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MX960 Universal Routing Platform Hardware Guide

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

MX960 Universal Routing Platform Hardware Guide

The information in this document is current as of the date on the title page.

YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

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Site Planning, Preparation, and Specifications

About the Documentation

IN THIS SECTION

Use this guide to install hardware and perform initial software configuration, routine maintenance, and troubleshooting for the MX960 5G Universal Routing Platform. After completing the installation and basic configuration procedures covered in this guide, refer to the Junos OS documentation for information about further software configuration.

Documentation and Release Notes

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

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

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Using the Examples in This Manual

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   system {
       scripts {
           commit {
               file ex-script.xsl;
           }
       }
   }
   interfaces {
       fxp0 {
           disable;
           unit 0 {
               family inet {
                   address 10.0.0.1/24;
               }
           }
       }
   }
   ```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

   ```
   [edit]
   user@host# load merge /var/tmp/ex-script.conf
   load complete
   ```

Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   commit {
       file ex-script-snippet.xsl; }
   ```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

   ```
   [edit]
   user@host# edit system scripts
   [edit system scripts]
   ```

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

   ```
   [edit system scripts]
   user@host# load merge relative /var/tmp/ex-script-snippet.conf
   load complete
   ```

For more information about the **load** command, see CLI Explorer.

Documentation Conventions

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

Table 1: Notice Icons

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

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

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the **configure** command: user@host> **configure**
`Fixed-width text like this`	Represents output that appears on the terminal screen.	`user@host>` **show chassis alarms** `No alarms currently active`
Italic text like this	• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User Guide* • RFC 1997, *BGP Communities Attribute*

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

<table>
<tr><th>Convention</th><th>Description</th><th>Examples</th></tr>
<tr><td>Italic text like this</td><td>Represents variables (options for which you substitute a value) in commands or configuration statements.</td><td>Configure the machine’s domain name:
[edit]
root@# set system domain-name domain-name</td></tr>
<tr><td>Text like this</td><td>Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.</td><td>• To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level.
• The console port is labeled CONSOLE.</td></tr>
<tr><td>< > (angle brackets)</td><td>Encloses optional keywords or variables.</td><td>stub <default-metric <i>metric</i>>;</td></tr>
<tr><td>| (pipe symbol)</td><td>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.</td><td>broadcast | multicast
(string1 | string2 | string3)</td></tr>
<tr><td># (pound sign)</td><td>Indicates a comment specified on the same line as the configuration statement to which it applies.</td><td>rsvp { # Required for dynamic MPLS only</td></tr>
<tr><td>[ ] (square brackets)</td><td>Encloses a variable for which you can substitute one or more values.</td><td>community name members [community-ids]</td></tr>
<tr><td>Indention and braces ({ })</td><td>Identifies a level in the configuration hierarchy.</td><td rowspan="2">[edit]
routing-options {
  static {
    route default {
      nexthop address;
      retain;
    }
  }
}</td></tr>
<tr><td>; (semicolon)</td><td>Identifies a leaf statement at a configuration hierarchy level.</td></tr>
<tr><td colspan="3">GUI Conventions</td></tr>
</table>

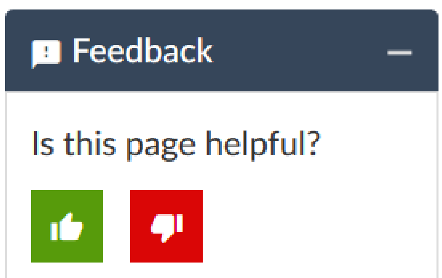
Table 2: Text and Syntax Conventions *(continued)*

Convention	Description	Examples
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select **Protocols>Ospf**.

Documentation Feedback

We encourage you to provide feedback so that we can improve our documentation. You can use either of the following methods:

- Online feedback system—Click TechLibrary Feedback, on the lower right of any page on the Juniper Networks TechLibrary site, and do one of the following:



  - Click the thumbs-up icon if the information on the page was helpful to you.
  - Click the thumbs-down icon if the information on the page was not helpful to you or if you have suggestions for improvement, and use the pop-up form to provide feedback.

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

Requesting Technical Support

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

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

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- Search for known bugs: https://prsearch.juniper.net/
- Find product documentation: https://www.juniper.net/documentation/
- Find solutions and answer questions using our Knowledge Base: https://kb.juniper.net/
- Download the latest versions of software and review release notes: https://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://kb.juniper.net/InfoCenter/
- Join and participate in the Juniper Networks Community Forum: https://www.juniper.net/company/communities/
- Create a service request online: https://myjuniper.juniper.net

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

Creating a Service Request with JTAC

You can create a service request with JTAC on the Web or by telephone.

- Visit https://myjuniper.juniper.net.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see https://support.juniper.net/support/requesting-support/.

1

PART

Overview

CHAPTER 1

System Overview

IN THIS CHAPTER

MX960 Router Overview

The MX960 5G Universal Routing Platform is an Ethernet-optimized edge router that provides both switching and carrier-class Ethernet routing. The MX960 router enables a wide range of business and residential applications and services, including high-speed transport and VPN services, next-generation broadband multiplay services, high-speed Internet and data center internetworking.

The MX960 chassis provides redundancy and resiliency. The hardware system is fully redundant, including power supplies, fan trays, Routing Engines, and Switch Control Boards.

The MX960 router is 16 rack units (U) tall. Three routers can be stacked in a single floor-to-ceiling rack, for increased port density per unit of floor space. The router provides 14 slots that can be populated with 11 or 12 Dense Port Concentrators (DPCs) or Modular Port Concentrators (MPCs), six Flexible PIC Concentrators (FPCs), and two Switch Control Boards (SCBs) in nonredundant fabric configurations.

Fully populated, the MX960 router provides an aggregate switch fabric capacity of up to 10.56 Tbps, with line-rate throughput on 264 10-Gigabit Ethernet ports, 22 100-Gigabit Ethernet and 44 10-Gigabit Ethernet ports and 66 40-Gigabit Ethernet ports.

Table 3 on page 2 lists the MX960 router capacity.

Table 3: MX960 Router Capacity

Description	Capacity
System capacity	10.56 Tbps half duplex
Switch fabric capacity per slot	480 Gbps
MPCs and DPCs per chassis	11 or 12 (depending on protection scheme)
Chassis per rack	3

Several types of DPCs are available. Each DPC includes either two or four Packet Forwarding Engines (PFE). Each PFE enables a throughput of 10 Gbps.

Up to two PICs can be installed in each FPC. Fully populated, the MX960 supports up to 12 PICs.

Up to two Modular Interface Cards (MICs) can be installed in each MPC. Fully populated, the MX960 supports up to 24 MICs.

MPCs support fixed interfaces or up to two Modular Interface Cards (MICs) that can be installed in each MPC. Fully populated, the MX960 supports up to 22 MICs.

For a list of the supported DPCs, FPCs, MPCs, MICs, PICs, and SCBs, see the *MX Series Interface Module Reference*.

Table 4 on page 3 compares the switch fabric bandwidth capacities.

Table 4: Switch Control Board Capacities for MX Series 5G Universal Routing Platforms (Full-Duplex)

Description	Fabric Bandwidth Per Slot	MX240 Fabric Bandwidth	MX480 Fabric Bandwidth	MX960 Fabric Bandwidth
Enhanced MX Switch Control Board (model SCBE3-MX)	Up to 1.5 Tbps (non-redundant fabric configuration with MPC10E line cards); 1 Tbps (redundant fabric configuration with MPC10E line cards)	Up to 6 Tbps	Up to 18 Tbps	Up to 33 Tbps
Enhanced MX Switch Control Board (SCBE2-MX)	Up to 480 Gbps (non-redundant fabric configuration); 340 Gbps (redundant fabric configuration)	Up to 1.92 Tbps	Up to 5.76 Tbps	Up to 10.56 Tbps
Enhanced MX Switch Control Board (SCBE-MX)	Up to 240 Gbps (non-redundant fabric configuration); 160 Gbps (redundant fabric configuration)	Up to 930 Gbps	Up to 2.79 Tbps	Up to 5.25 Tbps
Switch Control Board (SCB-MX)	Up to 240 Gbps (non-redundant fabric configuration); 120 Gbps (redundant fabric configuration)	Up to 465 Gbps	Up to 1.39 Tbps	Up to 2.6 Tbps

The connections between interface cards and SCBs are organized in three groups:

- Switch fabric—Connects the interface cards and provides for packet transport between DPCs, FPCs, and MPCs. Two SCBs provide one non-redundant fabric. Three SCBs are required for a redundant fabric configuration.

- Control Plane—Gigabit Ethernet links between the combined SCBs/Routing Engines and each DPC, FPC, or MPC. All board-to-board information is passed over Ethernet except for low-level status and commands.
- Management signals—Provide low-level status diagnostic support.

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CHAPTER 2

Chassis Components and Descriptions

IN THIS CHAPTER

MX960 Chassis Description

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 7, Figure 3 on page 7, Figure 4 on page 8, and Figure 5 on page 9). The chassis installs in many types of racks, including 800-mm deep (or larger) enclosed cabinets, standard 19-in. equipment racks, or telco open-frame racks. Two types of chassis are available for the MX960 router:

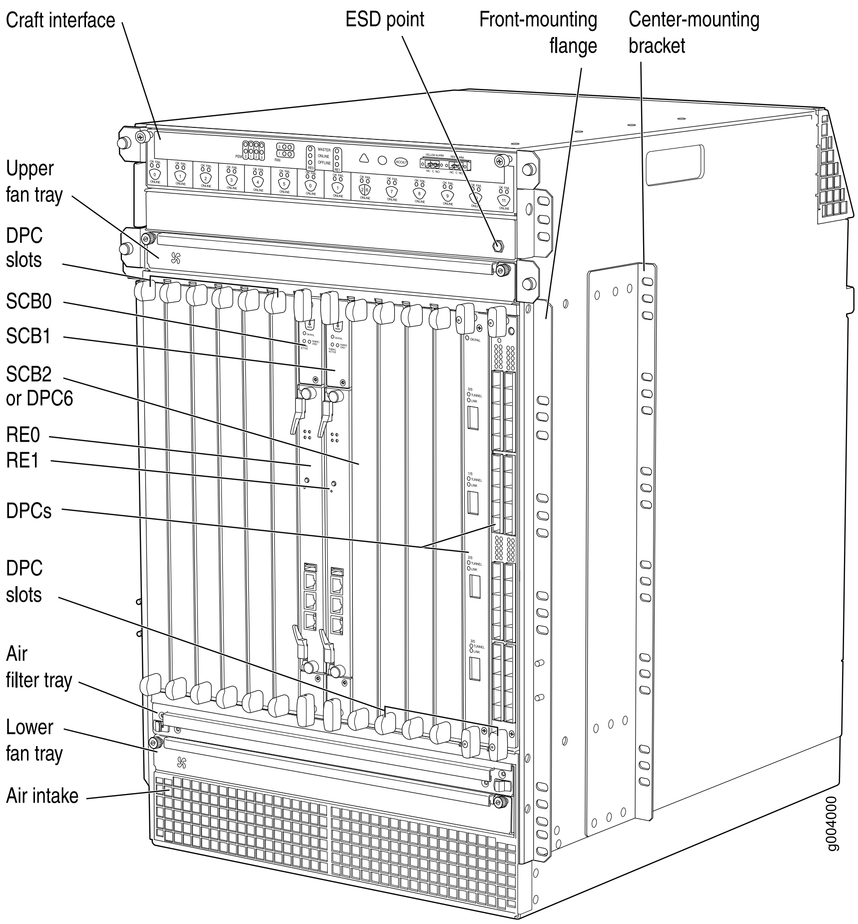
- The standard chassis measures 27.75 in. (70.49 cm) high, 17.37 in. (44.11 cm) wide (excluding the mounting flanges and brackets), and 23.0 in. (58.42 cm) deep (from the front-mounting flanges to the rear of the chassis). The standard cable manager extends the depth to 28.0 in. (71.1 cm). Up to three routers can be installed in a 48-U rack if the rack can handle their combined weight, which can be greater than 1,050 lb (476.3 kg).

NOTE: The chassis depth with the high-capacity AC power supply is 30.6" and the depth with high-capacity DC power supply is 32.8".

- The chassis with the extended cable manager installed measures 36.5 in. (92.7 cm) high, 17.37 in. (44.11 cm) wide, and approximately 29.00 in. (73.7 cm) deep (from the front-mounting flanges to the rear of the extended cable manager). Up to two routers with the extended cable manager can be installed in a 48-U rack if the rack can handle their combined weight, which can be greater than 748 lb (339.28 kg).

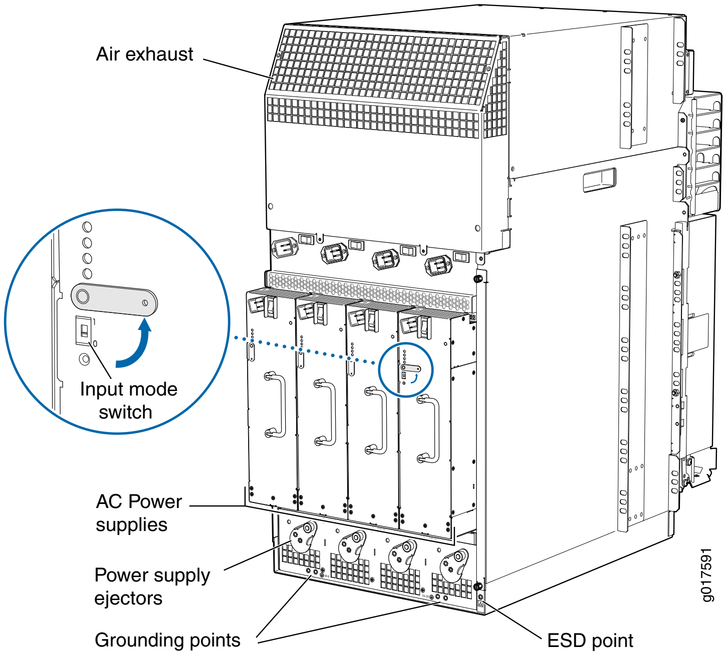
Mounting hardware includes front-mounting flanges on the front of the chassis, and two center-mounting brackets attached to the center of the chassis.

Figure 1: Front View of a Fully Configured MX960 Router Chassis



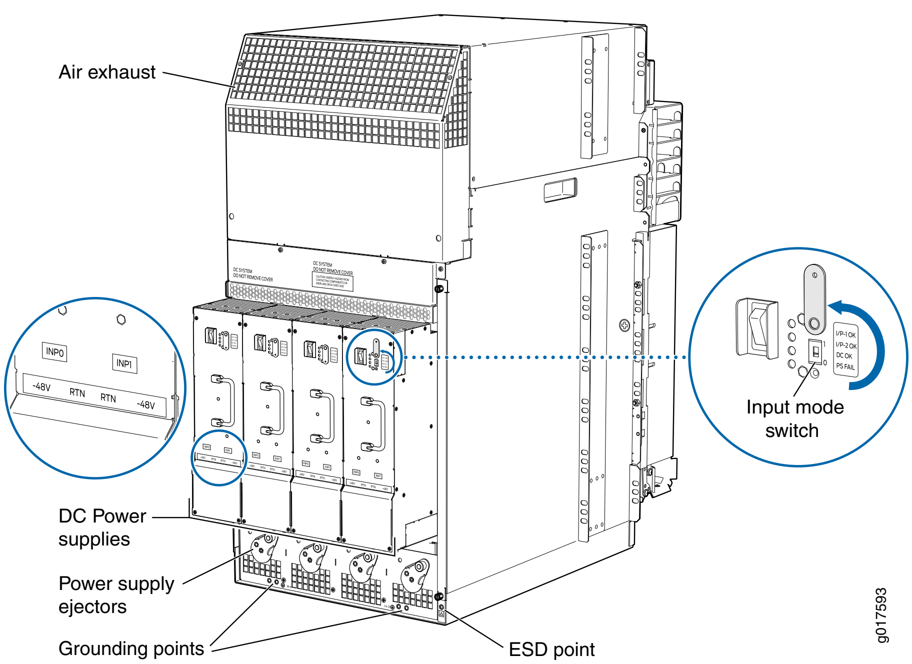
> **NOTE:** The chassis is shown without the extended cable manager.

Figure 2: Rear View of a Fully Configured AC-Powered MX960 Router Chassis



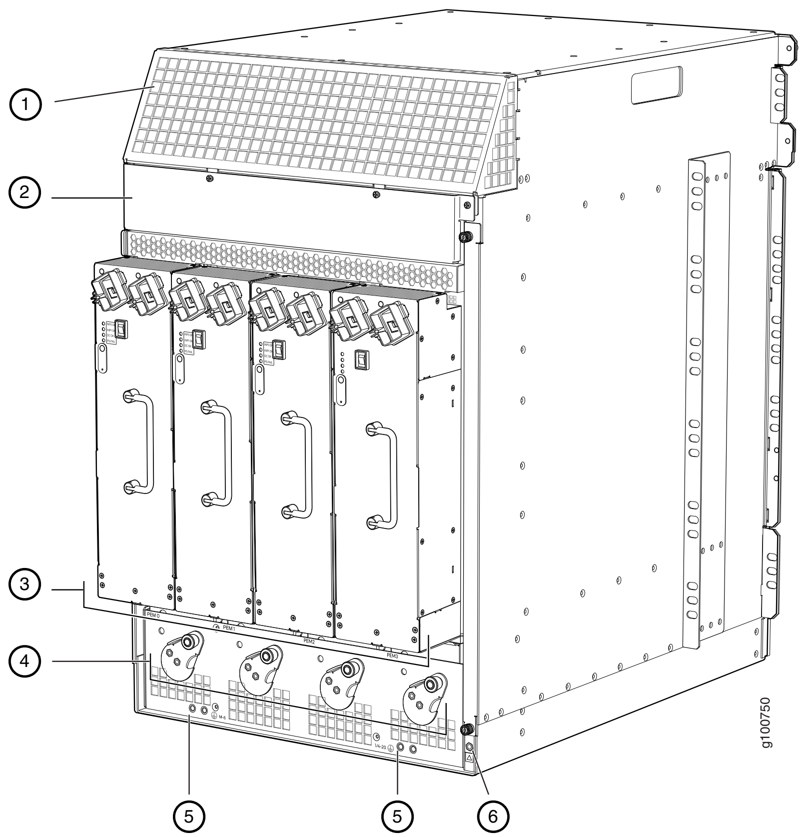
NOTE: The chassis is shown with the extended cable manager.

Figure 3: Rear View of a Fully Configured DC-Powered MX960 Router Chassis



NOTE: The chassis is shown with the extended cable manager.

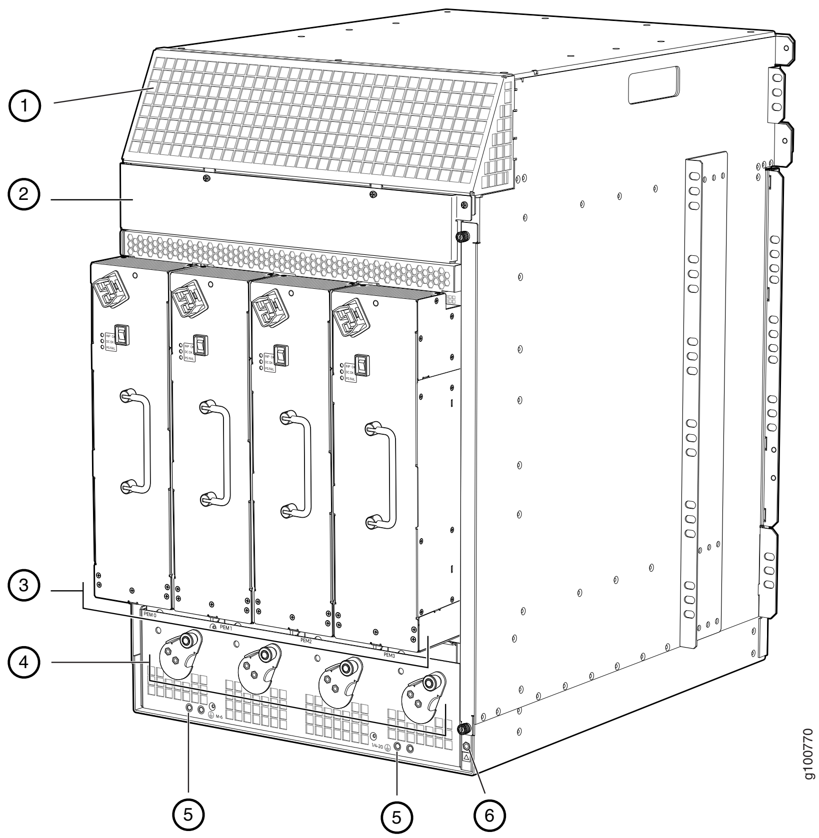
Figure 4: Rear View of a Fully Configured AC-powered (High-Capacity Second-Generation) MX960 Router Chassis



1–Air exhaust	4–Power supply ejectors
2–Power distribution unit cover	5–Grounding points
3–High-capacity second-generation AC power supplies	6–ESD point

NOTE: The chassis is shown without the extended cable manager.

Figure 5: Rear View of a Fully Configured MX960 Router Chassis with High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supplies



1–Air exhaust	4–Power supply ejectors
2–Power distribution unit cover	5–Grounding points
3–High-voltage second-generation universal (HVAC/HVDC) power supplies	6–ESD point

NOTE: The chassis is shown without the extended cable manager.

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MX960 Router Grounding Specifications | 194

MX960 Component Redundancy

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 and an SCB. The router can have one or two host subsystems. If two host subsystems are installed, one functions as the primary and the other functions as the backup. If the primary host subsystem (or either of its components) fails, the backup can take over as the primary. To operate, each host subsystem requires a Routing Engine installed directly into in an SCB.
- Power supplies—In the AC configuration with normal capacity AC power supplies, a minimum of three power supplies is required to supply power to a fully configured router. All AC power supplies share the load evenly. The addition of a fourth power supply provides full power redundancy. If one power supply fails in a redundant configuration, the three remaining power supplies provide full power. In the DC configuration, AC configuration with high capacity power supplies, high-capacity second-generation AC power supplies, and high-voltage second-generation universal (HVAC or HVDC) power supplies, two power supplies are required to supply power to a fully configured router. One power supply supports approximately half of the components in the router, and the other power supply supports the remaining components. The addition of two power supplies provides full power redundancy. If one power supply fails, the remaining power supplies provide full power to the router.
- 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.

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How to Return a Hardware Component to Juniper Networks, Inc. | 714

MX960 Router Hardware and CLI Terminology Mapping

The MX960 router supports the components in Table 5 on page 11.

Table 5: MX960 Router Hardware Components and CLI Terminology

Component	Hardware Model Number	CLI Name	Description
Chassis	MX960BASE-AC	**MX960**	"MX960 Router Physical Specifications" on page 176 "MX960 Chassis Description" on page 5
	MX960BASE-DC		
Craft Interface Panel	CRAFT-MX960-S	**Front Panel Display**	"MX960 Craft Interface Overview" on page 15
Cooling System			
Fan tray	FFANTRAY-MX960	**Fan Tray**	"MX960 Cooling System Description" on page 23
Filter tray	FFILTER-MX960	N/A	
	FFILTER-MX960-HC	N/A	
Filter kit	FLTR-KIT-MX960	N/A	
Host Subsystem			"MX960 Host Subsystem Description" on page 27
Routing Engine	See "Supported Routing Engines by Router" on page 38.		"MX960 Routing Engine Description" on page 28
SCB	MX960-SCB-S	**MX SCB**	"SCB-MX Description" on page 169
Interface Modules			
DPC	See "DPCs Supported on MX240, MX480, and MX960 Routers" on page 61 in the *MX Series Interface Module Reference*.		"MX960 Dense Port Concentrator Description" on page 58
DPC or SCB blank panel	DPC-SCB-BLANK	N/A	
FPC	MX-FPC2	**MX FPC Type 2**	"MX960 Flexible PIC Concentrator Description" on page 68
	MX-FPC3	**MX FPC Type 3**	

Table 5: MX960 Router Hardware Components and CLI Terminology *(continued)*

Component	Hardware Model Number	CLI Name	Description
MIC	See "MICs Supported by MX Series Routers" on page 94 in the *MX Series Interface Module Reference*.		"MX960 Modular Interface Card Description" on page 93
MIC blank panel	MIC-BLANK	N/A	
MPC	See "MPCs Supported by MX Series Routers" on page 112 in the *MX Series Interface Module Reference*.		"MX960 Modular Port Concentrator Description" on page 108
PIC	See "PICs Supported by MX240, MX480, and MX960 Routers" on page 75 in the *MX Series Interface Module Reference*.		"MX960 PIC Description" on page 72
	SCBE-MX960-S	**Enhanced MX SCB**	
Transceiver	See *MX Series Interface Module Reference*.	**Xcvr**	"Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC" on page 447
Power System			"MX960 Power System Overview" on page 125
Power distribution module (PDM)	Power Distribution Module	**Power Distribution Module**	"MX960 Power System Overview" on page 125
AC power supply	PWR-MX960-AC	**AC Power Entry Module**	"MX960 AC Power Supply Description" on page 127
	PWR-MX960-4100-AC	**AC 4.1kW Power Entry Module**	
	MX-PSM-5K-AC	**MX960-5100W-AC-PSM**	
DC power supply	PWR-MX960-DC	**DC Power Entry Module**	"MX960 DC Power Supply" on page 138
	PWR-MX960-4100-DC	**DC 4.1kW Power Entry Module**	

Table 5: MX960 Router Hardware Components and CLI Terminology *(continued)*

Component	Hardware Model Number	CLI Name	Description
HVAC/HVDC	MX960-PSM-HV	MX960-UNIVERSAL-HV-PSM	"MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply Description" on page 140
Power supply blank panel	PWR-BLANK-MX960	N/A	"MX960 Power System Overview" on page 125

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MX960 PIC Port and Interface Numbering | 73
MX Series Router Interface Names

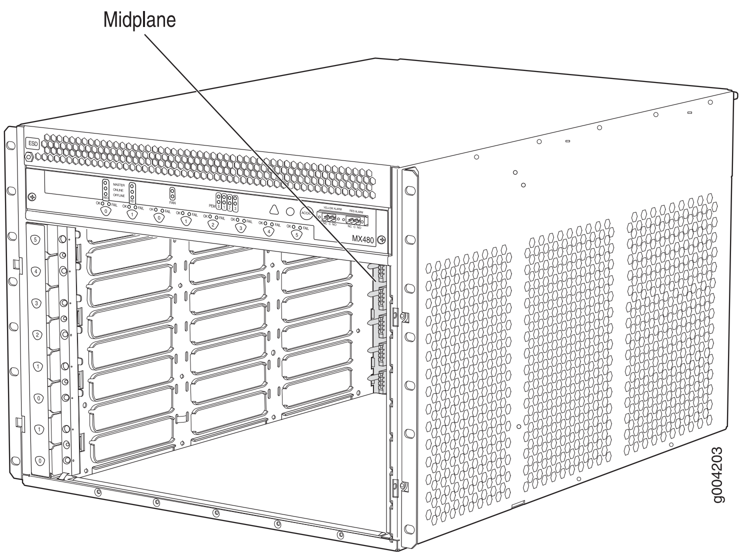
MX960 Midplane Description

The midplane is located toward the rear of the chassis and forms the rear of the card cage (see Figure 6 on page 14). The line cards 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 line cards 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 line cards, SCBs, Routing Engines, and other system components for monitoring and control of the system.

Figure 6: Midplane



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MX960 Rack-Mounting Hardware

The rack-mounting hardware for the MX960 router includes:

- The large mounting shelf for mounting in four-post racks, cabinets, and open-frame racks
- The small mounting shelf for front-mounting in a four-post rack or cabinet

- Front-mounting flanges on the front of the chassis for front-mounting in a four-post rack or cabinet
- Two center-mounting brackets attached to the center of the chassis for center-mounting in an open-frame rack. For an open-frame rack, center-mounting is preferable because of the more even distribution of weight.

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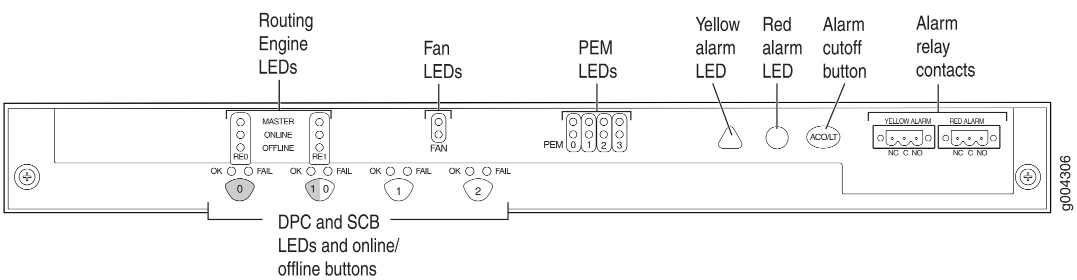
Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet | 269

MX960 Craft Interface Overview

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 card cage and contains LEDs for the router components, the alarm relay contacts, and alarm cutoff button. See Figure 7 on page 15.

Figure 7: Front Panel of the Craft Interface



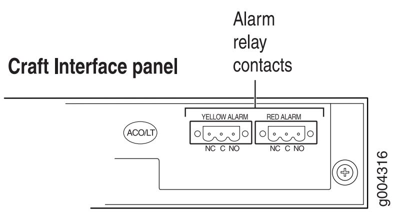
NOTE: At least one SCB must be installed in the router for the craft interface to obtain power.

RELATED DOCUMENTATION

MX960 Alarm Relay Contacts on the Craft Interface

The craft interface has two alarm relay contacts for connecting the router to external alarm devices (see Figure 8 on page 16). 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 8: Alarm Relay Contacts



RELATED DOCUMENTATION

MX960 Alarm LEDs and Alarm Cutoff/Lamp Test Button

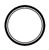
Two large alarm LEDs are located at the upper right of the craft interface. The circular red LED lights to indicate a critical condition that can result in a system shutdown. The triangular yellow LED lights to indicate a less severe condition that requires monitoring or maintenance. Both LEDs can be lit simultaneously.

A condition that causes an LED to light also activates the corresponding alarm relay contact on the craft interface.

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 6 on page 17 describes the alarm LEDs and alarm cutoff button in more detail.

Table 6: Alarm LEDs and Alarm Cutoff/Lamp Test Button

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

RELATED DOCUMENTATION

MX960 Craft Interface Overview | 15
MX960 Alarm Relay Contacts on the Craft Interface | 16
MX960 Router Overview | 2

MX960 Component LEDs on the Craft Interface

IN THIS SECTION

MX960 Host Subsystem LEDs on the Craft Interface

Each host subsystem has three LEDs, located in the middle 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 7 on page 18 describes the functions of the host subsystem LEDs.

Table 7: Host Subsystem LEDs on the Craft Interface

Label	Color	State	Description
MASTER	Green	On steadily	Host is functioning as the primary.
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.

MX960 Power Supply LEDs on the Craft Interface

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 8 on page 18 describes the functions of the power supply LEDs on the craft interface.

Table 8: 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.

MX960 DPC and MPC LEDs on the Craft Interface

Each DPC or MPC has LEDs on the craft interface that indicate its status. The LEDs, labeled **0** through **5**, **2/6**, and **7** through **11**, are located along the bottom of the craft interface. Slot **2/6** is for an additional DPC, FPC, MPC, or SCB. Table 9 on page 19 describes the functions of the LEDs.

Table 9: DPC and MPC LEDs on the Craft Interface

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

MX960 FPC LEDs on the Craft Interface

An FPC takes up two DPC slots when installed in an MX Series router. The LEDs, labeled **0** through **5**, **2/6**, and **7** through **11**, are located along the bottom of the craft interface. Slot **2/6** is for an additional DPC, FPC, MPC, or SCB. The LED corresponds to the lowest DPC slot number in which the FPC is installed. Table 10 on page 19 describes the functions of the FPC LEDs.

Table 10: FPC LEDs on the Craft Interface

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

MX960 SCB LEDs on the Craft Interface

Each SCB has two LEDs on the craft interface that indicates its status. The SCB LEDs, labeled **0**, **1**, and **2/6**, are located along the bottom of the craft interface. Table 11 on page 20 describes the functions of the SCB LEDs.

Table 11: SCB LEDs on the Craft Interface

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.

MX960 Fan LEDs on the Craft Interface

The fan LEDs are located on the top left of the craft interface. Table 12 on page 20 describes the functions of the fan LEDs.

Table 12: Fan LEDs on the Craft Interface

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

RELATED DOCUMENTATION

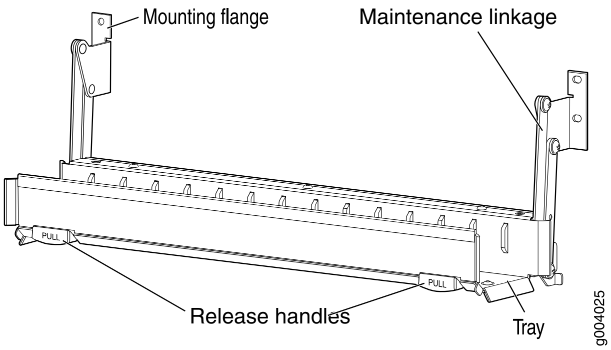
MX960 Craft Interface Overview | 15
MX960 Alarm Relay Contacts on the Craft Interface | 16

MX960 Cable Manager Description

The standard cable manager (see Figure 9 on page 21) is a tray located below the line-card cage, which has a row of fourteen dividers for securing the cables for each Dense Port Concentrator (DPC), Modular Port Concentrator (MPC), Modular Interface Card (MIC), or PIC.

You can use cable strips or other ties to gently secure the cables in the standard cable manager. To secure the cables in place, loop the tie through the cable anchor and secure the tie. You can pull the standard cable manager up and outward to lock it into the maintenance position. This allows you to access the lower fan tray and the air filter.

Figure 9: Standard Cable Manager



The extended cable manager allows you to route cables away from the front of the DPCs, MPCs, MICs, and PICs, and provides additional access (see Figure 11 on page 22 and Figure 10 on page 21).

Figure 10: Extended Cable Manager

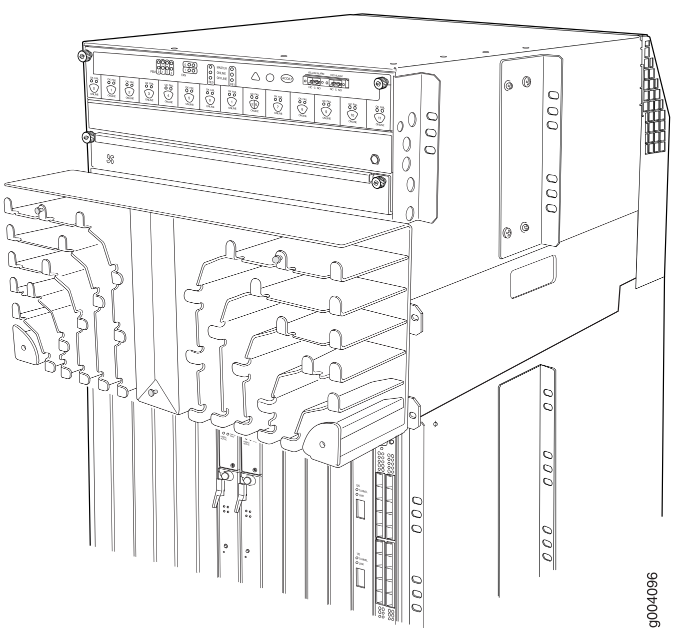
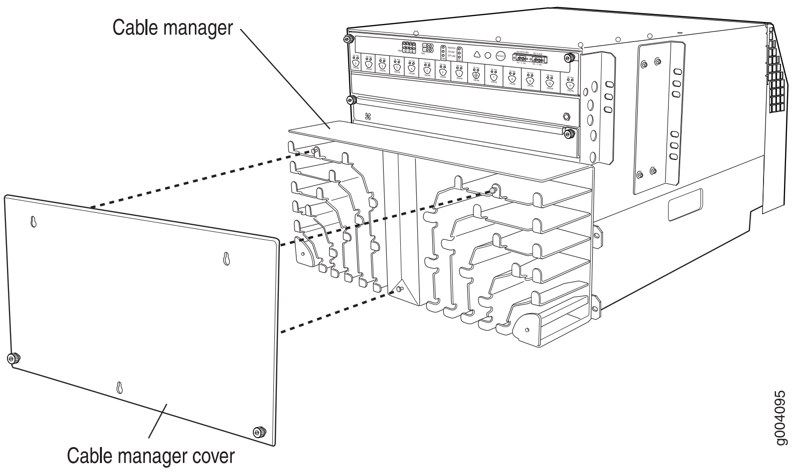


Figure 11: Extended Cable Manager Cover



RELATED DOCUMENTATION

CHAPTER 3

Cooling System Components and Descriptions

IN THIS CHAPTER

MX960 Cooling System Description

The cooling system consists of the following components:

- Upper front fan tray
- Lower front fan tray
- Front air filter

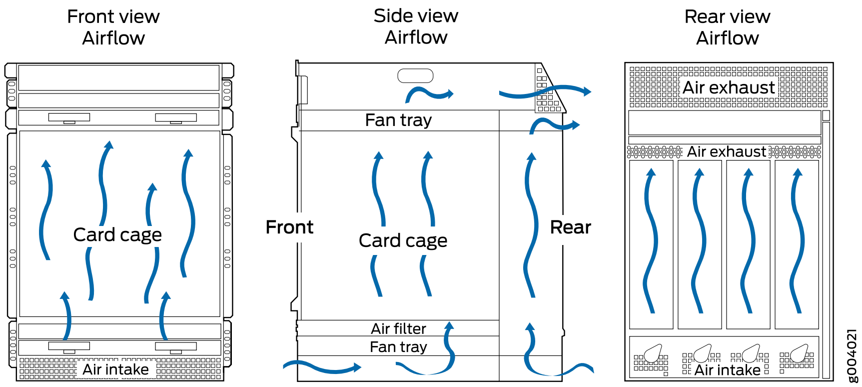
The cooling system components work together to keep all router components within the acceptable temperature range (see Figure 12 on page 24, Figure 13 on page 24, Figure 14 on page 24, and Figure 15 on page 25). The router has two fan trays located in the front of the router that install horizontally above and below the card cage. Each normal-capacity fan tray contains six fans. High-capacity fan trays that contain twelve fans can be installed in the upper and lower fan tray slots. The fan trays are hot-insertable and hot-removable.

The MX960 requires high-capacity fan trays to satisfy cooling requirements for high-density DPCs and MPCs. When replacing normal-capacity fan trays with high-capacity fan trays, you must replace them in both the upper and lower fan trays. Additionally, you must replace the front normal air filter tray with a high capacity filter tray and air filter.

There is a single air intake in the front of the router. Air is pushed up through the card cage and through the upper fan tray where it is exhausted out the upper rear of the system through the larger air exhaust shown in Figure 12 on page 24.

At the bottom rear of the chassis, there is an air intake for power supply cooling. Air flows over the power supplies and is exhausted out the rear of the chassis through the smaller air exhaust below the main exhaust.

Figure 12: Airflow Through the 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 PEM.

Figure 13: Normal Fan Tray

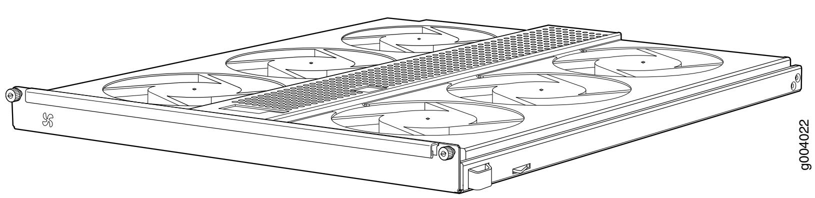


Figure 14: Air Filter

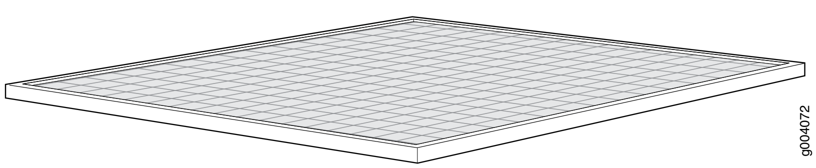


Figure 15: Normal Air Filter Tray

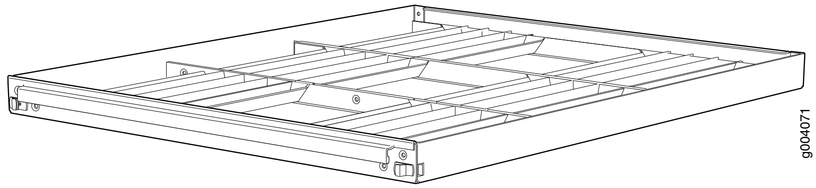


Figure 16: High-Capacity Fan Tray

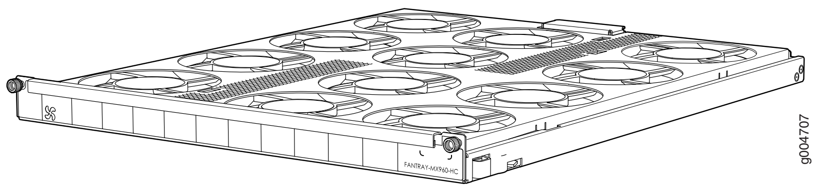
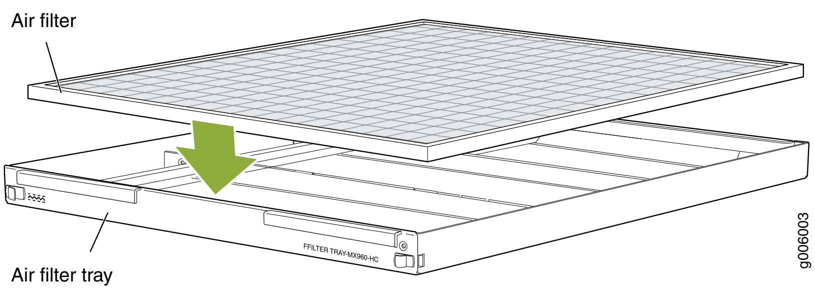


Figure 17: High-Capacity Filter Tray with Air Filter



RELATED DOCUMENTATION

Troubleshooting the MX960 Cooling System | 674
Maintaining the MX960 Air Filter | 610
Maintaining the MX960 Fan Trays | 610

MX960 Fan LED

Each fan has an LED that displays its status. The fan LEDs are located on the top left of the craft interface. For more information, see “MX960 Fan LEDs on the Craft Interface” on page 20.

