measures.  
VCCI-A

### **United States**

The router has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## ***Compliance Statements for Environmental Requirements***

### **Lithium Battery**

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.

## ***Compliance Statements for Acoustic Noise***

Maschinenlärminformations-Verordnung - 3. GPSGV, der höchste Schalldruckpegel beträgt 70 dB(A) oder weniger gemäss EN ISO 7779

Translation:

The emitted sound pressure is below 70 dB(A) per EN ISO 7779



## Appendix B

# Physical Specifications

- Physical Specifications on page 161

### Physical Specifications

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Table 25 on page 161 summarizes the physical specifications for the router chassis.

**Table 25: Physical Specifications**

Description	Value
Chassis dimensions	8.71 in. (22.1 cm) high 17.45 in. (44.3 cm) wide 24.5 in. (62.2 cm) deep (from front-mounting bracket to chassis rear) Total depth (including cable management system) 27.75 in. (70.5 cm)
Router weight	Chassis with midplane, fan tray, air filter, and cable management system: 52.0 lb (23.6 kg) Maximum configuration: 128 lb (58.1 kg)
Routing Engine weight	2.4 lb (1.1 kg)
SCB weight	9.6 lb (4.4 kg)
DPC weight	13.1 lb (5.9 kg)
Craft interface weight	1.1 lb (0.5 kg)
Fan tray weight	4.2 lb (1.9 kg)
Air filter weight	1.0 lb (0.5 kg)
Cable managment weight	0.3 lb (0.14 kg)
DC power supply weight	3.8 lb (1.7 kg)
AC power supply weight	5.0 lb (2.3 kg)



## Appendix C

# Router Environmental Specifications

- Router Environmental Specifications on page 163

## Router Environmental Specifications

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Table 26 on page 163 specifies the environmental specifications required for normal router operation. In addition, the site should be as dust-free as possible. For more information, see “Maintaining Hardware Components” on page 67.

**Table 26: 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 container: -40°F (-40°C) to 158°F (70°C)
Seismic	Designed to meet Telcordia Technologies Zone 4 earthquake requirements
Maximum thermal output	AC power: 7161 BTU/hour (2100 W)  DC power: 5074 BTU/hour (1488 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.

For additional safety guidelines and requirements, see “Safety and Regulatory Compliance Information” on page 125.

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## Appendix D

# Power Guidelines, Requirements, and Specifications

- Chassis Grounding Specifications on page 165
- DC Power Specifications and Requirements on page 166
- AC Power Specifications and Requirements on page 171
- Site Electrical Wiring Guidelines on page 176

### Chassis Grounding Specifications

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To meet safety and electromagnetic interference (EMI) requirements and to ensure proper operation, the router must be adequately grounded before power is connected. To ground AC-powered and DC-powered routers, you must connect a grounding cable to earth ground and then attach it to the chassis grounding points using the two screws provided.

Two threaded inserts (PEM nuts) are provided on the upper rear of the chassis for connecting the router to earth ground. The grounding points fit UNC 1/4–20 screws (American). The grounding points are spaced at 0.625-in. (15.86-mm) centers. Figure 30 on page 55, or Figure 31 on page 58).

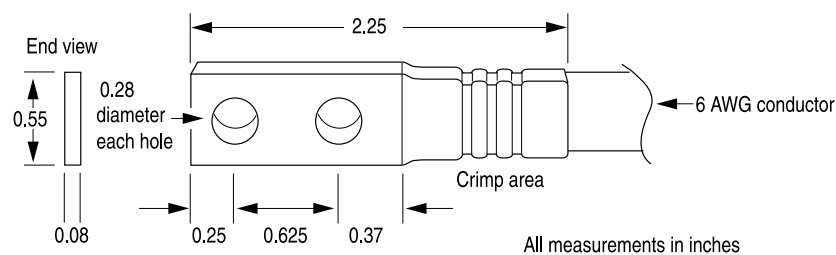


**NOTE:** Additional grounding is provided to an AC-powered router when you plug its power supplies into grounded AC power receptacles.

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### Grounding Cable Lug Specification

The accessory box shipped with the router includes one cable lug that attaches to the grounding cable (see Figure 61 on page 166) and two UNC 1/4–20 screws used to secure the grounding cable to the grounding points.

**Figure 61: Grounding Cable Lug**

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**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.



**NOTE:** The same cable lug is used for the DC power cables.

## Grounding Cable Specification

The grounding cable that you provide must meet the specifications in Table 27 on page 166.

**Table 27: Grounding Cable Specifications**

Cable Type	Quantity and Specification
Grounding	One 6-AWG (13.3 mm <sup>2</sup> ), minimum 60°C wire, or as permitted by the local code

## DC Power Specifications and Requirements

- DC Power Specifications on page 166
- Power Consumption for DC-Powered Routers on page 167
- DC Power Circuit Breaker Specifications on page 169
- DC Power Cable Specifications on page 170

### DC Power Specifications

- DC Power System Electrical Specifications on page 167
- DC Power Supply Electrical Specifications on page 167

## DC Power System Electrical Specifications

Table 28 on page 167 lists the DC power system electrical specifications.

**Table 28: DC Power System Electrical Specifications**

Item	Specification
DC input voltage	Operating range: –40.5 to –72 VDC
DC system current rating	31 A @ –48 VDC per input (maximum)
DC system input power	29.58 A @ –48 VDC (1,420 W DC)

## DC Power Supply Electrical Specifications

Table 29 on page 167 lists the DC power supply electrical specifications.

**Table 29: DC Power Supply Electrical Specifications**

Item	Specification
Maximum output power	1600 W
DC input voltage	Minimum: –40.5 VDC Nominal: –48 VDC, –60 VDC Operating range: –40.5 to –72 VDC
DC input current rating	33.3 A @ –48 VDC
Internal supplementary protector	40 A

## Power Consumption for DC-Powered Routers



**NOTE:** If you plan to operate a maximally configured DC-powered router, we recommend that you provision at least 31 A @ –48 VDC per input for each power supply.

If you do not plan to provision at least 31 A @ –48 VDC per input for each power supply, you can use the information in Table 30 on page 168 and Table 31 on page 168 to calculate the power consumption @ –48 VDC and thermal output for your hardware configuration.

Table 30 on page 168 lists the power requirements for base AC-powered routers operating under typical voltage conditions and includes nonredundant and redundant

power supply configurations. The base DC-powered router includes the midplane, craft interface, and fan tray running at normal speed.

**Table 30: DC-Powered Base Router Power Requirements**

DC Power Supply Configuration	Power Requirement (Watts)	Current Requirement (Amps @ -48 VDC)
One DC power supply (nonredundant configuration)	50 W (approximate)	1.04 A (approximate)
Two DC power supplies (redundant configuration)	66 W (approximate)	1.38 A (approximate)

Table 31 on page 168 lists the power requirements for various hardware components when the router is operating under typical voltage conditions.

**Table 31: Component Power Requirements**

Component	Power Requirement (Watts)	Current Requirement (Amps @ -48 VDC)
SCB	150 W	3.1 A
Routing Engine	90 W	1.9 A
Fan tray (full speed) – Fan tray (normal speed)	70 W – 50 W = 20 W	0.4 A
DPC—Generalized typical value	312 W	6.5 A
DPC—Generalized maximum value	365 W	7.6 A

These examples use generalized values for DPCs. For DPC power requirements, see the *MX-series Ethernet Services Router DPC Guide*.