RELATED DOCUMENTATION

MX960 Cooling System Description | **23**
Maintaining the MX960 Fan Trays | **610**
Troubleshooting the MX960 Cooling System | **674**

CHAPTER 4

Host Subsystem Components and Descriptions

IN THIS CHAPTER

MX960 Host Subsystem Description

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 in the middle of the craft interface.

RELATED DOCUMENTATION

MX960 Host Subsystem LEDs | 28

Maintaining the MX960 Host Subsystem | 613

Taking an MX960 Host Subsystem Offline

Effect of Taking the MX960 Host Subsystem Offline

Replacing an MX960 Routing Engine | 483

MX960 Host Subsystem LEDs

Each host subsystem has three LEDs that display its status. The host subsystem LEDs are located in the middle of the craft interface. For more information, see "MX960 Host Subsystem LEDs on the Craft Interface" on page 18.

RELATED DOCUMENTATION

MX960 Routing Engine Description

IN THIS SECTION

If the host system is redundant, the backup Routing Engine is hot-removable and hot-insertable, but the primary Routing Engine is hot-pluggable. A Routing Engine that is not redundant is hot-pluggable.

Supported Routing Engines

The MX960 router supports the following Routing Engines:

- RE-S-1300-2048 supported for Junos OS Release 8.2 and later.
- RE-S-2000-4096 supported for Junos OS Release 8.2 and later.
- RE-S-1800x2 supported for Junos OS Release 10.4 and later.

- RE-S-1800x4 supported for Junos OS Release 10.4 and later.
- RE-S-X6-64G supported for Junos OS Release 15.1F4, 16.1 and later.
- RE-S-X6-64G-LT supported for Junos OS Release 17.2R1 and later.

> **NOTE:** The Routing Engine is equipped with limited encryption support only.

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

Routing Engine Function

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

Routing Engine Slots

You can install one or two Routing Engines in the router. Each Routing Engine must be installed directly into an SCB. A USB port on the Routing Engine accepts a USB memory device that allows you to load Junos OS. The Routing Engines install into the front of the chassis in vertical slots directly into the SCBs labeled **0** and **1**. If two Routing Engines are installed, one functions as the primary and the other acts as the backup. If the primary Routing Engine fails or is removed and the backup is configured appropriately, the backup takes over as the primary.

On the MX960 router, a Routing Engine installed in SCB slot **2/6** receives no power and supplies no additional routing functions. If no SCB is installed in slot **2/6**, install a blank panel in the slot.

Routing Engine Interface Ports

Three ports, located on the right side of the routing engine, connect the Routing Engine to one or more external devices on which system administrators can issue Junos OS command-line interface (CLI) commands to manage the router.

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 or MGMT**—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 right 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.

RELATED DOCUMENTATION

RJ-45 Connector Pinouts for MX Series Routing Engine AUX and CONSOLE Ports | 198
RJ-45 Connector Pinouts for an MX Series Routing Engine ETHERNET Port | 197
Replacing an MX960 Routing Engine | 483

MX Routing Engine LEDs

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 13 on page 30 describes the functions of the Routing Engine LEDs.

Table 13: Routing Engine LEDs

Label	Color	State	Description
MASTER	Blue	On steadily	Routing Engine is the Primary.
HDD	Green	Blinking	Indicates activity on the hard disk drive.
ONLINE	Green	Blinking	Routing Engine is transitioning online.
		On steadily	Routing Engine is functioning normally.
FAIL	Red	On steadily	Routing Engine has failed.

RELATED DOCUMENTATION

MX960 Routing Engine Description | 28

Replacing an MX960 Routing Engine | 483

Routing Engine Specifications

Table 14 on page 31 lists the current specifications for Routing Engines supported on M Series, MX Series, and T Series routers. Table 15 on page 35 lists the hardware specifications of the Routing Engines with VMHost support. Table 16 on page 36 lists the specifications for end-of-life Routing Engines.

NOTE: For a list of the routing engines that are supported on the M Series, MX Series, T Series, and PTX routers, see "Supported Routing Engines by Router" on page 38.

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

Table 14: Routing Engine Specifications

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-400-768	400-MHz Celeron	768 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	9.0	–
RE-A-1000-2048	1.0-GHz Pentium	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.1	–
RE-A-2000-4096	2.0-GHz Pentium	4096 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.1	–
RE-S-1300-2048	1.3-GHz Pentium	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.2	SCB, SCBE

Table 14: Routing Engine Specifications *(continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-S-2000-4096	2.0-GHz Pentium	4096 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.2	SCB, SCBE
RE-C1800	1.8-GHz	8 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	T1600 router in a routing matrix: 9.6R2 Standalone T640 or T1600 router:11.2	CB-T for a standalone router. CB-LCC for a router in a routing matrix.
	1.8 Ghz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	32-bit Junos OS on a standalone T1600 router: 11.4R2 32-bit Junos OS on a T1600 router in a routing matrix: 11.4R2 64-bit Junos OS on a standalone T1600 router: 11.4R2 64-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	CB-T for a standalone router. CB-LCC for a router in a routing matrix.
RE-C2600	2.6-GHz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	TX Matrix Plus router: 9.6R2	–
RE-A-1800x2	1800-MHz	8 GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	–

Table 14: Routing Engine Specifications *(continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-S-1800x2	1800-MHz	8 GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	SCB, SCBE, SCBE2, SCBE3
RE-S-1800x4	1800-MHz	8GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	SCB, SCBE, SCBE2, SCBE3
RE-S-MX104	1.8-GHz	4 GB	Gigabit Ethernet	–	8 GB NAND Flash	13.2	–
RE-B-1800x1-4G	1.73-GHz	4 GB	Gigabit Ethernet	64 GB SSD	4 GB CompactFlash card	12.1R2, 11.4R4, and 12.2R1	–
RE-MX2000-1800x4	1.8- GHz	16 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	12.3R2	SFB
RE-S-1800X4-32G-S	1.8- Ghz	32 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	• 12.3R4 • 13.2R1	SCB, SCBE, SCBE2, SCBE3
REMX2K-1800-32G-S	1.8- Ghz	32 GB	Gigabit Ethernet	32 GB SSD	4GB Fixed Internal CompactFlash card	• 12.3R4 • 13.2R1	–
RE-S-X6-64G, RE-S-X6-64G-LT	2 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	-	• 15.1F4 and 16.1 (RE-S-X6-64G) • 17.2R1 (RE-S-X6-64G-LT)	SCBE2, SCBE3
REMX2K-X8-64G	2.3 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	15.1F5-S1, 16.1R2, and 16.2R1	–

Table 14: Routing Engine Specifications *(continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
REMX2K-X8-64G-LT	2.3 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	17.2R1	–
REMX2008-X8-64G	2.3 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	–	15.1F7	–
RE-S-1600x8	1.6 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	–	17.3R1	–
REMX2008-X8-64G-LT	2.1 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	17.2R1	-
REMX2008-X8-128G	2.3 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	18.2R1	-
RE-S-X6-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	18.1R1 (SCBE2) 18.4R1 (SCBE3)	SCBE2, SCBE3
REMX2K-X8-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	18.1R1	-
JNP10003-RE1	1.6-GHz	64 GB	Gigabit Ethernet	Two 100 GB SSDs	-	17.3R1	-
JNP10003-RE1-LT	1.6-GHz	64 GB	Gigabit Ethernet	Two 100 GB SSDs	-	18.1R1	-
JNP10K-RE0	2.5 GhZ	32 GB	Gigabit Ethernet	Two 50 GB SSDs	-	17.2R1	-

Table 14: Routing Engine Specifications *(continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
JNP10K-RE1	2.3 GhZ	64 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.2R1	-
JNP10K-RE1-LT	2.3 GhZ	64 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.3R1	-
JNP10K-RE1-128	2.3 GhZ	128 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.3R1	-

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

Table 15 on page 35 lists the hardware specifications of the Routing Engines with VMHost support.

Table 15: Hardware Specifications of the RE-MX-X6, RE-MX-X8, RE-PTX-X8, RCBPTX, RE-QFX10002-60C, and RE-PTX10002-60C Routing Engines

Model Number	Supported on Device	Specifications
RE-S-X6-64G	MX240, MX480, and MX960	• 6-core Haswell CPU • Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 64-GB solid-state drives (SSDs)
RE-S-X6-128G	MX240, MX480, and MX960	• 6-core Haswell CPU • Wellsburg PCH-based Routing Engine with 128-GB DRAM and two 128-GB solid-state drives (SSDs)
REMX2K-X8-64G	MX2020 and MX2010	• 8-core Haswell CPU • Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 64-GB SSDs
RE-PTX-X8-64G	PTX5000	• 8-core Haswell CPU • Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 64-GB SSDs • New Control Board CB2-PTX

Table 15: Hardware Specifications of the RE-MX-X6, RE-MX-X8, RE-PTX-X8, RCBPTX, RE-QFX10002-60C, and RE-PTX10002-60C Routing Engines *(continued)*

Model Number	Supported on Device	Specifications
RCBPTX	PTX3000	• Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 64-GB SSDs • Multi-core Haswell CPU RCB combines the functionality of a Routing Engine, Control Board, and Centralized Clock Generator (CCG)
RE-S-1600x8	MX10003	• High-performance 1.6-GHz Intel 8 Core X86 CPU • 64-GB DDR4 RAM • 100-GB SATA SSD
RE-S-1600x8	MX204	• High-performance 1.6-GHz Intel 8 Core X86 CPU • 32-GB DDR4 RAM • 100-GB SATA SSD
RE-QFX10002-60C	QFX10002-60C	• High-performance 1.6-GHz Intel 8 Core X86 CPU • 32-GB DDR4 RAM • Two 50-GB SATA SSD
RE-PTX10002-60C	PTX10002-60C	• High-performance 1.6-GHz Intel 8 Core X86 CPU • 32-GB DDR4 RAM • Two 50-GB SATA SSD
RE-ACX-5448	ACX5448	• High-performance 1.6-GHz Intel 8 Core X86 CPU • 32-GB two DIMM DRAM • Two 100-GB SATA SSD
RE-X10	MX10008	• High-performance 1.6-GHz Intel 10 Core X86 CPU • 64-GB DDR4 RAM • Two 200-GB SATA SSD

Table 16: End-of-Life Routing Engine Specifications

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	EOL Details
RE-333-256	333-MHz Pentium II	256 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.4	PSN-2003-01-063

Table 16: End-of-Life Routing Engine Specifications *(continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	EOL Details
RE-333-768	333-MHz Pentium II	768 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.4	PSN-2003-01-063
RE-600-512	600-MHz Pentium III	512 MB	Fast Ethernet	30 GB hard disk	256 MB CompactFlash card	5.4	PSN-2004-07-019
RE-600-2048	600-MHz Pentium III	2048 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	5.3	PSN-2008-02-018
RE-850-1536	850-MHz Pentium III	1536 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	7.2	PSN-2011-04-226
RE-M40	200-MHz Pentium	256 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.2	FA-HW-0101-001
RE-M40-333-768	333-MHz Pentium II	768 MB	Fast Ethernet	10 GB hard disk	80 MB CompactFlash card	4.2	PSN-2003-01-063
RE-M40-600-2048	600-MHz Pentium III	2048 MB	Fast Ethernet	30 GB hard disk	128 MB CompactFlash card	5.4	PSN-2004-11-020
RE-1600-2048	1.6-GHz Pentium M	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	6.2	PSN-2008-02-019

NOTE: The memory in Table 14 on page 31 indicates the amount of total memory. To determine the amount of available memory, issue the **show chassis routing-engine** CLI command.

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

RELATED DOCUMENTATION

Supported Routing Engines by Router | 38

Supported Routing Engines by Router

IN THIS SECTION

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

M7i Routing Engines

Table 17 on page 39 lists the Routing Engines supported by the M7i router. The M7i router supports 32-bit Junos OS only.

Table 17: M7i Routing Engines

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

M10i Routing Engines

Table 18 on page 39 lists the Routing Engines supported by the M10i router. The M10i router supports 32-bit Junos OS only.

Table 18: M10i Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-400-768 (EOL details: TSB16445)	**RE-5.0**	9.0	fxp0	fxp1 fxp2
RE-850-1536 (EOL details: TSB15553)	**RE-850**	7.2	fxp0	fxp1 fxp2

Table 18: M10i Routing Engines *(continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-B-1800X1-4G	**RE-B-1800x1**	11.4R4 12.1R2	fxp0	em0

M40e Routing Engines

Table 19 on page 40 lists the Routing Engines supported by the M40e router.

Table 19: M40e Routing Engines

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: TSB14373)	**RE-3.0** or **RE-3.0 (RE-600)**	5.3	fxp0	fxp1 fxp2
RE-A-1000-2048	**RE-A-1000**	8.1	fxp0	fxp1 fxp2

M120 Routing Engines

Table 20 on page 40 lists the Routing Engines supported by the M120 router.

Table 20: M120 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-1000-2048	**RE-A-1000**	8.0R2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	**RE-A-2000**	8.0R2	–	fxp0	em0 bcm0

Table 20: M120 Routing Engines *(continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-1800X2-8G	**RE-A-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	fxp1 fxp2
RE-A-1800X2-16G	**RE-A-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	fxp1 fxp2
RE-A-1800X4-16G	**RE-A-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1

M320 Routing Engines

Table 21 on page 41 lists the Routing Engines supported by the M320 router.

Table 21: M320 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-1600-2048 (EOL details: TSB14374)	**RE-4.0**	6.2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	**RE-A-2000**	8.1	–	fxp0	em0 bcm0
RE-A-1800X2-8G	**RE-A-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 bcm0
RE-A-1800X2-16G	**RE-A-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 bcm0

Table 21: M320 Routing Engines *(continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-1800X4-8G	**RE-A-1800X4**	• 11.4R5 • 12.1R3 • 12.2	10.4	fxp0	em0 em1

MX5, MX10, MX40, and MX80 Routing Engine

Table 22 on page 42 lists the Routing Engines supported by the MX5, MX10, MX40, and MX80 routers.

Table 22: MX5, MX10, MX40, and MX80 Routing Engine

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

MX104 Routing Engines

Table 23 on page 42 lists the Routing Engines supported by MX104 routers.

Table 23: MX104 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-MX104	**Routing Engine**	13.2	–	fxp0	em0 em1

MX204 Routing Engine

Table 24 on page 43 lists the Routing Engines supported by the MX204 router.

Table 24: MX204 Routing Engine

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
Built-in Routing Engine	**RE-S-1600x8**	-	17.4	fxp0	em2 em3 em4

MX240 Routing Engines

Table 25 on page 43 lists the Routing Engines supported by MX240 routers.

Table 25: MX240 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1300-2048 (EOL details: TSB16556	**RE-S-1300**	9.0	–	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: TSB16735	**RE-S-2000**	9.0	–	fxp0	fxp1 fxp2
RE-S-1800X2-8G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800x2-16G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-8G	**RE-S-1800X4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1

Table 25: MX240 Supported Routing Engines *(continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X4-16G	**RE-S-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	**RE-S-1800X4**	• 12.3R4 • 13.2R1	• 12.3R4 • 13.2R1	fxp0	em0, em1
RE-S-X6-64G	**RE-S-1600x8**	–	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	**RE-S-1600x8-LT**	–	17.2R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	**RE-S-1600x8-128**	–	18.1R1	fxp0	ixlv0, igb0 em0

MX480 Routing Engines

Table 26 on page 44 lists the Routing Engines supported by MX480 routers.

Table 26: MX480 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1300-2048 (EOL details: TSB16556	**RE-S-1300**	8.4	–	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: TSB16735	**RE-S-2000**	8.4	–	fxp0	fxp1 fxp2
RE-S-1800X2-8G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1

Table 26: MX480 Supported Routing Engines *(continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X2-16G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-8G	**RE-S-1800X4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-16G	**RE-S-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	**RE-S-1800X4**	• 12.3R4 • 13.2R1	• 12.3R4 • 13.2R1	fxp0	em0 em1
RE-S-X6-64G	**RE-S-1600x8**	–	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	**RE-S-1600x8-LT**	–	17.2R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	**RE-S-1600x8-128**	–	18.1R1	fxp0	ixlv0, igb0 em0

MX960 Routing Engines

Table 27 on page 46 lists the Routing Engines supported by MX960 routers.

Table 27: MX960 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1300-2048 (EOL details: TSB16556	**RE-S-1300**	8.2	–	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: TSB16735	**RE-S-2000**	8.2	–	fxp0	fxp1 fxp2
RE-S-1800X2-8G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X2-16G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-8G	**RE-S-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-16G	**RE-S-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	**RE-S-1800x4**	• 12.3R4 • 13.2R1	• 12.3R4 • 13.2R1	fxp0	em0 em1
RE-S-X6-64G	**RE-S-1600x8**	–	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G (For MX960-VC)	**RE-S-1600x8**	–	17.2R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	**RE-S-1600x8-LT**	–	17.2R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	**RE-S-1600x8-128**	–	18.1R1	fxp0	ixlv0, igb0 em0

MX2008 Routing Engines

Table 28 on page 47 lists the Routing Engines supported by MX2008 routers.

Table 28: MX2008 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
REMX2008-X8-64G	**RE-MX2008-X8-64G**	15.1F7	fxp0	ixlv0 ixlv1
REMX2008-X8-64G-LT	**RE-MX2008-X8-64G-LT**	17.2R1	fxp0	ixlv0 ixlv1
REMX2008-X8-128G	RE-MX2008-X8-128G	18.2R1	fxp0	ixlv0 ixlv1

MX2010 Routing Engines

Table 29 on page 47 lists the Routing Engines supported by MX2010 routers.

Table 29: MX2010 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-MX2000-1800X4	**RE-S-1800x4**	12.3R2	fxp0	em0 em1
REMX2K-1800-32G-S	**RE-S-1800x4**	• 12.3R4 • 13.2R1	fxp0	em0 em1
REMX2K-X8-64G	**RE-S-2X00x8**	• 15.1F5-S1 • 16.1R2 • 16.2R1	fxp0	ixlv0 ixlv1 em0

Table 29: MX2010 Supported Routing Engines *(continued)*

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
REMX2K-X8-64G-LT	**RE-S-2X00x8**	17.2R1	fxp0	ixlv0 ixlv1 em0
REMX2K-X8-128G	**RE-MX200X8-128G**	18.1R1	fxp0	ixlv0 ixlv1

MX2020 Supported Routing Engines

Table 30 on page 48 lists the Routing Engines supported by MX2020 routers.

Table 30: MX2020 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-MX2000-1800X4	**RE-S-1800x4**	12.3R2	fxp0	em0 em1
REMX2K-1800-32G-S	**RE-S-1800x4**	• 12.3R4 • 13.2R1	fxp0	em0 em1
REMX2K-X8-64G	**RE-S-2X00x8**	• 15.1F5-S1 • 16.1R2 • 16.2R1	fxp0	ixlv0 ixlv1 em0
REMX2K-X8-64G-LT	**RE-S-2X00x8**	17.2R1	fxp0	ixlv0 ixlv1 em0

Table 30: MX2020 Supported Routing Engines *(continued)*

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
REMX2K-X8-128G	**RE-MX200X8-128G**	18.1R1	fxp0	ixlv0 ixlv1 em0

MX10003 Routing Engines

Table 31 on page 49 lists the Routing Engines supported by MX10003 routers.

Table 31: MX10003 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
JNP10003-RE1	**RE-S-1600x8**	17.3R1	fxp0	em3 em4
JNP10003-RE1-LT	**RE-S-1600x8**	18.1R1	fxp0	em3 em4

MX10008 Routing Engines

Table 32 on page 49 lists the Routing Engines supported on the MX10008 router.

Table 32: MX10008 Routing Engines

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
JNP10K-RE1	**RE X10**	18.2R1	em0	bme0 bme1

PTX1000 Routing Engines

Table 33 on page 50 lists the Routing Engine supported on the PTX1000.

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

Table 33: PTX1000 Routing Engines

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
Built-in Routing Engine	**RE-PTX1000**	• 16.1X65-D30 • 17.2R1	em0	bme0 em1

PTX3000 Routing Engines

Table 34 on page 50 lists the Routing Engines supported on the PTX3000.

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

Table 34: PTX3000 Routing Engines

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-DUO-C2600-16G	**RE-DUO-2600**	13.2R2	em0	ixgbe0 ixgbe1
RCB-PTX-X6-32G	**RE-PTX-2X00x6**	16.1R4 17.1R1 This Routing Engine does not support Junos OS Release 16.2.	em0	ixlv0 ixlv1

PTX5000 Routing Engines

Table 35 on page 51 lists the Routing Engines supported on the PTX5000.

> **NOTE:**
> - PTX5000 supports 64-bit Junos OS only.
> - The PTX5000 router supports two midplanes. The midplane identified as **Midplane-8S** in the CLI output is supported in Junos OS releases, 12.1X48, 12.3, and 13.2. The enhanced midplane, identified as **Midplane-8SeP** is supported from Junos OS release 14.1 onwards.
>
>   The RE-DUO-2600 routing engine with Junos OS 13.2 or earlier is not supported on the PTX5000BASE2 midplane.

Table 35: PTX5000 Routing Engines

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

PTX10008 and PTX10016 Routing Engines

Table 36 on page 52 lists the Routing Engines supported on the PTX10008 and PTX10016 routers.

Table 36: PTX10008 and PTX10016 Routing Engines

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
JNP10K-RE0	**RE-PTX-2X00x4**	17.2R1	em0, em1	bme0 bme1
JNP10K-RE1 (on PTX10008)	**RE X10**	18.2R1	em0	bme0 bme1

T320 Routing Engines

Table 37 on page 52 lists the Routing Engines supported by the T320 router.

Table 37: T320 Routing Engines

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

The T320 router supports the CB-T control board.

T640 Routing Engines

Table 38 on page 53 lists the Routing Engines supported by the T640 router.

Table 38: T640 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: TSB14373)	**RE-3.0** or **RE-3.0 (RE-600)**	5.3	–	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: TSB14374	**RE-4.0**	6.2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	**RE-A-2000**	8.1	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	**RE-DUO-1800**	32-bit Junos OS on a standalone T640 router: 11.2 32-bit Junos OS on a T640 router in a routing matrix: 11.4R9	64-bit Junos OS on a standalone T640 router: 11.3 64-bit Junos OS on a T640 router in a routing matrix: 11.4R9	em0	bcm0 em1
RE-DUO-C1800-16G	**RE-DUO-1800**	32-bit Junos OS on a standalone T640 router: 11.4R2 32-bit Junos OS on a T640 router in a routing matrix: 11.4R9	64-bit Junos OS on a standalone T640 router: 11.4R2 64-bit Junos OS on a T640 router in a routing matrix: 11.4R9	em0	bcm0 em1

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

T1600 Routing Engines

Table 39 on page 54 lists the Routing Engines supported by the T1600 router.

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

Table 39: T1600 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: TSB14373)	**RE-3.0** or **RE-3.0 (RE-600)**	8.5	–	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: TSB14374	**RE-4.0 (RE-1600)**	8.5	–	fxp0	fxp1 fxp2
RE-A-2000-4096	**RE-A-2000**	8.5	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	**RE-TXP-LCC** or **RE-DUO-1800**	32-bit Junos OS on a T1600 router in a routing matrix: 9.6 **NOTE:** Junos OS Releases 9.6 through 10.4 support RE-DUO-C1800-8G only during upgrade to a line-card chassis (LCC) in a routing matrix. 32-bit Junos OS on a standalone T1600 router: 11.1	64-bit Junos OS on a T1600 router in a routing matrix: 9.6 64-bit Junos OS on a standalone T1600 router: 11.1	em0	bcm0 em1
RE-DUO-C1800-16G	**RE-DUO-1800**	32-bit Junos OS on a standalone T1600 router: 11.4R2 32-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	64-bit Junos OS on a standalone T1600 router: 11.4R2 64-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	em0	bcm0 em1

T4000 Routing Engines

Table 40 on page 55 lists the Routing Engines supported by the T4000 router.

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

Table 40: T4000 Routing Engines

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

The T4000 router supports the CB-LCC control board.

TX Matrix Routing Engines

Table 41 on page 55 lists the Routing Engines supported by the TX Matrix router.

Table 41: TX Matrix Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: TSB14373)	**RE-3.0** or **RE-3.0 (RE-600)**	7.0	–	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: TSB14374	**RE-4.0 (RE-1600)**	7.0	–	fxp0	fxp1 fxp2

Table 41: TX Matrix Routing Engines *(continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-2000-4096	**RE-A-2000**	8.5	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	**RE-DUO-1800**	11.4R9	11.4R9	em0	bcm0 em1
RE-DUO-C1800-16G	**RE-DUO-1800**	11.4R9	11.4R9	em0	bcm0 em1

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

TX Matrix Plus Routing Engines

Table 42 on page 56 lists the Routing Engines supported by the TX Matrix Plus router.

Table 42: TX Matrix Plus Routing Engines

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

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

TX Matrix Plus (with 3D SIBs) Routing Engines

Table 43 on page 57 lists the Routing Engines supported by the TX Matrix Plus router with 3D SIBs.

Table 43: Routing Engines on TX Matrix Plus with 3D SIBs

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

RELATED DOCUMENTATION

Understanding Internal Ethernet Interfaces

Understanding Management Ethernet Interfaces

CHAPTER 5

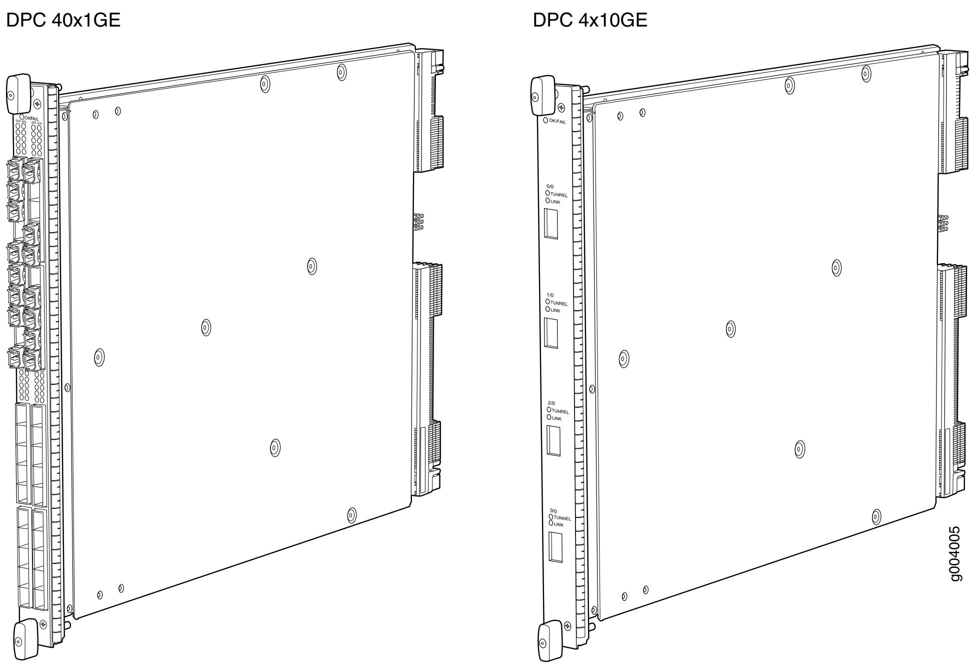
Interface Modules—DPCs

IN THIS CHAPTER

MX960 Dense Port Concentrator Description

A Dense Port Concentrator (DPC) is optimized for Ethernet density. Figure 18 on page 58 shows two examples of DPCs. For a list of the DPCs supported, see the *MX Series Interface Module Reference*.

Figure 18: Typical DPCs Supported by the Router



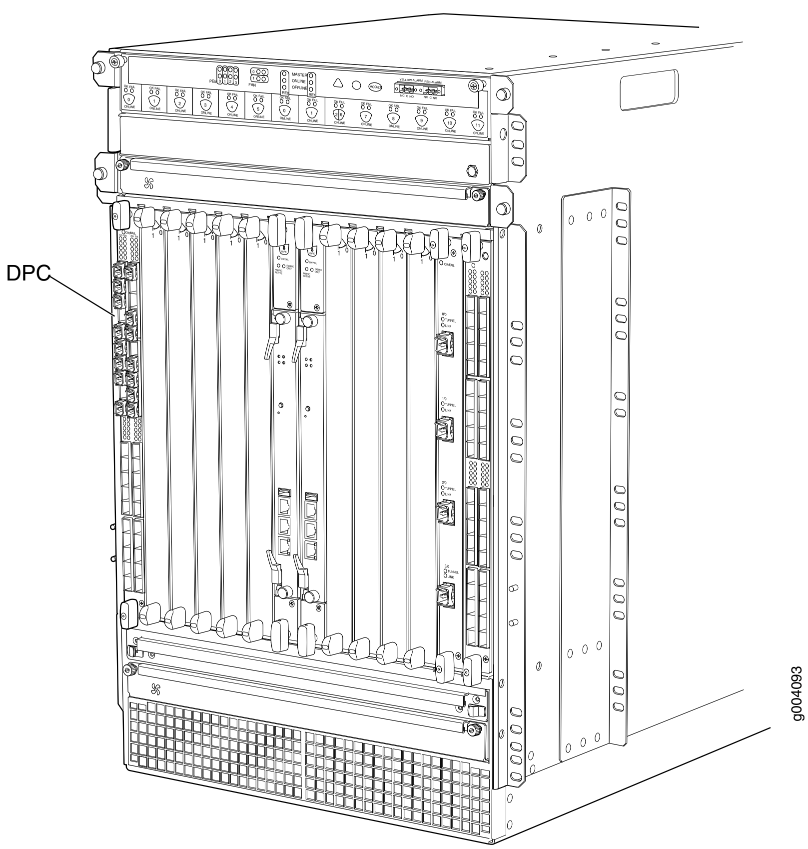
The DPC assembly combines packet forwarding and Ethernet interfaces on a single board, with either two or four 10-Gbps Packet Forwarding Engines. Each Packet Forwarding Engine consists of one I-chip for Layer 3 processing and one Layer 2 network processor. The DPCs interface with the power supplies and Switch Control Boards (CBs).

The router has 11 dedicated DPC slots. DPCs install vertically in the front of the router (see Figure 19 on page 59). The dedicated DPC slots are numbered **0** though **5**, and **7** though **11**, left to right. An additional multifunction slot labeled **2/6** supports either an SCB or a DPC. A DPC can be installed in any slot that supports DPCs. You can install any combination of DPC types in the router.

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

DPCs are hot-removable and hot-insertable. 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.

Figure 19: DPCs Installed Vertically in the MX960 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.
- Two or 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 DPC faceplate. For more information about LEDs on the DPC faceplate, see the *MX Series Interface Module Reference*.

Two LEDs, located on the craft interface above the DPC, display the status of the DPC and are labeled **OK** and **FAIL**.

RELATED DOCUMENTATION

MX960 Dense Port Concentrator LEDs | 60
MX960 Field-Replaceable Units | 400
Replacing an MX960 DPC | 507

MX960 Dense Port Concentrator LEDs

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 on the craft interface, see "MX960 DPC and MPC LEDs on the Craft Interface" on page 18.

Each DPC also has LEDs located on the faceplate. For more information about LEDs on the DPC faceplate, see the "LEDs" section for each DPC in the *MX Series Interface Module Reference*.

RELATED DOCUMENTATION

MX960 Dense Port Concentrator Description | 58
Maintaining MX960 DPCs | 616
Replacing an MX960 DPC | 507

DPCs Supported on MX240, MX480, and MX960 Routers

> **NOTE:** These DPCs have all been announced as End of Life (EOL). The End of Support (EOS) milestone dates for each model are published at https://www.juniper.net/support/eol/mseries_hw.html.

Table 44 on page 61 lists the DPCs supported by the MX240, MX480, and MX960 routers.

Table 44: DPCs Supported in MX240, MX480, and MX960 Routers

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
Gigabit Ethernet				
Gigabit Ethernet DPC with SFP	DPC-R-40GE-SFP EOL (see PSN-2009-06-400)	40	40 Gbps	8.2
Gigabit Ethernet Enhanced DPC with SFP	DPCE-R-40GE-SFP EOL (see PSN-TSB16810)	40	40 Gbps	8.4
Gigabit Ethernet Enhanced Ethernet Services DPC with SFP	DPCE-X-40GE-SFP EOL (see PSN-TSB16810)	40	40 Gbps	8.4
Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP	DPCE-X-Q-40GE-SFP EOL (see PSN-2013-02-851)	40	40 Gbps	8.5

Table 44: DPCs Supported in MX240, MX480, and MX960 Routers *(continued)*

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP	DPCE-R-Q-20GE-SFP EOL (see PSN-2013-02-851)	20	20 Gbps	9.1
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP	DPCE-R-Q-40GE-SFP EOL (see PSN-2011-07-314)	40	40 Gbps	8.5
10-Gigabit Ethernet DPC with XFP	DPC-R-4XGE-XFP EOL (see PSN-2009-06-400)	4	40 Gbps	8.2
10-Gigabit Ethernet				
10-Gigabit Ethernet Enhanced DPCs with XFP	DPCE-R-2XGE-XFP EOL (see PSN-2011-02-314)	2	20 Gbps	9.1
10-Gigabit Ethernet Enhanced DPCs with XFP	DPCE-R-4XGE-XFP EOL (see PSN-TSB16810)	4	40 Gbps	8.4
10-Gigabit Ethernet Enhanced Ethernet Services DPC with XFP	DPCE-X-4XGE-XFP EOL (see PSN-TSB16810)	4	40 Gbps	8.4
10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP	DPCE-X-Q-4XGE-XFP EOL (see PSN-2013-02-851)	4	40 Gbps	8.5
10-Gigabit Ethernet Enhanced Queuing IP Services DPC with XFP	DPCE-R-Q-4XGE-XFP EOL (see PSN-2011-02-314)	4	40 Gbps	8.5

Table 44: DPCs Supported in MX240, MX480, and MX960 Routers *(continued)*

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
Mulit-Rate Ethernet				
Multi-Rate Ethernet Enhanced DPC with SFP and XFP	DPCE-R-20GE-2XGE EOL (see PSN-TSB16810)	22	40 Gbps	9.2
Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP	DPCE-X-20GE-2XGE EOL (see PSN-2011-02-314)	22	40 Gbps	9.2
Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP	DPCE-R-Q-20GE-2XGE EOL (see PSN-TSB16810)	22	40 Gbps	9.3
Tri-Rate Ethernet				
Tri-Rate Enhanced DPC	DPCE-R-40GE-TX EOL (see PSN-2013-02-851)	40	40 Gbps	9.1
Tri-Rate Enhanced Ethernet Services DPC	DPCE-X-40GE-TX EOL (see PSN-2011-07-315.)	40	40 Gbps	9.1
Services				
Multiservices DPC	MS-DPC EOL (see PSN-TSB16812)	2 (Not supported)	–	9.3

RELATED DOCUMENTATION

Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)

Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)

Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q)

Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q)

Protocols and Applications Supported by the Multiservices DPC (MS-DPC)

MX960 DPC Port and Interface Numbering

Each port on a DPC corresponds to a unique interface name in the CLI.

In the syntax of an interface name, a hyphen (**-**) separates the media type from the DPC number (represented as an **FPC** in the CLI). The DPC slot number corresponds to the first number in the interface. The second number in the interface corresponds to the logical PIC number. The last number in the interface matches the port number on the DPC. Slashes (/) separate the DPC number from the logical PIC number and port number.

type-fpc/pic/port

- *type*—Media type, which identifies the network device. For example:
  - ge—Gigabit Ethernet interface
  - so—SONET/SDH interface
  - xe—10-Gigabit Ethernet interface

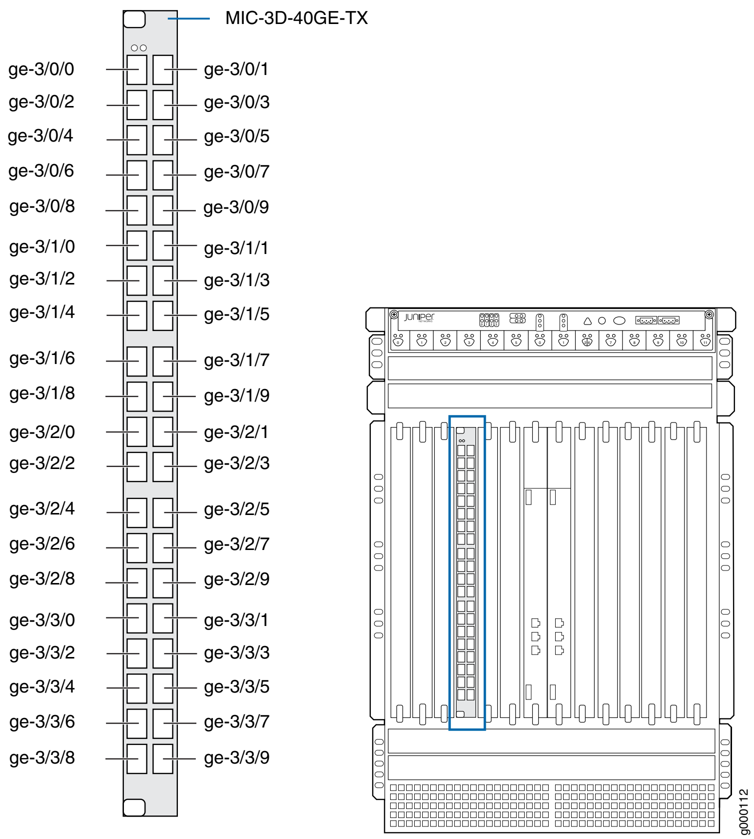
  For a complete list of media types, see *Interface Naming Overview*.
- *fpc*—Slot in which the DPC is installed. On the MX960 router, the DPCs are represented in the CLI as **FPC 0** through **FPC 11**.
- *pic*—Logical PIC on the DPC. The number of logical PICs varies depending on the type of DPC. For example, a:
  - 20-port Gigabit Ethernet DPC has two logical PICs, numbered 0 through 1.
  - 40-port Gigabit Ethernet DPC has four logical PICs, numbered 0 through 3.
  - 2-port 10-Gigabit Ethernet DPC has two logical PICs, numbered 0 through 1.
  - 4-port 10-Gigabit Ethernet DPC has four logical PICs, numbered 0 through 3.

  For more information on specific DPCs, see “DPCs Supported on MX240, MX480, and MX960 Routers” on page 61 in the *MX Series Interface Module Reference*.
- *port*—Port number.

The MX960 router supports up to twelve DPCs that install vertically and are numbered 0 through 11 from left to right.

Figure 20 on page 65 shows a 40-port Gigabit Ethernet DPC with SFP installed in slot **3** on the MX960 router.

Figure 20: MX960 DPC Interface Port Mapping



The DPC contains four logical PICs, numbered **PIC 0** through **PIC 3** in the CLI. Each logical PIC contains 10 ports numbered **0** through **9**.

The **show chassis hardware** command output displays a 40-port Gigabit Ethernet DPC with SFP (**DPCE-R-40GE-SFP**) installed in DPC slot **3**. The DPC is shown as **FPC 3** and the DPC's four logical PICs — **10x 1GE(LAN)** — are shown as **PIC 0** through **PIC 3**.

`user@host>` **show chassis hardware**

```
...
FPC 3             REV 07   750-018122   KB8222             DPCE 40x 1GE R
  CPU             REV 06   710-013713   KA9010             DPC PMB
  PIC 0                    BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 0        REV 01   740-011782   PCH2NU4            SFP-SX
```

```
    Xcvr 1        REV 01   740-011782   PCH2P4R          SFP-SX
    Xcvr 2        REV 01   740-011782   PCH2NYL          SFP-SX
    Xcvr 3        REV 01   740-011782   PCH2UW6          SFP-SX
    Xcvr 4        REV 01   740-011782   PCH2P4N          SFP-SX
    Xcvr 5        REV 01   740-011782   PCH2UME          SFP-SX
    Xcvr 6        REV 01   740-011613   PCE1H5P          SFP-SX
    Xcvr 7        REV 01   740-011782   PCH2UFG          SFP-SX
    Xcvr 8        REV 02   740-011613   AM0947SEYU2      SFP-SX
    Xcvr 9        REV 02   740-011613   AM0947SEYTQ      SFP-SX
  PIC 1                    BUILTIN      BUILTIN          10x 1GE(LAN)
    Xcvr 0        REV 01   740-011782   PCH2UYF          SFP-SX
    Xcvr 1        REV 01   740-011782   PCH2P4L          SFP-SX
    Xcvr 2        REV 01   740-011782   PCH2UCL          SFP-SX
    Xcvr 3        REV 01   740-011782   PCH2P4X          SFP-SX
    Xcvr 4        REV 01   740-011782   PCH2P1E          SFP-SX
    Xcvr 5        REV 01   740-011782   PCH2UD2          SFP-SX
    Xcvr 6        REV 01   740-011782   PCH2PLC          SFP-SX
    Xcvr 7        REV 01   740-011782   PCH2UDJ          SFP-SX
    Xcvr 8        REV 02   740-011613   AM0947SEX7S      SFP-SX
  PIC 2                    BUILTIN      BUILTIN          10x 1GE(LAN)
    Xcvr 0        REV 01   740-011782   PCH2NV7          SFP-SX
    Xcvr 1        REV 01   740-011782   PCH2P6Q          SFP-SX
    Xcvr 2        REV 01   740-011782   PCH2NUG          SFP-SX
    Xcvr 3        REV 01   740-011782   PCH2P10          SFP-SX
    Xcvr 9        REV 02   740-011613   AM0947SEXBT      SFP-SX
  PIC 3                    BUILTIN      BUILTIN          10x 1GE(LAN)
    Xcvr 0        REV 01   740-011782   PCH2PL4          SFP-SX
    Xcvr 1        REV 01   740-011782   PCH2P1K          SFP-SX
    Xcvr 2        REV 01   740-011782   PCH2PLM          SFP-SX
    Xcvr 3        REV 01   740-011782   PCH2UFF          SFP-SX
    Xcvr 8        REV 02   740-011613   AM1003SFV5S      SFP-SX
    Xcvr 9        REV 02   740-011613   AM0947SEXBX      SFP-SX
...
```

The **show interfaces terse** command output displays the Gigabit Ethernet interfaces that correspond to the 40 ports located on the DPC.

`user@host>` **show interfaces terse ge-3***

```

Interface               Admin Link Proto    Local                 Remote
ge-3/0/0                up    up
ge-3/0/1                up    down
```

```
ge-3/0/2                up    up
ge-3/0/3                up    up
ge-3/0/4                up    up
ge-3/0/5                up    up
ge-3/0/6                up    up
ge-3/0/7                up    up
ge-3/0/8                up    up
ge-3/0/9                up    up
ge-3/1/0                up    down
ge-3/1/1                up    down
ge-3/1/2                up    down
ge-3/1/3                up    down
ge-3/1/4                up    up
ge-3/1/5                up    up
ge-3/1/6                up    up
ge-3/1/7                up    up
ge-3/1/8                up    up
ge-3/1/9                up    down
ge-3/2/0                up    down
ge-3/2/1                up    down
ge-3/2/2                up    down
ge-3/2/3                up    down
ge-3/2/4                up    down
ge-3/2/5                up    down
ge-3/2/6                up    down
ge-3/2/7                up    down
ge-3/2/8                up    down
ge-3/2/9                up    down
ge-3/3/0                up    down
ge-3/3/1                up    down
ge-3/3/2                up    down
ge-3/3/3                up    down
ge-3/3/4                up    down
ge-3/3/5                up    down
ge-3/3/6                up    down
ge-3/3/7                up    down
ge-3/3/8                up    down
ge-3/3/9                up    down
```

RELATED DOCUMENTATION

MX960 Router Hardware and CLI Terminology Mapping | 10

CHAPTER 6

Interface Modules—FPCs and PICs

IN THIS CHAPTER

MX960 Flexible PIC Concentrator Description

A Flexible PIC Concentrator (FPC) occupies two Dense Port Concentrator (DPC) slots on an MX Series router. The MX960 router has 11 dedicated DPC slots and one multifunction slot that supports either a DPC, FPC, or Switch Control Board (SCB). The dedicated DPC slots are numbered **0** though **5**, and **7** though **11**, left to right. The multifunction slot is labeled **2/6**. Up to six FPCs can be installed vertically in any two slots that support FPCs (see Figure 21 on page 69). The interface corresponds to the lowest numbered DPC slot for which the FPC is installed.

Figure 21: FPC Installed in the MX960 Router Chassis

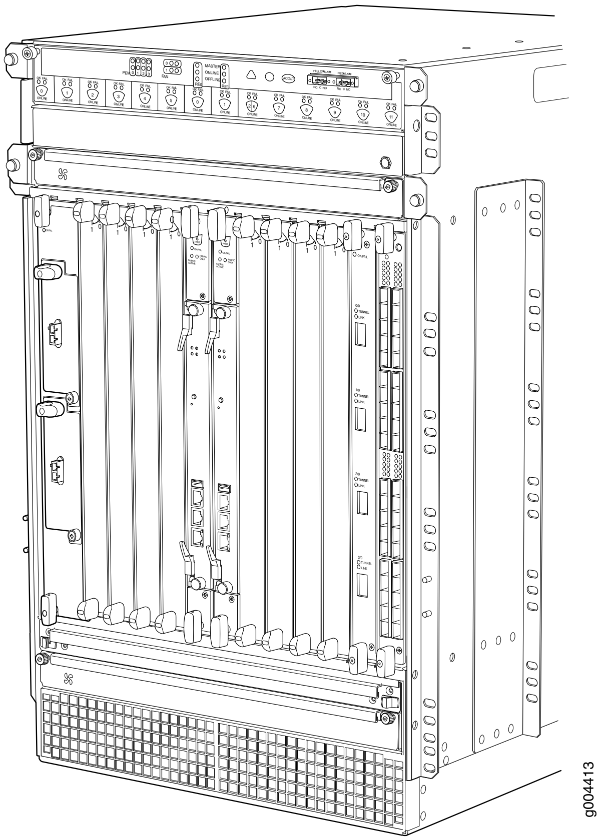
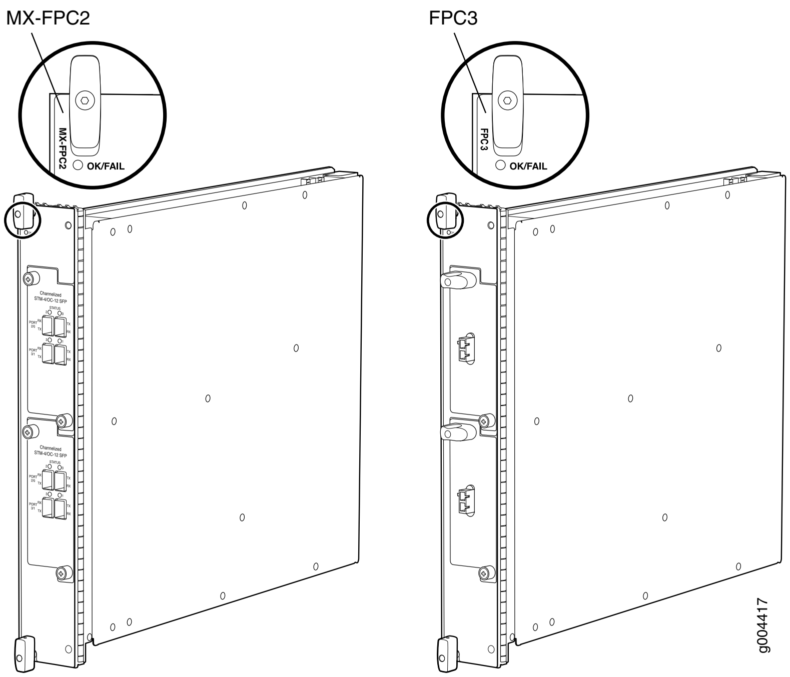


Figure 22 on page 70 shows the typical FPCs supported on the MX960 router.

Figure 22: Typical FPCs Supported on the MX960 Router



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

Each FPC supports up to two PICs. On an FPC2, one Packet Forwarding Engine receives incoming packets from the PICs installed on the FPC and forwards them through the switch planes to the appropriate destination port. On an FPC3, two Packet Forwarding Engines receive incoming packets from the PICs installed on the FPC and forward them through the switch planes to the appropriate destination port. The FPCs interface with the power supplies and SCBs.

FPCs are hot-removable and hot-insertable, as described in "MX960 Component Redundancy" on page 10. When you install an FPC into a functioning router, the Routing Engine downloads the FPC software, the FPC runs its diagnostics, and the PICs, housed on the FPC, are enabled. Forwarding continues uninterrupted during this process. When you remove or install an FPC, packet forwarding between other DPCs or FPCs is not affected.

FPC Components

Each FPC consists of the following components:

- FPC card carrier, which includes two PIC slots
- Up to two Packet Forwarding Engines, each consisting of one I-chip for Layer 3 processing and one Layer 2 network processor
- Midplane connectors and power circuitry

- Processor subsystem (PMB), which includes a 1.2-GHz CPU, system controller, 1 GB of SDRAM, and two Gigabit Ethernet interfaces
- Two LEDs, located on the craft interface above the FPC, that display the status of the FPC and are labeled **OK** and **FAIL**
- FPC online/offline button, located on the craft interface above the FPC

RELATED DOCUMENTATION

MX960 Flexible PIC Concentrator (FPC) LEDs

Two LEDs, located on the craft interface above the FPC, that display the status of the FPC and are labeled **OK** and **FAIL**. For more information about the FPC LEDs located on the craft interface, see "MX960 FPC LEDs on the Craft Interface" on page 19.

RELATED DOCUMENTATION

FPCs Supported by MX240, MX480, and MX960 Routers

An FPC occupies two slots when installed in an MX240, MX480, or MX960 router. The maximum number of supported FPCs varies per router:

- MX960 router—6 FPCs

- MX480 router—3 FPCs
- MX240 router—1 FPC

Table 45 on page 72 lists FPCs supported by MX240, MX480, and MX960 routers.

Table 45: FPCs Supported by MX240, MX480, and MX960 Routers

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported	Maximum Throughput per FPC (Full-duplex)	First Junos OS Release
3	FPC3	MX-FPC3	2	20 Gbps	9.4
2	FPC2	MX-FPC2	2	10 Gbps	9.5

RELATED DOCUMENTATION

MX Series FPC and PIC Overview
PICs Supported by MX240, MX480, and MX960 Routers | 75
High Availability Features

MX960 PIC Description

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

PICs are hot-removable and hot-insertable. Up to two PICs can be installed in the slots in each FPC. Up to six FPCs can be installed in an MX960 router. PICs used in an FPC2 have captive screws at their upper and lower corners. PICs used in a Type 3 FPC have an upper ejector handle and a lower captive screw.

RELATED DOCUMENTATION

PICs Supported by MX240, MX480, and MX960 Routers | 75
MX960 PIC LEDs | 73

MX960 PIC LEDs

Each PIC has LEDs located on the faceplate. For more information about LEDs on the PIC faceplate, see the “LEDs” section for each PIC in the *MX Series Interface Module Reference*.

RELATED DOCUMENTATION

MX960 PIC Port and Interface Numbering

Each port on a PIC corresponds to a unique interface name in the CLI.

In the syntax of an interface name, a hyphen (-) separates the media type from the FPC slot number (represented as an **FPC** in the CLI). The FPC slot number corresponds to the first number in the interface. The second number in the interface corresponds to the PIC number. The last number in the interface matches the port number on the PIC. Slashes (/) separate the FPC number from the PIC number and port number:

type-fpc/pic/port

- *type*—Media type, which identifies the network device. For example:
  - ge—Gigabit Ethernet interface
  - so—SONET/SDH interface
  - xe—10-Gigabit Ethernet interface

For a complete list of media types, see *Interface Naming Overview*.

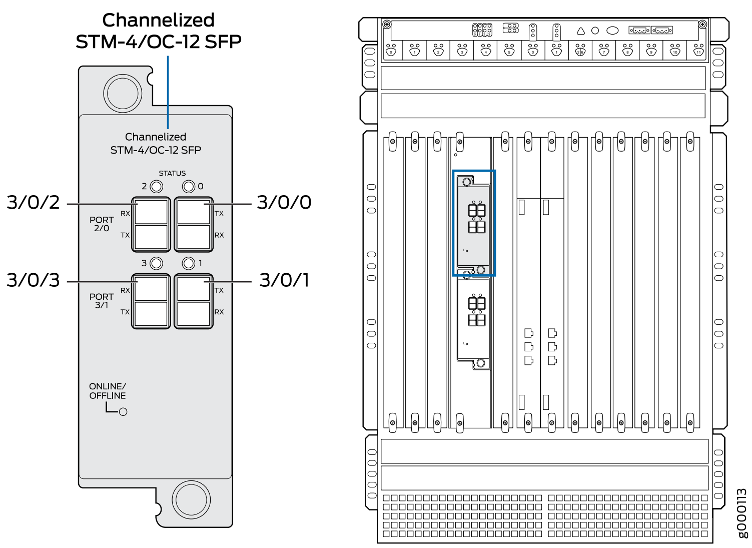
- *fpc*—Lowest slot number in which the FPC is installed. On the MX960 router, the FPCs occupy two slots and are represented in the CLI as **FPC 0** through **FPC 10**.
- *pic*—PIC number, 0 or 1 depending on the FPC slot.

  For more information on specific PICs, see "PICs Supported by MX240, MX480, and MX960 Routers" on page 75 in the *MX Series Interface Module Reference*.
- *port*—Port number.

The MX960 supports up to six FPCs that install vertically and are numbered from left to right. Each FPC accepts up to two PICs.

Figure 23 on page 74 shows a Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP installed in PIC slot**0**of an FPC installed in slot**3** and slot**4**.

Figure 23: MX960 PIC Interface Port Mapping



The **show chassis hardware** command output displays a Channelized OC12/STM4 Enhanced IQ (IQE) PIC (**4x CHOC12 IQE SONET**) installed in an **MX FPC Type 2**.

`user@host>` **show chassis hardware**

```
...
FPC 3            REV 01   710-024386   JW9571            MX FPC Type 2
  CPU            REV 03   710-022351   KE2986            DPC PMB
  PIC 0          REV 00   750-022630   DS1284            4x CHOC12 IQE SONET
    Xcvr 0       REV 01   740-011782   PB821SG           SFP-SX
```

```
    Xcvr 1        REV 01   740-011782   PB829Q6           SFP-SX
    Xcvr 2        REV 01   740-011613   P9F15NQ           SFP-SX
    Xcvr 3        REV 01   740-011782   P7N036X           SFP-SX...
```

The **show interfaces terse** command output displays the channelized SONET OC12 interfaces (**coc12**), that correspond to the four ports located on the PIC.

`user@host>` **show interfaces terse coc12***

```

Interface               Admin Link Proto    Local                 Remote
coc12-3/0/0             up    up
coc12-3/0/1             up    up
coc12-3/0/2             up    up
coc12-3/0/3             up    up
```

RELATED DOCUMENTATION

MX960 Router Hardware and CLI Terminology Mapping | 10

PICs Supported by MX240, MX480, and MX960 Routers

Table 46 on page 75 lists the PICs supported by MX240, MX480, and MX960 routers.

Table 46: PICs Supported by MX240, MX480, and MX960 Routers

PIC Name	PIC Model Number	Ports	Type	First Junos OS Release
Channelized IQ PICs				
Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	PB-4CHOC12-STM4-IQE-SFP	4	2	9.5
Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP	PB-1CHOC48-STM16-IQE	1	2	9.5
SONET/SDH PICs				

Table 46: PICs Supported by MX240, MX480, and MX960 Routers *(continued)*

PIC Name	PIC Model Number	Ports	Type	First Junos OS Release
SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	PB-4OC3-1OC12-SON2-SFP	4	2	9.5
SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	PB-4OC3-4OC12-SON-SFP	4	2	9.5
SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP	PC-4OC48-STM16-IQE-SFP	4	3	10.4R2
SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP	PB-1OC48-SON-B-SFP	1	2	9.5
SONET/SDH OC48/STM16 PIC with SFP	PC-4OC48-SON-SFP	4	3	9.4
SONET/SDH OC192c/STM64 PIC	PC-1OC192-SON-VSR	1	3	9.4
SONET/SDH OC192c/STM64 PIC with XFP	PC-1OC192-SON-XFP	1	3	9.4

RELATED DOCUMENTATION

MX Series FPC and PIC Overview

FPCs Supported by MX240, MX480, and MX960 Routers | 71

High Availability Features

CHAPTER 7

Interface Modules—MPCs and MICs

IN THIS CHAPTER

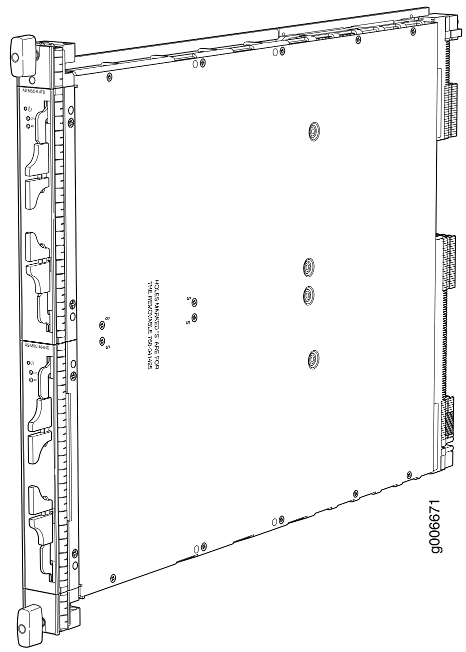
MX960 Application Services Modular Line Card Description

The Application Services Modular Line Card (AS MLC) is an X86-based card for MX960, MX480, and MX240 routers to deliver integrated application service solutions. The first application that network operators can take advantage of is the Junos Content Encore system, a high-throughput, solid state storage platform for media rich content delivery. Additionally, the AS MLC can serve as the platform for Juniper Networks JunosV App Engine, powering a host of network applications directly embedded into your MX Series 5G Universal Routing Platforms.

> **NOTE:** The Application Services - Modular Carrier Card (AS-MCC) has reached End of Life. See End of Life Announcement: AS-MCC.

The AS MLC is modular and decouples CPU and storage in individual field-upgradeable units. The AS MLCs are designed to enable application throughput up to 50 Gbps and a storage capacity of 400 gigabytes (GB) of NAND Flash.

Figure 24: Application Services Modular Line Card (AS MLC)



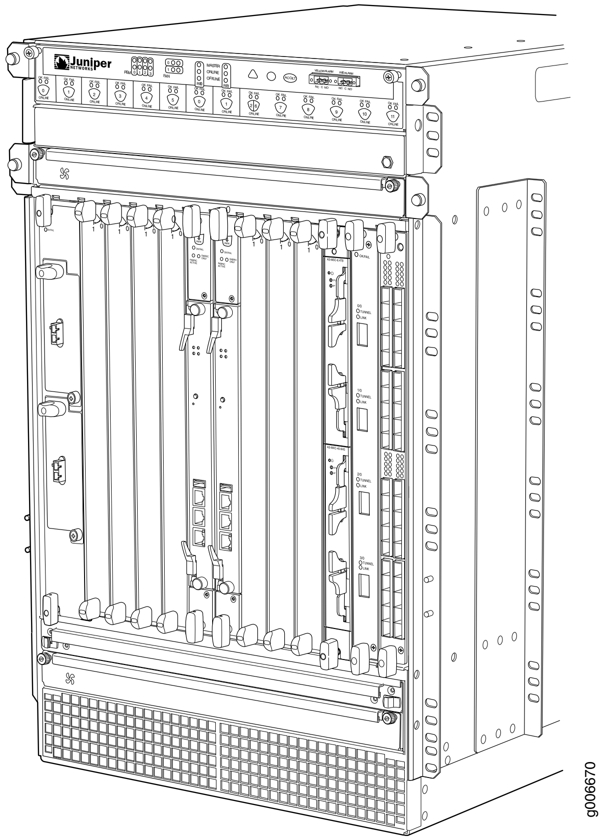
MX960 AS MLC Function

The AS MLC provides modular processing and modular storage. Installed on the AS MLC, the Junos Content Encore system operates as a caching application, in either HTTP reverse proxy mode or HTTP transparent proxy mode, to manage client requests for content and the distribution of the content to clients from origin servers. In the future, the AS MLC will run other Juniper Networks router services and applications, and serve as a virtualized platform for third-party applications. The AS MLC provides Ethernet switching and high-speed fabric interface to MX routers. Graceful Routing Engine switchover is also supported on the AS MLC.

Integrated with application forwarding on MX Series routers, the AS MLC provides increased service flexibility with reduced power and space requirements for the network infrastructure.

The AS MLC Modular Carrier Card (AS MCC), the carrier card of the AS MLC, fits vertically in the front of the MX960 router (see Figure 25 on page 79).

Figure 25: AS MLC Installed in the MX960 Router Chassis



AS MLC Components

Each AS MLC consists of the following components:

- AS MLC Modular Carrier Card (AS MCC), which fits vertically in front of the MX960 router, includes two slots for the Application Services Modular Storage Card (AS MSC) and Application Services Modular Processing Card (AS MXC)
- AS MXC with 64 GB RAM for processing
- AS MSC with 400 GB NAND Flash capacity for modular storage

> **NOTE:** The AS MCC, AS MXC, and AS MSC are hot-removable and hot-insertable.

- Switch fabric interfaces to the chassis
- XM ASIC chip, which owns and manages the packet data memory built from external DDR3 memory chips, the fabric queuing system, a portion of the WAN queuing system, and the host queuing system

- LU ASIC chip, which performs all functions relating to header processing including input processing, route lookup, classification, filtering, policing, accounting, encapsulation, and statistics
- Midplane connectors and power circuitry
- Processor Mezzanine Board (PMB), which that contains the host processor and supporting peripherals
- LED on the AS MCC, which displays the status of the AS MLC

MX960 SCB, Power Supply, and Cooling System Requirements for AS MLC

Each MX960 router requires specific SCB, power supply, and cooling system models to run the AS MLC.

- SCB—Enhanced MX Switch Control Board (SCBE-MX). See "SCBE-MX Description" on page 164 for details.
- Power supply:
  - 4100W AC power supply—Model PWR-MX960-AC
  - 4100W DC power supply—Model PWR-MX960-DC
- Power requirement for AS MLC:
  - AS MCC—191W
  - AS MXC—259W
  - AS MSC—50W
- Cooling system—Required fan and fan tray models:
  - Fans:
    - For AC power supply: PWR-FAN-MX960-AC-HC-U
    - For DC power supply: PWR-FAN-MX960-DC-HC-U
  - Fan tray—FFANTRAY-MX960-HC

RELATED DOCUMENTATION

Replacing an MX960 AS MLC | 463
Replacing an MX960 AS MSC | 468
Replacing an MX960 AS MXC | 471

MX960 Application Services Modular Storage Card Description

Application Services Modular Storage Card (AS MSC) is a NAND Flash-based card that is inserted into the upper slot of the Application Services Modular Line Card (AS MLC). The AS MSC (see Figure 26 on page 81) serves as the second tier caching storage for platforms such as the Junos Content Encore system. This card is equivalent to a PIC or a Modular Interface Card (MIC) and provides a maximum of 3.6 Gbps read and 2 Gbps of write memory.

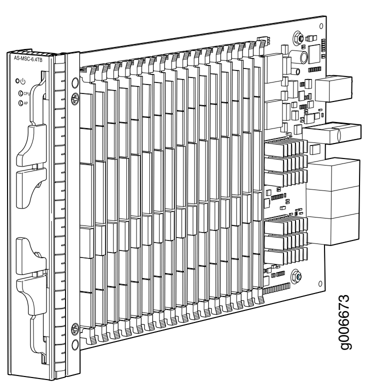
The AS MSC has the following features:

- 400 GB NAND Flash memory
- Up to 10 years of write memory
- Multilevel cell (MLC) NAND memory support
- Best-in-class NAND controller for maximum performance and reliability

AS MSCs are hot-removable and hot-insertable. One AS MSC can be installed in the top slot of each AS MLC. Each AS MSC has these components:

- SATA-3 controller—An eight-ports, 6 Gbps SAS/SATA controller.
- NAND Flash controller— NAND Flash and NAND Flash controller are used in an AS MSC.
- Control plane—Inter-integrated circuit control plane that allows Peripheral Component Interconnect Express (PCIe) control.
- LEDs—Two LEDs display the status of the AS MSC and storage.
- Online/offline button—To power on or power off the AS MSC.

Figure 26: Application Services Modular Storage Card



RELATED DOCUMENTATION

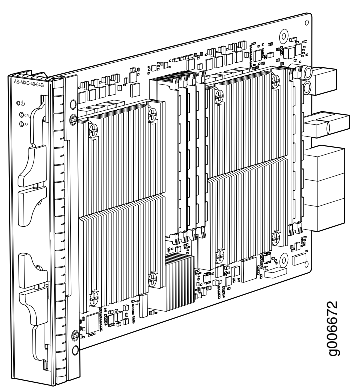
MX960 Application Services Modular Processing Card Description

The Application Services Modular Processing Card (AS MXC) is a pluggable X86-based card that can be inserted into the lower slot of the Application Services Modular Line Card (AS MLC). The AS MXC serves as the processing card for the Junos Content Encore system and contains the two X86, Intel 8-core processors with interface ability greater than 80 Gbps. The AS MXC (see Figure 27 on page 82) is equivalent to a PIC or MIC (Modular Interface Card).

AS MXCs are hot-removable and hot-insertable. One MXC can be installed in the lower slot of each AS MLC. Each MXC has these components:

- Two 8-core Intel processors—Contains eight execution cores with Ring Interconnect architecture. Each core supports two threads, up to 16 threads per socket.
- 64 GB DRAM—On DIMM sockets.
- LEDs—Two LEDs on the faceplate display the CPU and application status.

Figure 27: Application Services Modular Processing Card (AS MXC)



RELATED DOCUMENTATION

MX960 AS MSC LEDs

Two LEDs (**CPU** and **AP**) indicate the status of the AS MSC and are located on the AS MSC. Table 47 on page 83 describes the functions of the AS MSC LEDs.

Table 47: AS MSC LEDs

Label	Color	State	Description
CPU	Green	On steadily	AS MSC operates normally.
	Red	On steadily	AS MSC has an error or has failed.
	–	Off	AS MSC is offline.
AP	Green	On steadily	AS MSC storage operation is normal.
	Red	On steadily	AS MSC storage operation has an error.
	–	Off	AS MSC storage operation is not activated.

RELATED DOCUMENTATION

MX960 Application Services Modular Storage Card Description | 81
Replacing an MX960 AS MSC | 468

MX960 AS MXC LEDs

Two LEDs (**CPU** and **AP**) indicate the status of the AS MXC and are located on the AS MXC. Table 48 on page 84 describes the functions of the AS MXC LEDs.

Table 48: AS MXC LEDs

Label	Color	State	Description
CPU	Green	On steadily	AS MXC operates normally.
	Red	On steadily	AS MXC has an error or has failed.
	–	Off	AS MXC is offline.
AP	Green	On steadily	AS MXC applications operation is normal.
	Red	On steadily	AS MXC applications operation has an error.
	–	Off	AS MXC applications are not activated.

RELATED DOCUMENTATION

MX960 Application Services Modular Processing Card Description | 82
Replacing an MX960 AS MXC | 471

MIC/MPC Compatibility

The following tables provide a compatibility matrix for the MICs currently supported by MPC1, MPC2, MPC3, MPC6, MPC8, and MPC9 on MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 routers. Each table lists the first Junos OS release in which the MPC supports the MIC. For example, Junos OS Release 10.2 is the first release in which the MX-MPC1-3D supports the Gigabit Ethernet MIC with SFP. An en dash indicates that the MIC is not supported.

Table 49: MIC/MPC1 Compatibility

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
MIC-3D-8OC3-2OC12-ATM *(ATM MIC with SFP)*	–	–	12.1	12.1R4

Table 49: MIC/MPC1 Compatibility *(continued)*

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
MIC-3D-20GE-SFP *(Gigabit Ethernet MIC with SFP)*	10.2	11.2R4	10.2	11.2R4
MIC-3D-20GE-SFP-E *(Gigabit Ethernet MIC with SFP (E))*	13.2R2	13.2R2	13.2R2	13.2R2
MIC-3D-2XGE-XFP *(10-Gigabit Ethernet MICs with XFP)*	10.2	11.2R4	10.2	11.2R4
MIC-3D-4XGE-XFP *(10-Gigabit Ethernet MICs with XFP)*	–	–	–	–
MIC-3D-40GE-TX *(Tri-Rate MIC)*	10.2	11.2R4	10.2	11.2R4
MIC-3D-4OC3OC12-1OC48, MIC-3D-8OC3OC12-4OC48 *(SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP)*	11.2	11.2R4	11.2	11.2R4
MIC-3D-4COC3-1COC12-CE *(Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP)*	–	–	12.2	12.2
MIC-3D-1OC192-XFP *(SONET/SDH OC192/STM64 MIC with XFP)*	12.2	12.2	12.2	12.2

Table 49: MIC/MPC1 Compatibility *(continued)*

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
MIC-3D-4CHOC3-2CHOC12, MIC-3D-8CHOC3-4CHOC12 MIC-4COC3-2COC12-G, MIC-8COC3-4COC12-G (*Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP*)	—	—	11.4	11.4
MIC-3D-16CHE1-T1-CE (*Channelized E1/T1 Circuit Emulation MIC*)	13.2 **NOTE:** Support for Non-Channelized MIC only.	13.2 **NOTE:** Support for Non-Channelized MIC only.	12.3	12.3
MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B (*DS3/E3 MIC*) **NOTE:** You cannot run Channelized DS3 (MIC-3D-8CHDS3-E3) on non-Q MPCs. Channelized DS3 is supported only on Q and EQ-based MPCs.	11.4	11.4	11.4	11.4
MIC-MACSEC-20GE *Gigabit Ethernet MIC with 256b-AES MACsec*	18.3R1	18.3R1	18.3R1	18.3R1
MS-MIC-16G (*Multiservices MIC*)	13.2	13.2	13.2	13.2

Table 50: MIC/MPC2 Compatibility

MIC Name	MPC2	MPC2E	MPC2E NG	MPC2 Q	MPC2E Q	MPC2 EQ	MPC2E EQ	MPC2E P	MPC2E NG Q
MIC-3D-8OC3-2OC12-ATM (*ATM MIC with SFP*)	—	—	14.1R4, 14.2R3 with Junos Continuity 15.1	12.1	12.1R4	12.1	12.1R4	—	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-20GE-SFP (*Gigabit Ethernet MIC with SFP*)	10.1	11.2R4	14.1R4, 14.2R3 with Junos Continuity 15.1	10.1	11.2R4	10.1	11.2R4	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-20GE-SFP-E (*Gigabit Ethernet MIC with SFP (E)*)	13.2R2	13.2R2	14.1R4, 14.2R3 with Junos Continuity 15.1	13.2R2	13.2R2	13.2R2	13.2R2	13.2R2	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-2XGE-XFP (*10-Gigabit Ethernet MIC with XFP*)	10.2	11.2R4	14.1R4, 14.2R3 with Junos Continuity 15.1	10.2	11.2R4	10.2	11.2R4	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4XGE-XFP (*10-Gigabit Ethernet MICs with XFP*)	10.1	11.2R4	14.1R4, 14.2R3 with Junos Continuity 15.1	10.1	11.2R4	10.1	11.2R4	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-40GE-TX (*Tri-Rate MIC*)	10.2	11.2R4	14.1R4, 14.2R3 with Junos Continuity 15.1	10.2	11.2R4	10.2	11.2R4	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1

Table 50: MIC/MPC2 Compatibility *(continued)*

MIC Name	MPC2	MPC2E	MPC2E NG	MPC2 Q	MPC2E Q	MPC2 EQ	MPC2E EQ	MPC2E P	MPC2E NG Q
MIC-3D-4OC3OC12-1OC48, MIC-3D-8OC3OC12-4OC48 (*SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP*)	11.4	11.4	14.1R4, 14.2R3 with Junos Continuity 15.1	11.4	11.4	11.4	11.4	-	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4COC3-1COC12-CE (*Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP*)	—	—	—	12.2	12.2	12.2	12.2	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-1OC192-XFP (*SONET/SDH OC192/STM64 MIC with XFP*)	12.2	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1	12.2	12.2	12.2	12.2	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4CHOC3-2CHOC12, MIC-3D-8CHOC3-4CHOC12 MIC-4COC3-2COC12-G, MIC-8COC3-4COC12-G (*Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP*)	—	—	15.1 with flexible queuing option	11.4	11.4	11.4	11.4	—	15.1 14.1R4, 14.2R3 with Junos Continuity
MIC-3D-16CHE1-T1-CE (*Channelized E1/T1 Circuit Emulation MIC*)	13.2 **NOTE:** Support for Non-Channelized MIC only.		15.1 with flexible queuing option	12.3	12.3	12.3	12.3	—	14.1R4, 14.2R3 with Junos Continuity 15.1

Table 50: MIC/MPC2 Compatibility *(continued)*

MIC Name	MPC2	MPC2E	MPC2E NG	MPC2 Q	MPC2E Q	MPC2 EQ	MPC2E EQ	MPC2E P	MPC2E NG Q
MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B (*DS3/E3 MIC*) **NOTE:** You cannot run Channelized DS3 (MIC-3D-8CHDS3-E3) on non-Q MPCs. Channelized DS3 is supported only on Q and EQ-based MPCs.	11.4	11.4	14.1R4, 14.2R3 with Junos Continuity 15.1	11.4	11.4	11.4	11.4	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1
MS-MIC-16G (*Multiservices MIC*) **NOTE:** Only one MS-MIC-16G can be installed into any MPC.	13.2	13.2	14.1R4, 14.2R3 with Junos Continuity 15.1	13.2	13.2	13.2	13.2	13.2	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-MACSEC-20GE *Gigabit Ethernet MIC with 256b-AES MACsec*	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1

Table 51: MIC/MPC3 Compatibility

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
MIC-3D-8OC3-2OC12-ATM (*ATM MIC with SFP*)	—	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-20GE-SFP (*Gigabit Ethernet MIC with SFP*)	12.1	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-20GE-SFP-E (*Gigabit Ethernet MIC with SFP (E)*)	13.2R2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1

Table 51: MIC/MPC3 Compatibility *(continued)*

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
MIC3-3D-1X100GE-CFP (*100-Gigabit Ethernet MIC with CFP*)	12.1	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-2XGE-XFP (*10-Gigabit Ethernet MICs with XFP*)	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4XGE-XFP (*10-Gigabit Ethernet MICs with XFP*)	—	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-10XGE-SFPP (*10-Gigabit Ethernet MIC with SFP+ (10 Ports)*)	12.3	14.1R4, 14.2 R3 and Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-2X40GE-QSFPP (*40-Gigabit Ethernet MIC with QSFP+*)	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-1X100GE-CXP (*100-Gigabit Ethernet MIC with CXP*)	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-100G-DWDM (*100-Gigabit DWDM OTN MIC with CFP2-ACO*)	15.1F5 15.1F6 17.1R1	15.1F5 15.1F6 17.1R1	15.1F5 15.1F6 17.1R1
MIC-3D-4OC3OC12-1OC48 MIC-3D-8OC3OC12-4OC48 (*SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP*)	13.3	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1

Table 51: MIC/MPC3 Compatibility *(continued)*

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
MIC-3D-1OC192-XFP (*SONET/SDH OC192/STM64 MIC with XFP*)	13.3	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4COC3-1COC12-CE (*Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP*)	—	—	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-16CHE1-T1-CE (*Channelized E1/T1 Circuit Emulation MIC*)	—	15.1 with flexible queuing option	15.1
MS-MIC-16G (*Multiservices MIC*) **NOTE:** On MPC3E, the installation of the Multiservices MIC (MS-MIC-16G) with MIC3-3D-2X40GE-QSFPP, MIC3-3D-10XGE-SFPP, or MIC3-3D-1X100GE-CFP does not meet the NEBS criteria. **NOTE:** Only one MS-MIC-16G can be installed into any MPC.	13.2R2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-40GE-TX *Tri-Rate MIC*	—	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4OC3OC12-1OC48, MIC-3D-8OC3OC12-4OC48 *SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP*	12.1	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4CHOC3-2CHOC12, MIC-3D-8CHOC3-4CHOC12 MIC-4COC3-2COC12-G, MIC-8COC3-4COC12-G *Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP*	—	15.1 with flexible queuing option	14.1R4, 14.2R3 with Junos Continuity 15.1

Table 51: MIC/MPC3 Compatibility *(continued)*

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B *DS3/E3 MIC* **NOTE:** You cannot run Channelized DS3 (MIC-3D-8CHDS3-E3) on non-Q MPCs. Channelized DS3 is supported only on Q and EQ-based MPCs.	12.1	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-MACSEC-20GE *Gigabit Ethernet MIC with 256b-AES MACsec*	18.3R1	18.3R1	18.3R1

Table 52: MIC/MPC6 Compatibility

MIC Name	MPC6E
MIC6-10G *10-Gigabit Ethernet MIC with SFP+ (24 Ports)*	13.3R2
MIC6-10G-OTN *10-Gigabit Ethernet OTN MIC with SFP+ (24 Ports)*	13.3R3
MIC6-100G-CXP *100-Gigabit Ethernet MIC with CXP (4 Ports)*	13.3R2
MIC6-100G-CFP2 *100-Gigabit Ethernet MIC with CFP2*	13.3R3

Table 53: MIC/MPC8 Compatibility

MIC Name	MPC8E
MIC-MRATE *MIC MRATE*	• 15.1F5 with Junos Continuity • 16.1R1
MIC-MACSEC-MRATE *Multi-Rate Ethernet MIC*	17.4

Table 54: MIC/MPC9 Compatibility

MIC Name	MPC9E
MIC-MRATE *MIC MRATE*	• 15.1F5 with Junos Continuity • 16.1R1
MIC-MACSEC-MRATE *Multi-Rate Ethernet MIC*	17.4

Table 55: MIC/MPC10003 Compatibility

MIC Name	MPC10003
JNP-MIC1 *Multi-Rate Ethernet MIC*	17.3
JNP-MIC1-MACSEC *Multi-Rate Ethernet MIC*	17.3R2

RELATED DOCUMENTATION

MICs Supported by MX Series Routers | 94

Junos Continuity Software User Guide (Junos OS Release 14.1R4 and Later Releases)

MX960 Modular Interface Card Description

Modular Interface Cards (MICs) install into Modular Port Concentrators (MPCs) and provide the physical connections to various network media types. MICs allow different physical interfaces to be supported on a single line card. You can install MICs of different media types on the same MPC as long as the MPC supports those MICs.

MICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each MIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets through the MIC interfaces, the MPCs encapsulate the packets received.

MICs are hot-removable and hot-insertable. You can install up to two MICs in the slots in each MPC.

RELATED DOCUMENTATION

MX960 Modular Interface Card (MIC) LEDs

Each MIC has LEDs located on the faceplate. For more information about LEDs on the MIC faceplate, see the "LEDs" section for each MIC in the *MX Series Interface Module Reference*.

RELATED DOCUMENTATION

MICs Supported by MX Series Routers

The following tables list the first supported Junos OS release for the MX Series.

- Table 56 on page 95 lists the first supported Junos OS release for MICs on MX240, MX480, MX960, and MX2008 routers.
- Table 57 on page 97 lists the first supported Junos OS release for MICs on MX2010 and MX2020 routers.
- Table 58 on page 100 list the first supported Junos OS release for MICs on MX5, MX10, and MX40 routers.
- Table 59 on page 102 lists the first supported Junos OS release for MICs on MX80 and MX104 routers.
- Table 60 on page 104 lists the first supported Junos OS release for MICs on MX10003 router.

Table 56: MICs Supported by MX240, MX480, MX960 and MX2008 Routers

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
ATM				
ATM MIC with SFP	MIC-3D-8OC3-2OC12-ATM	8	12.1	15.1F7
DS3/E3				
DS3/E3 MIC	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	11.4	15.1F7
Circuit Emulation				
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	16	12.3	15.1F7
Gigabit Ethernet				
Gigabit Ethernet MIC with SFP	MIC-3D-20GE-SFP	20	10.1	15.1F7
Gigabit Ethernet MIC with SFP (E)	MIC-3D-20GE-SFP-E	20	13.3	15.1F7
Gigabit Ethernet MIC with 256b-AES MACsec	MIC-MACSEC-20GE	20	18.3	-
10-Gigabit Ethernet				
10-Gigabit Ethernet MICs with XFP	MIC-3D-2XGE-XFP	2	10.2	15.1F7
10-Gigabit Ethernet MICs with XFP	MIC-3D-4XGE-XFP	4	10.1	15.1F7
10-Gigabit Ethernet MIC with SFP+ (10 Ports)	MIC3-3D-10XGE-SFPP	10	12.3	15.1F7
10-Gigabit Ethernet MIC with SFP+ (24 Ports)	MIC6-10G	24	-	15.1F7
10-Gigabit Ethernet OTN MIC with SFP+ (24 Ports)	MIC6-10G-OTN	24	-	15.1F7

Table 56: MICs Supported by MX240, MX480, MX960 and MX2008 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
40-Gigabit Ethernet				
40-Gigabit Ethernet MIC with QSFP+	MIC3-3D-2X40GE-QSFPP	2	12.2	15.1F7
100-Gigabit Ethernet				
100-Gigabit Ethernet MIC with CFP	MIC3-3D-1X100GE-CFP	1	12.1	15.1F7
100-Gigabit Ethernet MIC with CXP	MIC3-3D-1X100GE-CXP	1	12.2	15.1F7
100-Gigabit Ethernet MIC with CXP (4 Ports)	MIC6-100G-CXP	4	-	15.1F7
100-Gigabit Ethernet MIC with CFP2	MIC6-100G-CFP2	2	-	15.1F7
100-Gigabit DWDM OTN				
100-Gigabit DWDM OTN MIC with CFP2-ACO	MIC3-100G-DWDM	1	15.1F5 15.1F6 17.1R1	15.1F7
Multi-Rate				
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4OC3OC12-1OC48	4	11.2	15.1F7
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8OC3OC12-4OC48	8	11.2	15.1F7
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4CHOC3-2CHOC12	4	11.4	15.1F7
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4CHOC12	8	11.4	15.1F7

Table 56: MICs Supported by MX240, MX480, MX960 and MX2008 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	4	12.2	15.1F7
MIC MRATE (12-Port Multi-Rate MIC with QSFP+)	MIC-MRATE	12	-	15.1F7
Multi-Rate Ethernet MIC (12-Port Multi-Rate MACsec MIC with QSFP+)	MIC-MACSEC-MRATE	12		17.4
Tri-Rate				
Tri-Rate MIC	MIC-3D-40GE-TX	40	10.2	15.1F7
Services				
Multiservices MIC	MS-MIC-16G	0	13.2	15.1F7
SONET/SDH				
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	1	12.2	15.1F7

Table 57: MICs Supported by MX2010 and MX2020 Routers

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
ATM				
ATM MIC with SFP	MIC-3D-8OC3-2OC12-ATM	8	12.3	12.3
DS3/E3				
DS3/E3 MIC	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	12.3	12.3
Circuit Emulation				

Table 57: MICs Supported by MX2010 and MX2020 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	16	–	–
Gigabit Ethernet				
Gigabit Ethernet MIC with SFP	MIC-3D-20GE-SFP	20	12.3	12.3
Gigabit Ethernet MIC with SFP (E)	MIC-3D-20GE-SFP-E	20	13.3	13.3
10-Gigabit Ethernet				
10-Gigabit Ethernet MICs with XFP	MIC-3D-2XGE-XFP	2	12.3	12.3
10-Gigabit Ethernet MICs with XFP	MIC-3D-4XGE-XFP	4	12.3	12.3
10-Gigabit Ethernet MIC with SFP+ (10 Ports)	MIC3-3D-10XGE-SFPP	10	12.3	12.3
10-Gigabit Ethernet MIC with SFP+ (24 Ports)	MIC6-10G	24	13.3R2	13.3R2
10-Gigabit Ethernet OTN MIC with SFP+ (24 Ports)	MIC6-10G-OTN	24	13.3R3	13.3R3
40-Gigabit Ethernet				
40-Gigabit Ethernet MIC with QSFP+	MIC3-3D-2X40GE-QSFPP	2	12.3	12.3
100-Gigabit Ethernet				
100-Gigabit Ethernet MIC with CFP	MIC3-3D-1X100GE-CFP	1	12.3	12.3
100-Gigabit Ethernet MIC with CXP	MIC3-3D-1X100GE-CXP	1	12.3	12.3

Table 57: MICs Supported by MX2010 and MX2020 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
100-Gigabit Ethernet MIC with CXP (4 Ports)	MIC6-100G-CXP	4	13.3R2	13.3R2
100-Gigabit Ethernet MIC with CFP2	MIC6-100G-CFP2	2	13.3R3	13.3R3
100-Gigabit DWDM OTN				
100-Gigabit DWDM OTN MIC with CFP2-ACO	MIC3-100G-DWDM	1	15.1F5 15.1F6 17.1R1	15.1F5 15.1F6 17.1R1
Multi-Rate				
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4OC3OC12-1OC48	4	12.3	12.3
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8OC3OC12-4OC48	8	12.3	12.3
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4CHOC3-2CHOC12	4	12.3	12.3
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4CHOC12	8	12.3	12.3
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	4	12.3	12.3
MIC MRATE (12-Port Multi-Rate MIC with QSFP+)	MIC-MRATE	12	• 15.1F5 with Junos Continuity • 16.1R1 and later	• 15.1F5 with Junos Continuity • 16.1R1 and later
Multi-Rate Ethernet MIC (12-Port Multi-Rate MACsec MIC with QSFP+)	MIC-MACSEC-MRATE	12	17.4	17.4

Table 57: MICs Supported by MX2010 and MX2020 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
Tri-Rate				
Tri-Rate MIC	MIC-3D-40GE-TX	40	12.3	12.3
Services				
Multiservices MIC	MS-MIC-16G	0	13.2	13.2
SONET/SDH				
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	1	12.3	12.3

Table 58: MICs Supported by MX5, MX10, and MX40 Routers

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
ATM					
ATM MIC with SFP	MIC-3D-8OC3-2OC12-ATM	8	12.1	12.1	12.1
DS3/E3					
DS3/E3 MIC	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	11.4	11.4	11.4
Circuit Emulation					
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	16	13.2R2	13.2R2	13.2R2
Channelized E1/T1 Circuit Emulation MIC (H)	MIC-3D-16CHE1-T1-CE-H	16	–	–	–
Gigabit Ethernet					
Gigabit Ethernet MIC with SFP	MIC-3D-20GE-SFP	20	11.2R4	11.2R4	11.2R4
Gigabit Ethernet MIC with SFP (E)	MIC-3D-20GE-SFP-E	20	13.2R2	13.2R2	13.2R2

Table 58: MICs Supported by MX5, MX10, and MX40 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
Gigabit Ethernet MIC with SFP (EH)	MIC-3D-20GE-SFP-EH	20	–	–	–
10-Gigabit Ethernet					
10-Gigabit Ethernet MICs with XFP	MIC-3D-2XGE-XFP	2	11.2R4	11.2R4	11.2R4
Multi-Rate					
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4OC3OC12-1OC48	4	11.2R4	11.2R4	11.2R4
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8OC3OC12-4OC48	8	11.2R4	11.2R4	11.2R4
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4CHOC3-2CHOC12	4	11.4	11.4	11.4
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4CHOC12	8	11.4	11.4	11.4
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	4	12.2	12.2	12.2
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (H)	MIC-4COC3-1COC12-CE-H	-	-	-	-
Tri-Rate					
Tri-Rate MIC	MIC-3D-40GE-TX	40	–	11.2R4	11.2R4
Services					
Multiservices MIC	MS-MIC-16G	0	13.2 Rear slot only.	13.2 Rear slot only.	13.2 Rear slot only.