Typical power consumption for DC-powered routers:

- Minimum DC-powered configuration:

Base router (with fan tray at normal speed and one power supply) + 1 SCB + 1 Routing Engine + 1 DPC =  
 $1.04\text{ A} + 3.1\text{ A} + 1.9\text{ A} + 6.5\text{ A} = 12.5\text{ A @ -48 VDC} = 600.0\text{ W DC}$

- Maximum DC-powered configuration with one host subsystem and a third DPC in the multifunction slot:

Base router and two power supplies + fan tray at full speed + 1 SCB + 1 Routing Engine + 3 DPCs

$$\begin{aligned}
 &1.38 \text{ A} + 0.4 \text{ A} + 3.1 \text{ A} + 1.9 \text{ A} + 3(7.6 \text{ A}) = \\
 &1.38 \text{ A} + 0.4 \text{ A} + 3.1 \text{ A} + 1.9 \text{ A} + 22.8 \text{ A} = \\
 &29.58 \text{ A @ } -48 \text{ VDC} = 1,420 \text{ W DC}
 \end{aligned}$$

- Input current from a DC source other than -48 VDC (based on maximum configuration; applies to DC power supply only):

$$\begin{aligned}
 &(-54 \text{ VDC input}) * (\text{input current X}) = (-48 \text{ VDC input}) * (\text{input current Y}) \\
 &54 * X = 48 * 29.58 \text{ A} \\
 &X = 48 * 29.58 \text{ A} / 54 = 26.3 \text{ A}
 \end{aligned}$$

- System thermal output (based on maximally configured DC-powered router):

$$\begin{aligned}
 &\text{Watts DC} * 3.41 = \text{BTU/hr} \\
 &1,420 * 3.41 = 4,842 \text{ BTU/hr}
 \end{aligned}$$

### **DC Power Circuit Breaker Specifications**

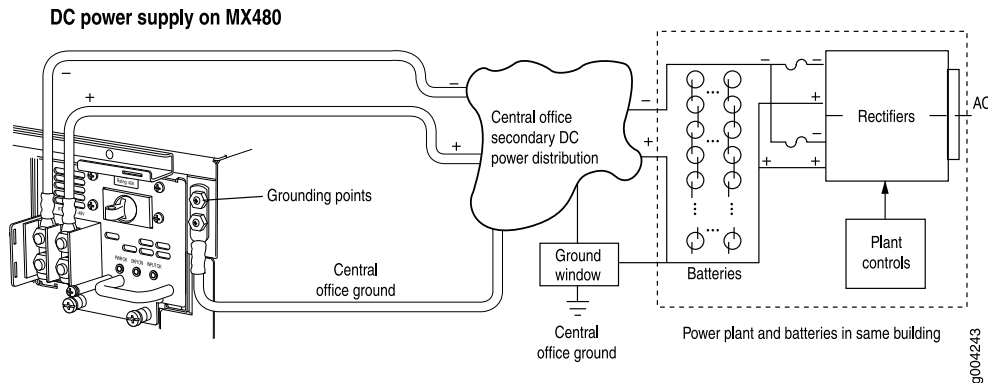
Each DC power supply has a single DC input (-48 VDC and return) that requires a dedicated circuit breaker. We recommend that you use a dedicated facility circuit breaker rated for 40 A (-48 VDC) minimum, or as permitted by local code. Doing so enables you to operate the router in any configuration without upgrading the power infrastructure.

If you plan to operate a DC-powered router at less than the maximum configuration and do not provision a 40 A (-48 VDC) circuit breaker, we recommend that you provision a dedicated facility circuit breaker for each DC power supply rated for at least 125% of the continuous current that the system draws at -48 VDC.

## DC Power Cable Specifications

Figure 62 on page 170 shows a typical DC source cabling arrangement.

**Figure 62: Typical DC Source Cabling to the Router**



The DC power supply in PEM0 must be powered by dedicated power feeds derived from feed A, and the DC power supply in PEM2 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.



**CAUTION:** You must 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 “Electrical Safety Guidelines and Warnings” on page 144.



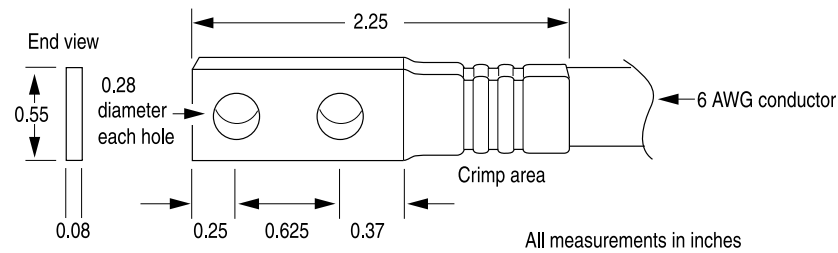
**CAUTION:** Power cords and cables must not block access to router components or drape where people could trip on them.

For a description of the DC power supply, see “DC Power Supply” on page 23. For instructions on connecting the DC power and grounding cables during initial installation, see “Connecting Power to a DC-Powered Router” on page 56. For instructions on replacing a DC power cable, see “Replacing a DC Power Supply Cable” on page 119.

## DC Power Cable Lug Specifications

The accessory box shipped with the router includes the cable lugs that attach to the terminal studs of each power supply (see Figure 63 on page 171).

**Figure 63: DC Power Cable Lug**



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**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.



**NOTE:** The same cable lug is used for the grounding cable.

## DC Power Cable Specifications

Table 32 on page 171 summarizes the specifications for the power cables, which you must supply.

**Table 32: DC Power Cable Specifications**

Cable Type	Quantity and Specification
Power	Four 6-AWG (13.3 mm <sup>2</sup> ), minimum 60°C wire, or as permitted by the local code

## AC Power Specifications and Requirements

- AC Power Specifications on page 172
- Power Consumption for AC-Powered Routers on page 172
- AC Power Circuit Breaker Specifications on page 174
- AC Power Cord Specifications on page 174

## AC Power Specifications

- AC Power System Electrical Specifications on page 172
- AC Power Supply Electrical Specifications on page 172

### AC Power System Electrical Specifications

Table 33 on page 172 lists the AC power system electrical specifications.

**Table 33: AC Power System Electrical Specifications**

Item	Specification
AC input voltage	Operating range: 100 - 240 VAC
AC input line frequency	50 - 60 Hz (nominal)
AC system current rating	21 A @ 100 VAC (11 A maximum per inlet) or 7 A @ 240 VAC
AC system input power	Low-line configuration: 2113 W High-line configuration: 1943 W

### AC Power Supply Electrical Specifications

Table 34 on page 172 lists the AC power supply electrical specifications.

**Table 34: AC Power Supply Electrical Specifications**

Item	Specification
Maximum output power	1200 W (low line)/ 1700 W (high line)
AC input voltage	Operating range: 100 - 240 VAC (nominal)
AC input line frequency	50 - 60 Hz (nominal)
AC input current rating	14.5 A @ 110 VAC or 11.0 A @ 200 VAC maximum

## Power Consumption for AC-Powered Routers



**NOTE:** If you plan to operate a maximally configured AC-powered router, we recommend that you provision 21 A @ 100 VAC (11 A maximum per inlet) or 7 A @ 240 VAC for the system, or 14.5 A @ 110 VAC or 11.0 A @ 200 VAC for each power supply.



For AC-powered routers, you can use the information in Table 35 on page 173 and Table 36 on page 173 to calculate the power consumption and thermal output for your hardware configuration.

Table 35 on page 173 lists the power requirements for base AC-powered routers operating under typical voltage conditions and includes various power supply configurations. The base AC-powered router includes the midplane, craft interface and fan tray running at normal speed.

**Table 35: AC Base Router Power Requirements**

Power Supply Configuration	Power Requirement (Watts)
One AC power supply (high-line nonredundant configuration @ 220 V)	195 W (approximate)
Two AC power supplies (high-line redundant configuration @ 220 V)	350 W (approximate)
Two AC power supplies (low-line nonredundant configuration @ 110 V)	270 W (approximate)
Four AC power supplies (low-line redundant configuration @ 110 V)	520 W (approximate)

Table 36 on page 173 lists the power requirements for various hardware components when the router is operating under typical voltage conditions.

**Table 36: Component Power Requirements for AC-Powered Routers**

Component	Power Requirement (Watts)	Power Requirement (Watts) with 85% Efficiency
Fan tray (full speed) – Fan tray (normal speed)	70 W – 50 W = 20 W	24 W
SCB	150 W	176 W
Routing Engine	90 W	106 W
DPC—Generalized typical value	312 W	367 W
DPC—Generalized maximum value	365 W	429 W

These examples use generalized values per DPC. For DPC power requirements, see the *MX-series Ethernet Services Router DPC Guide*.

Typical power consumption for AC-powered routers:

- Minimum AC-powered low-line configuration @ 110 V (includes 85 % efficiency):

Base router (with fan tray at normal speed and two power supplies) + 1 SCB +  
1 Routing Engine + 1 DPC =  
270 W + 176 W + 106 W + 367 W = 919 W

- Maximum AC-powered low-line configuration @ 110 V with one host subsystem and a third DPC in the multifunction slot (includes 85 % efficiency):

Base router with four power supplies + fan tray at full speed + 1 SCB + 1 Routing  
Engine + 3 DPCs  
520 W + 24 W + 176 W + 106 W + 3 (429 W) =  
520 W + 24 W + 176 W + 106 W + 1287 W = 2113 W

- Minimum AC-powered high-line configuration @ 220 V (includes 85 % efficiency):

Base router with one power supply + fan tray at normal speed + 1 SCB + 1 Routing  
Engine + 1 DPC =  
195 W + 176 W + 106 W + 367 W = 844 W

- Maximum AC-powered high-line configuration @ 220 V with one host subsystem and a third DPC in the multifunction slot (includes 85 % efficiency):

Base router with two power supplies + fan tray at full speed + 1 SCB + 1 Routing  
Engine + 3 DPCs =  
350 W + 24 W + 176 W + 106 W + 3 (429 W) =  
350 W + 24 W + 176 W + 106 W + 1287 W = 1943 W

- System thermal output (based on maximally configured AC-powered router @ 110 V):

Watts AC PEM \* 3.41 = BTU/hr  
2113 W) \* 3.41 = 7205 BTU/hr

## AC Power Circuit Breaker Specifications

We recommend that you use a dedicated facility circuit breaker rated for 15 A (250 VAC) minimum for each AC power feed, or as permitted by local code. Doing so enables you to operate the router in any configuration without upgrading the power infrastructure.

## AC Power Cord Specifications

Each AC power supply has a single AC appliance inlet located on the power supply that requires a dedicated AC power feed. Most sites distribute power through a main conduit that leads to frame-mounted power distribution panels, one of which can be located at the top of the rack that houses the router. An AC power cord connects each power supply to the power distribution panel.

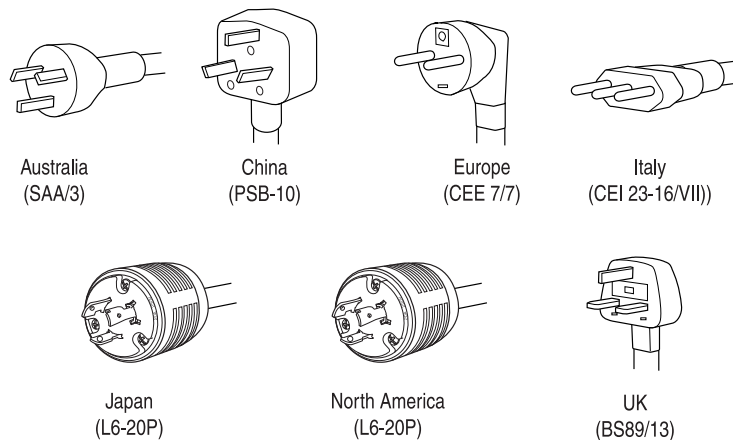
Detachable AC power cords, each 2.5 m (approximately 8 ft) long, are supplied with the router. The C19 appliance coupler at the female end of the cord inserts into the AC appliance inlet coupler, type C20 (right angle) as described by International Electrotechnical Commission (IEC) standard 60320. The plug at the male end of the power cord fits into the power source receptacle that is standard for your geographical location.

Table 37 on page 175 provides specifications and Figure 64 on page 175 depicts the plug on the AC power cord provided for each country or region.

**Table 37: AC Power Cord Specifications**

Country	Model Number	Electrical Specification	Plug Type
Australia	CBL-M-PWR-RA-AU	240 VAC, 50 Hz AC	SAA/3/15
China	CBL-M-PWR-RA-CH	220 VAC, 50 Hz AC	CH2-16P
Europe (except Denmark, Italy, Switzerland, and United Kingdom)	CBL-M-PWR-RA-EU	220 or 230 VAC, 50 Hz AC	CEE 7/7
Italy	CBL-M-PWR-RA-IT	230 VAC, 50 Hz AC	CEI 23-16/VII
Japan	CBL-PWR-RA-JP15	125 VAC, 50 or 60 Hz AC	JIS 8303
	CBL-M-PWR-RA-JP	220 VAC, 50 or 60 Hz AC	NEMA L6-20P
North America	CBL-PWR-RA-US15	125 VAC, 60 Hz AC	NEMA 5-15P
	CBL-PWR-RA-TWLK-US15	125 VAC, 60 Hz AC	NEMA L5-15P
	CBL-M-PWR-RA-US	250 VAC, 60 Hz AC	NEMA 6-20
	CBL-M-PWR-RA-TWLK-US	250 VAC, 60 Hz AC	NEMA L6-20P
United Kingdom	CBL-M-PWR-RA-UK	240 VAC, 50 Hz AC	BS89/13

**Figure 64: AC Plug Types**



**WARNING:** The AC power cord for the router is intended for use with the router only and not for any other use.



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**NOTE:** In North America, AC power cords must not exceed 4.5 m (approximately 14.75 ft) in length, to comply with National Electrical Code (NEC) Sections 400-8 (NFPA 75, 5-2.2) and 210-52, and Canadian Electrical Code (CEC) Section 4-010(3). The cords supplied with the router are in compliance.

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**WARNING:** The router is pluggable type A equipment installed in a restricted-access location. It has a separate protective earthing terminal (sized for UNC 1/4-20 ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earthing terminal must be permanently connected to earth.

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

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For information about the AC power supply, including a description of components, see “AC Power Supply” on page 21. For instructions on connecting the power cord and grounding cable during initial installation, see “Connecting Power to an AC-Powered Router” on page 54. For instructions on replacing the AC power cord, see “Replacing an AC Power Cord” on page 118.

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## Site Electrical Wiring Guidelines

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When planning the electrical wiring at your site, consider the factors discussed in the following sections.

### ***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 router 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/surge requirements, intrabuilding wiring must be shielded, and the shield for the wiring must be grounded at both ends.

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## Appendix E

# Cable and Wire Guidelines and Specifications

To prepare for router or component installation, ensure that you have all required cables and wires.