Table 58: MICs Supported by MX5, MX10, and MX40 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	1	12.2	12.2	12.2

Table 59: MICs Supported by MX80 and MX104 Routers

MIC Name	MIC Model Number	Ports	MX80	MX104
ATM				
ATM MIC with SFP	MIC-3D-8OC3-2OC12-ATM	8	12.1	13.3
DS3/E3				
DS3/E3 MIC	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	11.4	13.3
Circuit Emulation				
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	16	13.2R2	13.2R2
Channelized E1/T1 Circuit Emulation MIC (H)	MIC-3D-16CHE1-T1-CE-H	16	–	13.2R2
Gigabit Ethernet				
Gigabit Ethernet MIC with SFP	MIC-3D-20GE-SFP	20	10.2	13.2R2
Gigabit Ethernet MIC with SFP (E)	MIC-3D-20GE-SFP-E	20	13.2R2	13.2R2
Gigabit Ethernet MIC with SFP (EH)	MIC-3D-20GE-SFP-EH	20	–	13.2R2
Gigabit Ethernet MIC with 256b-AES MACsec	MIC-MACSEC-20GE	20	18.3	18.3
10-Gigabit Ethernet MICs with XFP	MIC-3D-2XGE-XFP	2	10.2	13.2R2
Multi-Rate				

Table 59: MICs Supported by MX80 and MX104 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX80	MX104
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4OC3OC12-1OC48	4	11.2	13.3
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8OC3OC12-4OC48	8	11.2	13.3
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4CHOC3-2CHOC12	4	11.4	13.3
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4CHOC12	8	11.4	13.3
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	4	12.2	13.2R2
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (H)	MIC-4COC3-1COC12-CE-H	-	-	13.2R2
Tri-Rate				
Tri-Rate MIC	MIC-3D-40GE-TX	40	10.2	13.2R2
Services				

Table 59: MICs Supported by MX80 and MX104 Routers *(continued)*

MIC Name	MIC Model Number	Ports	MX80	MX104
Multiservices MIC	MS-MIC-16G	0	13.2 Rear slot only. Supported on the modular MX80 and fixed MX80-48T	13.3R2 NOTE: Starting From Junos OS 13.3R3, 14.1R2, and 14.2R1, MX104 supports only two Multiservices MICs.
SONET/SDH				
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	1	12.2	13.3

Table 60: MICs Supported by MX10003 Router

MIC Name	MIC Model Number	Ports	MX10003
Multi-Rate			
Multi-Rate Ethernet MIC (12-Port Multi-Rate MIC with QSFP+)	JNP-MIC1	12	17.3
Multi-Rate Ethernet MIC (12-Port Multi-Rate MACsec MIC with QSFP+)	JNP-MIC1-MACSEC	12	17.3R2

RELATED DOCUMENTATION

MX Series MIC Overview

MIC/MPC Compatibility | 84

MX960 MIC Port and Interface Numbering

Each port on a MIC corresponds to a unique interface name in the CLI.

> **NOTE:** Fixed configuration MPCs, that is, MPCs with built-in MICs follow the port numbering of DPCs.

In the syntax of an interface name, a hyphen (-) separates the media type from the MPC number (represented as an **FPC** in the CLI). The MPC slot number corresponds to the first number in the interface. The second number in the interface corresponds to the logical PIC number. The last number in the interface matches the port number on the MIC. Slashes (/) separate the MPC number from the logical PIC number and port number:

type-fpc/pic/port

- *type*—Media type, which identifies the network device. For example:
  - ge—Gigabit Ethernet interface
  - so—SONET/SDH interface
  - xe—10-Gigabit Ethernet interface

  For a complete list of media types, see *Interface Naming Overview*.
- *fpc*—Slot in which the MPC is installed. On the MX960 router, the MPCs are represented in the CLI as **FPC 0** through **FPC 11**.
- *pic*—Logical PIC on the MIC, numbered 0 or 1 when installed in MIC slot 0 and 2 or 3 when installed in MIC slot 1. The number of logical PICs varies depending on the type of MIC. For example, a:
  - 20-port Gigabit Ethernet MIC has two logical PICs, numbered 0 and 1 when installed in MIC slot 0, or 2 and 3 when installed in MIC slot 1.
  - 4-port 10-Gigabit Ethernet MIC has two logical PICs numbered 0 and 1 when installed in MIC slot 0, or 2 and 3 when installed in MIC slot 1.
  - 100-Gigabit Ethernet MIC with CFP has one logical PIC numbered 0 when installed in MIC slot 0 or 2 when installed in MIC slot 1.

  For more information on specific MICs, see "MICs Supported by MX Series Routers" on page 94 in the *MX Series Interface Module Reference*.
- *port*—Port number.

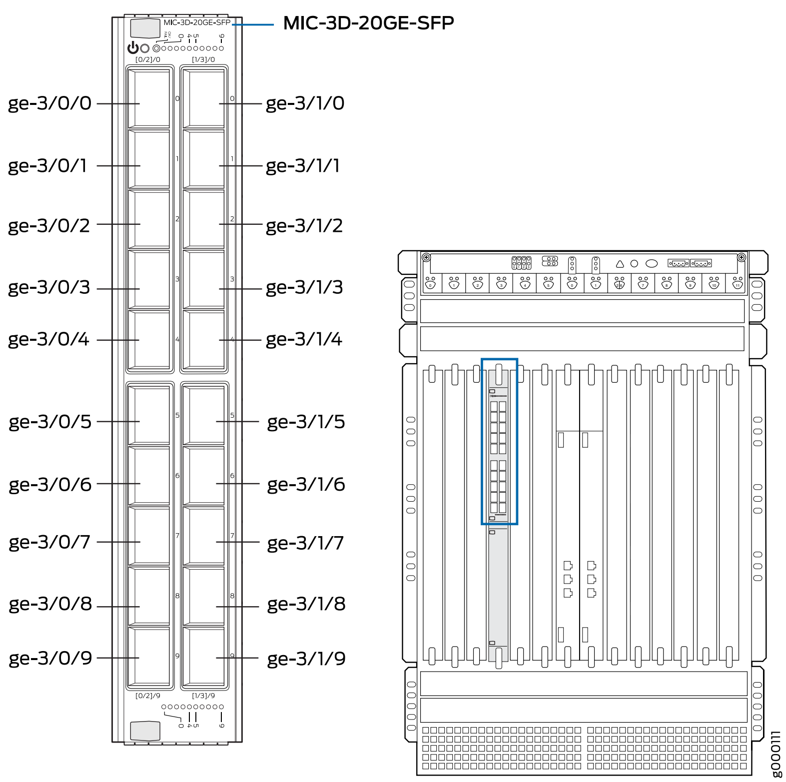
> **NOTE:** The MIC number is not included in the interface name.

The MX960 supports up to twelve MPCs that install vertically and are numbered from left to right. Each MPC accepts up to two MICs.

Figure 28 on page 106 shows an example of a 20-port Gigabit Ethernet MIC with SFP installed in MIC slot **0** of an MPC in slot **3**.

> **NOTE:** The 20-port Gigabit Ethernet MIC with SFP-E has a different port numbering. See *Gigabit Ethernet MIC with SFP (E)*

Figure 28: Port Mapping for the 20-Port Gigabit Ethernet MIC with SFP Installed in the MX960



The MIC contains two logical PICs, numbered **PIC 0** through **PIC 1** in the CLI. Each logical PIC contains 10 ports numbered **0** through **9**.

The **show chassis hardware** command output displays a 20-port Gigabit Ethernet MIC with SFP — **3D 20x 1GE(LAN) SFP** — installed in MIC slot 0 of an MPC (**MPC Type 2 3D EQ**) in slot **3**. The MPC is shown as **FPC 3** and the MIC's two logical PICs — **10x 1GE(LAN) SFP** — are shown as **PIC 0** and **PIC 1**.

`user@host>` **show chassis hardware**

```
...
FPC 3            REV 28   750-031090   YH8181           MPC Type 2 3D EQ
  CPU            REV 06   711-030884   YH9437           MPC PMB 2G
  MIC 0          REV 22   750-028392   YD0439           3D 20x 1GE(LAN) SFP
    PIC 0                 BUILTIN      BUILTIN          10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-011613   PCE14D5          SFP-SX
      Xcvr 1     REV 01   740-011782   P9C280T          SFP-SX
      Xcvr 2     REV 01   740-011782   P9C2512          SFP-SX
      Xcvr 3     REV 02   740-011613   AM0951SFF3Z      SFP-SX
      Xcvr 4     REV 02   740-011613   AM0951SFF33      SFP-SX
      Xcvr 5     REV 02   740-011613   AM0951SFF3Y      SFP-SX
      Xcvr 6     REV 02   740-011613   AM0951SFF4B      SFP-SX
      Xcvr 7     REV 01   740-011613   E08H01273        SFP-SX
      Xcvr 8     REV 02   740-011613   AM0951SFFWK      SFP-SX
    PIC 1                 BUILTIN      BUILTIN          10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-011613   E08H00516        SFP-SX
      Xcvr 1     REV 01   740-011613   E08G03648        SFP-SX
      Xcvr 2     REV 01   740-011613   E08H00514        SFP-SX
...
```

The **show interfaces terse** command output displays the Gigabit Ethernet interfaces that correspond to the 20 ports located on the MIC.

`user@host>` **show interfaces terse ge-3***

```
Interface               Admin Link Proto    Local                 Remote
ge-3/0/0                up    down
ge-3/0/1                up    down
ge-3/0/2                up    down
ge-3/0/3                up    up
ge-3/0/4                up    up
ge-3/0/5                up    up
ge-3/0/6                up    up
ge-3/0/7                up    up
ge-3/0/8                up    up
ge-3/0/9                up    down
ge-3/1/0                up    up
ge-3/1/1                up    up
ge-3/1/2                up    up
ge-3/1/3                up    down
ge-3/1/4                up    down
```

```
ge-3/1/5                up    down
ge-3/1/6                up    down
ge-3/1/7                up    down
ge-3/1/8                up    down
ge-3/1/9                up    down
```

RELATED DOCUMENTATION

MX960 Router Hardware and CLI Terminology Mapping | 10

MX960 Modular Port Concentrator Description

Modular Port Concentrators (MPCs) provide packet forwarding services. The MPCs are inserted into a slot in a router. Modular Interface Cards (MICs) provide the physical interfaces and install into the MPCs. You can install up to two MICs of different media types on the same MPC as long as the MPC supports those MICs.

A specialized fixed configuration MPC provides higher port density over MICs and combines packet forwarding and Ethernet interfaces onto a single line card. The fixed configuration MPC is inserted into a slot in a router and contains no slots for MICs.

MICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each MIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets through the MIC interfaces, the MPCs encapsulate the packets received. Each MPC is equipped with up to four Junos Trio chipsets, which perform control functions tailored to the MPC's media type. The MPCs interface with the power supplies and Switch Control Boards (SCBs). You must install redundant SCBs to support full line rate.

The MX960 router supports up to 12 MPCs. You must install a high-capacity fan tray to use an MPC. For power requirements, see "Calculating Power Requirements for MX960 Routers" on page 212.

The router has 11 dedicated line-card slots for DPCs, MPCs, or FPCs. MPCs install vertically in the front of the router. The dedicated slots are numbered **0** though **5**, and **7** though **11**, left to right. An additional multifunction slot labeled **2/6** supports either an SCB, a DPC, an FPC, or an MPC. An MPC can be installed in any slot that supports MPCs. You can install any combination of MPC types in the router.

When a slot is not occupied by an MPC or other line card, you must insert a blank DPC panel to fill the empty slot and ensure proper cooling of the system.

MPCs are hot-removable and hot-insertable. When you install an MPC in an operating router, the Routing Engine downloads the MPC software, the MPC runs its diagnostics, and the Packet Forwarding Engines housed on the MPC are enabled. Forwarding on other MPCs continues uninterrupted during this process.

Figure 29 on page 109 shows a typical MPC supported on the MX960 router. Figure 30 on page 110 shows an MPC installed vertically in the MX960 router. For more information about MPCs, see the *MX Series Ethernet Services Routers Line Card Guide*.

Figure 29: Typical MPC Supported on the MX960 Router

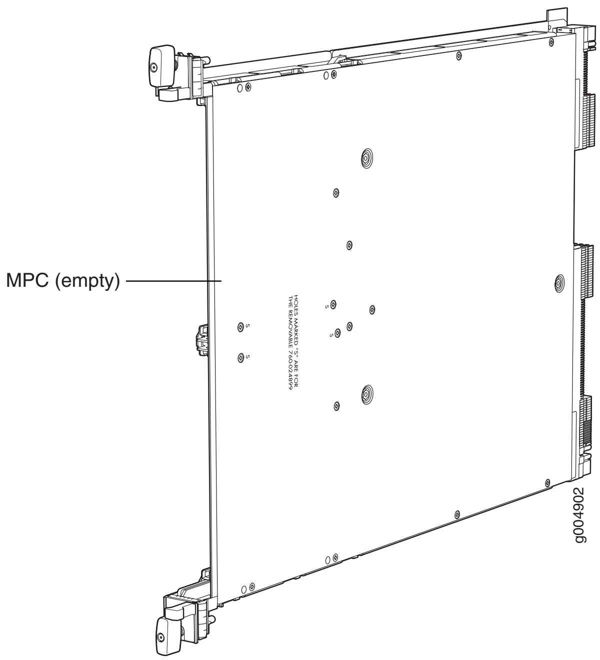
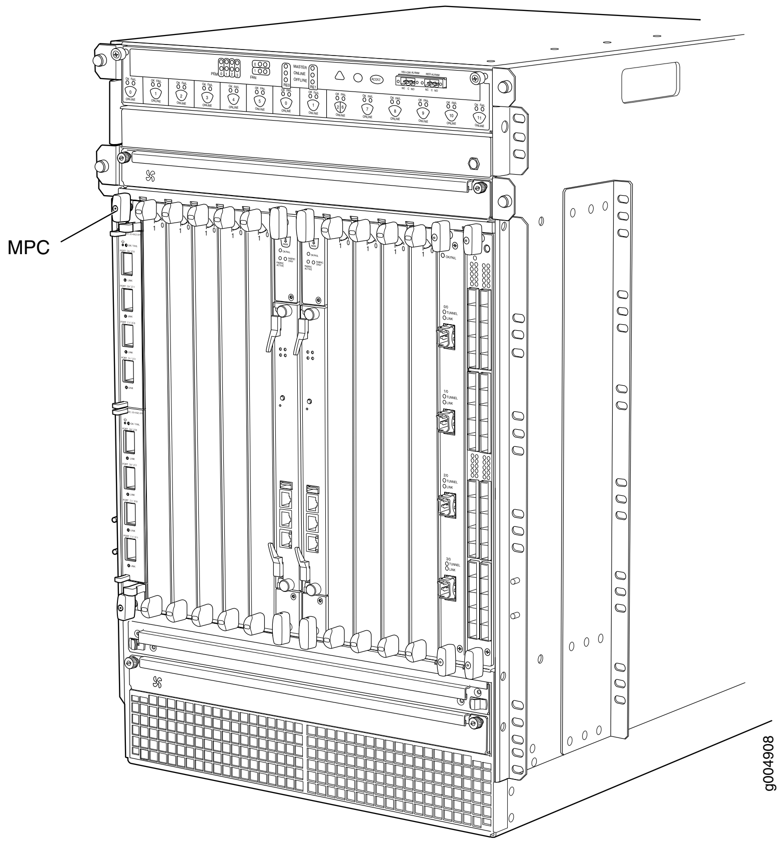


Figure 30: MPC Installed Vertically in the MX960 Router



MPC Components

Each MPC consists of the following components:

- MPC card carrier, which includes two MIC slots (excludes the fixed configuration MPC).
- 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 MPCs.
- Two interfaces from the SCBs that enable the MPCs to be powered on and controlled.
- Physical MPC connectors.
- Up to four Junos Trio chipsets, which perform control functions tailored to the MPC's media type.
- Midplane connectors and power circuitry.
- Processor subsystem, which includes a 1.5-GHz CPU, system controller, and 1 GB of SDRAM.

- Online button which takes the MPC online or offline when pressed.
- **OK/Fail** LED on the MPC faceplate. For more information about LEDs on the MPC faceplate, see the *MX Series Interface Module Reference*.

Two LEDs, located on the craft interface above the MPC, display the status of the line cards and are labeled **OK** and **FAIL**.

RELATED DOCUMENTATION

MPCs Supported by MX Series Routers | 112
MX960 Modular Port Concentrator LEDs | 111
MX960 Field-Replaceable Units | 400
Maintaining MX960 MPCs | 631
Troubleshooting the MX960 MPCs | 682
Replacing an MX960 MPC | 532

MX960 Modular Port Concentrator LEDs

Two LEDs, located on the craft interface above the MPC, display the status of the line cards and are labeled **OK** and **FAIL**. For more information about the line card LEDs on the craft interface, see “MX960 DPC and MPC LEDs on the Craft Interface” on page 18.

Each MPC also has LEDs located on the faceplate. For more information about LEDs on the MPC faceplate, see the “LEDs” section for each MPC in the *MX Series Interface Module Reference*.

RELATED DOCUMENTATION

MX960 Modular Port Concentrator Description | 108
Maintaining MX960 MPCs | 631
Troubleshooting the MX960 MPCs | 682
Replacing an MX960 MPC | 532

MPCs Supported by MX Series Routers

Table 61 on page 112 lists the MPCs and their first supported Junos OS release on MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 routers.

Table 61: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers

MPC Name	MPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers	First Junos OS Release on MX2008 Routers	First Junos OS Release on MX2010 Routers	First Junos OS Release on MX2020 Routers	First Junos OS Release on MX10003 Routers	Firs Jur Rel on MX Rou
Fixed Configuration MPCs							
MPC-3D-16XGE-SFPP	MPC-3D-16XGE-SFP	10.0R2	15.1F7	12.3	12.3	–	–
Multiservices MPC	MS-MPC	13.2R4	15.1F7	15.1	15.1	–	–
32x10GE MPC4E	MPC4E-3D-32XGE-SFPP	12.3R2	15.1F7	12.3R2	12.3R2	–	–
2x100GE + 8x10GE MPC4E	MPC4E-3D-2CGE-8XGE	12.3R2	15.1F7	12.3R2	12.3R2	–	–
6x40GE + 24x10GE MPC5E	MPC5E-40G10G	13.3R2	15.1F7	13.3R2	13.3R2	–	–
6x40GE + 24x10GE MPC5EQ	MPC5EQ-40G10G	13.3R2	15.1F7	13.3R2	13.3R2	–	–
2x100GE + 4x10GE MPC5E	MPC5E-100G10G	13.3R3	15.1F7	13.3R3	13.3R3	–	–
2x100GE + 4x10GE MPC5EQ	MPC5EQ-100G10G	13.3R3	15.1F7	13.3R3	13.3R3	–	–

Table 61: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers *(continued)*

MPC Name	MPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers	First Junos OS Release on MX2008 Routers	First Junos OS Release on MX2010 Routers	First Junos OS Release on MX2020 Routers	First Junos OS Release on MX10003 Routers	Firs Jun Rel on MX Rou
MPC7E-MRATE	MPC7E-MRATE	• 15.1F4 with Junos Continuity • 16.1R1 and later	15.1F7	• 15.1F4 with Junos Continuity • 16.1R1 and later	• 15.1F4 with Junos Continuity • 16.1R1 and later	–	–
MPC7E-10G	MPC7E-10G	• 15.1F5 with Junos Continuity • 16.1R1 and later	15.1F7	• 15.1F5 with Junos Continuity • 16.1R1 and later	• 15.1F5 with Junos Continuity • 16.1R1 and later	–	–
MPC10E-10C-MRATE	MPC10E-10C-MRATE	19.2R1	–	–	–	–	–
MPC10E-15C-MRATE	MPC10E-15C-MRATE	19.1R1	–	–	–	–	–
MPCs							
MPC1	MX-MPC1-3D	10.2	15.1F7	12.3	12.3	–	–
MPC1E	MX-MPC1E-3D	11.2R4	15.1F7	12.3	12.3	–	–
MPC1 Q	MX-MPC1-3D-Q	10.2	15.1F7	12.3	12.3	–	–
MPC1E Q	MX-MPC1E-3D-Q	11.2R4	15.1F7	12.3	12.3	–	–
MPC2	MX-MPC2-3D	10.1	15.1F7	12.3	12.3	–	–
MPC2E	MX-MPC2E-3D	11.2R4	15.1F7	12.3	12.3	–	

Table 61: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers *(continued)*

MPC Name	MPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers	First Junos OS Release on MX2008 Routers	First Junos OS Release on MX2010 Routers	First Junos OS Release on MX2020 Routers	First Junos OS Release on MX10003 Routers	Firs Jun Rel on MX Rou
MPC2 Q	MX-MPC2-3D-Q	10.1	15.1F7	12.3	12.3	–	–
MPC2E Q	MX-MPC2E-3D-Q	11.2R4	15.1F7	12.3	12.3	–	–
MPC2 EQ	MX-MPC2-3D-EQ	10.1	15.1F7	12.3	12.3	–	–
MPC2E EQ	MX-MPC2E-3D-EQ	11.2R4	15.1F7	12.3	12.3	–	–
MPC2E P	MX-MPC2E-3D-P	12.2	15.1F7	12.3	12.3	–	–
MPC2E NG	MX-MPC2E-3D-NG	14.1R4, 14.2R3 and Junos Continuity 15.1	15.1F7	14.1R4, 14.2R3 and Junos Continuity 15.1	14.1R4, 14.2R3 and Junos Continuity 15.1	–	–
MPC2E NG Q	MX-MPC2E-3D-NG-Q	14.1R4, 14.2R3 and Junos Continuity 15.1	15.1F7	14.1R4, 14.2R3 and Junos Continuity 15.1	14.1R4, 14.2R3 and Junos Continuity 15.1	–	–
MPC3E	MX-MPC3E-3D	12.1	15.1F7	12.3	12.3	–	–
MPC3E-3D-NG	MX-MPC3E-3D-NG	14.1R4, 14.2R3 and Junos Continuity 15.1	15.1F7	14.1R4, 14.2R3 and Junos Continuity 15.1	14.1R4, 14.2R3 and Junos Continuity 15.1	–	–

Table 61: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers *(continued)*

MPC Name	MPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers	First Junos OS Release on MX2008 Routers	First Junos OS Release on MX2010 Routers	First Junos OS Release on MX2020 Routers	First Junos OS Release on MX10003 Routers	Firs Jun Rel on MX Rou
MPC3E-3D-NG-Q	MX-MPC3E-3D-NG-Q	14.1R4, 14.2R3 and Junos Continuity 15.1	15.1F7	14.1R4, 14.2R3 and Junos Continuity 15.1	14.1R4, 14.2R3 and Junos Continuity 15.1	–	–
MPC6E	MX2K-MPC6E	–	15.1F7	13.3R2	13.3R2	–	–
MPC8E	MX2K-MPC8E	–	15.1F7	• 15.1F5 with Junos Continuity • 16.1R1 and later	• 15.1F5 with Junos Continuity • 16.1R1 and later	–	–
MPC9E	MX2K-MPC9E	–	15.1F7	• 15.1F5 with Junos Continuity • 16.1R1 and later	• 15.1F5 with Junos Continuity • 16.1R1 and later	–	–
MX10003 MPC (Multi-Rate)	MX10003-LC2103	–	–	–	–	17.3	

Table 61: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers *(continued)*

MPC Name	MPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers	First Junos OS Release on MX2008 Routers	First Junos OS Release on MX2010 Routers	First Junos OS Release on MX2020 Routers	First Junos OS Release on MX10003 Routers	Firs Jur Rel on MX Ro
MX2K-MPC11E Modular Port Concentrator	MX2K-MPC11E	-	-	• 19.3R2 and later 19.3 releases • 20.1R1 **NOTE:** The MX2K-MPC11E MPC is not supported in any 19.4 releases.	• 19.3R2 and later 19.3 releases • 20.1R1 **NOTE:** The MX2K-MPC11E MPC is not supported in any 19.4 releases.	-	-

RELATED DOCUMENTATION

MX Series MPC Overview

MIC/MPC Compatibility | 84

MX Series MIC Overview

MICs Supported by MX Series Routers | 94

Junos Continuity Software Overview

Pathfinder: Hardware Supported by Junos Continuity Software

CHAPTER 8

Services Processing Card—MX-SPC3

IN THIS CHAPTER

Services Processing Card—MX-SPC3 Services Card

IN THIS SECTION

MX-SPC3 Services Card Overview and Support on MX240, MX480, and MX960 Routers

The MX-SPC3 Services Card is a Services Processing Card (SPC) that provides additional processing power to run Next Gen Services. The MX-SPC3 contains two Services Processing Units (SPUs) with 128 GB of memory per SPU. Line cards such as DPCs, MPCs, and MICs, intelligently distribute all traffic traversing the router to the SPUs to have services processing applied to it.
Next Gen Services provide the best of both routing and security features on MX Series routers MX240, MX480, and MX960. All Next Gen Services are provided by the MX-SPC3 Services Card. Next Gen Services provide capabilities for manipulating traffic before it's delivered to its destination.

> **NOTE:** The only services card that supports Next Gen Services is the MX-SPC3.

Table 62 on page 118 shows the SPC and its first supported Junos OS release on MX240, MX480, and MX960, routers.

Table 62: MX-SPC3 Supported by MX240, MX480, and MX960 Routers

SPC Name	SPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers
"MX-SPC3 Services Card" on page 119	JNP-SPC3	19.3R2

The MX-SPC3 services card is compatible end-to-end with the MX Series Switch Fabrics, Routing Engines and MPC line cards for MX240, MX480, and MX960 routers. See Table 63 on page 118

Table 63: MX-SPC3 Services Card Compatibility with MX Series Switch Fabrics, Routing Engines and MPC Line Cards

Switch Fabric	Route Engine	MPC Line Cards
SCBE	RE-S-1800X4-16G-UPG-BB RE-S-1800X4-32G-UB	MPC2E-3D MPC2-3D-NG MPC3E and MPC3E-3D-NG MPC4E-3D MPC-3D-16XGE
SCBE2	RE-S-1800X4-16G-UPG-BB RE-S-1800X4-32G-UB RE-S-X6-64G-UB RE-S-X6-64G-S RE-S-X6-64G-S-R RE-S-X6-64G-S-BB RE-S-X6-128G-S-S RE-S-X6-128G-S-R RE-S-X6-128G-S-BB	MPC2E-3D MPC2-3D-NG MPC3E and MPC3E-3D-NG MPC4E-3D MPC5E and MPC5EQ MPC7E and MPC7EQ MPC-3D-16XGE

SEE ALSO

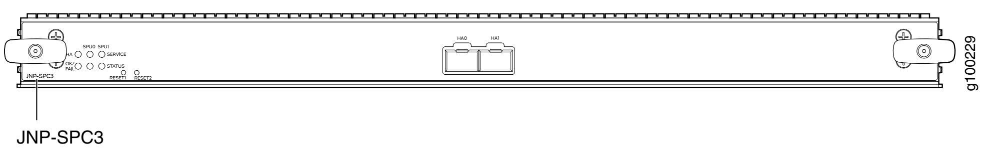
Protocols and Applications Supported by MX-SPC3 Services Card

MX-SPC3 Services Card

The MX-SPC3 Services Card is supported on MX240, MX480, and MX960 routers. It provides additional processing power to run the Next Gen Services.
It contains two Services Processing Units (SPUs) with 128 GB of memory per SPU. Line cards such as DPCs, MICs, and MPCs intelligently distribute all traffic traversing the router to the SPUs to have services processing applied to it (see Figure 31 on page 119).

You can install the MX-SPC3 in any of the slots that are not reserved for Switch Control Board (SCB). If a slot is not occupied by a card, you must install a blank panel to shield the empty slot and to allow cooling air to circulate properly through the device.

Figure 31: MX-SPC3 Services Card



Software release	• Junos OS Release 19.3R2 and later
Description	Services Processing Card (SPC) with two SPUs of 256 GB memory. • Power requirement: 650 W maximum • Weight: Approximately 18 lb (8.3 kg)

Hardware features	• Two 10–Gigabit Ethernet small form-factor pluggable plus (SFP+) chassis cluster control ports for connecting multiple devices into a redundant chassis cluster.
	• Fabric interfaces
	• One Gigabit Ethernet switch that provides control connectivity to the Routing Engine.
	• Two interfaces from the SCBs that enable the boards to be powered on and controlled.
	• Physical SPC connectors
	• Midplane connectors and power circuitry
	• Each SPU includes:
	  ◦ Two 2.3-GHz CPUs
	  ◦ One Crypto Engine
	  ◦ 128 GB memory
	• Two 128 GB solid state-drives (SSDs).
	• LEDs on the faceplate that indicate the SPC and SPU status.

Supported Slots	• MX240–Any slot, except the bottom slot **0** which is reserved for SCB/RE. • MX480–Any slot, except the bottom slots **0** or **1** which are reserved for SCB/RE. • MX960–Any slot, except slot **11**, and slots **0** or **1** which are reserved for SCB/RE.

Compatibility	The MX-SPC3 services card is compatible end-to-end with the MX Series Switch Fabrics, Routing Engines and MPC line cards. See Table 64 on page 122:

LEDs	**OK/FAIL** LED, one bicolor:
	• Steady green–The SPC is operating normally.
	• Red–The SPC has failed and is not operating normally.
	• Off–The SPC is powered down.
	STATUS LED, one tricolor for each SPU **SPU 0** and **SPU 1**:
	• Off–The SPU is offline.
	• Blinking Amber–The SPU is initializing.
	• Green–The SPU initialization is done and it is operating normally.
	• Red–The SPU has encountered an error or a failure.
	SERVICE LED, one tricolor for each SPU **SPU 0** and **SPU 1**:
	• Off–The SPU is offline.
	• Blinking Red–The SPU initialization is done.
	• Blinking Amber–Service is initializing on the SPU.
	• Green–Service is running on the SPU under acceptable load.
	• Solid Red–Service encountered an error or a failure.
	HA LED, one tricolor:
	• Green–Clustering is operating normally. All cluster members and monitored links are available, and no error conditions are detected.
	• Red–A critical alarm is present on clustering. A cluster member is missing or unreachable, or the other node is no longer part of a cluster because it has been disabled by the dual membership and detection recovery process in reaction to a control-link or fabric-link failure.
	• Amber–All cluster members are present, but an error condition has compromised the performance and resiliency of the cluster. The reduced bandwidth could cause packets to be dropped or could result in reduced resiliency because a single point of failure might exist. The error condition might be caused by:
	  ◦ The loss of chassis cluster links which causes an interface monitoring failure.
	  ◦ An error in an SPU or NPU.
	  ◦ Failure of the spu-monitoring or cold-sync-monitoring processes.
	  ◦ A chassis cluster IP monitoring failure.
	• Off–The node is not configured for clustering or it has been disabled by the dual membership and detection recovery process in reaction to a control link or fabric link failure.
	LINK/ACT LED, one for each of the two ports **CHASSIS CLUSTER CONTROL 0** and **CHASSIS CLUSTER CONTROL 1**:
	• Green–Chassis cluster control port link is active.
	• Off–No link.

Table 64: MX-SPC3 Services Card Compatibility with MX Series Switch Fabrics, Routing Engines and MPC Line Cards

Switch Fabric	Route Engine	MPC Line Cards
SCBE	RE-S-1800X4-16G-UPG-BB RE-S-1800X4-32G-UB	MPC2E-3D MPC2-3D-NG MPC3E and MPC3E-3D-NG MPC4E-3D MPC-3D-16XGE
SCBE2	RE-S-1800X4-16G-UPG-BB RE-S-1800X4-32G-UB RE-S-X6-64G-UB RE-S-X6-64G-S RE-S-X6-64G-S-R RE-S-X6-64G-S-BB RE-S-X6-128G-S-S RE-S-X6-128G-S-R RE-S-X6-128G-S-BB	MPC2E-3D MPC2-3D-NG MPC3E and MPC3E-3D-NG MPC4E-3D MPC5E and MPC5EQ MPC7E and MPC7EQ MPC-3D-16XGE

Table 65 on page 123 provides a summary of Next Gen Services supported by MX-SPC3.

Table 65: Next Gen Services Supported by MX-SPC3 Services Card

Next Gen Services Supported by MX-SPC3 Services Card		
Carrier Grade NAT	19.3R2	Basic-NAT44
		Basic-NAT66
		Dynamic-NAT44
		Static Destination NAT
		Basic-NAT-PT
		NAPT-PT
		NAPT44
		NAPT66
		Port Block Allocation
		Deterministic-nat44 and nat64
		End Point Independent Mapping (EIM)/End Point
		Independent Filtering (EIF)
		Persistent NAT – Application Pool Pairing (APP)
		Twice-NAT44 – Basic, Dynamic and NAPT
		NAT64
		XLAT-464
		NPTv6
	20.1R1	Port Control Protocol (PCP) – v1 and v2
	20.2R1	DS-Lite
		NAT46

Table 65: Next Gen Services Supported by MX-SPC3 Services Card *(continued)*

Next Gen Services Supported by MX-SPC3 Services Card		
Stateful Firewall Services	19.3R2	
Intrusion Detection Services (IDS)		
Traffic Load Balancer		
DNS Request Filtering		
Aggregated Multiservices Interfaces		
Inter-chassis High Availability	19.3R2	CGNAT, Stateful Firewall, and IDS Flows
URL Filtering	20.1R1	
See *Protocols and Applications Supported by MX-SPC3 Services Card* for information about the protocols and applications that this SPC3 supports.		

SEE ALSO

MX-SPC3 Services Card Overview and Support on MX240, MX480, and MX960 Routers | **117**

CHAPTER 9

Power System Components and Descriptions

IN THIS CHAPTER

MX960 Power System Overview

The MX960 router uses either AC, DC, or universal (HVAC or HVDC) 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.

The MX960 router is configurable with one of these options:

- Three or four normal-capacity AC power supplies
- Up to four high-capacity DC power supplies
- Up to four high-capacity AC power supplies
- Up to four high-capacity second-generation AC power supplies
- Up to four high-voltage second-generation universal (HVAC or HVDC) power supplies

CAUTION: The router cannot be powered from AC and DC power supplies simultaneously. The first type of power supply detected by the router when initially powered on determines the type of power supply allowed by the router. All installed power supplies of the other type are disabled by the router. If you install a power supply of the other type while the router is operating, the router disables the power supply and generates an alarm.

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

Unlike systems with previous MX960 AC supplies, the systems with MX Series high-capacity power supplies are zoned. No current sharing between power supplies is needed with the upgraded system because the redundancy changes from 3+1 per system to 1+1 per zone. For MX960 AC configurations, two zones are present. Two adjacent power supplies need to be installed in the chassis with two feeds attached.

NOTE: Two AC power cables are required when installing the high-capacity AC power supplies or high-capacity second-generation AC power supplies.

NOTE: Routers configured with DC power supplies, high-capacity second-generation AC power supplies, and high-voltage second-generation universal (HVAC/HVDC) power supplies are shipped with a blank panel installed over the power distribution modules. Routers configured with normal-capacity AC power supplies and high-capacity AC power have no blank panel.

NOTE: When upgrading to enhanced power supplies, always upgrade power supplies in adjacent slots.

RELATED DOCUMENTATION

Troubleshooting the MX960 Power System | 685
MX960 AC Power Supply Description | 127
MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply Description | 140
MX960 DC Power Supply | 138

MX960 AC Power Supply Description

IN THIS SECTION

Four types of AC power supplies can be used: normal-capacity, high-capacity, high-capacity second-generation, and high-voltage second-generation universal (HVAC/HVDC) power supplies (for more information on the HVAC/HVDC power supplies, see "MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply Description" on page 140. Each of the high-capacity power supplies has a corresponding AC receptacle located in the MX960 chassis directly above the power supply. High-capacity second-generation have two AC receptacles on the power supply itself. Each receptacle requires a dedicated AC power feed and a dedicated breaker. For all power supplies the circuit breaker protection should be designed according to National Electrical Code (NEC) or any similar local standard based on maximum drawn current of the power supply specified in this document. See "AC Power Cord Specifications for the MX960 Router" on page 217 for more details.

Normal-capacity AC power supply configurations have one overall zone that provides power to all components in the MX960 chassis. The DC and high-capacity AC, and high-capacity second-generation AC power supply configurations have two zones each of which provide power to specific components in the MX960 chassis.

Figure 32 on page 128 and Figure 33 on page 128, Figure 34 on page 129, and Figure 35 on page 130 illustrate normal-capacity and high-capacity AC power supplies for the MX960.

Figure 32: MX960 Normal-Capacity AC Power Supply

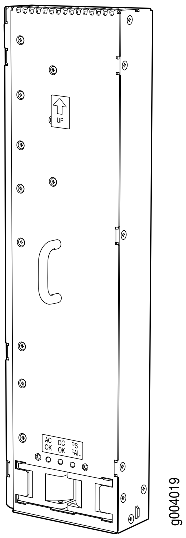
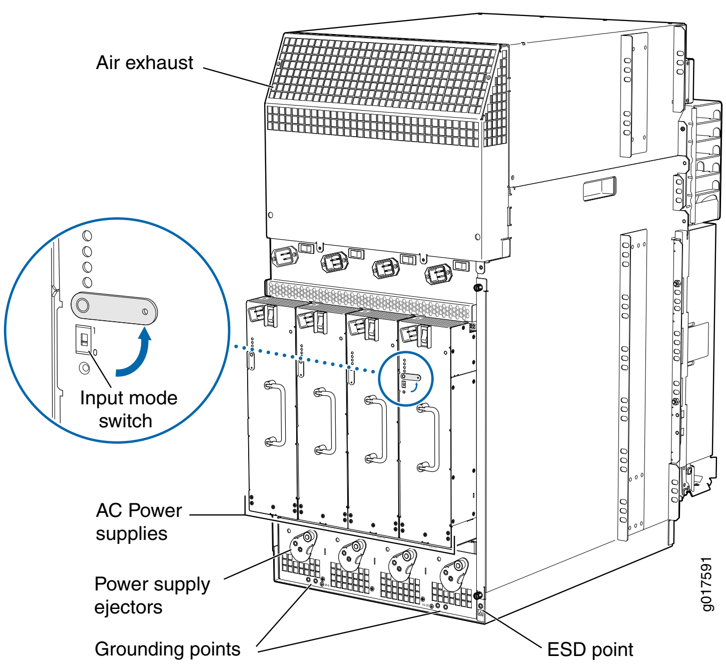


Figure 33: MX960 with High-Capacity AC Power Supplies Installed



NOTE: The chassis is shown with the extended cable manager.