- Network Cable Specifications and Guidelines on page 179
- Routing Engine Interface Cable and Wire Specifications on page 183

### Network Cable Specifications and Guidelines

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The various PICs supported on the router accept different kinds of network cable, including multimode and single-mode fiber-optic cable. For more information, see the following sections:

- Fiber-Optic and Network Cable Specifications on page 179
- Signal Loss in Multimode and Single-Mode Fiber-Optic Cable on page 179
- Attenuation and Dispersion in Fiber-Optic Cable on page 180
- Calculating Power Budget for Fiber-Optic Cable on page 181
- Calculating Power Margin for Fiber-Optic Cable on page 181

### Fiber-Optic and Network Cable Specifications

The router supports DPCs that use various kinds of network cable, including multimode and single-mode fiber-optic cable. For information about the type of cable used by each DPC, see the *MX-series Ethernet Services Router DPC Guide*.

### 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. LEDs are not coherent sources, however. 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 (HOL) 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. It is consequently more expensive.

For information about the maximum transmission distance and supported wavelength range for the types of single-mode and multimode fiber-optic cable used by DPCs on the MX240 router, see the *MX-series Ethernet Services Router DPC Guide*. 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 in time. The following two types of dispersion can affect an optical data link:

- Chromatic dispersion—The spreading of the signal in time resulting from the different speeds of light rays.
- Modal dispersion—The spreading of the signal in 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. For more information about power budget, see “Calculating Power Budget for Fiber-Optic Cable” on page 181.



### Calculating Power Budget for Fiber-Optic Cable

To ensure that fiber-optic connections have sufficient power for correct operation, 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 (using the equation described in “Calculating Power Budget for Fiber-Optic Cable” on page 181), 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:

$$P_M = P_B - LL$$

A  $P_M$  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 38 on page 181 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 38: 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

**Table 38: Estimated Values for Factors Causing Link Loss** (continued)

Link-Loss Factor	Estimated Link-Loss Value
Splice	0.5 dB
Fiber attenuation	Single-mode—0.5 dB/km
	Multimode—1 dB/km

The following example uses the estimated values in Table 38 on page 181 to calculate link loss (LL) for a 2 km-long multimode link with a power budget ( $P_B$ ) of 13 dB:

- Fiber attenuation for 2 km @ 1.0 dB/km = 2 dB
- Loss for five connectors @ 0.5 dB per connector = 5(0.5 dB) = 2.5 dB
- Loss for two splices @ 0.5 dB per splice = 2(0.5 dB) = 1 dB
- Higher-order loss = 0.5 dB
- Clock recovery module = 1 dB

The power margin ( $P_M$ ) is calculated as follows:

$$P_M = P_B - LL$$

$$P_M = 13 \text{ dB} - 2 \text{ km (1.0 dB/km)} - 5 (0.5 \text{ dB}) - 2 (0.5 \text{ dB}) - 0.5 \text{ dB [HOL]} - 1 \text{ dB [CRM]}$$

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

$$P_M = 6 \text{ dB}$$

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 38 on page 181 to calculate link loss (LL) as the sum of fiber attenuation (8 km @ 0.5 dB/km, or 4 dB) and loss for seven connectors (0.5 dB per connector, or 3.5 dB). The power margin ( $P_M$ ) is calculated as follows:

$$P_M = P_B - LL$$

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

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

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

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

## Routing Engine Interface Cable and Wire Specifications

Table 39 on page 183 lists the specifications for the cables that connect to management ports and the wires that connect to the alarm relay contacts.

**Table 39: 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 RJ-45/DB-9 connectors	6 ft (1.83 m)	RJ-45/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	—



## Appendix F

# Cable Connector Pinouts

This appendix describes the pinouts for the following cable connectors:

- RJ-45 Connector Pinouts for the Routing Engine ETHERNET Port on page 185
- RJ-45 Connector Pinouts for the Routing Engine AUX and CONSOLE Ports on page 185

### RJ-45 Connector Pinouts for the Routing Engine ETHERNET Port

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The port on the craft interface labeled ETHERNET is an autosensing 10/100-Mbps Ethernet RJ-45 receptacle that accepts an Ethernet cable for connecting the Routing Engine to a management LAN (or other device that supports out-of-band management). For more information, see “Routing Engine Interface Ports” on page 16. Table 40 on page 185 describes the RJ-45 connector pinout.

**Table 40: RJ-45 Connector Pinout for the Routing Engine ETHERNET Port**

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

### RJ-45 Connector Pinouts for the Routing Engine AUX and CONSOLE Ports

---

The ports on the craft interface labeled AUX and CONSOLE are RJ-TGB232 serial interfaces that accept an RJ-45 connectors. The ports connect the Routing Engine to

an auxiliary or console management device. For more information, see “Routing Engine Interface Ports” on page 16. Table 41 on page 186 describes the RJ-45 connector pinout.

**Table 41: RJ-45 Connector Pinout for the AUX and CONSOLE Ports**

Pin	Signal	Description
1	RTS	Request to Send
2	DTR	Data Terminal Ready
3	TXD	Transmit Data
4	Ground	Signal Ground
5	Ground	Signal Ground
6	RXD	Receive Data
7	DSR/DCD	Data Set Ready
8	CTS	Clear to Send

## Appendix G

# Installing the Router Without a Mechanical Lift

If you cannot use a mechanical lift to install the router (the preferred method), you can install it manually. Before installing the router manually, you must first remove components from the chassis, and you must reinstall the components once the router is installed in the rack. At least two people are needed to safely lift the chassis into the rack or cabinet. With components removed, the chassis weighs approximately 52.0 lb (23.6 kg).

Before installing the router in the rack, read the safety information in “Chassis-Lifting Guidelines” on page 132. Remove the router from the shipping container as described in “Unpacking the Router” on page 37. Install the mounting hardware as described in “Installing the Mounting Hardware” on page 41.

This appendix discusses the following router installation topics:

- Tools and Parts Required on page 187
- Removing Components from the Chassis on page 187
- Installing the Chassis in the Rack Manually on page 192
- Reinstalling Components in the Chassis on page 193

## Tools and Parts Required

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

- Phillips (+) screwdrivers, numbers 1 and 2
- 3/8-in. nut driver
- ESD grounding wrist strap

## Removing Components from the Chassis

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To make the 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:

- Removing the Power Supplies on page 188
- Removing the Fan Tray on page 189
- Removing SCBs on page 189
- Removing DPCs on page 190

## Removing the Power Supplies

The power supplies are located at the rear of the chassis. Each AC power supply weighs approximately 5.0 lb (2.3 kg) and each DC power supply weighs approximately 3.8 lb (1.7 kg).

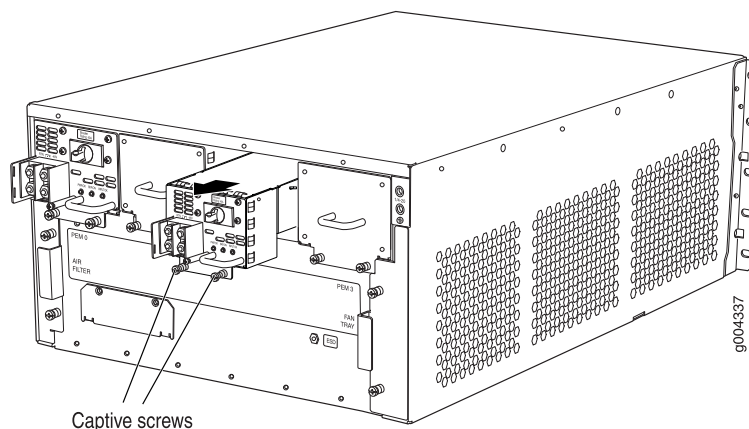
Remove the leftmost power supply first and then work your way to the right. To remove the AC or DC power supplies for each power supply (see Figure 65 on page 188):

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. For more information about ESD, see “Preventing Electrostatic Discharge Damage” on page 130.
2. For an AC-powered router, switch the circuit breaker in the chassis above the power supply slot to the off position (O). For a DC-powered router, switch the circuit breaker on the power supply to the OFF position.