Figure 34: MX960 High-Capacity Second-Generation AC Power Supply

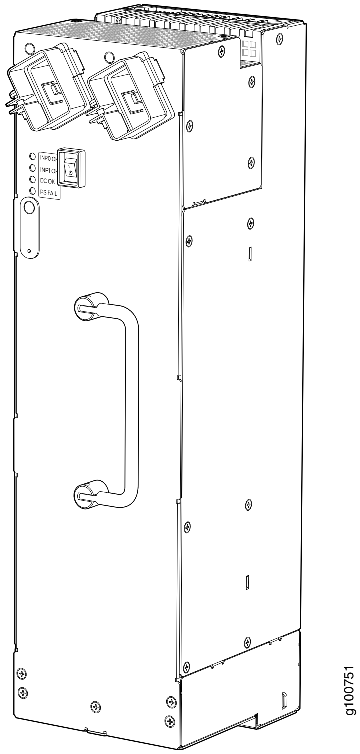
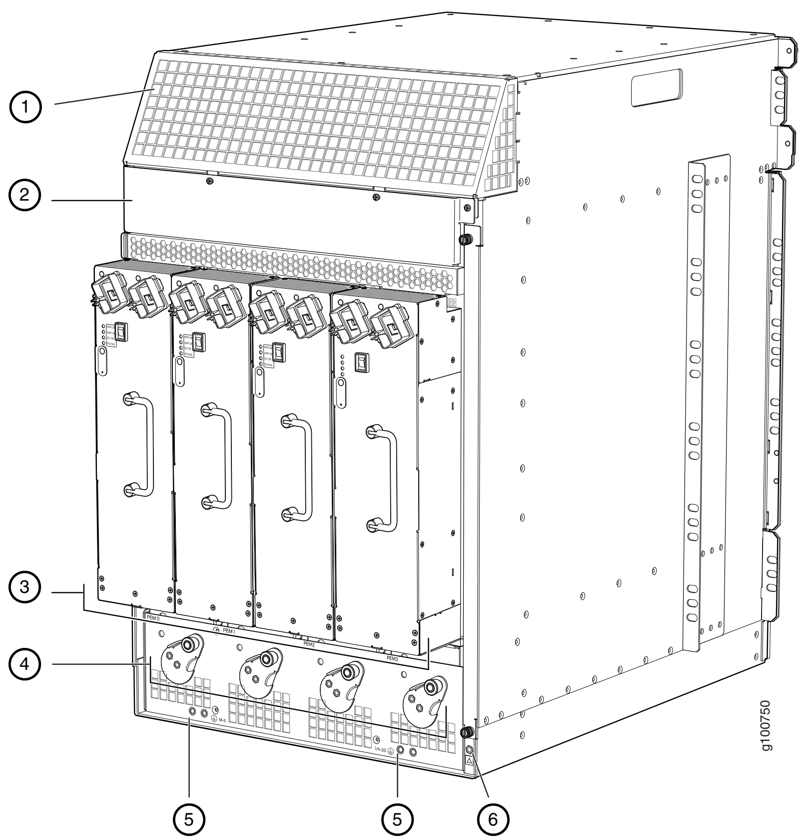


Figure 35: MX960 with High-Capacity Second-Generation AC Power Supplies Installed



1–Air exhaust	4–Power supply ejectors
2–Power distribution unit cover	5–Grounding points
3–Power supplies	6–ESD

NOTE: The chassis is shown without the extended cable manager.

The minimum number of power supplies must be present in the router at all times. Refer to Table 66 on page 130.

Table 66: Minimum Number of Power Supplies Required for the MX960

Router Model	Configuration	Minimum Required Number of Power Supplies	Model Number
MX960	High-capacity AC	One per zone x two zones = 2 power supplies	PWR-MX960-4100-AC

Table 66: Minimum Number of Power Supplies Required for the MX960 *(continued)*

MX960	Normal-capacity AC	Three power supplies	PWR-MX960-AC
MX960	High-capacity second-generation AC	One per zone x two zones = 2 power supplies	MX960-PSM-5K-AC

Normal-Capacity AC Power Supplies

The MX960 can be powered by three normal-capacity AC power supplies (non-redundant configuration) or four normal-capacity AC power supplies (redundant configuration). In a non-redundant configuration, the three AC power supplies share power almost equally within a fully-populated MX960 system. In a redundant configuration there is full power redundancy meaning if one power supply fails or is removed, the remaining power supplies instantly assume the entire electrical load without interruption and provide full power for the maximum configuration for as long as the router is operational.

NOTE: Each normal-capacity power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker. Juniper recommends that you use a 15 A (250 VAC) minimum, or as required by local code.

High-Capacity AC Power Supplies

The MX960 can also be powered by two high-capacity AC power supplies. The high-capacity power supplies must be installed in adjacent slots in the chassis. They can operate in one-feed mode or two-feed mode. The maximum inrush current for a high-capacity AC power supply is 38 A per feed at 264 VAC.

In one-feed mode, the power supplies output power at a reduced capacity (1700W). In two-feed mode, the power supplies provide power at full capacity (4100W). To operate the MX960 at full capacity, you must use two-feed mode. High-capacity power supplies require one power cord per feed. Therefore, to operate the MX960 at full capacity, you will need four power cords.

Each high-capacity AC power supply accepts two AC feeds in two unique AC receptacles, one receptacle located on the chassis and the other on the power supply.

When using the high-capacity AC power supplies in one-feed mode, plug one end of the power cord into the corresponding AC receptacle directly above the power supply in the chassis and the other end into an AC outlet. When using the high-capacity power supply in two-feed mode, you need two power cords. Plug one power cord into the AC receptacle on the chassis and then plug the other end into an AC outlet. Next, plug the second power cord into the AC receptacle on the AC power supply and plug the other end into an AC outlet.

In high-capacity AC power supply configurations, there are two zones that provide power to specific components in the MX system. No current sharing between power supplies is needed with the high-capacity system because the redundancy changes from 3+1 per system to 1+1 per zone.Table 67 on page 132 lists the components that receive power for each zone in a high-capacity AC power supply configuration.

Table 67: Zoning for High-Capacity Power Supplies in an MX960

Chassis Power Configuration	Zone	Power Supply (PEM)	Components Receiving Power
MX960 AC high-capacity power supplies	Zone 0	PEM 0 or 2	• Lower fan tray • DPC/MPC slots 6 through 11 • SCB slots 1 through 2
MX960 AC high-capacity power supplies	Zone 1	PEM 1 or 3	• Upper fan tray • DPC/MPC slots 0 through 5 • SCB slot 0

High-Capacity Second-Generation AC Power Supplies

The MX960 can also be powered by four high-capacity second-generation AC power supplies. The high-capacity second-generation power supplies must be installed in adjacent slots in the chassis. They can operate in either one-feed mode or two-feed mode. The maximum inrush current per feed for a high-capacity AC power supply is 38 A per feed at 264 VAC.

In the one-feed mode, the power supplies provide power at a reduced capacity (2000 W). In the two-feed mode, the power supplies provide power at full capacity (5100 W). To operate the MX960 at full capacity, you must use the two-feed mode. High-capacity second-generation AC power supplies require one power cord per feed. Therefore, to operate the MX960 at full capacity, you need eight power cords.

Each high-capacity second-generation AC power supply accepts two AC feeds in two C19/C20 AC receptacles, both receptacles are located on the power supply. Do not use the receptacle located on the chassis. For supported power cables, see “AC Power Cord Specifications for the MX960 Router” on page 217.

When using the high-capacity second-generation AC power supplies in one-feed mode, plug one end of the power cord into the corresponding AC receptacle directly on the power supply and the other end into an AC outlet. When using the high-capacity second-generation AC power supply in two-feed mode, you need two power cords. Plug both power cords into the AC receptacles on the power supply the other ends of the cable into AC outlets.

In high-capacity second-generation AC power supply configurations, there are two zones that provide power to specific components in the MX system. Redundancy is 1+1 per zone. Table 67 on page 132 lists the components that receive power for each zone in a high-capacity AC power supply configuration.

Table 68: Zoning for High-Capacity Second-Generation Power Supplies in an MX960

Chassis Power Configuration	Zone	Power Supply (PEM)	Components Receiving Power
High-capacity second-generation AC power supplies	Zone 0	PEM 0 or 2	• Lower fan tray DPC/MPC slots 6 through 11 • SCB slots 1 through 2
High-capacity second-generation AC power supplies	Zone 1	PEM 1 or 3	• Upper fan tray DPC/MPC slots 0 through 5 • SCB slot 0

Understanding Input Mode Switch (DIP Switch) Settings

Each PSM has two input mode switches (DIP switches) on the faceplate. The DIP switches provide critical information to the power management subsystem to help generate alarms in case of a feed failure or a wrong connection. Each PSM has an LED per feed indicating whether the feed is active and whether the feed is properly connected. You must set the DIP switch on each high-capacity AC or high-capacity second-generation AC power supply according to how many feeds are connected. When one feed is connected, the system is running in reduced capacity mode. When two feeds are connected the system is running in full-capacity mode. Use these DIP switch settings:

- **Position-0** indicates one AC feed is present
- **Position-1** indicates two AC feeds are present

Refer to Figure 36 on page 133.

Figure 36: Setting the Input Mode Switch (DIP Switch)

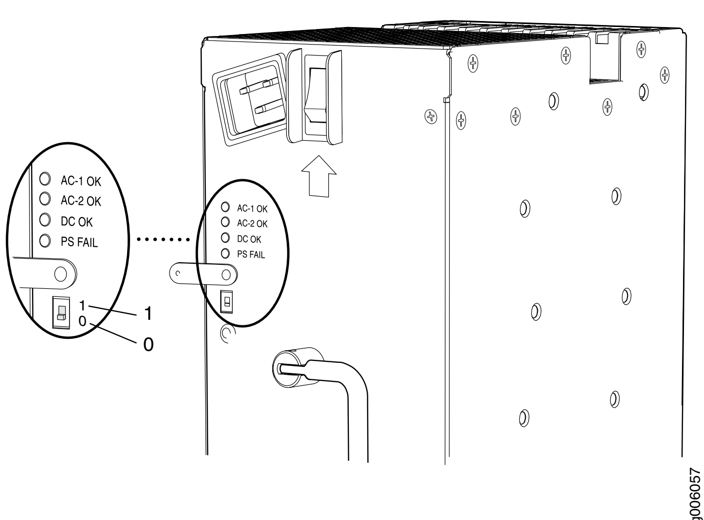
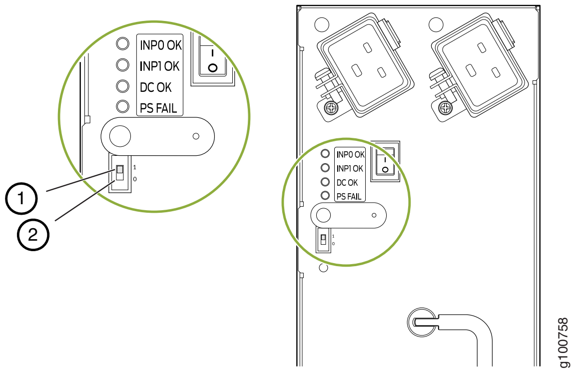


Figure 37: Setting the Input Mode Switch (DIP Switch) on High-Capacity Second-Generation AC PSM



1—Position **1** indicates two AC feeds are present	2—Position **0** indicates one AC feeds is present

Use the **show chassis power** command to verify that the DIP switch settings on the high-capacity AC power supplies are set to the correct position. Here are examples of the command output:

Example 1: Proper setting of the DIP switch

`user@host>`**show chassis power**

```
PEM 0:
  State:      Online
  AC input:   OK (2 feed expected, 2 feed connected)
  Capacity:   4100 W (maximum 4100 W)
  DC output: 855 W (zone 0, 15 A at 57 V, 20% of capacity)

PEM 1:
  State:      Online
  AC input:   OK (1 feed expected, 1 feed connected)
  Capacity:   1700 W (maximum 4100 W)
  DC output: 969 W (zone 1, 17 A at 57 V, 57% of capacity)
```

In Example 1, **PEM 0** is running at full capacity (4100 W) with two AC feeds expected and two AC feeds connected. This indicates that the DIP switch is properly set to **Position 1** since two AC feeds are connected. The example also shows that **PEM 1** is running at reduced capacity (1700W) with one AC feed expected and one AC feed connected. This indicates that the DIP switch is correctly set to **Position 0** since one feed is present.

Example 2 shows the **show chassis power** command output when the DIP switch is set improperly:

Example 2: Improper Setting of the DIP Switch

`user@host>`**show chassis power**

```
PEM 0:
  State:      Online
  AC input:   OK (2 feed expected, 2 feed connected)
  Capacity:   4100 W (maximum 4100 W)
  DC output:  0 W (zone 0, 0 A at 56 V, 0% of capacity)

PEM 1:
  State:      Present
  AC input:   Check (2 feed expected, 1 feed connected)
  Capacity:   1700 W (maximum 4100 W)
```

The **PEM 0** status indicates the system is **Online**, the **AC Input** is **OK**, is running at full capacity (4100 W) with two AC feeds expected and two AC feeds connected. But notice the status for **PEM 1**. The **State** is **Present** and the **AC input** is **Check (2 feed expected, 1 feed connected)**. This indicates there is a mismatch between the DIP switch setting and the number of feeds connected. Therefore, the power supply is running at reduced capacity (1700 W). If PEM 1 should be running at full-capacity, verify that there are two feeds connected to the power supplies and the DIP switch is set to position 1.

RELATED DOCUMENTATION

MX960 Router Grounding Specifications | 194

Electrical Specifications for the MX960 AC Power Supply

Electrical Specifications for the MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | 243

Calculating Power Requirements for MX960 Routers | 212

Power Requirements for an MX960 Router | 202

AC Power Circuit Breaker Requirements for the MX960 Router | 217

High-Voltage Second-Generation Universal (HVAC or HVDC) Power Circuit Breaker Requirements for the MX960 Router | 259

AC Power Cord Specifications for the MX960 Router | 217

High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router | 260

Site Electrical Wiring Guidelines for MX Series Routers

Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies | 352

Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies | 354

Connecting Power to an AC-Powered MX960 Router with High-Capacity Second-Generation Power Supplies | 358

MX960 Power Supply LEDs on the Craft Interface | 18

MX960 AC Power Supply LEDs

Each AC power supply faceplate contains three LEDs that indicate the status of the power supply (see Table 69 on page 136and Table 70 on page 137). The power supply status is also reflected in two LEDs on the craft interface In addition, a power supply failure triggers the red alarm LED on the craft interface.

Table 69: AC Power Supply LEDs

Label	Color	State	Description
AC OK	Green	Off	AC power applied to power supply is not within the normal operating range.
		On	AC power applied to power supply is within the normal operating range.
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. Check **AC OK** and **DC OK** LEDs for more information.

Each high-capacity second-generation AC power supply faceplate contains four LEDs that indicate the status of the power supply (see Figure 38 on page 137 and Table 70 on page 137).

Figure 38: High-Capacity Second-Generation AC Power Supply LEDs

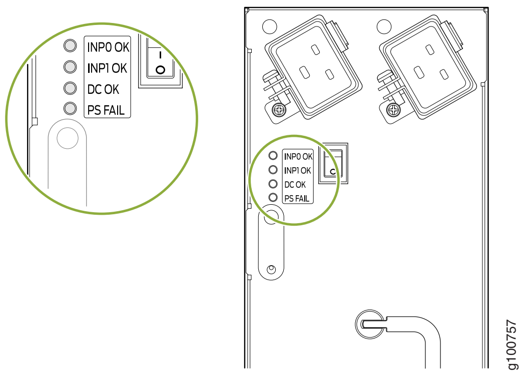


Table 70: High-Capacity Second-Generation AC Power Supply LEDs

Label	Color	State	Description
INP0 OK	Green	Off	AC power applied to power supply is not within the normal operating range.
		On	AC power applied to power supply is within the normal operating range.
INP1 OK	Green	Off	AC power applied to power supply is not within the normal operating range.
		On	AC power applied to power supply is within the normal operating range.
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. Check **AC OK** and **DC OK** LEDs for more information.

RELATED DOCUMENTATION

MX960 Chassis Description | 5
MX960 Power System Overview | 125
MX960 AC Power Supply Description | 127

MX960 DC Power Supply

In the DC power configuration, the router contains either two or four DC power supplies (see Figure 39 on page 138), located at the lower rear of the chassis in slots **PEM0** through **PEM3** (left to right). You can upgrade your DC power system from two to four power supplies. The DC power supplies in slots **PEM0** and **PEM2** provide power to the lower fan tray, DPC slots **6** through **11**, and SCB slots **1** and **2**. The DC power supplies in slots **PEM1** and **PEM3** provide power to the upper fan tray, DPC slots **0** through **5**, and SCB slot **0**.

Four power supplies provide full redundancy. If a DC power supply fails, its redundant power supply takes over without interruption.

For existing power supplies, each DC power supply has a single DC input (–48 VDC and return). For high-capacity power supplies, each DC power supply has two DC inputs (–48 VDC and return).

The minimum number of power supplies must be present in the router at all times. See Table 71 on page 138 for the minimum required number of power supplies.

Table 71: Minimum Required Number of DC Power Supplies

Router Model	Configuration	Minimum Required Number of Power Supplies	Model Number
MX960	High-capacity DC	One per zone x two zones = 2 power supplies	PWR-MX960-4100-DC
MX960	Normal-capacity DC	2	PWR-MX960-DC

Figure 39: DC Power Supply

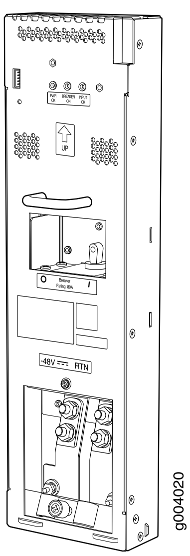
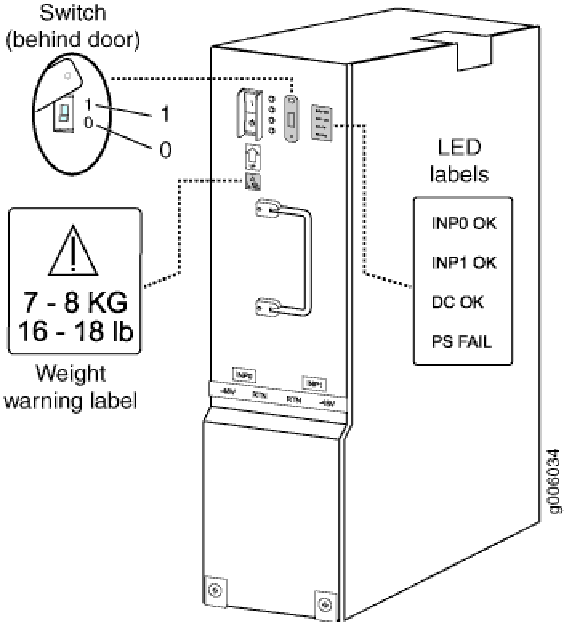


Figure 40: High-Capacity DC Power Supply



Each high-capacity DC power supply supports two DC feeds. You must set the input mode switch according to the number of DC feeds available for the power entry module(PEM). The input mode switch positions **0** and **1** indicate the following:

- **Position 0**—Indicates that only one DC feed is provided.
- **Position 1**—Indicates that two DC feeds are provided.

RELATED DOCUMENTATION

MX960 DC Power Supply LEDs | **140**

MX960 Router Grounding Specifications | **194**

Calculating Power Requirements for MX960 Routers | **212**

DC Power Circuit Breaker Requirements for the MX960 Router | **239**

DC Power Source Cabling for the MX960 Router | **239**

DC Power Cable Specifications for the MX960 Router | **241**

Site Electrical Wiring Guidelines for MX Series Routers

MX960 DC Power Supply LEDs

Each DC power supply faceplate contains three LEDs that indicate the status of the power supply (see Table 72 on page 140). The power supply status is also reflected in two LEDs on the craft interface. In addition, a power supply failure triggers the red alarm LED on the craft interface.

Table 72: 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.
BREAKER ON	Green	Off	DC power supply circuit breaker is turned off.
		On	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.
	Yellow	On	DC input is present, but connected in reverse polarity.

RELATED DOCUMENTATION

MX960 Power Supply LEDs on the Craft Interface | 18
MX960 Power System Overview | 125
MX960 AC Power Supply Description | 127
MX960 DC Power Supply | 138
Electrical Specifications for the MX960 DC Power Supply

MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply Description

The MX960 can be powered by four high-voltage second-generation universal power supplies (MX960-PSM-HV). The MX960-PSM-HV supports high-voltage alternating current (HVAC), or high-voltage direct current (HVDC.) The MX960-PSM-HV power supplies must be installed in adjacent slots in the chassis. The MX960-PSM-HV (HVAC/HVDC) power supply has one power inlet on front panel of the power supply rated at 30 A. The inlet requires a dedicated power feed and a dedicated breaker. For all power supplies the circuit breaker protection should be designed according to National Electrical Code (NEC) or any similar local standard based on maximum drawn current of the power supply specified in this document. See “High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router” on page 260 for more details.

The MX960-PSM-HV (HVAC/HVDC) power supply configurations are zoned meaning that certain components in the MX960 chassis are powered by specific power supplies.

Figure 41 on page 141 and Figure 42 on page 142 illustrates MX960-PSM-HV (HVAC/HVDC) power supplies for the MX960.

Figure 41: MX960-PSM-HV (HVAC/HVDC) Power Supply

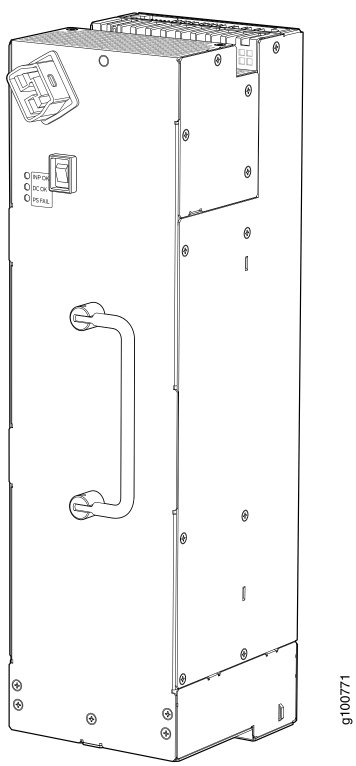
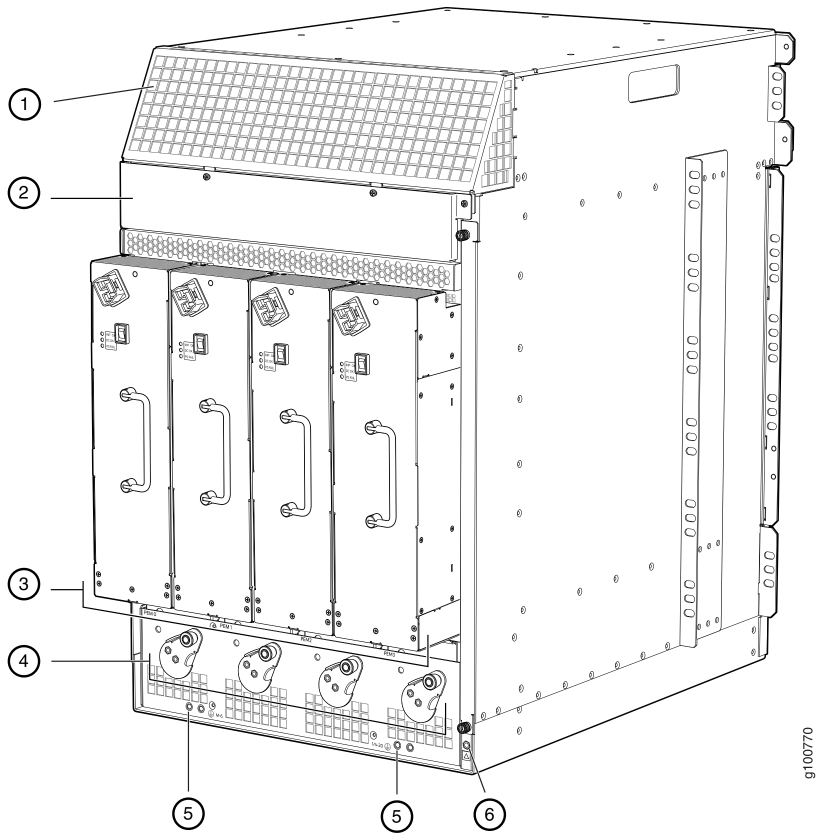


Figure 42: MX960-PSM-HV (HVAC/HVDC) Power Supplies Installed



1–Air exhaust	4–Power supply ejectors
2–Power distribution unit cover	5–Grounding points
3–Power supplies	6–ESD

NOTE: The chassis is shown without the extended cable manager.

The minimum number of power supplies must be present in the router at all times. Refer to Table 66 on page 130.

Table 73: Minimum Number of Power Supplies Required for the MX960

Router Model	Configuration	Minimum Required Number of Power Supplies	Model Number
MX960	HVAC or HVDC	One per zone x two zones = 2 power supplies	MX960-PSM-HV

RELATED DOCUMENTATION

MX960 Router Grounding Specifications | 194

Electrical Specifications for the MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | 243

Calculating Power Requirements for MX960 Routers | 212

Power Requirements for an MX960 Router | 202

High-Voltage Second-Generation Universal (HVAC or HVDC) Power Circuit Breaker Requirements for the MX960 Router | 259

High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router | 260

Site Electrical Wiring Guidelines for MX Series Routers

MX960 Power Supply LEDs on the Craft Interface | 18

MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply LEDs

Each high-voltage second-generation universal (MX960-PSM-HV) power supply faceplate contains three LEDs that indicate the status of the power supply (see Figure 43 on page 143). The power supply status is also reflected in two LEDs on the craft interface In addition, a power supply failure triggers the red alarm LED on the craft interface.

Figure 43: MX960-PSM-HV (HVAC/HVDC) Power Supply LEDs

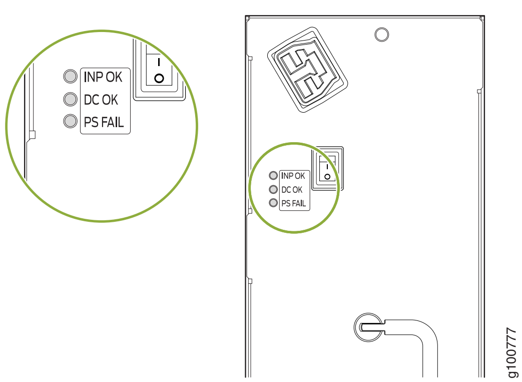


Table 74: MX960-PSM-HV (HVAC/HVDC) Power Supply LEDs

Label	Color	State	Description
INP OK	Green	Off	AC power applied to power supply is not within the normal operating range.
		On	AC power applied to power supply is within the normal operating range.
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. Check **AC OK** and **DC OK** LEDs for more information.

RELATED DOCUMENTATION

MX960 Chassis Description | 5
MX960 Power System Overview | 125
MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply Description | 140

CHAPTER 10

Switch Control Board Components and Descriptions

IN THIS CHAPTER

MX-Series Switch Control Board (SCB) Description

At the heart of the MX Series 5G Universal Routing Platform is the Switch and Control Board (SCB). The SCB is a single-slot card and has a carrier for the routing engine in the front. It has three primary functions: switch data between the line cards, control the chassis, and house the routing engine.

The MX-Series SCB:

- Controls power to MPCs
- Manages clocking, resets and boots
- Monitors and controls systems functions, such as the fan speed, Power Distribution Module (PDM) status, and the system front panel.

The switch fabric is Integrated into the SCB, interconnecting all the DPCs and MPCs within the chassis and supporting up to 48 Packet Forwarding Engines. The routing engine installs directly into the SCB.

The number of SCBs supported varies, depending on the MX chassis and the level of redundancy. The MX240 and MX480 require two SCBs for 1+1 redundancy, whereas the MX960 requires three SCBs for 2+1 redundancy.

There are four generations of SCBs for the MX Series 5G Universal Routing Platform: SCB-MX, SCBE-MX, SCBE2-MX, and SCBE3-MX.

- SCB-MX is the first-generation switch control board. The SCB-MX is designed to work with first-generation DPC line cards.
- The SCBE-MX is the second generation switch control board and is designed specifically for use with MPC3E line cards to provide full line-rate performance and redundancy without a loss of bandwidth.
- The SCBE2-MX provides improved fabric performance for high-capacity line cards using the third generation fabric XF2 chip (MPC4E, MPC5E, MPC2/3 NG, and MPC7E).
- The SCBE3-MX Enhanced Switch Control Board provides improved fabric performance and bandwidth capabilities for high-capacity line cards using the ZF-based switch fabric.

Table 4 on page 3 compares the SCB capacities of the MX Series 5G Universal Routing Platforms.

Table 76 on page 147 lists the supported routing engines per SCB.

Table 75: Switch Control Board Capacities for MX Series 5G Universal Routing Platforms (Full-Duplex)

Description	Fabric Bandwidth Per Slot	MX240 Fabric Bandwidth	MX480 Fabric Bandwidth	MX960 Fabric Bandwidth
Enhanced MX Switch Control Board (SCBE3-MX)	Up to 1.5 Tbps (non-redundant fabric configuration with MPC10E line cards); 1 Tbps (redundant fabric configuration with MPC10E line cards)	Up to 6 Tbps	Up to 18 Tbps	Up to 33 Tbps
Enhanced MX Switch Control Board (SCBE2-MX)	Up to 480 Gbps (non-redundant fabric configuration); 340 Gbps (redundant fabric configuration)	Up to 1.92 Tbps	Up to 5.76 Tbps	Up to 10.56 Tbps
Enhanced MX Switch Control Board (SCBE-MX)	Up to 240 Gbps (non-redundant fabric configuration); 160 Gbps (redundant fabric configuration)	Up to 930 Gbps	Up to 2.79 Tbps	Up to 5.25 Tbps
Switch Control Board (SCB-MX)	Up to 240 Gbps (non-redundant fabric configuration); 120 Gbps (redundant fabric configuration)	Up to 465 Gbps	Up to 1.39 Tbps	Up to 2.6 Tbps

Table 76: Supported Routing Engines for MX Series 5G Universal Routing Platforms Switch Control Boards

Switch Control Board	First Supported Routing Engines
SCBE3-MX	RE-S-1800x2 RE-S-1800x4 RE-S-X6-64G RE-S-X6-128G RE-S-X6-64G-LT
SCBE2-MX	RE-S-1300 (EOLed) RE-S-2000 (EOLed) RE-S-1800 (all variants) RE-S-X6-64G RE-S-X6-128G
SCBE-MX	RE-S-1300 (EOLed) RE-S-2000 (EOLed) RE-S-1800 (all variants)
SCB-MX	RE-S-1300 (EOLed) RE-S-2000 (EOLed) RE-S-1800

CLI Identification

The SCBs are identified in the CLI as:

SCB Model	CLI Identification
SCB-MX	**MX SCB**
SCBE-MX	**Enhanced MX SCB**
SCBE2-MX	**SCBE2-MX-S**

SCB Model	CLI Identification
SCBE3-MX	**SCBE3-MX-S**

user@host> **show chassis hardware | match SCB**

```
Item  Version  Part Number Serial Number Description
CB0  REV 07 710-021523 ABBC8281  MX SCB
CB1  REV 07 710-021523 ABBC8323  MX SCB
CB2  REV 07 710-021523 ABBD1410  MX SCB
```

user@host> **show chassis hardware models | match SCBE**

```
Item  Version  Part Number Serial Number Description
CB0  REV 02 750-031391 YE8505  Enhanced MX SCB
CB1  REV 07 710-031391 YL6769  Enhanced MX SCB
CB2  REV 07 710-031391 YE8492  Enhanced MX SCB
```

user@host> **show chassis hardware models | match SCBE2**

```
Item  Version  Part Number Serial Number Description
CB0  REV 01 750-062572 CAGN2123  SCBE2-MX-S
CB1  REV 07 750-062572 CAGN2456  SCBE2-MX-S
CB2  REV 07 750-062572 CAGN2789  SCBE2-MX-S
```

user@host> **show chassis hardware models | match SCBE3**

```
Item             Version  Part number  Serial number     FRU model number
 CB 0             REV 23   750-070866   CALH6007          SCBE3-MX-S
 CB 1             REV 23   750-070866   CALH6017          SCBE3-MX-S
 CB 2             REV 23   750-070866   CALH6015          SCBE3-MX-S
```

Power Requirements for Switch Control Boards

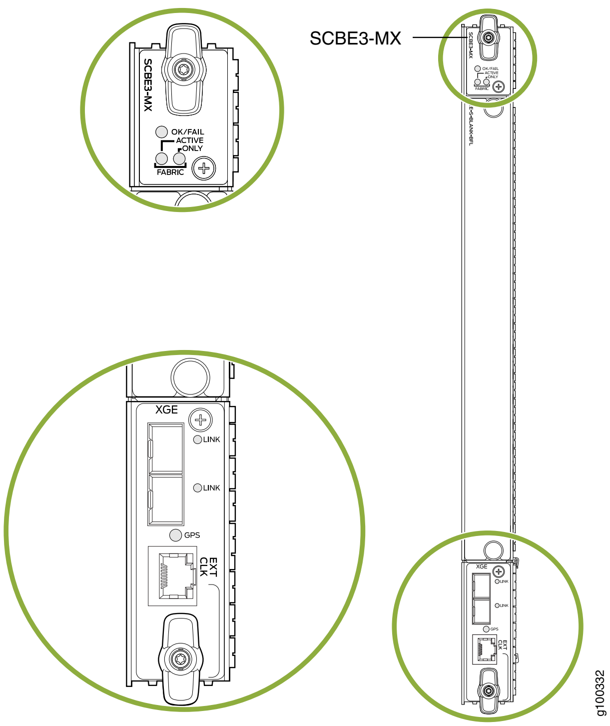
Component	Part Number	Maximum Power Requirement
"SCB-MX" on page 169	SCB-MX (applies to MX240, MX480, and MX960)	185 W at 55° C 160 W at 40° C 155 W at 25° C
"SCBE-MX" on page 164	SCBE-MX (applies to MX240, MX480, and MX960)	160 W at 55° C 130 W at 40° C 120 W at 25° C
"SCBE2-MX" on page 157	SCBE2-MX (applies to MX240, MX480, and MX960)	185 W at 55° C 160 W at 40° C 155 W at 25° C
"SCBE3-MX" on page 149	SCBE3-MX (applies to MX240, MX480, and MX960)	275 W at 55° C 260 W at 40° C 245 W at 25 C°

SCBE3-MX Description

IN THIS SECTION

The SCBE3-MX Enhanced Switch Control Board provides improved fabric performance and bandwidth capabilities for high-capacity line cards using the ZF-based switch fabric. In a redundant configuration, the SCBE3-MX provides fabric bandwidth of up to 1 Tbps per slot. In a non-redundant configuration the SCBE3-MX provides fabric bandwidth of up to 1 Tbps per slot (four fabric planes) and 1.5 Tbps per slot fabric bandwidth when all six fabric planes are used (with MPC10E line cards). The SCBE3-MX is supported on Junos 18.4R1 and later releases. It is installed vertically into the MX960 chassis, and horizontally in the MX480 and MX240 chassis.

Figure 44: SCBE3-MX



Software release	Junos OS Release 18.4R1 and later Name in CLI: **SCBE3-MX-S**

SCBE3-MX LEDs	**OK/FAIL**—A green LED indicates the board is OK. A red LED indicates the board has failed. If the LED is not lit, the SCBE3-MX is offline. **FABRIC ACTIVE**—A green LED indicates the switch fabric on this board is in Active mode. **FABRIC ONLY**—A green LED indicates the switch is in fabric-only mode and on slot 8. **XGE Port LINK**—Indicates the status of the respective SFP+ interface. **GPS EXT CLK**—Indicates the status of the GPS clocking interface. If the LED is green, the link is OK. If the LED is blinking amber, there is activity on the clocking interface.
SCBE3-MX Weights and Dimensions	Physical: • Weight: 13.6 lb (6.2 kg) • Width: 15.7 in (39.87 cm) • Depth: 21.2 in (53.85 cm) • Height: 1.2 in (3.05 cm) Shipping box: • Weight: 19.9 lb (9.03 kg) • Width: 24.5 in (62.2 cm) • Depth: 29.5 in (74.93 cm) • Height: 7.5 in (19.05 cm)
SCBE3-MX Power and Cooling Requirements	For efficient and reliable power and cooling, you must install MX-series high-capacity power supplies and fan trays in the MX chassis. Additionally, for the MX960, you must install a high-capacity filter tray. **NOTE:** If you are using old fan trays and the internal temperature of the chassis exceeds 25° C, the chassis may overheat and a shutdown may occur.

SCBE3-MX Components and Features

Component/Feature	Description
XGE ports	Two Ethernet ports provide 10 GE/1 GE SFP+ interfaces. These ports also are connected to the Ethernet control switch which limits the traffic for the 10 GE port and provides security to prevent unwanted access to the control plane via the external ports.

Component/Feature	Description
GPS port	One RJ-45 GPS external clock interface port receives GPS and PPS timing from the GPS external interface. A red LED indicates there is no clock present or the clock is not OK. A green LED indicates the clock interface is active and OK. If the LED is off, the clock interface is not enabled.
External clock interface	The external clock interface is on the SCBE3-MX front panel. The clock source interface receives GPS and PPS timing from the GPS external interface.
Centralized Stratum3E clock module	The clock module performs clock monitoring, filtering, and holdover on the centralized fabric card. This centralized clocking architecture also provides clock cleanup and distribution.
In-system removable Routing Engine	The in-system Routing Engine can support any new Routing Engine that conforms to the standard modular Routing Engine I/O interface and form factor. **NOTE:** When a Routing Engine is not installed in the SCBE3-MX, you need to cover the empty slot with a blank panel.
Hot-Swappable	The SCBE3-MX and associated Routing Engine assembly are hot-swappable. The system software provides a mechanism to shut down, or acquiesce the Routing Engine/SCBE3-MX. The system software also provides a method to reset or reboot the Routing Engine/SCBE3-MX. This support is provided via cli commands, and various hardware support circuits. **NOTE:** The Routing Engine must be brought offline prior to removal to avoid possible corruption of the hard drive.
System upgrade capabilities	See “Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX” on page 603for details.
Redundancy	With three SCBE3-MX’s installed, the MX960 router provides 2 + 1 redundancy. With two SCBE3-MX’s installed, the MX240 router and MX480 router provide 1 + 1 redundancy.
DMR	Supports Dynamic Multicast Replication (DMR)
GRES	Supports Graceful Routing Engine Switchover (GRES)
MPC line cards	Supports the MPCs listed in Table 77 on page 155.
Hitless Operation	Allows you to upgrade programmable parts and reboot with “hitless” operation if the redundant SCBE3-MX’s are inserted in the system and are operational.

Component/Feature	Description
Removable Routing Engine Module	You can remove the Routing Engine module FRU in the existing form factor.

SCBE3-MX Fabric Bandwidth Performance and Redundancy

MX960 Routers

- The MX960 system may contain up to three SCBE3-MX's to provide a total of six switch fabric planes for packet forwarding among the MPCs. Two fabric planes per SCBE3-MX's are required. To achieve full fabric bandwidth performance, three SCBE3-MX's must be installed in the MX960 chassis.
- Two chassis slots are provided in the center of the MX960 chassis in slots 6 and 7 (also designated as slot SCB 0 and slot SCB 1) for two SCBE3-MXs, each equipped with a Routing Engine.
- To provide 2 + 1 fabric redundancy for an MX960, a third SCBE3-MX must be installed in slot 8 (also designated as slot SCB 2).
- Slot 8 in the MX960 chassis is a dual-purpose slot, and supports either an SCBE3-MX or an MPC. When the SCBE3-MX/Routing Engine are plugged into slot 8, the Routing Engine is powered down and does not provide any control functionality for the board or the MX960. The fabric-only LED on the card faceplate will be lit when an SCBE3-MX/Routing Engine assembly is plugged into slot 8.
- Once redundancy is configured, the primary SCBE3-MX controls the chassis.
- Graceful upgrades can be achieved on a non-primary redundant SCBE3-MX.
- In a redundant configuration, the non-primary redundant Routing Engine can be removed or installed without affecting the switching plane functionality on the SCBE3-MX in which it resides.
- In a non-redundant configuration, all six fabric planes will be in Active mode for increased fabric bandwidth.
- There is one ZF-based switch fabric per SCBE3-MX and it acts as two virtual planes in MX960.

MX480 and MX240 Routers

- You can install either one or two SCBE3-MX's in the MX480 and MX240 router chassis in the slots labeled 0 and 1.
- The SCBE3-MX in slot 0 (SCB 0) provides two fabric planes; the SCBE3-MX in slot 1 (SCB 1) provides four fabric planes. A total of six fabric planes are available in the MX240 and MX480 routers.
- In redundant configuration, two fabric planes on the first SCBE3-MX and two fabric planes on the other SCBE3-MX will be in Active mode.
- There is one ZF-based switch fabric per SCBE3-MX and it acts as four virtual planes in the MX480 and MX240.

Two SCBE3-MX's installed in the MX240 or MX480 are required for 1 + 1 redundancy. To provide 1 + 1 fabric redundancy, there must be an SCBE3-MX installed in slot 1.

> **NOTE:**
> - If SCB 0 fails, SCB 1 will be automatically configured with four fabric planes active. In this fail over scenario, the SCBE3-MX will support full line rate 100% redundancy.
> - If SCB 1 fails, SCB 0 has only two available fabric planes; therefore, in this failover mode, the line rate will drop to 50%.

SCBE3-MX Maximum Power Consumption Per Ambient Temperature and CB slot

> **NOTE:** These power consumption values are for the SCBE3-MX only. They do not include re-allocated power.

MX Model	Ambient Temperature	Maximum Power Consumption	Slot
MX960	55°C 40°C 25C°	425 W 400 W 385 W	SCB 0, SCB 1, SCB 2
MX480	55°C 40°C 25C°	295 W 280 W 265 W	SCB 0 (Primary)
MX480	55°C 40°C 25C°	295 W 280 W 265 W	SCB 1 (Backup)
MX240	55°C 40°C 25C°	275 W 260 W 245 W	SCB 0 (Primary)

MX Model	Ambient Temperature	Maximum Power Consumption	Slot
MX240	55°C 40°C 25C°	295 W 280 W 265 W	SCB 1 (Backup)

SCBE3-MX Interoperability with Existing Hardware

Table 77: SCBE3 Interoperabilitiy with MPCs and Routing Engines

SCBE3-MX Operating Mode	MX240/480/960	Supported
Enhanced IP/Enhanced Ethernet Mode Only	DPC/MS-DPC	No
	MS-MPC	Yes
	MPC1E	No
	MPC2E	No
	MPC2E-NG	Yes
	MPC3E	Yes
	MPC3E-NG	Yes
	MPC4E	Yes
	MPC-3D-16XGE (see note)	Yes
	MPC5E	Yes
	MPC6E	No
	MPC7E (480 Gbps)	Yes
	MPC8E (960 Gbps)	No
	MPC9E (1.6 Tbps)	No
	MPC10E (1.5 Tbps)*	Yes

Table 77: SCBE3 Interoperabilitiy with MPCs and Routing Engines *(continued)*

SCBE3-MX Operating Mode	MX240/480/960	Supported
Supported Routing Engines	RE-S-1300(EOLed)	no
	RE-S-2000 (EOLed)	no
	RE-S-1800 (all variants)	yes
	RE-S-X6 (all variants)	yes

NOTE: Starting with Junos OS release 19.4, the SCBE3 interoperates with MPC-3D-16XGE and MPC10E line cards on MX240, MX480, and MX960 routers with an enhanced midplane. The MPC-3D-16x10GE linecard does not interoperate with MX240, MX480, and MX960 routers with a standard midplane.

NOTE: Hyper-mode is the default forwarding mode on the SCBE3-MX. If your deployment does not need hyper-mode, disable hyper-mode using the **set forwarding-options no-hyper-mode** cli command before installing the Routing Engine into the SCBE3-MX.

NOTE: Enhanced IP is the default network service on the SCBE3-MX.

SCBE3-MX Unsupported Functions and Capabilities from Legacy SCBs

- The SCBE3-MX does not support the external UTI/DTI interface (front panel LED and daughter card interface).
- The SCBE3-MX does not interoperate with any previous generation SCBs (SCB, SCBE, and SCBE2). Smooth upgrade is not supported.
- The SCBE3-MX does not support the MPC1/2 NEO line card or legacy I-chip based line cards.
- The SCBE3-MX does not support BITS.
- The SCBE3-MX does not support DPCs.
- The SCBE3-MX does not support mixed mode (DPC+MPC).
- The SCBE3-MX does not support the JAM release.

RELATED DOCUMENTATION

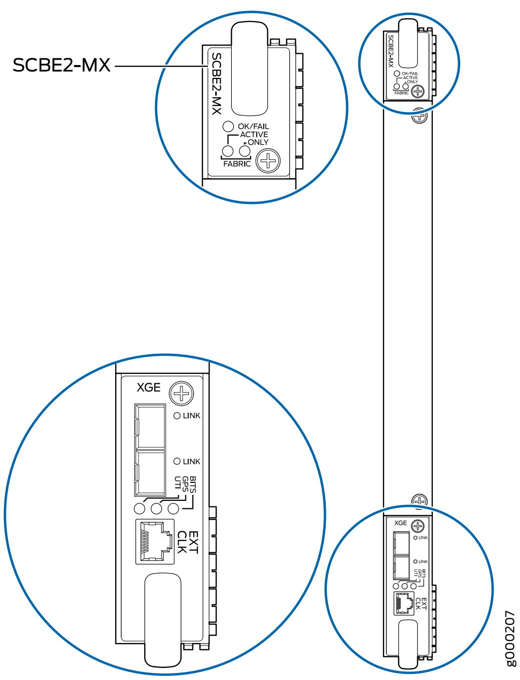
Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX | 603

SCBE2-MX Description

The MX Enhanced Switch Control Board (SCBE2-MX) serves the carrier Ethernet services router and carrier Ethernet transport markets that require higher-capacity traffic support, demanding greater interface density (slot and capacity scale) as well as improved services. The SCBE2-MX is supported on MX960, MX480, and MX240 routers.

The SCBE2-MX is installed vertically in the MX960 chassis and horizontally in the MX480 and MX240 chassis. The routing engine is installed directly into a slot on the SCBE2-MX (see Figure 45 on page 157).

Figure 45: SCBE2-MX



Software release	• Junos OS Release 13.3 R1 and later • Name in CLI: **SCBE2**
SCBE2-MX Weight and Dimensions	• Weight: 9.6 lb (4.4 kg) (with Routing Engine installed) • Width: 17 in (43.2 cm) • Depth: 22 in (55.9 cm) • Height: 1.25 in (3.2 cm) height.

SCBE2-MX Maximum Power Requirements	185 W at 55° C 160 W at 40° C 155 W at 25° C
SCBE2-MX Cooling Requirements	For proper cooling, you must install MX-series high-capacity fan trays in the MX chassis. Additionally, for the MX960, you must install a high-capacity filter tray.

SCBE2-MX Features

Feature	Description
Centralized Stratum 3 Clock Module	Provides a central clocking module and a centralized clocking architecture that supports clock cleanup and distribution. The Stratum 3 clock module performs clock monitoring, filtering, and holdover at a centralized chassis location.
External Clocking Interface (**EXT CLK**)	Allows BITS, GPS, or UTI clock source input to the centralized timing circuit. Also allows centralized timing to be output to BITS or GPS.
Cross-Coupling of Clocking Input	You can configure the system such that one SCBE2-MX supports a GPS clocking interface, and the other SCBE2-MX supports a BITS clocking interface. This requires an enhanced midplane: • MX960—CHAS-BP3-MX960-S • MX480—CHAS-BP3-MX480-S • MX240—CHAS-BP3-MX240-S
Improved Fabric Performance	Provides improved fabric performance for high-capacity line cards using the third generation fabric XF2 chip (MPC4E, MPC5E, MPC2/3 NG, and MPC7E).
Software Control Plane Features	Supports Dynamic Multicast Replication (DMR), Graceful Routing Engine Switchover (GRES), Non-Stop Routing (NSR), and Non-Stop Bridging (NSB) to ensure Routing Engine failures do not impact transit traffic while the backup Routing Engine becomes the new primary.
Increased Bandwidth	Provides up to 480 Gbps (non-redundant fabric configuration); 340 Gbps (redundant fabric configuration)
In-system removable Routing Engine	The in-system Routing Engine can support any new Routing Engine that conforms to the standard modular Routing Engine I/O interface and form factor. **NOTE:** When a Routing Engine is not installed in the SCBE2-MX, you need to cover the empty slot with a blank panel.

Feature	Description
Hot-Swappable	The SCBE2-MX and associated Routing Engine assembly are hot-swappable and do not require downtime to replace. The system software provides a mechanism to shut down, or acquiesce the Routing Engine/SCBE2-MX. The system software also provides a method to reset or reboot the Routing Engine/SCBE2-MX. This support is provided via CLI commands, and various hardware support circuits. **NOTE:** The Routing Engine must be brought offline prior to removal to avoid possible corruption of the hard drive.
Redundancy	With three SCBE2-MX's installed, the MX960 router provides 2 + 1 redundancy. With two SCBE2-MX's installed, the MX240 router and MX480 router provide 1 + 1 redundancy.
1000Base-T Ethernet Controller	Provides a 1 Gbps Ethernet link between the Routing Engines.
Hitless Operation	Allows you to upgrade programmable parts and reboot with "hitless" operation if the redundant SCBE2-MX's are inserted in the system and are operational.

SCBE2-MX Components

Component	Description
OK/FAIL, **FABRIC-ACTIVE**, **FABRIC-ONLY** LEDs	Indicate the status of the SCBE2-MX. See Table 78 on page 160.
XGE ports	Two Ethernet ports, labeled **XGE**, provide 10 GbE/1 GbE SFP+ interfaces. These ports also are connected to the Ethernet control switch which limits the traffic for the 10 GbE port and provides security to prevent unwanted access to the control plane via the external ports.
XGE port LEDs	Two **LINK** LEDs indicate the status of the **XGE** ports. See Table 78 on page 160.
EXT CLKport	The RJ-45 external clock interface port, labeled **EXT CLK**, receives GPS and PPS timing from the GPS external interface.
EXT CLK port LEDs	Three LEDs labeled **BITS**, **GPS**, and **UTI** indicate the external clocking interface status. See Table 78 on page 160.

SCBE2-MX LEDs

Table 78: SCBE2-MX LEDs

Label	Color	State	Description
FABRIC ACTIVE	Green	On steadily	Fabric is in active mode.
FABRIC ONLY	Green	On steadily	SCBE2-MX operates in fabric-only mode.
	–	Off	SCBE2-MX operates in fabric or control-board mode.
OK/FAIL	Green	On steadily	SCBE2-MX is online.
	Red	On steadily	SCBE2-MX has failed.
	–	Off	SCBE2-MX is offline.
BITS	Green	On steadily	Building-integrated timing supply (BITS) clocking interface is active.
	Red	On steadily	BITS clocking interface has failed.
	–	Off	BITS clocking interface is offline.
GPS	Green	On steadily	Global positioning system (GPS) clocking interface is active.
	Red	On steadily	GPS clocking interface has failed.
	–	Off	GPS clocking interface is offline.

Table 78: SCBE2-MX LEDs *(continued)*

Label	Color	State	Description
UTI	Green	On steadily	Universal Timing Interface (UTI) clocking interface is active.
	Red	On steadily	UTI clocking interface has failed.
	–	Off	UTI clocking interface is offline.
LINK	Green	On steadily	Port is enabled and link is established.
	–	Off	Port is disabled or no link is established.

SCBE2-MX Fabric Planes and Redundancy

For the MX960:

- Each SCBE2-MX provides two switch fabric planes for packet forwarding among the MPCs in the MX960.
- The MX960 chassis may contain up to three SCBE2-MX's Therefore, six fabric planes are available.
- Three SCBE2-MX’s are required for 2 + 1 redundancy.
- In redundant fabric mode, four fabric planes from the first two SCBE2-MX’s will be in Active mode, and two fabric planes from the third SCBE2-MX will be in Spare mode.
- In a non-redundant fabric mode, all six fabric planes will be in Active mode to increase fabric bandwidth.

For the MX240 and MX480 routers:

- Each SCBE2-MX provides four switch fabric planes for packet forwarding among the MPCs in the MX480 and MX240 chassis.
- The MX480 and MX240 routers contain a maximum of two SCBE2-MX’s. Therefore, eight logical planes are available.
- Two SCBE2-MX’s are required for 1 + 1 redundancy.
- In redundant fabric mode, four fabric planes from the first SCBE2-MX will be in Active mode, and four fabric planes from the second SCBE2-MX will be in Spare mode.
- In a non-redundant fabric mode, all eight fabric planes will be in Active mode to provide increased fabric bandwidth.
- Each fabric ASIC is configured in virtual plane mode, where two virtual planes exist on one fabric ASIC.

SCBE2-MX Slot Locations in the MX Chassis

For the MX960:

- You can install up to three SCBE2-MX's in the MX960 router chassis.
- SCBE2-MX's are installed vertically into the front of the MX960 chassis in the slots labeled **0**, **1**, and **2**. If any slots are empty, you must install a blank panel.
- The two SCBE2-MX's residing in slot 6 and slot 7 of the MX960 chassis provide both control and switch fabric features, while the third SCBE2-MX residing in slot 8 of the chassis (hybrid slot) will only do fabric functions.

For the MX480 and MX240 routers:

- You can install either one or two SCBE2-MX's in the MX480 and MX240 router chassis.

  SCBE2-MX's are installed horizontally into the front of the MX480 and MX240 chassis in the slots labeled 0 and 1. If any slots are empty, you must install a blank panel.

Interoperability with Routing Engines

Routing Engines	Maximum Power Requirement
RE-S-X6-64G RE-S-X6-128G	110 W
RE-S-1300 (EOLed) RE-S-2000 (EOLed) RE-S-1800 (all variants) RE-S-2000-4096 (EOL'd)	90 W

SCBE2-MX Interoperability with Existing Hardware

SCBE2-MX Operating Mode	MX240/480/960	Supported
Enhanced IP/Enhanced Ethernet Mode Only	DPC/MS-DPC	No
	MS-MPC	Yes
	MPC1	Yes
	MPC2	Yes
	MPC3	Yes
	MPC4	Yes
	MPC2-NG	Yes
	MPC3E-NG	Yes
	16x10GE MPC	Yes
	MPC5	Yes
	MPC6	No
	MPC7 (480 Gbps)	Yes
	MPC8 (960 Gbps)	No
	MPC9 (1.6 Tbps)	No

Upgrading to the SCBE2-MX

Here’s the procedures for upgrading your MX960, MX480, or MX240 router to use the SCBE2-MX:

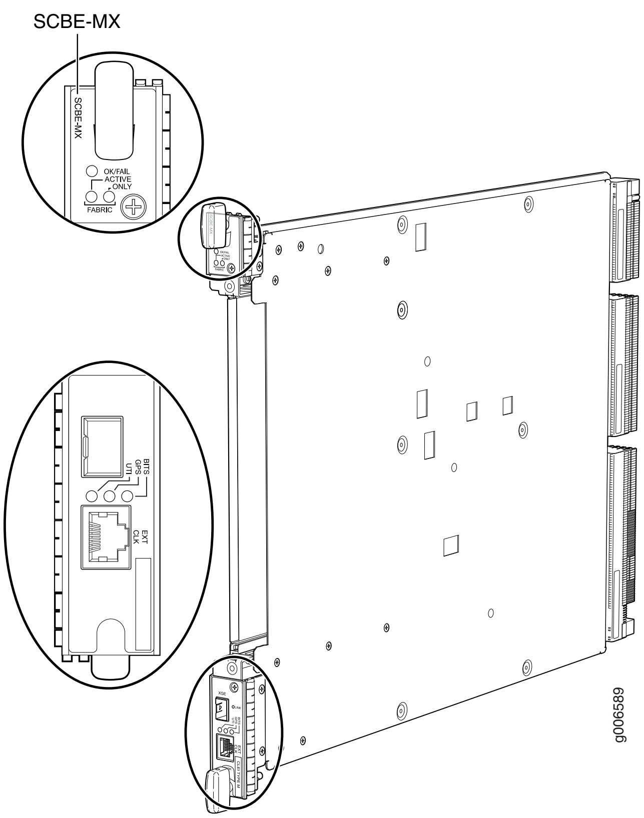
- *Upgrading an MX240 to Use the SCBE2-MX*
- *Upgrading an MX480 to Use the SCBE2-MX*
- Upgrading an MX960 to Use the SCBE2-MX on page 597

SCBE-MX Description

The SCBE-MX is the second generation switch control board and is designed specifically for use with MPC3E line cards to provide full line-rate performance and redundancy without a loss of bandwidth.

The SCBE-MX installs vertically in the MX960 chassis and horizontally in the MX480 and MX240 chassis. The routing engine installs directly into a slot on the SCBE-MX (see Figure 46 on page 164).

Figure 46: SCBE-MX



Software Release	11.4R1
CLI Identification	**Enhanced MX SCB**
SCBE-MX Maximum Power Requirements	160 W at 55° C 130 W at 40° C 120 W at 25° C
SCBE-MX Cooling Requirements	

Fabric Bandwidth Per Slot	Up to 240 Gbps (non-redundant fabric configuration); 160 Gbps (redundant fabric configuration). • MX240: Up to 930 Gbps • MX480: Up to 2.79 Tbps • MX960: Up to 5.25 Tbps
Switch Fabric Capacity	5.12 Tbps

SCBE-MX Features

Feature	Description
Increased Bandwidth	Provides 160 Gbps/slot bandwidth with redundant fabric support
Improved Fabric Performance	Provides improved fabric performance for high-capacity line cards using the next-generation fabric (XF) chip
Centralized Stratum 3 Clock Module	Provides a central clocking module and a centralized clocking architecture that supports clock cleanup and distribution. The Stratum 3 clock module performs clock monitoring, filtering, and holdover at a centralized chassis location.
Redundancy	Provides full performance with fabric redundancy for high-capacity line cards

Maximum Number of SCBE-MX's Per Chassis

Table 79 on page 165 lists the maximum number of SCBE-MXs you can install in the MX chassis, the corresponding slot labels, and the backup slot used for redundancy. If any slots are empty, you must install a blank panel.

Table 79: SCBE-MX Specifications

Chassis	Maximum SCBE-MXs	Slot Labels	Backup Slot
MX960	3	**0**, **1**, and **2**	**2**
MX480	2	**0** and **1**	**1**
MX240	2	**0** and **1**	**1**

SCBE-MX Interoperability with Routing Engines

Routing Engines	Maximum Power Requirement
RE-S-1800 (all variants) RE-S-1300 (EOLed) RE-S-2000 (EOLed) RE-S-2000-4096 (EOL'd)	90 W

SCBE-MX Interoperability with MPCs

The SCBE-MX was designed to be used specifically with MPC3E line cards to provide full line-rate performance and redundancy without a loss of bandwidth. It also supports the following MPCs:

SCBE-MX Operating Mode	MX240/480/960	Supported
Enhanced IP/Enhanced Ethernet Mode Only	DPC/MS-DPC	Yes
	MS-MPC	Yes
	MPC1	Yes
	MPC2	Yes
	MPC3	Yes
	MPC4	No
	MPC2-NG	Yes
	MPC3E-NG	Yes
	16x10GE MPC	No
	MPC5	Yes
	MPC6	No
	MPC7 (480 Gbps)	No
	MPC8 (960 Gbps)	No
	MPC9 (1.6 Tbps)	No
Routing Engines	RE-S-1300 (EOLed) RE-S-2000 (EOLed) RE-S-1800 (all variants)	yes yes yes yes

SCBE-MX LEDs

The **FABRIC ACTIVE**, **FABRIC ONLY**, and **OK/FAIL** LEDs indicate the status of the SCBE-MX. The **BITS**, **GPS**, and **UTI** LEDs (next to the **EXT CLK** port) indicate the status of the respective clocking interface. Table 80 on page 168 describes the behavior of the SCBE-MX LEDs.

Table 80: SCBE-MX LEDs

Label	Color	State	Description
FABRIC ACTIVE	Green	On steadily	Fabric is in active mode.
FABRIC ONLY	Green	On steadily	SCBE-MX operates in fabric-only mode.
	–	Off	SCBE-MX operates in fabric/control board mode.
OK/FAIL	Green	On steadily	SCBE-MX is online.
	Red	On steadily	SCBE-MX has failed.
	–	Off	SCBE-MX is offline.
	Red	On steadily	GPS clocking interface has failed.
	–	Off	GPS clocking interface is offline.
NOTE: The LEDs **BITS**, **GPS**, and **UTI** are not currently supported.			
BITS	Green	On steadily	Building-integrated timing supply (BITS) clocking interface is active.
	Red	On steadily	BITS clocking interface has failed.
	–	Off	BITS clocking interface is offline.

Table 80: SCBE-MX LEDs *(continued)*

Label	Color	State	Description
GPS	Green	On steadily	Global positioning system (GPS) clocking interface is active.
	Red	On steadily	GPS clocking interface has failed.
	–	Off	GPS clocking interface is offline.
UTI	Green	On steadily	Universal Timing Interface (UTI) clocking interface is active.
	Red	On steadily	UTI clocking interface has failed.
	–	Off	UTI clocking interface is offline.

Upgrading to the SCBE-MX

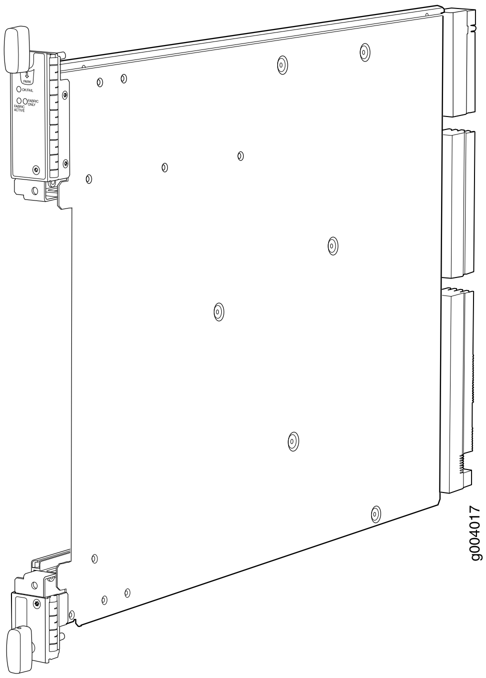
Here's the procedures for upgrading your MX960, MX480, or MX240 router to use the SCBE-MX:

- *Upgrading an MX240 to Use the SCBE-MX*
- *Upgrading an MX480 to Use the SCBE-MX*
- Upgrading an MX960 to Use the SCBE-MX on page 586

SCB-MX Description

The MX Switch Control Board (SCB-MX) provides control plane functions, chassis management functions, and switch plane functions for MX960, MX480, and MX240 routers. It is also a carrier for the Routing Engine which installs directly into a slot on the SCB-MX. See Figure 47 on page 170.

Figure 47: SCB-MX



Software release	• Junos OS Release 12.3 R1 and later • Name in CLI: **SCB**
SCB-MX Functions	• Powers on and powers off DPCs, FPCs, and MPCs. • Controls clocking, system resets, and booting. • Monitors and controls system functions, including fan speed, board power status, power distribution module status and control, and the craft interface • Provides Ethernet connectivity to all processors in the chassis for control plane communications. • Provides bandwidth of up to 160 Gbps per slot with redundant fabric support. • Provides interconnections to all the DPCs, FPCs, and MPCs within the chassis through the switch fabrics integrated into the SCB-MX.
SCB-MX Components	• Control Board and Routing Engine (CB-RE) primary-role mechanism. • External clock interface—Allows BITS or GPS clock source input to the centralized timing circuit, or allows centralized timing to be output to BITS or GPS. • Switch fabric—Provides switching functions for MPCs. • 1000Base-T Ethernet controller—Provides a 1 Gbps Ethernet link between the Routing Engines. • Power circuits for the Routing Engine and the SCBE2-MX. • LEDs—Provide status of the SCBE2-MX and the clocking interface.

SCB-MX Slot Numbers	For the MX960: • You can install up to three SCB-MXs in the MX960 chassis for a total of six switch fabrics and six fabric planes. The SCB-MXs install vertically into the front of the MX960 chassis in the slots labeled **0**, **1**, and **2/6**. **NOTE:** On the MX960, either a SCB-MX or a DPC can be plugged into slot 8. A third SCB-MX is used only for switch fabric redundancy. Therefore, if an application does not require switch fabric redundancy, a DPC can be used in slot 8. For the MX480 and MX240 routers: • You can install one or two SCB-MXs in the MX240 and MX480 for a total of four switch fabrics and eight fabric planes. The SCB-MX installs horizontally into the front of the chassis in the slots labeled **0** and **1**. If any slots are empty, you must install a blank panel.
Weight and Dimensions	• Weight: 9.6 lb (4.4 kg) (with Routing Engine installed) • Width: 17 in (43.2 cm) • Depth: 22 in (55.9 cm) • Height: 1.25 in (3.2 cm) height.

SCB-MX Fabric Planes and Redundancy	For MX960 routers: • Each SCB-MX provides two switch fabric planes for packet forwarding among the DPCs and MPCs in the MX960. • The MX960 chassis may contain up to three SCB-MX's Therefore, six fabric planes are available. • The MX960 provides 2 + 1 SCB-MX redundancy when used with DPC line cards. • In redundant fabric mode, four fabric planes from the first two SCB-MX’s will be in Active mode, and two fabric planes from the third SCB-MX will be in Spare mode. • In a non-redundant fabric mode, all six fabric planes will be in Active mode to increase fabric bandwidth. • SCB-MXs installed in slots **0** and **1** provide non-redundant fabric connections. An SCB-MX installed in slot **2/6**, in conjunction with SCB-MXs in slots **0** and **1**, provides redundant fabrics, but the Routing Engine installed on it receives no power and provides no additional routing functions. If no SCB-MX is installed in slot **2/6**, you must install a blank panel in the slot. For MX240 and MX480 routers: • Each fabric ASIC is configured in virtual plane mode, where two virtual planes exist on one fabric ASIC. This means that the MX240 and MX480 require only a single SCB-MX to provide line rate throughput, and an additional SCB-MX to provide 1 + 1 SCB redundancy. • In redundant fabric mode, four virtual planes from the first SCB-MX will be in Active mode, and four virtual planes from the second SCB-MX will be in Spare mode. • In a non-redundant fabric mode, all eight virtual planes will be in Active mode to provide the maximum fabric bandwidth.
SCB-MX Maximum Power Requirements	185 W at 55° C 160 W at 40° C 155 W at 25° C

SCB-MX 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 81 on page 172 describes the functions of the SCB LEDs.

Table 81: SCB-MX LED Descriptions

Label	Color	State	Description
FABRIC ACTIVE	Green	On steadily	Fabric is in active mode.

Table 81: SCB-MX LED Descriptions *(continued)*

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

SCB-MX Fabric Plane Scale and Redundancy

Each of the fabric planes on the SCB-MX is able to process 20 Gbps of bandwidth. The MX240 and MX480 use eight fabric planes across two SCB-MXs, whereas the MX960 uses six fabric planes across three SCB-MX's˙. Because of the fabric plane virtualization, the aggregate fabric bandwidth between the MX240, MX480, and MX960 is different. Refer to Table 82 on page 173.

Table 82: SCB-MX Fabric Plane Scale and Redundancy Assuming Four PFEs per FPC

SCB-MX	MX240	MX480	MX960
PFEs	12	24	48
SCBs	2	2	3
Switch Fabrics	4	4	6
Fabric Planes	8	8	6
Spare Planes	4 (1+1 SCB-MX redundancy)	4 (1+1 SCB-MX redundancy)	2 (2+1 SCB-MX redundancy)
Fabric Bandwidth Per Slot	160 Gbps	160 Gbps	120 Gbps

Interoperability With Routing Engines

Routing Engines	Maximum Power Requirement
RE-S-X6-64G RE-S-X6-128G	110 W
RE-S-1300 (EOLed) RE-S-2000 (EOLed) RE-S-1800 (all variants) RE-S-2000-4096 (EOL'd)	90 W

RELATED DOCUMENTATION

MX-Series Switch Control Board (SCB) Description | 145

RE-S-1300 Routing Engine Description

RE-S-2000 Routing Engine Description

RE-S-1800 Routing Engine Description

2

PART

Site Planning, Preparation, and Specifications

CHAPTER 11

Preparation Overview

IN THIS CHAPTER

MX960 Router Physical Specifications

Table 83 on page 176 summarizes the physical specifications for the router chassis.

Table 83: Physical Specifications

Description	Weight	Width	Depth	Height
Standard chassis dimensions	Standard chassis with midplane, two fan trays, air filter, and standard cable manager: 150 lb (68.04 kg) Standard chassis with maximum configuration: 350 lb (158.76 kg) Standard chassis with components removed: 150 lb (68.04 kg)	17.37 in. (44.11 cm) (excluding the mounting flanges or brackets)	23.0 in. (58.42 cm) (from front-mounting flange to chassis rear) Total depth (including standard cable manager) 27.75 in. (70.49 cm)	27.75 in. (70.49 cm)

Table 83: Physical Specifications *(continued)*

Description	Weight	Width	Depth	Height
Router with extended cable manager installed	Chassis with midplane, two fan trays, air filter, and extended cable manager: 174 lb (78.93 kg) Chassis with extended cable manager and maximum configuration: 374 lb (169.64 kg) Chassis with components removed: 174 lb (78.93 kg)	17.37 in. (44.11 cm) (excluding the mounting flanges or brackets)	23.0 in. (58.42 cm) (from front-mounting flange to chassis rear) Total depth (including extended cable manager) approximately 29.00 in. (73.7 cm)	36.5 in. (92.7 cm) high
Router with high-capacity power supplies installed	Standard chassis with midplane, two fan trays, air filter, and standard cable manager: 195 lb (88.45 kg) Standard chassis with maximum configuration: 395 lb (179.17 kg) Standard chassis with components removed: 195 lb (88.45 kg)	17.37 in. (44.11 cm) (excluding the mounting flanges or brackets)	Router with high-capacity power supplies installed. Depth with high-capacity AC power supply is 30.65" (77.9 cm); depth with high-capacity DC power supply is 32.85" (83.4 cm).	27.75 in. (70.49 cm)
Craft interface	1.5 lb (0.68 kg)	17 in (43.2 cm)	8.5 in (21.6 cm)	6.25 in (15.9 cm)
DPC	Maximum up to 14.5 lb (6.6 kg) Blank panel in DPC slot: 9 lb	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)

Table 83: Physical Specifications *(continued)*

Description	Weight	Width	Depth	Height
FPC	FPC2: 15 lb (6.8 kg) FPC3: 14 lb (6.5 kg)	17 in (43.2 cm)	22 in (55.9 cm)	2.5 in (6.4 cm)
PIC	2 lb (0.9 kg)	7.75 in (28.3 cm)	11.125 in (19.7 cm)	4.125 in (10.5 cm)
MPC weight (fixed configuration)	18.35 lb (8.3 kg)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
MPC (without MICs)	14 lb (6.4 kg)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
MIC	Maximum up to 1.2 lb (0.54 kg)	6.25 in (15.9 cm)	6.8 in (17.3 cm)	1.25 in (3.2 cm)
AC power supply	5 lb (2.3 kg) each	14.5 in (36.8 cm)	4 in (10.2 cm)	1.75 in (4.4 cm)
High-capacity AC power supply	11.9 lb (5.4 kg) each	14.5 in (36.8 cm)	6.85 in (12.92 cm)	1.75 in (4.4 cm)
DC power supply	3.8 lb (1.7 kg)	14.5 in (36.8 cm)	4 in (10.2 cm)	1.75 in (4.4 cm)
High-capacity DC power supply	15.8 lb (7.2 kg)	14.5 in (36.8 cm)	9.05 in (22.99 cm)	1.75 in (4.4 cm)
High-capacity second-generation AC power supply	10.4 lb (4.72 kg) each	14.5 in (36.8 cm)	5.25 in (13.334 cm)	1.75 in (4.4 cm)
High-voltage second-generation universal (HVAC or HVDC) power supply	11.9 lb (5.4 kg) each	14.5 in (36.8 cm)	5.20 in (13.21 cm)	1.75 in (4.4 cm)
Air filter	1 lb (0.5 kg)	16.7 in (42.4 cm)	19.7 in (50 cm)	0.43 in (1.1 cm)
SCB	9.6 lb (4.4 kg) (with Routing Engine installed)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
SCBE	9.6 lb (4.4 kg) (with Routing Engine installed)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)

Table 83: Physical Specifications *(continued)*

Description	Weight	Width	Depth	Height
SCBE2	9.6 lb (4.4 kg) (with Routing Engine installed)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
Routing Engine	2.4 lb (1.1 kg)	11 in (27.9 cm)	7.75 in (19.7 cm)	1.25 in (3.2 cm)
Routing Engine (RE-S-1800)	2.4 lb (1.1 kg)	11 in (27.9 cm)	7.75 in (19.7 cm)	1.25 in (3.2 cm)
Routing Engine (RE-S-X6-64G)	2.69 lb (1.18 kg)	10.7 in (27.18 cm)	7.47 in (18.97 cm)	1.19 in (3.02 cm)
Upper fan tray	13 lb (5.9 kg)	16.9 in (43 cm)	20.6 in (52.3 cm)	1.4 in (3.6 cm)
Lower fan tray	13 lb (5.9 kg)	16.9 in (43 cm)	20.6 in (52.3 cm)	1.4 in (3.6 cm)
High-capacity fan tray	13 lb (5.9 kg)	16.9 in (43 cm)	20.6 in (52.3 cm)	1.4 in (3.6 cm)
Standard cable manager	4.1 lb (1.9 kg	18.9 in (43 cm)	5.5 in (14 cm)	6.7 in (17 cm)
Extended cable manager	39 lb (2.3 kg)	24.5 in (62.2 cm)	30 in (78 cm)	24.25 in (61.6 cm)

RELATED DOCUMENTATION

MX960 Router Overview | 2
MX960 Chassis Description | 5

MX960 Router Environmental Specifications

Table 84 on page 179 specifies the environmental specifications required for normal router operation. In addition, the site should be as dust-free as possible.

Table 84: Router Environmental Specifications

Description	Value
Altitude	No performance degradation to 10,000 ft (4038 m)

Table 84: Router Environmental Specifications *(continued)*

Description	Value
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: 27,007 BTU/hour (7920 W) DC power: 18,987 BTU/hour (5568 W)

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

RELATED DOCUMENTATION

Tools and Parts Required to Maintain the MX960 Router | 609

Definition of Safety Warning Levels

MX960 Site Preparation Checklist

The checklist in Table 85 on page 181 summarizes the tasks you must perform when preparing a site for router installation.

Table 85: MX960 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.	"MX960 Router Environmental Specifications" on page 179		
Select the type of rack or cabinet.	"MX960 Cabinet Size and Clearance Requirements" on page 186, "MX960 Rack Requirements" on page 182		
Plan rack or cabinet location, including required space clearances.	"MX960 Cabinet Size and Clearance Requirements" on page 186, "MX960 Rack Requirements" on page 182, "Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router" on page 184		
If a rack is used, secure rack to floor and building structure.	"MX960 Rack Requirements" on page 182		
Acquire cables and connectors.			
Locate sites for connection of system grounding.	"MX960 Router Grounding Specifications" on page 194		
Measure distance between external power sources and router installation site.			
Calculate the optical power budget and optical power margin.	"Calculating Power Budget and Power Margin for Fiber-Optic Cables" on page 189		

RELATED DOCUMENTATION

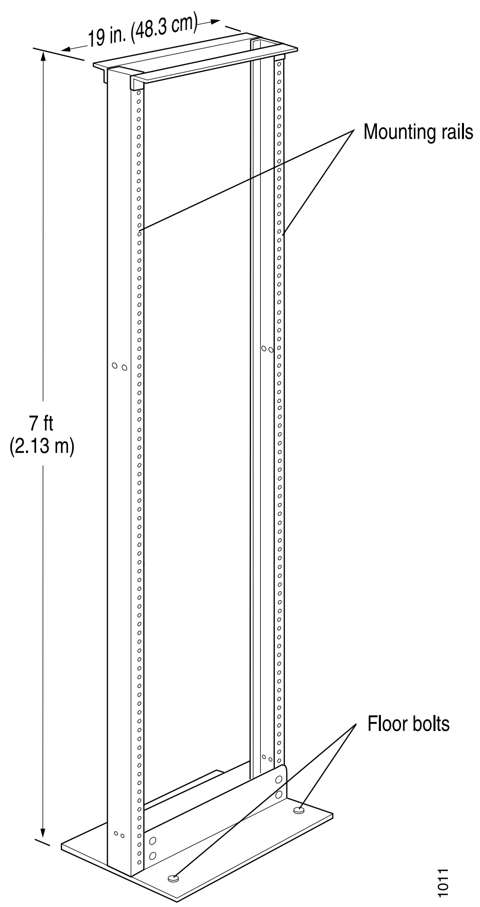
Installing an MX960 Router Overview | 277
Unpacking the MX960 Router | 264

MX960 Rack Requirements

IN THIS SECTION

The router can be installed in many types of racks, including four-post (telco) racks and open-frame racks. An example of an open-frame rack appears in Figure 48 on page 182.

Figure 48: Typical Open-Frame Rack



Rack Size and Strength

The size, strength, and location of the rack must accommodate the router's weight and external dimensions. The location of the rack must allow for the clearance requirements specified in "Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router" on page 184.

The chassis is 17.37 in. (44.11 cm) wide. The router is designed for installation in a standard 19-in. rack, as defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310-D) published by the Electronic Components Industry Association (ECIA) (http://www.ecianow.org). The spacing of the holes between the left and right front-mounting flanges and center-mounting brackets is 19 in. (48.3 cm) apart. However, the inner edge of the rack rails must allow sufficient space for the width of the chassis.

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

The weight, height, and depth of the router depends on the type of cable manager installed.

With the standard cable manager installed, use these guidelines:

- The rack must have sufficient vertical usable space to accomodate the height of the router: 27.75 in. (70.49 cm) high (approximately 16 U.),. You can stack three MX960 routers with the standard cable manager in a rack that has at least 48 U (89.3 in. or 2.24 m).

  > **NOTE:** A **U** is the standard rack unit defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310-D) published by the Electronic Components Industry Association (ECIA) (http://www.ecianow.org).

- The location of the rack must provide sufficient space to accomodate the depth of the router. The chassis is 23.0 in. (58.42 cm) deep, but The standard cable manager extends the depth to 28.0 in. (71.1 cm).
- The rack must be strong enough to support the weight of the fully configured router, up to 350 lb (158.76 kg). If you stack three fully configured routers, it must be capable of supporting up to 1,050 lb (476.3 kg).

With the extended cable manager installed, use these guidelines:

- The rack must have sufficient vertical usable space to accomodate the additional height of the extended cable manager: 36.5 in. (92.7 cm) high (approximately 21 U). You can stack two MX960 routers in a rack that has at least 48 U (89.3 in. or 2.24 m).
- The rack must be able to accomodate the additional depth of the extended cable manager. The chassis with the extended cable manager installed is29.00 in. (73.7 cm) deep.

- The rack must be strong enough to support up to 374 lb (169.64 kg). If you stack two fully configured routers, it must be capable of supporting up to 748 lb (339.28 kg).

Spacing of Mounting Bracket Holes

The holes within each set are spaced at 1 U (1.75 in. or 4.5 cm). The router can be mounted in any rack that provides holes spaced at those distances.

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

Connection to the 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.

RELATED DOCUMENTATION

Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router | 184
MX960 Rack-Mounting Hardware | 14
MX960 Cabinet Size and Clearance Requirements | 186
MX960 Cabinet Airflow Requirements | 187

Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router

When planning the installation site, you need to allow sufficient clearance around the rack (see Figure 50 on page 186):

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

  Airflow must always be from front to back with respect to the rack. The device must not interfere with the cooling of other systems in the rack. Fillers must be used as appropriate in the rack to ensure there is no recirculation of heated exhaust air back to the front of the rack. Care must also be taken around cables to ensure that no leakage of air in situations where recirculation may result.

- Additional clearance is required to accommodate the height and depth of the chassis with the extended cable manager:
  - 36.5 in. (92.7 cm) high
  - 29.00 in. (73.7 cm) deep approximately
- Additional clearance is also required to accommodate the depth of the MX960 high-capacity power supplies; they extend beyond the chassis as shown in Table 86 on page 185.

Table 86: Clearance Requirements for High-Capacity Power Supplies

Power Supply	Additional depth requirement
MX960 high-capacity AC power supply	2.85” (7.24 cm)
MX960 high-capacity DC power supply	5.05” (12.83 cm)

Figure 49: Chassis Dimensions and Clearance Requirements for the MX960 Router with the Normal-Capacity Power Supplies

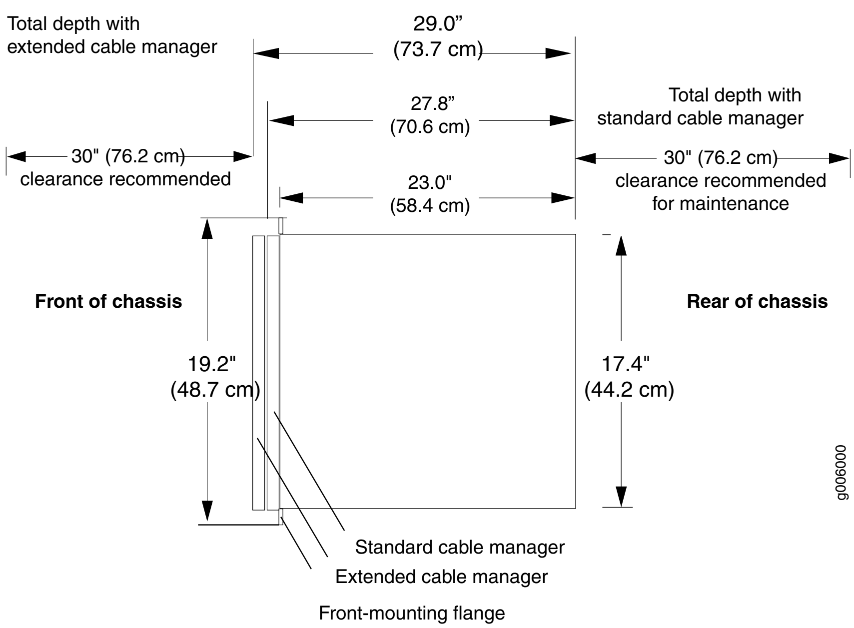
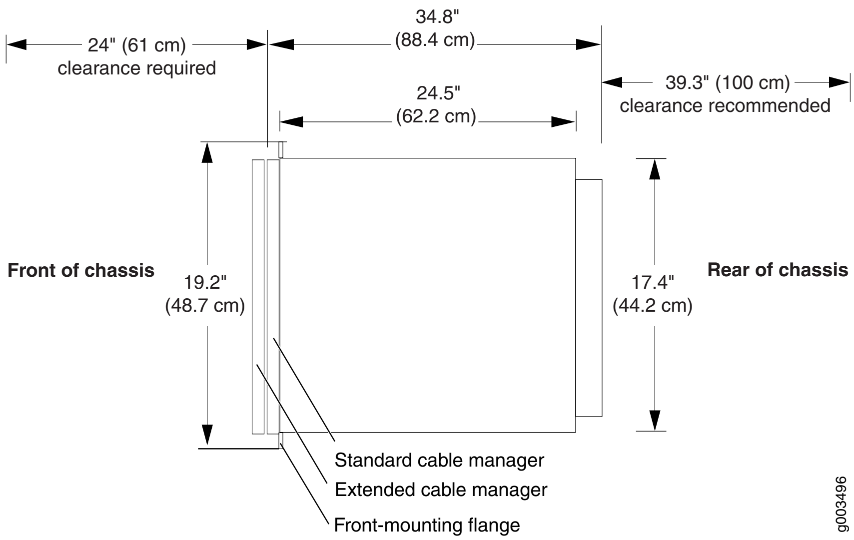


Figure 50: Chassis Dimensions and Clearance Requirements for the MX960 Router with the Standard Cable Manager and High-Capacity DC Power Supplies



RELATED DOCUMENTATION

MX960 Rack Requirements | 182

MX960 Rack-Mounting Hardware | 14

MX960 Cabinet Size and Clearance Requirements | 186

MX960 Cabinet Airflow Requirements | 187

MX960 Cabinet Size and Clearance Requirements

The minimum size cabinet that can accommodate the router is 600 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 16 U high. If you provide adequate cooling air and airflow clearance in a cabinet that has at least 48 U (89.3 in. or 224 mm) of usable vertical space, you can stack three routers with the standard cable manger installed, or two routers with the extended cable manager installed.