We recommend this even though the power supplies are not connected to power sources.

3. Pull the power supply straight out of the chassis.

**Figure 65: Removing a Power Supply Before Installing the Router**





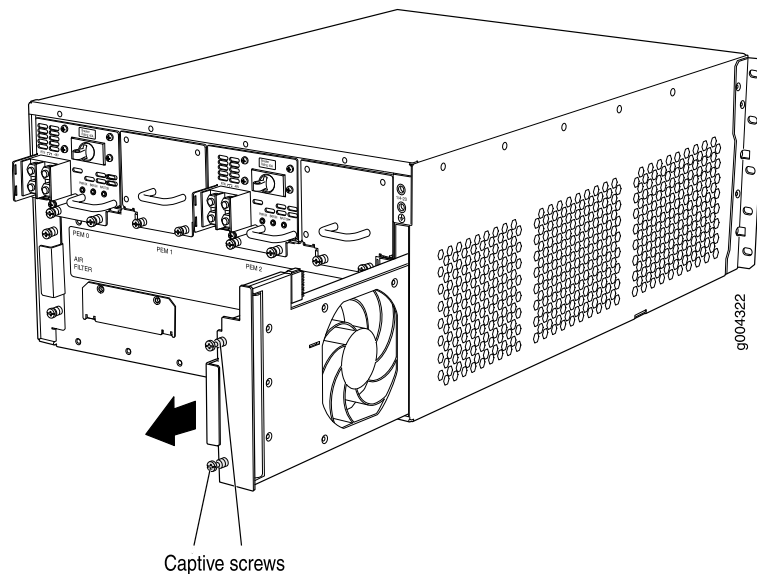
## Removing the Fan Tray

In the rear of the chassis, the fan tray is located on the right of the chassis. The fan tray weighs about 4.2 lb (1.9 kg).

To remove the fan tray (see Figure 66 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. For more information about ESD, see “Preventing Electrostatic Discharge Damage” on page 130.
2. Loosen the captive screw on each side of the fan tray faceplate.
3. Grasp both sides of the fan tray and pull it out approximately 1 to 3 inches.
4. Place one hand under the fan tray to support it and pull the fan tray completely out of the chassis.

**Figure 66: Removing the Fan Tray**



## Removing SCBs

The router can have two SCBs. They are located horizontally on the bottom front of the chassis in the slots marked 0 and 1/0. Each SCB weighs approximately 9.6 lb (4.4 kg).

To remove the SCBs (see Figure 67 on page 190):

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” on page 130.
3. Loosen the captive screws on the ejector handles on both sides of the SCB faceplate.

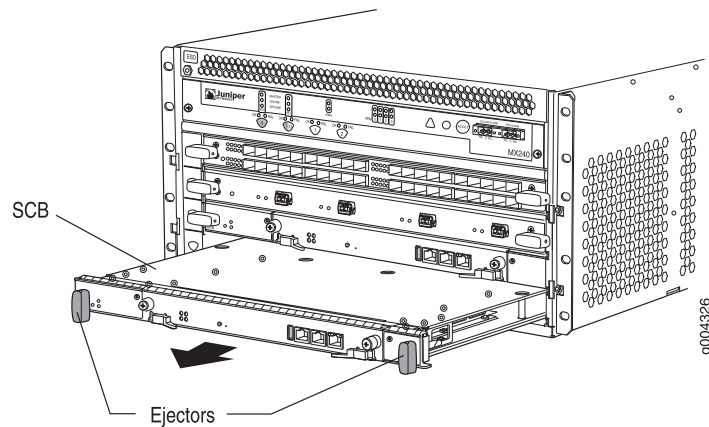
4. Simultaneously rotate the ejector handles counterclockwise to unseat the SCB.
5. Grasp the ejector handles and slide the SCB about halfway out of the chassis.
6. Place one hand underneath the SCB to support it and slide it completely out of the chassis. Place it on the antistatic mat.



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

7. Repeat the procedure for the second SCB.

**Figure 67: Removing an SCB**



## Removing DPCs

The router holds up to three DPCs, which are installed horizontally in the front of the router. A DPC weighs 13.1 lb (5.9 kg). Be prepared to accept its full weight.

To remove a DPC (see Figure 68 on page 191):

1. Have ready an antistatic mat for the DPC. Also have ready rubber safety caps for each DPC using an optical interface on the DPC 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. For more information about ESD, see “Preventing Electrostatic Discharge Damage” on page 130.
3. Simultaneously turn both the ejector handles counterclockwise to unseat the DPC.
4. Grasp the handles and slide the DPC straight out of the card cage halfway.
5. Place one hand around the front of the DPC and the other hand under it to support it. Slide the DPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



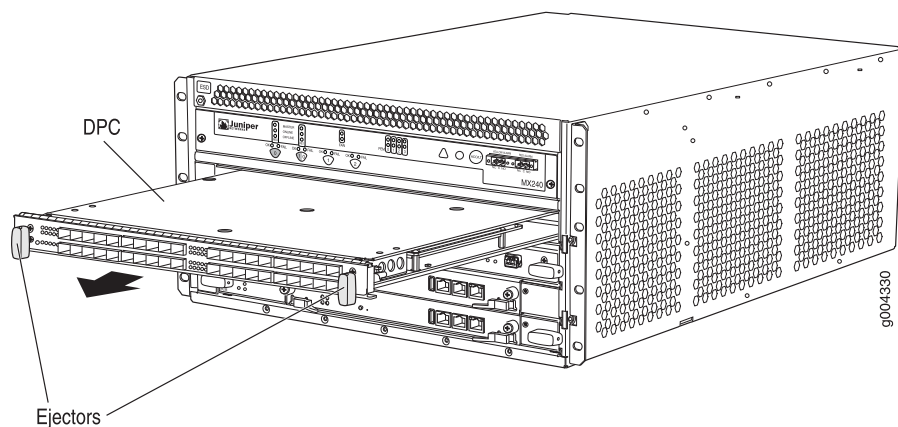
**CAUTION:** The weight of the DPC is concentrated in the back end. Be prepared to accept the full weight—up to 13.1 lb (5.9 kg)—as you slide the DPC out of the chassis.

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

Do not stack DPC 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.

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**Figure 68: Removing a DPC**



## Installing the Chassis in the Rack Manually

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To install the router in the rack (see Figure 69 on page 193):



**CAUTION:** If you are installing more than one router in a rack, install the lowest one first. Installing a router in an upper position in a rack or cabinet requires a lift.

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**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.

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**CAUTION:** Lifting the chassis and mounting it in a rack requires two people. The empty chassis weighs approximately 52.0 lb (23.6 kg).

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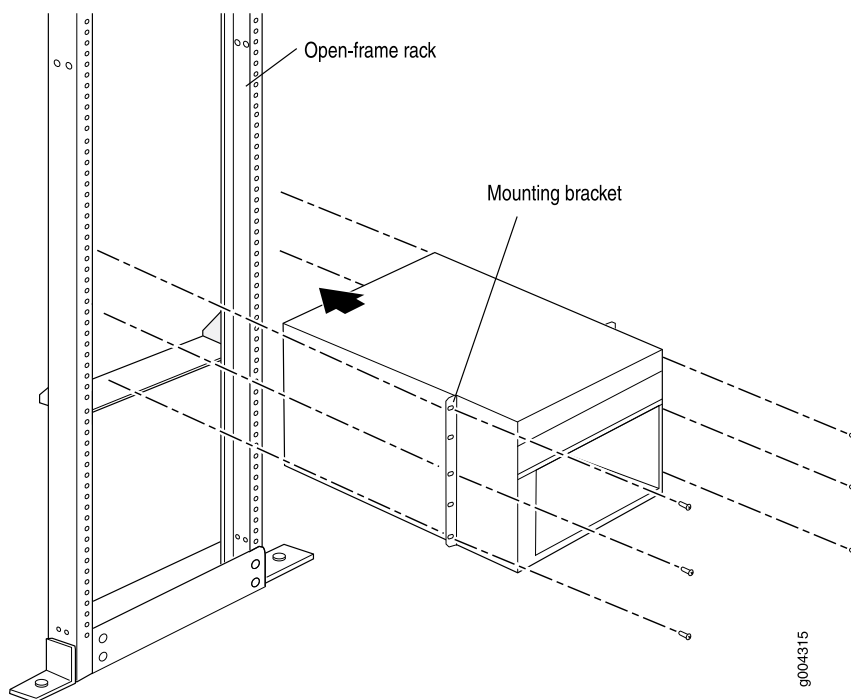
1. Ensure that the rack is in its permanent location and is secured to the building. Ensure that the installation site allows adequate clearance for both airflow and maintenance. For details, see “Preparing the Site for Router Installation” on page 29.
  2. Position the router in front of the rack or cabinet, centering it in front of the mounting shelf. Use a pallet jack if one is available.
  3. With one person on each side, hold onto the bottom of the chassis and carefully lift it onto the mounting shelf.
- 



**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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4. Slide the router onto the mounting shelf until the mounting brackets contact the rack rails. The shelf ensures that the holes in the mounting brackets of the chassis align with the holes in the rack rails.
5. Install a mounting screw into each of the open mounting holes aligned with the rack, starting from the bottom.
6. 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 69: Installing the Router in the Rack**

**NOTE:** This illustration depicts the router being installed in an open-frame rack. For an illustration of the mounting hardware required for a four-post rack or cabinet, see Figure 23 on page 42.

## Reinstalling Components in the Chassis

After the 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:

- Reinstalling the Power Supplies on page 193
- Reinstalling the Fan Tray on page 194
- Reinstalling SCBs on page 195
- Reinstalling DPCs on page 196

### Reinstalling the Power Supplies

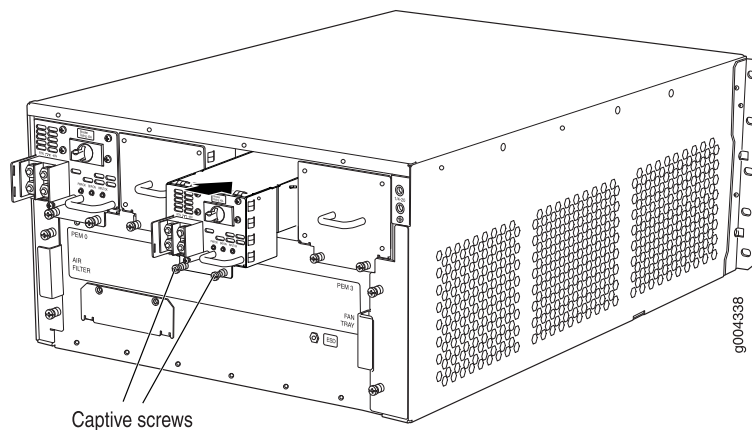
Reinstall the rightmost power supply first and then work your way to the left. To reinstall the AC or DC power supplies, follow this procedure for each power supply (see Figure 70 on page 194, which shows the installation of the DC power supplies):

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” on page 130.
2. For an AC-powered router, switch the AC switch on the power supply slot to the off position (O). For a DC-powered router, switch the circuit breaker on the power supply to the OFF position.

We recommend this even though the power supplies are not connected to power sources.

3. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplate or blank installed in the power supply slot.
4. Tighten the captive screws.

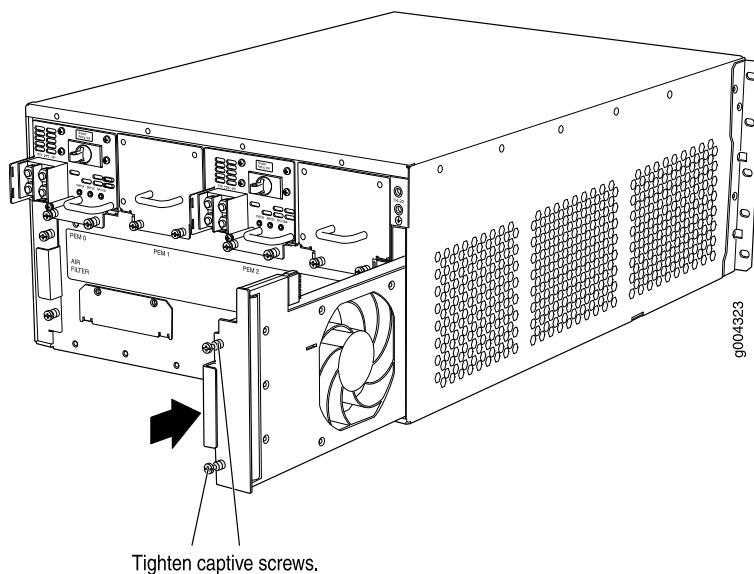
**Figure 70: Reinstalling a Power Supply**



## Reinstalling the Fan Tray

To reinstall the fan tray:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. For more information about ESD, see “Preventing Electrostatic Discharge Damage” on page 130.
2. Grasp the fan tray on each side and insert it straight into the chassis. Note the correct orientation by the "this side up" label on the top surface of the fan tray.
3. Tighten the captive screws on each side of the fan tray faceplate to secure it in the chassis.

**Figure 71: Installing a Fan Tray**

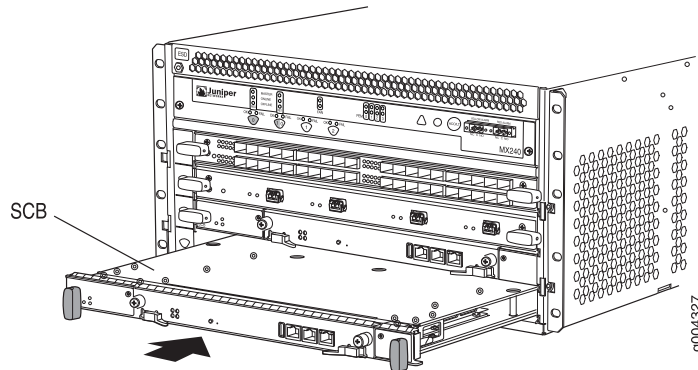
## Reinstalling SCBs

To reinstall an SCB (see Figure 72 on page 196):



**CAUTION:** Before removing or replacing an SCB, ensure that the ejector handles are stored vertically and pressed toward the center of the SCB.