The minimum front and rear clearance requirements depend on the mounting configuration you choose. The minimum total clearance inside the cabinet is 39.4 in or 1000 mm. between the inside of the front door and the inside of the rear door.

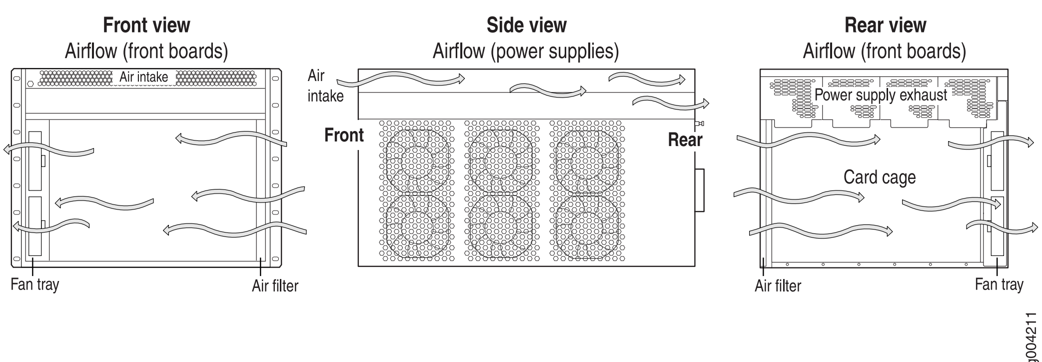
RELATED DOCUMENTATION

MX960 Cabinet Airflow Requirements

Before you install 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 51 on page 187.
- Install the router as close as possible to the front of the cabinet so that the cable management brackets just clear 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.

Figure 51: Airflow Through the Chassis



RELATED DOCUMENTATION

CHAPTER 12

Transceiver and Cable Specifications

IN THIS CHAPTER

Calculating Power Budget and Power Margin for Fiber-Optic Cables

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

TIP: You can use the Hardware Compatibility Tool to find information about the pluggable transceivers supported on your Juniper Networks device.

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

How to Calculate Power Budget for Fiber-Optic Cable

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

$P_B = P_T – P_R$

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

$P_B = P_T - P_R$

P_B = –15 dBm – (–28 dBm)

P_B = 13 dB

How to Calculate Power Margin for Fiber-Optic Cable

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

$P_M = P_B - LL$

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

Factors that can cause link loss include higher-order mode losses, modal and chromatic dispersion, connectors, splices, and fiber attenuation. Table 87 on page 190 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 87: Estimated Values for Factors Causing Link Loss

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

The following sample calculation for a 2-km-long multimode link with a power budget (P_B) of 13 dB uses the estimated values from Table 87 on page 190 to calculate link loss (LL) as the sum of fiber attenuation (2 km @ 1 dB/km, or 2 dB) and loss for five connectors (0.5 dB per connector, or 2.5 dB) and two splices (0.5 dB per splice, or 1 dB) as well as higher-order mode losses (0.5 dB). The power margin (P_M) is calculated as follows:

$P_M = P_B - LL$

P_M = 13 dB – 2 km (1 dB/km) – 5 (0.5 dB) – 2 (0.5 dB) – 0.5 dB

P_M = 13 dB – 2 dB – 2.5 dB – 1 dB – 0.5 dB

P_M = 7 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 87 on page 190 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 dB – 8 km (0.5 dB/km) – 7(0.5 dB)

P_M = 13 dB – 4 dB – 3.5 dB

P_M = 5.5 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.

Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion

IN THIS SECTION

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

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

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

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

Attenuation and Dispersion in Fiber-Optic Cable

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

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

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

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

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

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

Routing Engine Interface Cable and Wire Specifications for MX Series Routers

Table 88 on page 193 lists the specifications for the cables that connect to management ports and the wires that connect to the alarm relay contacts.

NOTE: In routers where the Routing Engine (RE) and Control Board (CB) are integrated into a single board, a CB-RE is known as Routing and Control Board (RCB). The RCB is a single FRU that provides RE and CB functionality.

Table 88: Cable and Wire Specifications for Routing Engine and RCB 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	1.83-m length with RJ-45/DB-9 connectors	1.83 m	RJ-45 socket
Routing Engine Ethernet interface	Category 5 cable or equivalent suitable for 100Base-T operation	One 4.57-m length with RJ-45/RJ-45 connectors	100 m	RJ-45 autosensing
Alarm relay contacts	Wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm^2)	No	None	–

RELATED DOCUMENTATION

MX960 Routing Engine Description | 28
Replacing Connections to MX960 Routing Engine Interface Ports | 495
Replacing an MX960 Routing Engine | 483

CHAPTER 13

Pinout Specifications

IN THIS CHAPTER

MX960 Router Grounding Specifications

IN THIS SECTION

MX960 Chassis Grounding Points Specifications

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 right of the lower rear of the chassis for connecting the router to earth ground (see Figure 52 on page 195 or Figure 53 on page 196).

Figure 52: Connecting AC Power to the Router

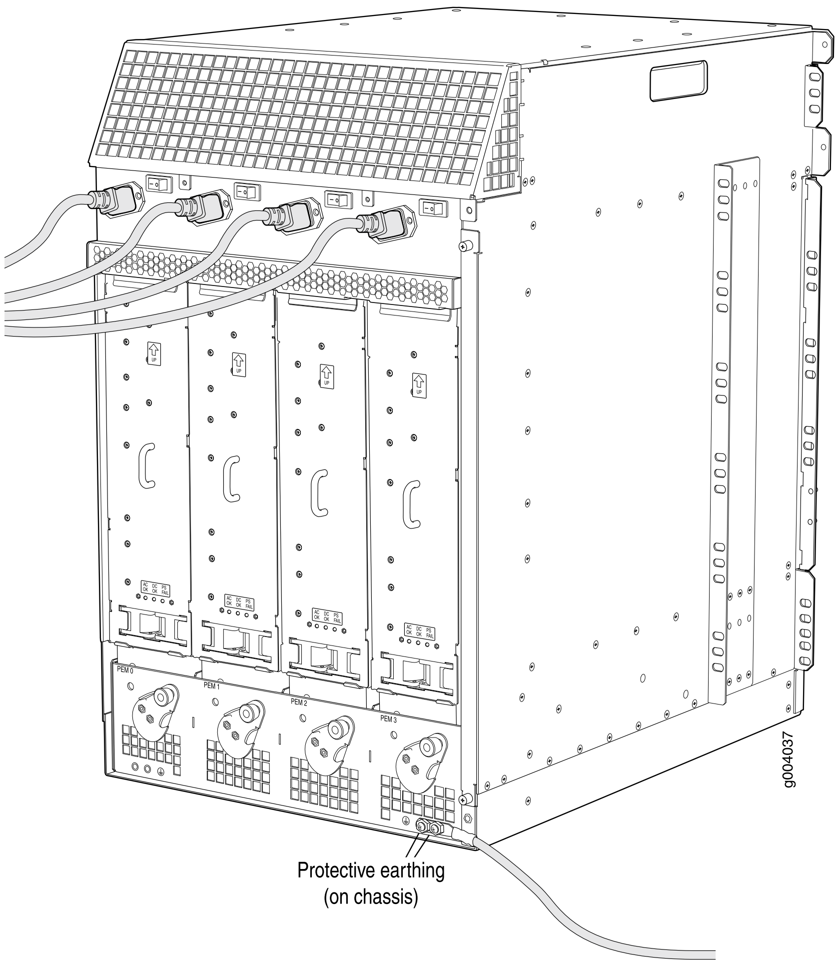
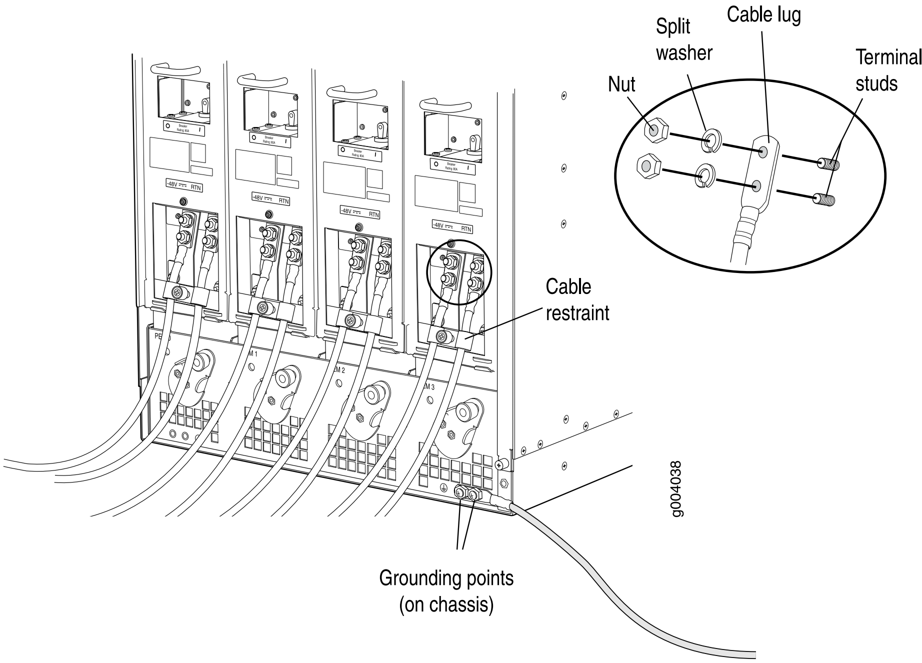


Figure 53: Connecting DC Power to the Router



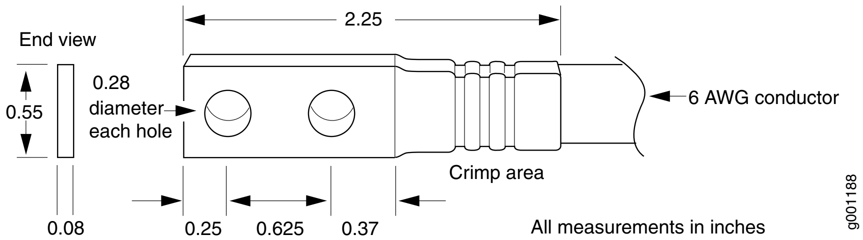
MX960 Router Grounding Cable Lug Specifications

> **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.

To ground AC-powered and DC-powered routers, connect a grounding cable to earth ground and then attach it to the chassis grounding points using two screws. The left pair of grounding points fits M6 screws (European), and the right pair fits UNC 1/4–20 screws (English). The grounding points are spaced at 0.625-in. (15.86-mm) centers. The accessory box shipped with the router includes the cable lug that attaches to the grounding cable (see Figure 54 on page 197) and two UNC 1/4–20 screws used to secure the grounding cable to the right pair of grounding points.

> **WARNING:** The router is a pluggable type A equipment installed in a restricted access location. It has a separate protective earthing terminal (Metric [–M6] and English [–¼-20] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.

Figure 54: Grounding Cable Lug



MX960 Router Grounding Cable Specifications

The 48 VDC facility must be equipped with a circuit breaker rated 40 A (–48 VDC), or 60 A (–48 VDC), and the grounding cable must be minimum 6 AWG, or as required by the local code.

NOTE: Additional grounding is provided to an AC-powered router when you plug its power supplies into grounded AC power receptacles.

WARNING: The router is installed in a restricted-access location. It has a separate protective earthing terminal (Metric [–M6] and English [–¼-20] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.

RELATED DOCUMENTATION

Grounding the MX960 Router | 350

Tools and Parts Required for MX960 Router Grounding and Power Connections | 348

RJ-45 Connector Pinouts for an MX Series Routing Engine ETHERNET Port

The port on the Routing Engine 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). Table 89 on page 198 describes the RJ-45 connector pinout.

Table 89: 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

RELATED DOCUMENTATION

MX960 Routing Engine Description | 28
Replacing Connections to MX960 Routing Engine Interface Ports | 495
Replacing an MX960 Routing Engine | 483

RJ-45 Connector Pinouts for MX Series Routing Engine AUX and CONSOLE Ports

The ports on the Routing Engine labeled **AUX** and **CONSOLE** are asynchronous serial interfaces that accept an RJ-45 connector. The ports connect the Routing Engine to an auxiliary or console management device. Table 90 on page 198 describes the RJ-45 connector pinout.

Table 90: RJ-45 Connector Pinout for the AUX and CONSOLE Ports

Pin	Signal	Description
1	RTS	Request to Send
2	DTR	Data Terminal Ready

Table 90: RJ-45 Connector Pinout for the AUX and CONSOLE Ports *(continued)*

Pin	Signal	Description
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

RELATED DOCUMENTATION

MX960 Routing Engine Description | 28
Replacing Connections to MX960 Routing Engine Interface Ports | 495
Replacing an MX960 Routing Engine | 483

CHAPTER 14

AC Power Requirements, Specifications, and Guidelines

IN THIS CHAPTER

Electrical Specifications for the MX960 AC Power Supply

Table 91 on page 200 lists the AC power supply electrical specifications. Table 93 on page 202 lists the AC power system specifications.

Table 91: AC Power Supply Electrical Specifications

Item	Specification
Normal-Capacity Power Supply	
Maximum output power	1700 W
AC nominal input voltage	Operating range: 200 to 240 VAC
AC input line frequency	50 to 60 Hz
AC input current rating	11 A @ 240 VAC maximum
Efficiency **NOTE:** This value is at full load and nominal voltage.	88%

Table 91: AC Power Supply Electrical Specifications *(continued)*

Item	Specification	
High-Capacity Power Supply		
Maximum output power	Two-feed mode	One-feed mode
	4100 W	1700 W
AC nominal input voltage	Operating range: 200 to 240 VAC	
AC input line frequency	50 to 60 Hz	
AC input current rating	Two-feed mode	One-feed mode
	26 A (13 A per feed) +/-5%	13 A +/-5%
Maximum AC inrush current	76 A (38 A per feed at 264 VAC)	38 A per feed at 264 VAC
Efficiency **NOTE:** This value is at full load and nominal voltage.	~88%	

Table 92: AC Power Supply Electrical Specifications (High-Capacity Second-Generation AC Power Supply)

High-Capacity Second-Generation AC Power Supply		
Maximum output power	Two-feed mode	One-feed mode
	5100 W	2300
AC nominal input voltage	200-240 Hz	
AC input line frequency	50 to 60 Hz	
AC input current rating	Two-feed mode	One-feed mode
	16 A @ 200 VAC maximum per feed	16 A
Maximum AC inrush current	34 per feed at 264 VAC	34 per feed at 264 VAC
Efficiency	91% at full load	

Table 93: AC Power System Specifications

Item	Normal-Capacity	High-Capacity	
		All PEMs in two-feed mode	All PEMs in one-feed mode
Redundancy	3+1	2+2	2+2
Output power (maximum) per supply	1700 W	4100 W	1700 W
Output power (maximum) per system	5100 W	8200 W	3400 W

Table 94: High-Capacity Second-Generation AC Power System Specifications

Item	High-Capacity Second-Generation AC	
	All PEMs in two-feed mode	All PEMs in one-feed mode
Redundancy	2+2	2+2
Output power (maximum) per supply	5100 W	2300 W

RELATED DOCUMENTATION

MX960 AC Power Supply Description | 127

Replacing an MX960 AC or High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | 557

Installing a MX960 AC Power Supply or High-Voltage Second-Generation Universal (HVAC or HVDC) | 433

show chassis power

Power Requirements for an MX960 Router

Table 95 on page 203 lists the MX960 base system and cooling system power requirements.
Table 96 on page 203 lists the FRU power requirements for Switch Control Boards (SCB), Routing Engines,

Modular Port Concentrators (MPC), Modular Interface Cards (MIC), Dense Port Concentrators (DPC), and Flexible PIC Concentrators (FPC).

Typical power represents power under certain temperatures and normal operating conditions.

Table 95: MX960 Common Component Power Requirements

Component	Maximum Power Requirement	Typical Power Requirement
Base system	50 W	50 W
Normal-capacity cooling system	600 W (full speed)	400 W (normal speed)
High-capacity cooling system	640 W (full speed)	450 W (normal speed)

Table 96: FRU Power Requirements

Component	Part Number	Maximum Power Requirement
Routing Engines		
	RE-S-X6-64G RE-S-X6-128G	110 W
	RE-S-1300-2048 (EOL’d) RE-S-2000-4096 (EOL’d) RE-S-1800 (all variants)	90 W
Fixed Configuration Modular Port Concentrators (MPC)		
MPC-3D-16XGE-SFPP	MPC-3D-16XGE-SFPP MPC-3D-16XGE-SFPP-R-B	440 W at 131° F (55° C) ambient 423 W at 77° F (25° C) ambient
Multiservices MPC	MS-MPC-128G	590 W

Table 96: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
32x10GE MPC4E	MPC4E-3D-32XGE-SFPP	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR optics 584 W at 40° C, with SFPP ZR optics 565 W at 77° F (25° C), with SFPP ZR optics
2x100GE + 8x10GE MPC4E	MPC4E-3D-2CGE-8XGE	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR and CFP LR4 optics 584 W at 104° F (40° C), with SFPP ZR and CFP LR4 optics 565 W at 77° F (25° C), with SFPP ZR and CFP LR4 optics
6x40GE + 24x10GE MPC5E *6x40GE + 24x10GE MPC5EQ*	MPC5E-40G10G MPC5EQ-40G10G	**With optics:** 607 W at 131° F (55° C) 541 W at 104° F (40° C) 511 W at 77° F (25° C)
2x100GE + 4x10GE MPC5E *2x100GE + 4x10GE MPC5EQ*	MPC5E-100G10G MPC5EQ-100G10G	**With optics:** 607 W at 131° F (55° C) 541 W at 104° F (40° C) 511 W at 77° F (25° C)

Table 96: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC7E-MRATE	MPC7E-MRATE	**With optics:** 545 W at 131° F (55° C) 465 W at 104° F (40° C) 440 W at 77° F (25° C)
MPC10E-10C-MRATE	MPC10E-10C-MRATE	620 W at 131° F (55° C) 590 W at 104° F (40° C) 545 W at 77° F (25° C)
MPC10E-15C-MRATE	MPC10E-15C-MRATE	785 W at 104° F (40° C): 720 W at 77° F (25° C)
Modular Port Concentrators (MPC)		
MPC1 *MPC1E*	MX-MPC1-3D MX-MPC1E-3D	165 W **With MICs and optics:** 239 W at 131° F (55° C) 227 W at 104° F (40° C) 219 W at 77° F (25° C)
MPC1 Q *MPC1E Q*	MX-MPC1-3D-Q MX-MPC1E-3D-Q	175 W **With MICs and optics:** 249 W at 131° F (55° C) 237 W at 104° F (40° C) 228 W at 77° F (25° C)

Table 96: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC2 *MPC2E*	MX-MPC2-3D MX-MPC2E-3D	274 W **With MICs and optics:** 348 W at 131° F (55° C) 329 W at 104° F (40° C) 315 W at 77° F (25° C)
MPC2 Q *MPC2E Q* *MPC2 EQ* *MPC2E EQ*	MX-MPC2-3D-Q MX-MPC2E-3D-Q MX-MPC2-3D-EQ MX-MPC2E-3D-EQ	294 W **With MICs and optics:** 368 W at 131° F (55° C) 347 W at 104° F (40° C) 333 W at 77° F (25° C)
MPC2E P	MX-MPC2E-3D-P	294 W **With MICs and optics:** 368 W at 131° F (55° C) 347 W at 104° F (40° C) 333 W at 77° F (25° C)
MPC2E NG	MPC2E-3D-NG	474 W **With MICs and optics:** 474 W at 131° F (55° C) 417 W at 104° F (40° C) 400 W at 77° F (25° C)

Table 96: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC2E NG Q	MPC2E-3D-NG-Q	529 W **With MICs and optics:** 529 W at 131° F (55° C) 460 W at 104° F (40° C) 438 W at 77° F (25° C)
MPC3E	MX-MPC3E-3D	440W **With MICs and optics:** 500 W at 131° F (55° C), two 40 W MICs 485 W at 104° F (40° C), two CFP MICs with LR4 optics 473 W at 77° F (25° C), two CFP MICs with LR4 optics
MPC3E-3D-NG	MPC3E-3D-NG	534 W **With MICs and optics:** 534 W at 131° F (55° C) 485 W at 104° F (40° C) 461 W at 77° F (25° C)
MPC3E-3D-NG-Q	MPC3E-3D-NG-Q	583 W **With MICs and optics:** 583 W at 131° F (55° C) 532 W at 104° F (40° C) 503 W at 77° F (25° C)
Modular Interface Cards (MIC)		

Table 96: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
ATM MIC with SFP	MPC4E-3D-2CGE-8XGE	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR and CFP LR4 optics 584 W at 40° C, with SFPP ZR and CFP LR4 optics 565 W at 77° F (25° C), with SFPP ZR and CFP LR4 optics
Gigabit Ethernet MIC with SFP	MIC-3D-20-GE-SFP	37 W
10-Gigabit Ethernet MICs with XFP	2-Port: MIC-3D-2XGE-XFP 4-Port: MIC-3D-4XGE-XFP	2-Port: 29 W 4-Port: 37 W
40-Gigabit Ethernet MIC with QSFP+	MIC3-3D-2X40GE-QSFPP	18 W
100-Gigabit Ethernet MIC with CFP	MIC3-3D-1X100GE-CFP	40 W
100-Gigabit Ethernet MIC with CFP2	MIC6-100G-CFP2	104 W
100-Gigabit Ethernet MIC with CXP	MIC3-3D-1X100GE-CXP	20 W
100-Gigabit Ethernet MIC with CXP (4 Ports)	MIC6-100G-CXP	57 W
100-Gigabit DWDM OTN MIC with CFP2	MIC3-100G-DWDM	**With optics:** 91 W at 131° F (55° C) 83 W at 77° F (25° C)

Table 96: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
100-Gigabit DWDM OTN MIC with CFP2-ACO	MIC3-100G-DWDM	**With optics:** 91 W at 131° F (55° C) 83 W at 77° F (25° C)
Multiservices MIC	MS-MIC-16G	60 W
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	4-Port: MIC-3D-4OC3OC12-1OC48	4-Port: 24 W at 131° F (55° C) 22.75 W at 40° C 21.5 W at 77° F (25° C)
	8-Port: MIC-3D-8OC3OC12-4OC48	8-Port: 29 W at 131° F (55° C) 27.75 W at 40° C 26.5 W at 77° F (25° C)
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	41 W at 131° F (55° C) 38.5 W at 40° C 36 W at 77° F (25° C)
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	4-Port: MIC-3D-4CHOC3-2CHOC12	4-Port: 41 W at 131° F (55° C) 40 W at 40° C 39 W at 77° F (25° C)
	8-Port: MIC-3D-8CHOC3-4CHOC12	8-Port: 52 W at 131° F (55° C) 50.5 W at 40° C 49 W at 77° F (25° C)

Table 96: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
Tri-Rate MIC	MIC-3D-40GE-TX	41 W
DS3/E3 MIC	MIC-3D-8DS3-E3 MIC-3D-8CHDS3-E3-B	36 W at 131° F (55° C) 35 W at 40° C 34 W at 77° F (25° C)
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	29.08 W at 131° F (55° C) 27.84 W at 40° C 26.55 W at 77° F (25° C)
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	36.48 W at 131° F (55° C) 35.04 W at 40° C 33.96 W at 77° F (25° C)
Dense Port Concentrators (DPC)		
Gigabit Ethernet DPC with SFP	DPC-R-40GE-SFP	335 W
Gigabit Ethernet Enhanced DPC with SFP	DPCE-R-40GE-SFP DPCE-X-40GE-SFP	335 W
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP	DPCE-R-Q-40GE-SFP DPCE-X-Q-40GE-SFP	365 W
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP	DPCE-R-Q-20GE-SFP	200 W
10-Gigabit Ethernet DPC with XFP	DPC-R-4XGE-XFP	310 W

Table 96: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
10-Gigabit Ethernet Enhanced DPC with XFP	DPCE-R-2XGE-XFP	175 W
10-Gigabit Ethernet Enhanced DPCs with XFP	DPCE-R-4XGE-XFP DPCE-X-4XGE-XFP	310 W
10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP	DPCE-R-Q-4XGE-XFP DPCE-X-Q-4XGE-XFP	330 W
Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP	DPCE-R-20GE-2XGE DPCE-X-20GE-2XGE	333 W
Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP	DPCE-R-Q-20GE-2XGE	335 W
Tri-Rate Enhanced DPC or *Tri-Rate Enhanced Ethernet Services DPC*	DPCE-R-40GE-TX DPCE-X-40GE-TX	320 W
Multiservices DPC	MS-DPC	265 W
Flexible PIC Concentrators (FPC)		
FPC Type 2	MX-FPC2	190 W (with PICs and optics)
FPC Type 3	MX-FPC3	265 W (with PICs and optics)

RELATED DOCUMENTATION

Electrical Specifications for the MX960 DC Power Supply

Electrical Specifications for the MX960 AC Power Supply

Calculating Power Requirements for MX960 Routers

The information in this topic helps you determine which power supplies are suitable for various configurations, as well as which power supplies are not suitable because output power is exceeded. You determine suitability by subtracting the total power draw from the maximum output of the power supplies. Afterward, the required input current is calculated. Finally, you calculate the thermal output. A sample configuration is provided in Table 67 on page 132.

We recommend that you provision power according to the maximum input current listed in the power supply electrical specifications (see *Electrical Specifications for the MX960 AC Power Supply* and *Electrical Specifications for the MX960 DC Power Supply*).

Use the following procedures to calculate the power requirement:

1. Calculate the power requirement.

2. Evaluate the power budget.

3. Calculate input power.

4. Calculate thermal output (BTUs) for cooling requirements.

Both normal-capacity and high-capacity MX960 chassis with DC power supplies; MX960 chassis with high-capacity AC power supplies; MX960 high-capacity second-generation AC power supplies; and MX960 high-voltage second-generation universal power supplies are zoned. MX960 chassis with normal-capacity AC power supplies have one overall zone. Zoning means that certain components are powered by specific power supplies (see Table 67 on page 132 for information on zoning). When calculating power requirements, be sure that there is adequate power for each zone.

Three AC power supplies are mandatory for MX960 chassis with normal-capacity AC power supplies.

Table 97: MX960 Zoning

Chassis Power Configuration	Zone	Power Supply (PEM)	Components Receiving Power
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (normal and high-capacity power supplies; MX960 AC high-capacity second-generation power supplies; and MX960 high-voltage second-generation universal (HVAC/HVDC) power supplies	Zone 0	PEM 0 or 2	• Lower fan tray • DPC/MPC slots 6 through 11 • SCB slots 1 through 2
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (normal and high-capacity power supplies); MX960 AC high-capacity second-generation power supplies; and MX960 high-voltage second-generation universal (HVAC/HVDC) power supplies	Zone 1	PEM 1 or 3	• Upper fan tray • DPC/MPC slots 0 through 5 • SCB slot 0

The following sample configuration shows an MX960 chassis with:

- Four high-capacity AC power supplies (using two feeds for each power supply); two supplies are active, two are redundant
- Six 16 port 10 GbE MPC with SFP+ interfaces (slots 0 through 5)
- Two SCBs with two (redundant) RE-1800x2 routing engines (SCB slot 0 and SCB slot 1)
- SCB (SCB slot 6)
- Five 16 port 10 GbE MPC with SFP+ interfaces (slots 7 through 11)
- High-capacity cooling system (upper and lower fan trays)

> **NOTE:** The high-capacity cooling system satisfies cooling requirements of MPCs, and must be used for proper cooling.

1. Calculate the power requirements (usage) using the values in “Power Requirements for an MX960 Router” on page 202 as shown in Table 98 on page 214.

Table 98: Sample Power Requirements for an MX960 Router

Chassis Component	Part Number	Power Requirement	Zone
Base system	MX960BASE-AC-HIGH	50 W[1]	—
High-capacity cooling system	FANTRAY-MX960-HC	320 W * 2 = 640 W	Zone 0 (lower fan tray) and Zone 1 (upper fan tray)
MPC - slots 0 through 5	MPC-3D-16XGE-SFPP	440 W * 6 = 2640 W	Zone 1
MPC - slots 7 through 11	MPC-3D-16XGE-SFPP	440 W * 5 = 2200 W	Zone 0
SCB 0	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 1
SCB 1	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 0
SCB 2 - slot 6	SCBE2-MX	185 W	Zone 0
MX960 normal-capacity AC (not zoned) Zone 0 total output power Zone 1 total output power		6265 W 3005 W 3260 W	

[1] Divided equally between zone 0 and zone 1.

2. Evaluate the power budget, including the budget for each zone if applicable. In this step, we check the required power against the maximum output power of available power supply options.

   Table 99 on page 215 lists the power supplies, their maximum output power, and unused power (or a power deficit).

Table 99: Calculating Power Budget

Power Supply	Maximum Output Power of Power Supply	Maximum Output Power for System	Nonzoned Unused Power	Zone 0 Unused Power[1]	Zone 1 Unused Power[2]
MX960 AC normal-capacity	1700 W	5100 W	Power exceeded (non-zoned; 5100 W - 6160 = power exceeded)	–	–
MX960 AC high-capacity	1700 W (one feed) 4100 W (two feeds)	3400 W (one feed) 8200 W (two feeds)	–	Power exceeded 1165 W	Power exceeded 875 W
MX960 DC normal-capacity	2800 W	5600 W	–	Power exceeded	Power exceeded
MX960 AC high-capacity second-generation	2300 W (one feed) 5100 W (two feeds)	4230 W (one feed) 10200 W (two feeds)		Power exceeded 2165 W	Power exceeded 18755 W
MX960 high-voltage second-generation (HVAC or HVDC)	5100 W	10200 W		Power exceeded	
MX960 DC high-capacity	1700 W (one feed) 4100 W (two feeds)	3400 W (one feed) 8200 W (two feeds)	–	Power exceeded 1165 W	Power exceeded 875 W

[1] For this configuration, output power is 2935 W.

[2] For this configuration, output power is 3225 W.

3. Calculate input power. In this step, the input power requirements for the example configuration are calculated. To do this, divide the total output requirement by the efficiency of the power supply as shown in Table 100 on page 216.

NOTE: MX960 AC and MX960 DC normal-capacity power supplies are not included in the following table, because their power budget was exceeded in the sample configuration.

Table 100: Calculating Input Power

Power Supply	Power Supply Efficiency[1]	Input Power Requirement[2]
MX960 AC high-capacity	~88 %	3335 W[3]
MX960 DC high-capacity	86 %	3413 W[3]
MX960 AC high-capacity second-generation	91 %	3225 W
MX960 (HVAC or HVDC) high-voltage second-generation universal	91 %	3225 W

[1] These values are at full load and nominal voltage.

[2] For this configuration, total power for zone 0 is 2935 W. The calculation method for zone 1 is the same as zone 0.

[3] Zone 0 requirement.

4. Calculate thermal output (BTUs). To calculate this, multiply the input power requirement (in watts) by 3.41 as shown in Table 101 on page 216.

Table 101: Calculating Thermal Output

Power Supply	Thermal Output (BTUs per hour)
MX960 AC high-capacity	3335 * 3.41 = 11,372 BTU/hr[1]
MX960 DC high-capacity	3413 * 3.41 = 11,638 BTU/hr[1]
MX960 AC high-capacity second-generation	3225 * 3.41 = 10997 BTU/hr[1]
MX960 (HVAC or HVDC) high-voltage second-generation universal	3225 * 3.41 = 10997 BTU/hr[1]

[1] Zone 0 output. The calculation method for zone 1 is the same as for zone 0.

RELATED DOCUMENTATION

Power Requirements for an MX960 Router | 202

Electrical Specifications for the MX960 AC Power Supply

Electrical Specifications for the MX960 DC Power Supply

AC Power Circuit Breaker Requirements for the MX960 Router

The circuit breaker protection for all the power supplies should be designed according to National Electrical Code (NEC) of the country of the system installation or any similar local standard based on the maximum drawn current of the power supply specified in this document.

Each normal-capacity AC power supply has a single AC receptacle located in the chassis directly above the power supply.

Each high-capacity AC power supply have dual feeds. One AC receptacle located on front panel of the power supply while second one is located on chassis above the power supply.

Each high-capacity AC PEM accepts two AC feeds in two unique AC receptacles. We recommend that you use a dedicated customer site circuit breaker rated for 38 A (264 VAC) minimum for each high- capacity AC power supply, or as required by local code.

Each high-capacity second-generation (MX960-PSM-5K-AC) power supply has dual feeds. Both AC receptacles are located on front panel of the power supply.

Each power cord feed must have a dedicated circuit breaker.

RELATED DOCUMENTATION

MX960 AC Power Supply Description | 127

MX960 AC Power Electrical Safety Guidelines and Warnings

Replacing an MX960 AC or High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | 557

AC Power Cord Specifications for the MX960 Router

Each normal capacity AC power supply has a single AC appliance inlet located in the chassis directly above the power supply that requires a dedicated AC power feed and each high-capacity AC PEM accepts two AC feeds in two unique AC receptacles. 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.

You can order detachable AC power cords, each approximately 8 ft (2.5 m) long that supply AC power to the router. The C19 appliance coupler 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 end of the power cord fits into the power source receptacle that is standard for your geographical location. If you want to use two AC feeds, two power cords are needed for each HC AC power supply. For more information about AC power supplies, see "MX960 AC Power Supply Description" on page 127.

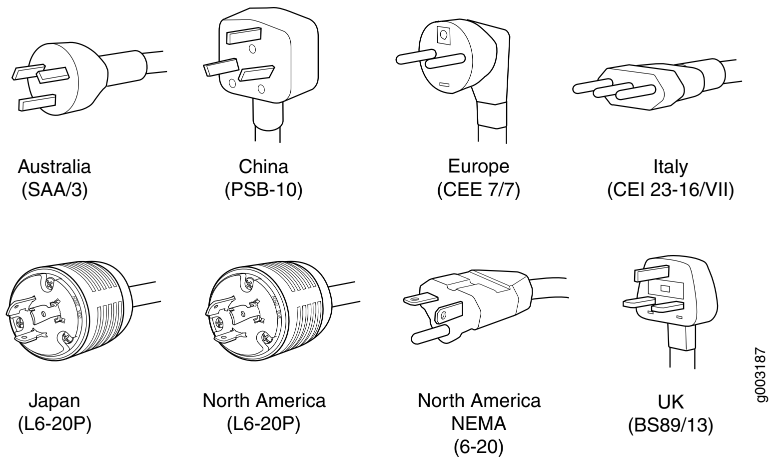
NOTE: For the high-voltage second-generation universal (HVAC/HVDC) PSMs power cord specifications, see "High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router" on page 260.

Table 102 on page 218 provides specifications and Figure 55 on page 219 depicts the plug on the AC power cord provided for each country or region. Table 103 on page 220 provides specifications and depicts the plug on the AC power cord provided for each country or region for the high-capacity second-generation PSMs.

Table 102: AC Power Cord Specifications

Country	Electrical Specification	Plug Type
Australia	240 VAC, 50 Hz AC	SAA/3
China	220 VAC, 50 Hz AC	PSB-10
Europe (except Denmark, Italy, Switzerland, and United Kingdom)	220 or 230 VAC, 50 Hz AC	CEE 7/7
Italy	230 VAC, 50 Hz AC	CEI 23-16/VII
Japan	220 VAC, 50 or 60 Hz AC	NEMA L6-20P
North America	250 VAC, 60 Hz AC	NEMA L6-20P
United Kingdom	240 VAC, 50 Hz AC	BS89/13

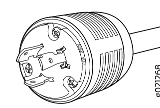
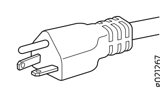
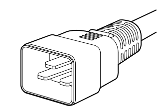
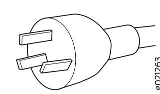
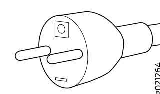
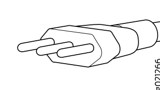
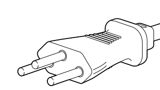
Figure 55: AC Plug Types



Each high-capacity second-generation (MX960-PSM-5K-AC) power supply has two AC appliance inlets located in the power supply itself. Each receptacle requires a dedicated AC power feed and a dedicated breaker. Table 103 on page 220 provides specifications for the high-capacity second-generation PSM.

CAUTION: The bend radius for the power cord cables is 7 inches. Avoid bending the cable beyond it’s bend radius when dressing the cables into the cable channels on the rack.

Table 103: AC Power Cord Specifications for the MX960-PSM-5K-AC PSM

Country	Model Number	Electrical Specification	Plug Type	Graphic
North America	CBL-M-PWR-RA-JP	250 VAC, 20 A, 50 or 60 Hz AC	NEMA L6-20P Type NEMA Locking	
North America	CBL-M-PWR-RA-US	250 VAC, 20 A, 60 Hz	NEMA 6-20, Type N6/20	
Worldwide (Except U.S.A)	CBL-MX-PWR-C19-C20	250 VAC, 16 A, 50 Hz	EN 60320-2-2/1	
China	CBL-PWR-C19S-162-CH	250 VAC, 16 A, 50Hz	GB 1002 Type PRC/3/16	
Continental Europe	CBL-PWR-C19S-162-EU	250 VAC, 16 A, 50 Hz	CEE (7) VII Type VIIG	
Italy	CBL-PWR-C19S-162-IT	250 VAC, 16 A, 50 Hz	CEI 23-16 Type I/3/16	
Switzerland	CBL-MX-PWR-C19-SZ	250 VAC, 16 A, 50 Hz	SEV 5934/2 Type 23G	

WARNING: The AC power cord for the router is intended for use with the router only and not for any other use.

WARNING:

注意

附属の電源コードセットはこの製品専用です。
他の電気機器には使用しないでください。

g017253

Translation from Japanese: The attached power cable is only for this product. Do not use the cable for another product.

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). You can order AC power cords that are in compliance.

WARNING: The router is a pluggable type A equipment installed in restricted access location. It has a separate protective earthing terminal (Metric [–M6] and English [–¼-20] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.

CAUTION: Power cords and cables must not block access to device components or drape where people could trip on them.

RELATED DOCUMENTATION

MX960 AC Power Supply Description | 127

Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies | 352

Replacing an MX960 AC Power Supply Cord | 575

CHAPTER 15

DC Power Requirements, Specifications, and Guidelines

IN THIS CHAPTER

Electrical Specifications for the MX960 DC Power Supply

Table 104 on page 222 lists the DC power supply electrical specifications.

Table 104: Power Supply Electrical Specifications

Item	Specification
Normal-Capacity Power Supplies	
Maximum output power	2800 W
DC input current rating	58 A @ –48 V nominal operating voltage
Maximum input current	70 A
DC input voltage	Operating range: –40 to –72 VDC Nominal: –48 VDC
Maximum DC inrush current	140.5 A for both feeds at nominal -48V

Table 104: Power Supply Electrical Specifications *(continued)*

Item	Specification	
Internal Circuit Breaker	80 A	
Efficiency **NOTE:** This value is at full load and nominal voltage.	99%	
High-Capacity Power Supplies		
Maximum output power	Two-Feed Mode	One-Feed Mode
	4100 W	1700 W
DC input voltage	Nominal: –48 VDC Operating range: –40 to –72 VDC	
DC nominal input current rating @48 VDC	Two-Feed Mode	One-Feed Mode
	104 A for both feeds (54 A and 50 A per feed)	42 A
Maximum input current rating @ 40 VDC input voltage	128 A for both feeds (66 A and 62 A per feed)	52 A
Maximum DC inrush current	140.5 A for both feeds (70 A and 70.5 A per feed	70 A
Efficiency **NOTE:** This value is at full load and nominal voltage.	86%	

Table 105: Power System Electrical Specifications

Item	Normal-Capacity	High-Capacity
Redundancy	2+2	2+2

Table 105: Power System Electrical Specifications *(continued)*

Item	Normal-Capacity	High-Capacity	
Output power (maximum) per supply	2800 W	Two-feed mode	One-feed mode
		4100 W	1700 W
Output power (maximum) per system	5600 W	8200 W	3400 W

RELATED DOCUMENTATION

Calculating Power Requirements for MX960 Routers | 212
MX960 DC Power Supply | 138
MX960 DC Power Electrical Safety Guidelines
show chassis power

Power Requirements for an MX960 Router

Table 95 on page 203 lists the MX960 base system and cooling system power requirements. Table 96 on page 203 lists the FRU power requirements for Switch Control Boards (SCB), Routing Engines, Modular Port Concentrators (MPC), Modular Interface Cards (MIC), Dense Port Concentrators (DPC), and Flexible PIC Concentrators (FPC).

Typical power represents power under certain temperatures and normal operating conditions.