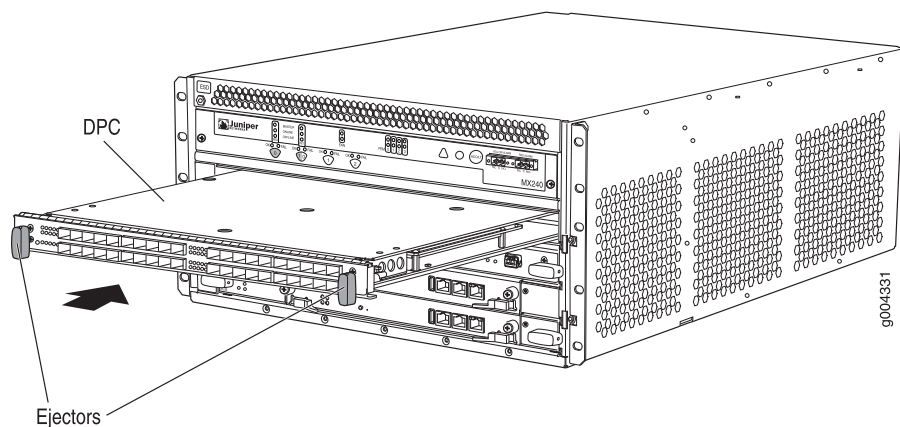
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. For more information about ESD, see “Preventing Electrostatic Discharge Damage” on page 130.
2. Carefully align the sides of the SCB with the guides inside the chassis.
3. Slide the SCB into the chassis, carefully ensuring that it is correctly aligned.
4. Grasp both ejector handles and rotate them simultaneously clockwise until the SCB is fully seated.
5. Place the ejector handles in their proper position, horizontally and toward the center of the board.

**Figure 72: Installing an SCB**

## Reinstalling DPCs

To reinstall a DPC (see Figure 73 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” on page 130.
2. Place the DPC on an antistatic mat or remove it from its electrostatic bag.
3. Identify the slot on the router where it will be installed.
4. Verify that each fiber-optic transceiver is covered by a rubber safety cap. If it does not, cover the transceiver with a safety cap.
5. Orient the DPC so that the faceplate faces you.
6. Lift the DPC into place and carefully align the sides of the DPC with the guides inside the card cage.
7. Slide the DPC all the way into the card cage until you feel resistance.
8. Grasp both ejector handles and rotate them clockwise simultaneously until the DPC is fully seated.

**Figure 73: Installing a DPC**



## Appendix H

# Contacting Customer Support and Returning Hardware

This appendix describes how to return the router or individual components to Juniper Networks for repair or replacement:

- Locating Component Serial Numbers on page 197
- Contacting Customer Support on page 202
- Return Procedure on page 203
- Tools and Parts Required on page 204
- Packing the Router for Shipment on page 204
- Packing Components for Shipment on page 205

## Locating Component Serial Numbers

Before contacting Juniper Networks, Inc. to request a Return Materials Authorization (RMA), you must find the serial number on the router or component. To list all of the router components and their serial numbers, enter the following command-line interface (CLI) command:

```
user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN10C75C9AFC  MX240
Midplane      REV 01   710-021041   TR1500         MX240 Backplane
FPM Board     REV 01   710-017254   KD4019         Front Panel Display
PEM 0         Rev 02   740-017330   000326         PS 1.2-1.7kW; 100-240V
AC in
PEM 1         Rev 02   740-017330   000333         PS 1.2-1.7kW; 100-240V
AC in
Routing Engine 0 REV 06   740-013063   1000701796    RE-S-2000
Routing Engine 1
CB 0          REV 07   710-013385   KD1348         MX SCB
CB 1          REV 07   710-013385   JZ0029         MX SCB
FPC 1         REV 01   750-018124   JY9650         DPCE 4x 10GE R
CPU           REV 06   710-013713   JZ6625         DPC PMB
PIC 0         BUILTIN  BUILTIN       1x 10GE(LAN/WAN)
Xcvr 0        REV 01   740-014279   KBC03VY       XFP-10G-LR
PIC 1         BUILTIN  BUILTIN       1x 10GE(LAN/WAN)
Xcvr 0        REV 01   740-014279   KB602C5       XFP-10G-LR
```

PIC 2			BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0	REV 01	740-014279	KB602C3		XFP-10G-LR
PIC 3			BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
FPC 2	REV 01	750-018124	JY9642		DPCE 4x 10GE R
CPU	REV 06	710-013713	JY9337		DPC PMB
PIC 0			BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0	REV 01	740-014279	KB602BQ		XFP-10G-LR
PIC 1			BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0	REV 01	740-014279	KB602BG		XFP-10G-LR
PIC 2			BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0	REV 01	740-014279	KBC03W1		XFP-10G-LR
PIC 3			BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Fan Tray 0	REV 01	710-021113	JS4641		MX240 Fan Tray

Most components also have a small rectangular serial number ID label (see Figure 74 on page 198) attached to the component body.

**Figure 74: Serial Number ID Label**

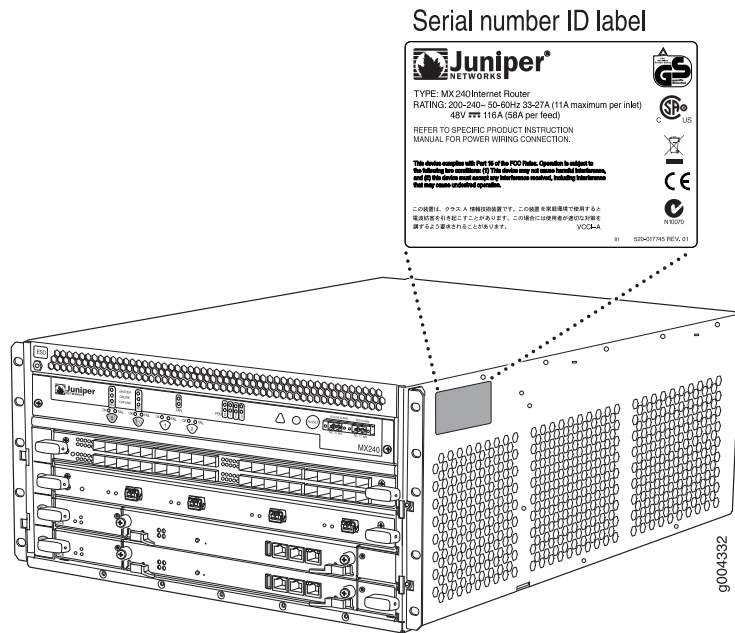


The following sections describe the label location on each type of component:

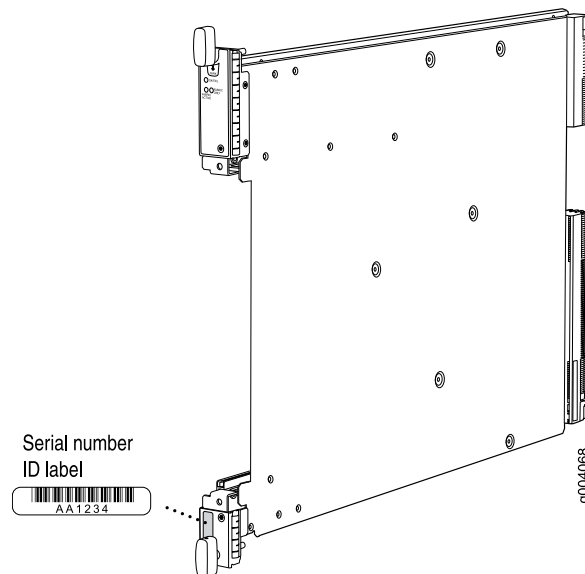
- MX240 Chassis Serial Number Label on page 198
- SCB Serial Number Label on page 199
- DPC Serial Number Label on page 200
- Power Supply Serial Number Labels on page 200
- Routing Engine Serial Number Label on page 201

### **MX240 Chassis Serial Number Label**

The chassis serial number is located on the side of the chassis (see Figure 75 on page 199).

**Figure 75: MX240 Chassis Serial Number Label****SCB Serial Number Label**

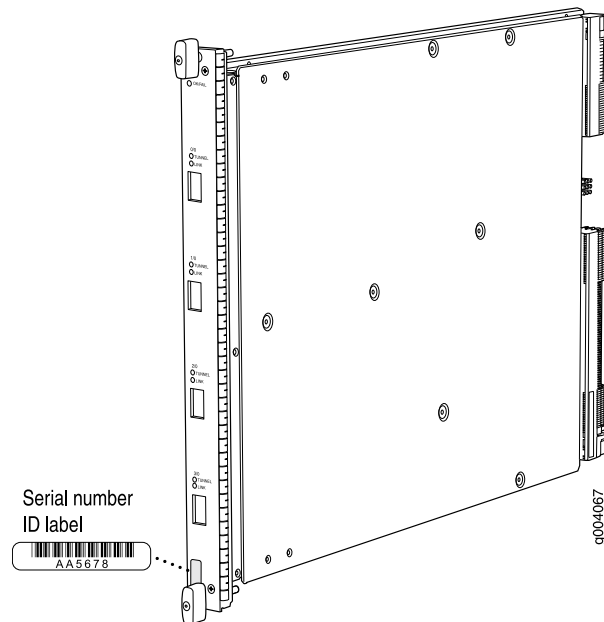
The serial number is located on the right side of the top of the SCB (see Figure 76 on page 199).

**Figure 76: SCB Serial Number Label**

### **DPC Serial Number Label**

The serial number label is located on the center of the right side of the DPC (see Figure 77 on page 200).

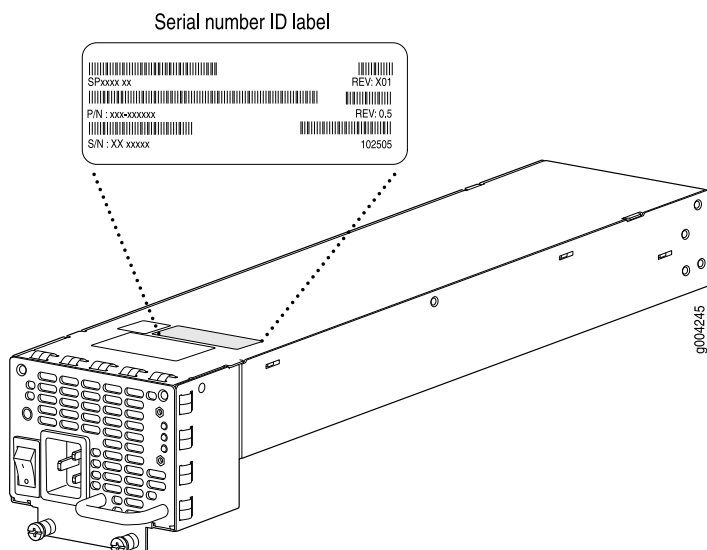
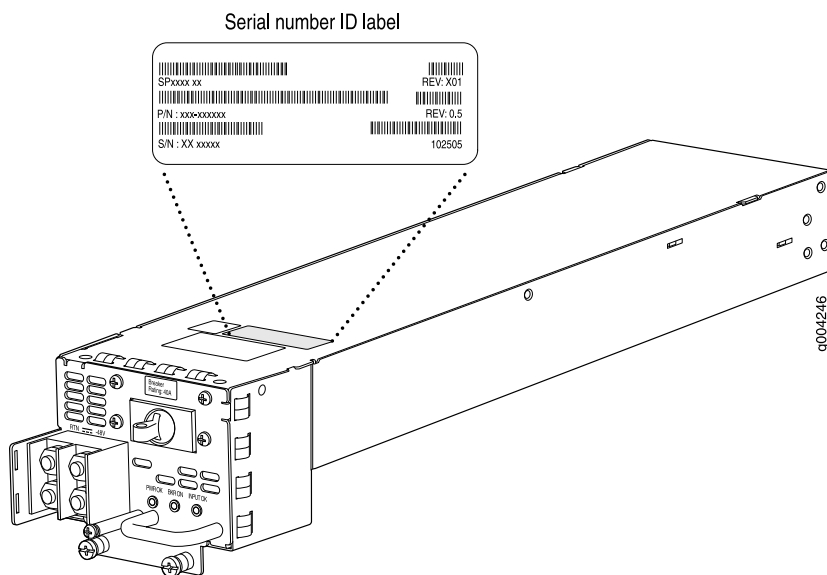
**Figure 77: DPC Serial Number Label**



### **Power Supply Serial Number Labels**

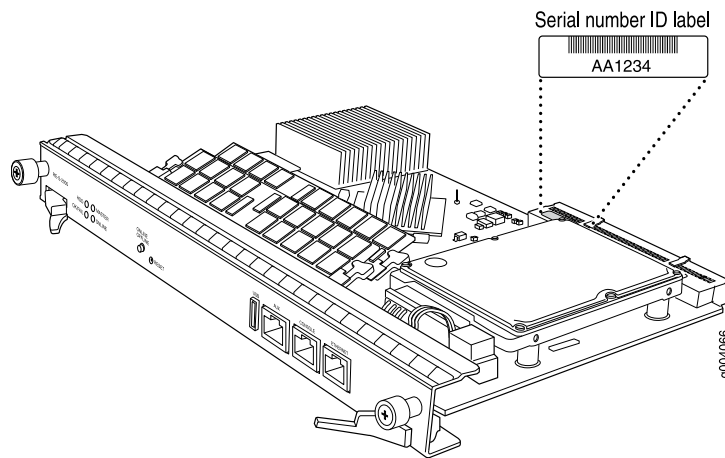
The serial number label is located on the top of the AC power supply (see Figure 78 on page 201).

The serial number label is located on the top of the DC power supply faceplate (see Figure 79 on page 201).

**Figure 78: AC Power Supply Serial Number Label****Figure 79: DC Power Supply Serial Number Label**

### **Routing Engine Serial Number Label**

The serial number label is located on the right side of the top of the Routing Engine (see Figure 80 on page 202).

**Figure 80: Routing Engine Serial Number Label**

## Contacting Customer Support

After you have located the serial numbers of the components you need to return, contact Juniper Networks Technical Assistance Center (JTAC) in one of the following ways. You can contact JTAC 24 hours a day, seven days a week:

- 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.

## Information You Might Need to Supply to JTAC

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 router when the problem occurred
- Configuration data using one or more of the show commands

## Return Procedure

---

If the 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 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).

To return a component:

1. Determine the part number and serial number of the component. For instructions, see “Locating Component Serial Numbers” on page 197.
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 router or component for shipment, as described “Packing the Router for Shipment” on page 204 or “Packing Components for Shipment” on page 205.

## Tools and Parts Required

---

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
- 3/8-in. 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 DPCs
- Wire cutters

## Packing the Router for Shipment

---

To pack the router for shipment:

1. Retrieve the shipping crate and packing materials in which the router was originally shipped. If you do not have these materials, contact your Juniper Networks representative about approved packaging materials.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. For more information about ESD, see “Preventing Electrostatic Discharge Damage” on page 130.
3. 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 the *JUNOS System Basics and Services Command Reference*.

4. Shut down power to the router by pressing the AC switch for all power supplies to the off (O) position. On both AC and DC power supplies, the switch is located on the power supply faceplate.
5. Disconnect power from the router. For instructions, see “Replacing an AC Power Cord” on page 118 or “Replacing a DC Power Supply Cable” on page 119.



6. Remove the cables that connect to all external devices. For instructions, see “Replacing Connections to Routing Engine Interface Ports” on page 104.
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, two people should grasp the router while a third 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.

## Packing Components for Shipment

---

To pack and ship individual components, follow these guidelines:

- When you return components, make sure they are adequately protected with packing materials and packed so that the pieces are prevented from moving around inside the carton.
- Use the original shipping materials if they are available.
- Place individual boards in electrostatic bags.
- Write the RMA number on the exterior of the box to ensure proper tracking.



**CAUTION:** Do not stack any of the router components.

---



## **Part 5**

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