Table 106: MX960 Common Component Power Requirements

Component	Maximum Power Requirement	Typical Power Requirement
Base system	50 W	50 W
Normal-capacity cooling system	600 W (full speed)	400 W (normal speed)
High-capacity cooling system	640 W (full speed)	450 W (normal speed)

Table 107: FRU Power Requirements

Component	Part Number	Maximum Power Requirement
Routing Engines		
	RE-S-X6-64G RE-S-X6-128G	110 W
	RE-S-1300-2048 (EOL’d) RE-S-2000-4096 (EOL’d) RE-S-1800 (all variants)	90 W
Fixed Configuration Modular Port Concentrators (MPC)		
MPC-3D-16XGE-SFPP	MPC-3D-16XGE-SFPP MPC-3D-16XGE-SFPP-R-B	440 W at 131° F (55° C) ambient 423 W at 77° F (25° C) ambient
Multiservices MPC	MS-MPC-128G	590 W
32x10GE MPC4E	MPC4E-3D-32XGE-SFPP	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR optics 584 W at 40° C, with SFPP ZR optics 565 W at 77° F (25° C), with SFPP ZR optics

Table 107: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
2x100GE + 8x10GE MPC4E	MPC4E-3D-2CGE-8XGE	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR and CFP LR4 optics 584 W at 104° F (40° C), with SFPP ZR and CFP LR4 optics 565 W at 77° F (25° C), with SFPP ZR and CFP LR4 optics
6x40GE + 24x10GE MPC5E *6x40GE + 24x10GE MPC5EQ*	MPC5E-40G10G MPC5EQ-40G10G	**With optics:** 607 W at 131° F (55° C) 541 W at 104° F (40° C) 511 W at 77° F (25° C)
2x100GE + 4x10GE MPC5E *2x100GE + 4x10GE MPC5EQ*	MPC5E-100G10G MPC5EQ-100G10G	**With optics:** 607 W at 131° F (55° C) 541 W at 104° F (40° C) 511 W at 77° F (25° C)
MPC7E-MRATE	MPC7E-MRATE	**With optics:** 545 W at 131° F (55° C) 465 W at 104° F (40° C) 440 W at 77° F (25° C)
MPC10E-10C-MRATE	MPC10E-10C-MRATE	620 W at 131° F (55° C) 590 W at 104° F (40° C) 545 W at 77° F (25° C)

Table 107: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC10E-15C-MRATE	MPC10E-15C-MRATE	785 W at 104° F (40° C): 720 W at 77° F (25° C)
Modular Port Concentrators (MPC)		
MPC1 *MPC1E*	MX-MPC1-3D MX-MPC1E-3D	165 W **With MICs and optics:** 239 W at 131° F (55° C) 227 W at 104° F (40° C) 219 W at 77° F (25° C)
MPC1 Q *MPC1E Q*	MX-MPC1-3D-Q MX-MPC1E-3D-Q	175 W **With MICs and optics:** 249 W at 131° F (55° C) 237 W at 104° F (40° C) 228 W at 77° F (25° C)
MPC2 *MPC2E*	MX-MPC2-3D MX-MPC2E-3D	274 W **With MICs and optics:** 348 W at 131° F (55° C) 329 W at 104° F (40° C) 315 W at 77° F (25° C)
MPC2 Q *MPC2E Q* *MPC2 EQ* *MPC2E EQ*	MX-MPC2-3D-Q MX-MPC2E-3D-Q MX-MPC2-3D-EQ MX-MPC2E-3D-EQ	294 W **With MICs and optics:** 368 W at 131° F (55° C) 347 W at 104° F (40° C) 333 W at 77° F (25° C)

Table 107: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC2E P	MX-MPC2E-3D-P	294 W **With MICs and optics:** 368 W at 131° F (55° C) 347 W at 104° F (40° C) 333 W at 77° F (25° C)
MPC2E NG	MPC2E-3D-NG	474 W **With MICs and optics:** 474 W at 131° F (55° C) 417 W at 104° F (40° C) 400 W at 77° F (25° C)
MPC2E NG Q	MPC2E-3D-NG-Q	529 W **With MICs and optics:** 529 W at 131° F (55° C) 460 W at 104° F (40° C) 438 W at 77° F (25° C)
MPC3E	MX-MPC3E-3D	440W **With MICs and optics:** 500 W at 131° F (55° C), two 40 W MICs 485 W at 104° F (40° C), two CFP MICs with LR4 optics 473 W at 77° F (25° C), two CFP MICs with LR4 optics

Table 107: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC3E-3D-NG	MPC3E-3D-NG	534 W **With MICs and optics:** 534 W at 131° F (55° C) 485 W at 104° F (40° C) 461 W at 77° F (25° C)
MPC3E-3D-NG-Q	MPC3E-3D-NG-Q	583 W **With MICs and optics:** 583 W at 131° F (55° C) 532 W at 104° F (40° C) 503 W at 77° F (25° C)
Modular Interface Cards (MIC)		
ATM MIC with SFP	MPC4E-3D-2CGE-8XGE	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR and CFP LR4 optics 584 W at 40° C, with SFPP ZR and CFP LR4 optics 565 W at 77° F (25° C), with SFPP ZR and CFP LR4 optics
Gigabit Ethernet MIC with SFP	MIC-3D-20-GE-SFP	37 W
10-Gigabit Ethernet MICs with XFP	2-Port: MIC-3D-2XGE-XFP 4-Port: MIC-3D-4XGE-XFP	2-Port: 29 W 4-Port: 37 W

Table 107: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
40-Gigabit Ethernet MIC with QSFP+	MIC3-3D-2X40GE-QSFPP	18 W
100-Gigabit Ethernet MIC with CFP	MIC3-3D-1X100GE-CFP	40 W
100-Gigabit Ethernet MIC with CFP2	MIC6-100G-CFP2	104 W
100-Gigabit Ethernet MIC with CXP	MIC3-3D-1X100GE-CXP	20 W
100-Gigabit Ethernet MIC with CXP (4 Ports)	MIC6-100G-CXP	57 W
100-Gigabit DWDM OTN MIC with CFP2	MIC3-100G-DWDM	**With optics:** 91 W at 131° F (55° C) 83 W at 77° F (25° C)
100-Gigabit DWDM OTN MIC with CFP2-ACO	MIC3-100G-DWDM	**With optics:** 91 W at 131° F (55° C) 83 W at 77° F (25° C)
Multiservices MIC	MS-MIC-16G	60 W
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	4-Port: MIC-3D-4OC3OC12-1OC48	4-Port: 24 W at 131° F (55° C) 22.75 W at 40° C 21.5 W at 77° F (25° C)
	8-Port: MIC-3D-8OC3OC12-4OC48	8-Port: 29 W at 131° F (55° C) 27.75 W at 40° C 26.5 W at 77° F (25° C)

Table 107: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	41 W at 131° F (55° C) 38.5 W at 40° C 36 W at 77° F (25° C)
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	4-Port: MIC-3D-4CHOC3-2CHOC12	4-Port: 41 W at 131° F (55° C) 40 W at 40° C 39 W at 77° F (25° C)
	8-Port: MIC-3D-8CHOC3-4CHOC12	8-Port: 52 W at 131° F (55° C) 50.5 W at 40° C 49 W at 77° F (25° C)
Tri-Rate MIC	MIC-3D-40GE-TX	41 W
DS3/E3 MIC	MIC-3D-8DS3-E3 MIC-3D-8CHDS3-E3-B	36 W at 131° F (55° C) 35 W at 40° C 34 W at 77° F (25° C)
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	29.08 W at 131° F (55° C) 27.84 W at 40° C 26.55 W at 77° F (25° C)
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	36.48 W at 131° F (55° C) 35.04 W at 40° C 33.96 W at 77° F (25° C)
Dense Port Concentrators (DPC)		
Gigabit Ethernet DPC with SFP	DPC-R-40GE-SFP	335 W

Table 107: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
Gigabit Ethernet Enhanced DPC with SFP	DPCE-R-40GE-SFP DPCE-X-40GE-SFP	335 W
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP	DPCE-R-Q-40GE-SFP DPCE-X-Q-40GE-SFP	365 W
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP	DPCE-R-Q-20GE-SFP	200 W
10-Gigabit Ethernet DPC with XFP	DPC-R-4XGE-XFP	310 W
10-Gigabit Ethernet Enhanced DPC with XFP	DPCE-R-2XGE-XFP	175 W
10-Gigabit Ethernet Enhanced DPCs with XFP	DPCE-R-4XGE-XFP DPCE-X-4XGE-XFP	310 W
10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP	DPCE-R-Q-4XGE-XFP DPCE-X-Q-4XGE-XFP	330 W
Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP	DPCE-R-20GE-2XGE DPCE-X-20GE-2XGE	333 W
Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP	DPCE-R-Q-20GE-2XGE	335 W

Table 107: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
Tri-Rate Enhanced DPC or *Tri-Rate Enhanced Ethernet Services DPC*	DPCE-R-40GE-TX DPCE-X-40GE-TX	320 W
Multiservices DPC	MS-DPC	265 W
Flexible PIC Concentrators (FPC)		
FPC Type 2	MX-FPC2	190 W (with PICs and optics)
FPC Type 3	MX-FPC3	265 W (with PICs and optics)

RELATED DOCUMENTATION

Electrical Specifications for the MX960 DC Power Supply

Electrical Specifications for the MX960 AC Power Supply

Calculating Power Requirements for MX960 Routers

The information in this topic helps you determine which power supplies are suitable for various configurations, as well as which power supplies are not suitable because output power is exceeded. You determine suitability by subtracting the total power draw from the maximum output of the power supplies. Afterward, the required input current is calculated. Finally, you calculate the thermal output. A sample configuration is provided in Table 67 on page 132.

We recommend that you provision power according to the maximum input current listed in the power supply electrical specifications (see *Electrical Specifications for the MX960 AC Power Supply* and *Electrical Specifications for the MX960 DC Power Supply*).

Use the following procedures to calculate the power requirement:

1. Calculate the power requirement.

2. Evaluate the power budget.

3. Calculate input power.

4. Calculate thermal output (BTUs) for cooling requirements.

Both normal-capacity and high-capacity MX960 chassis with DC power supplies; MX960 chassis with high-capacity AC power supplies; MX960 high-capacity second-generation AC power supplies; and MX960 high-voltage second-generation universal power supplies are zoned. MX960 chassis with normal-capacity AC power supplies have one overall zone. Zoning means that certain components are powered by specific power supplies (see Table 67 on page 132 for information on zoning). When calculating power requirements, be sure that there is adequate power for each zone.

Three AC power supplies are mandatory for MX960 chassis with normal-capacity AC power supplies.

Table 108: MX960 Zoning

Chassis Power Configuration	Zone	Power Supply (PEM)	Components Receiving Power
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (normal and high-capacity power supplies; MX960 AC high-capacity second-generation power supplies; and MX960 high-voltage second-generation universal (HVAC/HVDC) power supplies	Zone 0	PEM 0 or 2	• Lower fan tray • DPC/MPC slots 6 through 11 • SCB slots 1 through 2
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (normal and high-capacity power supplies); MX960 AC high-capacity second-generation power supplies; and MX960 high-voltage second-generation universal (HVAC/HVDC) power supplies	Zone 1	PEM 1 or 3	• Upper fan tray • DPC/MPC slots 0 through 5 • SCB slot 0

The following sample configuration shows an MX960 chassis with:

- Four high-capacity AC power supplies (using two feeds for each power supply); two supplies are active, two are redundant
- Six 16 port 10 GbE MPC with SFP+ interfaces (slots 0 through 5)
- Two SCBs with two (redundant) RE-1800x2 routing engines (SCB slot 0 and SCB slot 1)
- SCB (SCB slot 6)
- Five 16 port 10 GbE MPC with SFP+ interfaces (slots 7 through 11)
- High-capacity cooling system (upper and lower fan trays)

> **NOTE:** The high-capacity cooling system satisfies cooling requirements of MPCs, and must be used for proper cooling.

1. Calculate the power requirements (usage) using the values in “Power Requirements for an MX960 Router” on page 202 as shown in Table 98 on page 214.

Table 109: Sample Power Requirements for an MX960 Router

Chassis Component	Part Number	Power Requirement	Zone
Base system	MX960BASE-AC-HIGH	50 W[1]	—
High-capacity cooling system	FANTRAY-MX960-HC	320 W * 2 = 640 W	Zone 0 (lower fan tray) and Zone 1 (upper fan tray)
MPC - slots 0 through 5	MPC-3D-16XGE-SFPP	440 W * 6 = 2640 W	Zone 1
MPC - slots 7 through 11	MPC-3D-16XGE-SFPP	440 W * 5 = 2200 W	Zone 0
SCB 0	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 1
SCB 1	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 0
SCB 2 - slot 6	SCBE2-MX	185 W	Zone 0
MX960 normal-capacity AC (not zoned) Zone 0 total output power Zone 1 total output power		6265 W 3005 W 3260 W	

[1] Divided equally between zone 0 and zone 1.

2. Evaluate the power budget, including the budget for each zone if applicable. In this step, we check the required power against the maximum output power of available power supply options.

   Table 99 on page 215 lists the power supplies, their maximum output power, and unused power (or a power deficit).

Table 110: Calculating Power Budget

Power Supply	Maximum Output Power of Power Supply	Maximum Output Power for System	Nonzoned Unused Power	Zone 0 Unused Power[1]	Zone 1 Unused Power[2]
MX960 AC normal-capacity	1700 W	5100 W	Power exceeded (non-zoned; 5100 W - 6160 = power exceeded)	–	–
MX960 AC high-capacity	1700 W (one feed) 4100 W (two feeds)	3400 W (one feed) 8200 W (two feeds)	–	Power exceeded 1165 W	Power exceeded 875 W
MX960 DC normal-capacity	2800 W	5600 W	–	Power exceeded	Power exceeded
MX960 AC high-capacity second-generation	2300 W (one feed) 5100 W (two feeds)	4230 W (one feed) 10200 W (two feeds)		Power exceeded 2165 W	Power exceeded 18755 W
MX960 high-voltage second-generation (HVAC or HVDC)	5100 W	10200 W		Power exceeded	
MX960 DC high-capacity	1700 W (one feed) 4100 W (two feeds)	3400 W (one feed) 8200 W (two feeds)	–	Power exceeded 1165 W	Power exceeded 875 W

[1] For this configuration, output power is 2935 W.

[2] For this configuration, output power is 3225 W.

3. Calculate input power. In this step, the input power requirements for the example configuration are calculated. To do this, divide the total output requirement by the efficiency of the power supply as shown in Table 100 on page 216.

NOTE: MX960 AC and MX960 DC normal-capacity power supplies are not included in the following table, because their power budget was exceeded in the sample configuration.

Table 111: Calculating Input Power

Power Supply	Power Supply Efficiency[1]	Input Power Requirement[2]
MX960 AC high-capacity	~88 %	3335 W[3]
MX960 DC high-capacity	86 %	3413 W[3]
MX960 AC high-capacity second-generation	91 %	3225 W
MX960 (HVAC or HVDC) high-voltage second-generation universal	91 %	3225 W

[1] These values are at full load and nominal voltage.

[2] For this configuration, total power for zone 0 is 2935 W. The calculation method for zone 1 is the same as zone 0.

[3] Zone 0 requirement.

4. Calculate thermal output (BTUs). To calculate this, multiply the input power requirement (in watts) by 3.41 as shown in Table 101 on page 216.

Table 112: Calculating Thermal Output

Power Supply	Thermal Output (BTUs per hour)
MX960 AC high-capacity	3335 * 3.41 = 11,372 BTU/hr[1]
MX960 DC high-capacity	3413 * 3.41 = 11,638 BTU/hr[1]
MX960 AC high-capacity second-generation	3225 * 3.41 = 10997 BTU/hr[1]
MX960 (HVAC or HVDC) high-voltage second-generation universal	3225 * 3.41 = 10997 BTU/hr[1]

[1] Zone 0 output. The calculation method for zone 1 is the same as for zone 0.

RELATED DOCUMENTATION

Power Requirements for an MX960 Router | 202

Electrical Specifications for the MX960 AC Power Supply

Electrical Specifications for the MX960 DC Power Supply

DC Power Circuit Breaker Requirements for the MX960 Router

If you plan to operate a maximally configured DC-powered router with normal capacity power supplies, we recommend that you provision at least 116 A (58 A per feed) @ –48 VDC (nominal) for the system. Use a customer site circuit breaker rated according to respective National Electrical Code and customer site internal standards to maintain proper level of protection for the current specified above.

If you plan to operate a maximally configured DC-powered router with high-capacity power supplies, we recommend that you provision at least 208 A (104 A per supply) @ –48 VDC (nominal) for the system. This is maximum current draw at –48 VDC when two power supplies are providing the power to the system and the redundant power supplies are not supplying power or not present. Use a customer site circuit breaker rated according to respective National Electrical Code and customer site internal standards to maintain proper level of protection for the current specified above.

If you plan to operate a DC-powered router at less than the maximum configuration, we recommend that you provision a circuit breaker according to respective National Electrical Code and customer site internal standards to maintain proper level of protection for the current specified above or each DC power supply rated for at least 125% of the continuous current that the system draws at –48 VDC.

RELATED DOCUMENTATION

MX960 DC Power Supply | 138

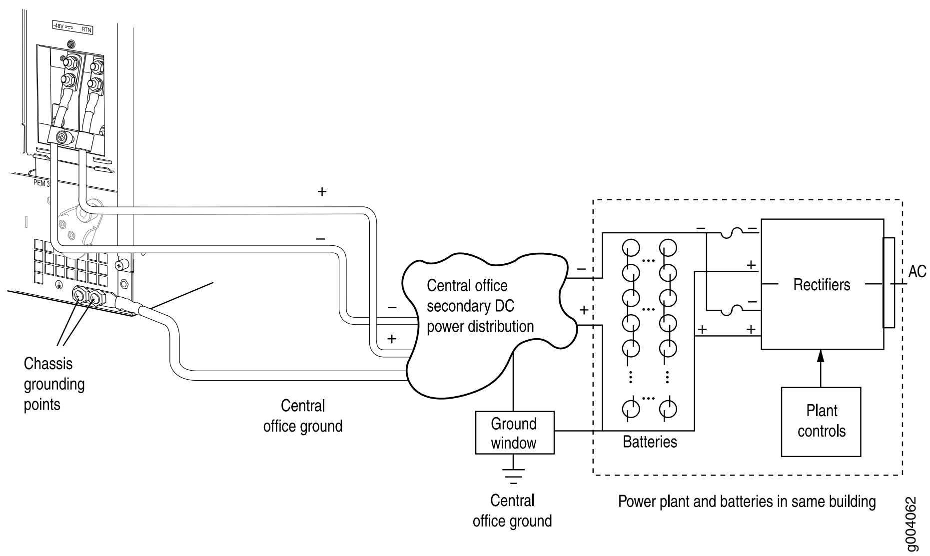
MX960 DC Power Electrical Safety Guidelines

Electrical Specifications for the MX960 DC Power Supply

DC Power Source Cabling for the MX960 Router

Figure 56 on page 240 shows a typical DC source cabling arrangement.

Figure 56: Typical DC Source Cabling to the Router



The DC power supplies in slots **PEM0** and **PEM1** must be powered by dedicated power feeds derived from feed **A**, and the DC power supplies in slots **PEM2** and **PEM3** 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.

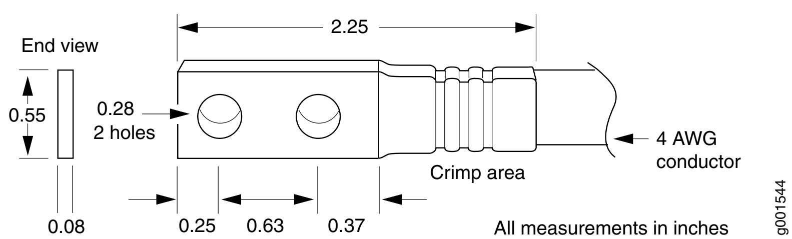
CAUTION: Power cords and cables must not block access to device components or drape where people could trip on them.

RELATED DOCUMENTATION

DC Power Cable Specifications for the MX960 Router

The accessory box shipped with the router includes the cable lugs that attach to the terminal studs of each power supply (see Figure 57 on page 241).

Figure 57: DC Power Cable Lug



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.

WARNING: The Router is a pluggable type A equipment installed in restricted access location. It has a separate protective earthing terminal (Metric [–M6] and English [–¼-20] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.

Table 113 on page 242 summarizes the specifications for the power cables, which you must supply.

Table 113: DC Power Cable Specifications

Cable Type	Quantity and Specification
Power	Eight 4-AWG (21.2 mm^2), minimum 60°C wire, or as required by the local code

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.

RELATED DOCUMENTATION

MX960 DC Power Supply | **138**

MX960 DC Power Electrical Safety Guidelines

DC Power Source Cabling for the MX960 Router | **239**

Connecting an MX960 DC Power Supply Cable | **379**

CHAPTER 16

High-Voltage Second-Generation Universal (HVAC or HVDC) Power Requirements, Specifications, and Guidelines

IN THIS CHAPTER

Electrical Specifications for the MX960 High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply

Table 114 on page 243 lists the MX960-PSM-HV (HVAC or HVDC) power supply electrical specifications.

Table 114: Power Supply Electrical Specifications

Item	Specification
HVAC/HVDC Power Supply	
Maximum output power	5100
AC nominal input voltage	Operating range: 200-305 VAC
DC nominal input voltage	200-410 VDC
AC input current rating	30 A maximum

Table 114: Power Supply Electrical Specifications *(continued)*

Item	Specification
DC input current rating	30 A maximum
Maximum AC inrush current	70 A @ 264 VAC
Maximum DC inrush current	70 A @ 410 VDC

Item	High-voltage Second-Generation Universal Power Supply
Redundancy	2+2
Output power (maximum) per supply	5100 W

RELATED DOCUMENTATION

MX960 AC Power Supply Description | 127

Replacing an MX960 AC or High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | 557

Installing a MX960 AC Power Supply or High-Voltage Second-Generation Universal (HVAC or HVDC) | 433

show chassis power

Power Requirements for an MX960 Router

Table 95 on page 203 lists the MX960 base system and cooling system power requirements.
Table 96 on page 203 lists the FRU power requirements for Switch Control Boards (SCB), Routing Engines, Modular Port Concentrators (MPC), Modular Interface Cards (MIC), Dense Port Concentrators (DPC), and Flexible PIC Concentrators (FPC).

Typical power represents power under certain temperatures and normal operating conditions.

Table 115: MX960 Common Component Power Requirements

Component	Maximum Power Requirement	Typical Power Requirement
Base system	50 W	50 W
Normal-capacity cooling system	600 W (full speed)	400 W (normal speed)
High-capacity cooling system	640 W (full speed)	450 W (normal speed)

Table 116: FRU Power Requirements

Component	Part Number	Maximum Power Requirement
Routing Engines		
	RE-S-X6-64G RE-S-X6-128G	110 W
	RE-S-1300-2048 (EOL'd) RE-S-2000-4096 (EOL'd) RE-S-1800 (all variants)	90 W
Fixed Configuration Modular Port Concentrators (MPC)		
MPC-3D-16XGE-SFPP	MPC-3D-16XGE-SFPP MPC-3D-16XGE-SFPP-R-B	440 W at 131° F (55° C) ambient 423 W at 77° F (25° C) ambient
Multiservices MPC	MS-MPC-128G	590 W

Table 116: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
32x10GE MPC4E	MPC4E-3D-32XGE-SFPP	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR optics 584 W at 40° C, with SFPP ZR optics 565 W at 77° F (25° C), with SFPP ZR optics
2x100GE + 8x10GE MPC4E	MPC4E-3D-2CGE-8XGE	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR and CFP LR4 optics 584 W at 104° F (40° C), with SFPP ZR and CFP LR4 optics 565 W at 77° F (25° C), with SFPP ZR and CFP LR4 optics
6x40GE + 24x10GE MPC5E *6x40GE + 24x10GE MPC5EQ*	MPC5E-40G10G MPC5EQ-40G10G	**With optics:** 607 W at 131° F (55° C) 541 W at 104° F (40° C) 511 W at 77° F (25° C)
2x100GE + 4x10GE MPC5E *2x100GE + 4x10GE MPC5EQ*	MPC5E-100G10G MPC5EQ-100G10G	**With optics:** 607 W at 131° F (55° C) 541 W at 104° F (40° C) 511 W at 77° F (25° C)

Table 116: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC7E-MRATE	MPC7E-MRATE	**With optics:** 545 W at 131° F (55° C) 465 W at 104° F (40° C) 440 W at 77° F (25° C)
MPC10E-10C-MRATE	MPC10E-10C-MRATE	620 W at 131° F (55° C) 590 W at 104° F (40° C) 545 W at 77° F (25° C)
MPC10E-15C-MRATE	MPC10E-15C-MRATE	785 W at 104° F (40° C): 720 W at 77° F (25° C)
Modular Port Concentrators (MPC)		
MPC1 *MPC1E*	MX-MPC1-3D MX-MPC1E-3D	165 W **With MICs and optics:** 239 W at 131° F (55° C) 227 W at 104° F (40° C) 219 W at 77° F (25° C)
MPC1 Q *MPC1E Q*	MX-MPC1-3D-Q MX-MPC1E-3D-Q	175 W **With MICs and optics:** 249 W at 131° F (55° C) 237 W at 104° F (40° C) 228 W at 77° F (25° C)

Table 116: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC2 *MPC2E*	MX-MPC2-3D MX-MPC2E-3D	274 W **With MICs and optics:** 348 W at 131° F (55° C) 329 W at 104° F (40° C) 315 W at 77° F (25° C)
MPC2 Q *MPC2E Q* *MPC2 EQ* *MPC2E EQ*	MX-MPC2-3D-Q MX-MPC2E-3D-Q MX-MPC2-3D-EQ MX-MPC2E-3D-EQ	294 W **With MICs and optics:** 368 W at 131° F (55° C) 347 W at 104° F (40° C) 333 W at 77° F (25° C)
MPC2E P	MX-MPC2E-3D-P	294 W **With MICs and optics:** 368 W at 131° F (55° C) 347 W at 104° F (40° C) 333 W at 77° F (25° C)
MPC2E NG	MPC2E-3D-NG	474 W **With MICs and optics:** 474 W at 131° F (55° C) 417 W at 104° F (40° C) 400 W at 77° F (25° C)

Table 116: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
MPC2E NG Q	MPC2E-3D-NG-Q	529 W **With MICs and optics:** 529 W at 131° F (55° C) 460 W at 104° F (40° C) 438 W at 77° F (25° C)
MPC3E	MX-MPC3E-3D	440W **With MICs and optics:** 500 W at 131° F (55° C), two 40 W MICs 485 W at 104° F (40° C), two CFP MICs with LR4 optics 473 W at 77° F (25° C), two CFP MICs with LR4 optics
MPC3E-3D-NG	MPC3E-3D-NG	534 W **With MICs and optics:** 534 W at 131° F (55° C) 485 W at 104° F (40° C) 461 W at 77° F (25° C)
MPC3E-3D-NG-Q	MPC3E-3D-NG-Q	583 W **With MICs and optics:** 583 W at 131° F (55° C) 532 W at 104° F (40° C) 503 W at 77° F (25° C)
Modular Interface Cards (MIC)		

Table 116: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
ATM MIC with SFP	MPC4E-3D-2CGE-8XGE	610 W **With optics:** 607 W at 131° F (55° C), with SFPP ZR and CFP LR4 optics 584 W at 40° C, with SFPP ZR and CFP LR4 optics 565 W at 77° F (25° C), with SFPP ZR and CFP LR4 optics
Gigabit Ethernet MIC with SFP	MIC-3D-20-GE-SFP	37 W
10-Gigabit Ethernet MICs with XFP	2-Port: MIC-3D-2XGE-XFP 4-Port: MIC-3D-4XGE-XFP	2-Port: 29 W 4-Port: 37 W
40-Gigabit Ethernet MIC with QSFP+	MIC3-3D-2X40GE-QSFPP	18 W
100-Gigabit Ethernet MIC with CFP	MIC3-3D-1X100GE-CFP	40 W
100-Gigabit Ethernet MIC with CFP2	MIC6-100G-CFP2	104 W
100-Gigabit Ethernet MIC with CXP	MIC3-3D-1X100GE-CXP	20 W
100-Gigabit Ethernet MIC with CXP (4 Ports)	MIC6-100G-CXP	57 W
100-Gigabit DWDM OTN MIC with CFP2	MIC3-100G-DWDM	**With optics:** 91 W at 131° F (55° C) 83 W at 77° F (25° C)

Table 116: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
100-Gigabit DWDM OTN MIC with CFP2-ACO	MIC3-100G-DWDM	**With optics:** 91 W at 131° F (55° C) 83 W at 77° F (25° C)
Multiservices MIC	MS-MIC-16G	60 W
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	4-Port: MIC-3D-4OC3OC12-1OC48	4-Port: 24 W at 131° F (55° C) 22.75 W at 40° C 21.5 W at 77° F (25° C)
	8-Port: MIC-3D-8OC3OC12-4OC48	8-Port: 29 W at 131° F (55° C) 27.75 W at 40° C 26.5 W at 77° F (25° C)
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	41 W at 131° F (55° C) 38.5 W at 40° C 36 W at 77° F (25° C)
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	4-Port: MIC-3D-4CHOC3-2CHOC12	4-Port: 41 W at 131° F (55° C) 40 W at 40° C 39 W at 77° F (25° C)
	8-Port: MIC-3D-8CHOC3-4CHOC12	8-Port: 52 W at 131° F (55° C) 50.5 W at 40° C 49 W at 77° F (25° C)

Table 116: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
Tri-Rate MIC	MIC-3D-40GE-TX	41 W
DS3/E3 MIC	MIC-3D-8DS3-E3 MIC-3D-8CHDS3-E3-B	36 W at 131° F (55° C) 35 W at 40° C 34 W at 77° F (25° C)
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	29.08 W at 131° F (55° C) 27.84 W at 40° C 26.55 W at 77° F (25° C)
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	36.48 W at 131° F (55° C) 35.04 W at 40° C 33.96 W at 77° F (25° C)
Dense Port Concentrators (DPC)		
Gigabit Ethernet DPC with SFP	DPC-R-40GE-SFP	335 W
Gigabit Ethernet Enhanced DPC with SFP	DPCE-R-40GE-SFP DPCE-X-40GE-SFP	335 W
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP	DPCE-R-Q-40GE-SFP DPCE-X-Q-40GE-SFP	365 W
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP	DPCE-R-Q-20GE-SFP	200 W
10-Gigabit Ethernet DPC with XFP	DPC-R-4XGE-XFP	310 W

Table 116: FRU Power Requirements *(continued)*

Component	Part Number	Maximum Power Requirement
10-Gigabit Ethernet Enhanced DPC with XFP	DPCE-R-2XGE-XFP	175 W
10-Gigabit Ethernet Enhanced DPCs with XFP	DPCE-R-4XGE-XFP DPCE-X-4XGE-XFP	310 W
10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP	DPCE-R-Q-4XGE-XFP DPCE-X-Q-4XGE-XFP	330 W
Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP	DPCE-R-20GE-2XGE DPCE-X-20GE-2XGE	333 W
Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP	DPCE-R-Q-20GE-2XGE	335 W
Tri-Rate Enhanced DPC or *Tri-Rate Enhanced Ethernet Services DPC*	DPCE-R-40GE-TX DPCE-X-40GE-TX	320 W
Multiservices DPC	MS-DPC	265 W
Flexible PIC Concentrators (FPC)		
FPC Type 2	MX-FPC2	190 W (with PICs and optics)
FPC Type 3	MX-FPC3	265 W (with PICs and optics)

RELATED DOCUMENTATION

Electrical Specifications for the MX960 DC Power Supply

Electrical Specifications for the MX960 AC Power Supply

Calculating Power Requirements for MX960 Routers

The information in this topic helps you determine which power supplies are suitable for various configurations, as well as which power supplies are not suitable because output power is exceeded. You determine suitability by subtracting the total power draw from the maximum output of the power supplies. Afterward, the required input current is calculated. Finally, you calculate the thermal output. A sample configuration is provided in Table 67 on page 132.

We recommend that you provision power according to the maximum input current listed in the power supply electrical specifications (see *Electrical Specifications for the MX960 AC Power Supply* and *Electrical Specifications for the MX960 DC Power Supply*).

Use the following procedures to calculate the power requirement:

1. Calculate the power requirement.

2. Evaluate the power budget.

3. Calculate input power.

4. Calculate thermal output (BTUs) for cooling requirements.

Both normal-capacity and high-capacity MX960 chassis with DC power supplies; MX960 chassis with high-capacity AC power supplies; MX960 high-capacity second-generation AC power supplies; and MX960 high-voltage second-generation universal power supplies are zoned. MX960 chassis with normal-capacity AC power supplies have one overall zone. Zoning means that certain components are powered by specific power supplies (see Table 67 on page 132 for information on zoning). When calculating power requirements, be sure that there is adequate power for each zone.

Three AC power supplies are mandatory for MX960 chassis with normal-capacity AC power supplies.

Table 117: MX960 Zoning

Chassis Power Configuration	Zone	Power Supply (PEM)	Components Receiving Power
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (normal and high-capacity power supplies; MX960 AC high-capacity second-generation power supplies; and MX960 high-voltage second-generation universal (HVAC/HVDC) power supplies	Zone 0	PEM 0 or 2	• Lower fan tray • DPC/MPC slots 6 through 11 • SCB slots 1 through 2
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (normal and high-capacity power supplies); MX960 AC high-capacity second-generation power supplies; and MX960 high-voltage second-generation universal (HVAC/HVDC) power supplies	Zone 1	PEM 1 or 3	• Upper fan tray • DPC/MPC slots 0 through 5 • SCB slot 0

The following sample configuration shows an MX960 chassis with:

- Four high-capacity AC power supplies (using two feeds for each power supply); two supplies are active, two are redundant
- Six 16 port 10 GbE MPC with SFP+ interfaces (slots 0 through 5)
- Two SCBs with two (redundant) RE-1800x2 routing engines (SCB slot 0 and SCB slot 1)
- SCB (SCB slot 6)
- Five 16 port 10 GbE MPC with SFP+ interfaces (slots 7 through 11)
- High-capacity cooling system (upper and lower fan trays)

> **NOTE:** The high-capacity cooling system satisfies cooling requirements of MPCs, and must be used for proper cooling.

1. Calculate the power requirements (usage) using the values in "Power Requirements for an MX960 Router" on page 202 as shown in Table 98 on page 214.

Table 118: Sample Power Requirements for an MX960 Router

Chassis Component	Part Number	Power Requirement	Zone
Base system	MX960BASE-AC-HIGH	50 W[1]	–
High-capacity cooling system	FANTRAY-MX960-HC	320 W * 2 = 640 W	Zone 0 (lower fan tray) and Zone 1 (upper fan tray)
MPC - slots 0 through 5	MPC-3D-16XGE-SFPP	440 W * 6 = 2640 W	Zone 1
MPC - slots 7 through 11	MPC-3D-16XGE-SFPP	440 W * 5 = 2200 W	Zone 0
SCB 0	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 1
SCB 1	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 0
SCB 2 - slot 6	SCBE2-MX	185 W	Zone 0
MX960 normal-capacity AC (not zoned) Zone 0 total output power Zone 1 total output power		6265 W 3005 W 3260 W	

[1] Divided equally between zone 0 and zone 1.

2. Evaluate the power budget, including the budget for each zone if applicable. In this step, we check the required power against the maximum output power of available power supply options.

   Table 99 on page 215 lists the power supplies, their maximum output power, and unused power (or a power deficit).

Table 119: Calculating Power Budget

Power Supply	Maximum Output Power of Power Supply	Maximum Output Power for System	Nonzoned Unused Power	Zone 0 Unused Power[1]	Zone 1 Unused Power[2]
MX960 AC normal-capacity	1700 W	5100 W	Power exceeded (non-zoned; 5100 W - 6160 = power exceeded)	–	–
MX960 AC high-capacity	1700 W (one feed) 4100 W (two feeds)	3400 W (one feed) 8200 W (two feeds)	–	Power exceeded 1165 W	Power exceeded 875 W
MX960 DC normal-capacity	2800 W	5600 W	–	Power exceeded	Power exceeded
MX960 AC high-capacity second-generation	2300 W (one feed) 5100 W (two feeds)	4230 W (one feed) 10200 W (two feeds)		Power exceeded 2165 W	Power exceeded 18755 W
MX960 high-voltage second-generation (HVAC or HVDC)	5100 W	10200 W		Power exceeded	
MX960 DC high-capacity	1700 W (one feed) 4100 W (two feeds)	3400 W (one feed) 8200 W (two feeds)	–	Power exceeded 1165 W	Power exceeded 875 W

[1] For this configuration, output power is 2935 W.

[2] For this configuration, output power is 3225 W.

3. Calculate input power. In this step, the input power requirements for the example configuration are calculated. To do this, divide the total output requirement by the efficiency of the power supply as shown in Table 100 on page 216.

NOTE: MX960 AC and MX960 DC normal-capacity power supplies are not included in the following table, because their power budget was exceeded in the sample configuration.

Table 120: Calculating Input Power

Power Supply	Power Supply Efficiency[1]	Input Power Requirement[2]
MX960 AC high-capacity	~88 %	3335 W[3]
MX960 DC high-capacity	86 %	3413 W[3]
MX960 AC high-capacity second-generation	91 %	3225 W
MX960 (HVAC or HVDC) high-voltage second-generation universal	91 %	3225 W

[1] These values are at full load and nominal voltage.

[2] For this configuration, total power for zone 0 is 2935 W. The calculation method for zone 1 is the same as zone 0.

[3] Zone 0 requirement.

4. Calculate thermal output (BTUs). To calculate this, multiply the input power requirement (in watts) by 3.41 as shown in Table 101 on page 216.

Table 121: Calculating Thermal Output

Power Supply	Thermal Output (BTUs per hour)
MX960 AC high-capacity	3335 * 3.41 = 11,372 BTU/hr[1]
MX960 DC high-capacity	3413 * 3.41 = 11,638 BTU/hr[1]
MX960 AC high-capacity second-generation	3225 * 3.41 = 10997 BTU/hr[1]
MX960 (HVAC or HVDC) high-voltage second-generation universal	3225 * 3.41 = 10997 BTU/hr[1]

[1] Zone 0 output. The calculation method for zone 1 is the same as for zone 0.

RELATED DOCUMENTATION

Power Requirements for an MX960 Router | 202

Electrical Specifications for the MX960 AC Power Supply

Electrical Specifications for the MX960 DC Power Supply

High-Voltage Second-Generation Universal (HVAC or HVDC) Power Circuit Breaker Requirements for the MX960 Router

The circuit breaker protection on all the power supplies should be designed according to National Electrical Code (NEC) of country of system installation or any similar local standard based on maximum drawn current of the power supply specified in this document.

Each high-voltage universal (MX960-PSM-HV) power supply has a single feed. The input AC or DC receptacle inlet is located on front panel of the power supply.

Each power cord feed should have dedicated circuit breakers. We recommend that size of the circuit breaker protection should be designed according to National Electrical Code (NEC) of country of system installation or any similar local standard based on maximum drawn current of the power supply specified in this document.

CAUTION: Use a 2-pole circuit breaker rated at minimum of 125% of the rated current per NEC or as local codes.
Primary Overcurrent Protection by the Building Circuit Breaker. This breaker must protect against excess current, short circuit, and earth grounding fault in accordance with NEC which is ANSI/NFPA 70.

RELATED DOCUMENTATION

MX960 AC Power Supply Description | 127

MX960 AC Power Electrical Safety Guidelines and Warnings

Replacing an MX960 AC or High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | 557

High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router

The MX960-PSM-HV (HVAC or HVDC) power supplies requires a high current cable assembly when set for 30-A input. One end of the cable has an Anderson APP-400 connector, the other end of the cable is bare wire. See Figure 58 on page 260 and Table 122 on page 261. These cables are separately orderable and are not shipped automatically with MX960-PSM-HV orders. An example of the right-angle cable and connector is shown in Figure 60 on page 261. For connection to AC systems, Juniper provides a cable with either a NEMA 30-A connector (Figure 58 on page 260) or an IEC 330P6W connector (Figure 59 on page 260).

Figure 58: NEMA 30-A Connector

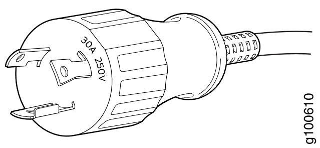
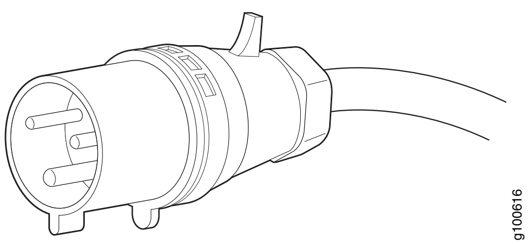


Figure 59: IEC 330P6W Connector



The MX960-PSM-HV (HVAC or HVDC) power supply has one C20 receptacles on front panel of the power supply. The cover needs to be installed to cover C20 receptacles on PDM on top of the chassis. Input receptacle is APP 2007G type from Anderson rated 30 A 400V.

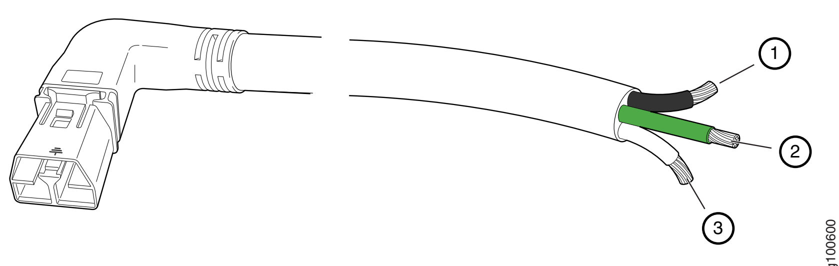
The high voltage alternating current (HVAC), and high voltage direct current (HVDC) have specific cord requirements. Table 122 on page 261 provides specifications and plug standards on the power cord provided for each country or region.

> **CAUTION:** The bend radius for the power cord cables is 7 inches. Avoid bending the cable beyond its bend radius when dressing the cables into the cable channels on the rack.

Table 122: 30-A Cabling Options

Spare Juniper Model Number	Locale	Cord Set Rating	Connector
CBL-PWR2-332P6W-RA	Continental Europe AC power cord	30-A 250 VAC	Anderson/right-angle to IEC 332P6
CBL-PWR2-BARE-RA	North America HVAC/HVDC power cord	30-A, 400 VAC	Anderson/right-angle to bare wire
CBL-PWR-SG4-RA	U.S.A	30-A, 400 VAC	SAF-D-GRID 400 right-angle (LH)
CBL-PWR-SG4	North America AC jumper power cord	30-A, 400 VAC	SAF-D-GRID 400 right-angle (LH)
CBL-PWR2-BARE	North America HVAC/HVDC power cord	30- A, 400 VAC	Anderson/straight to bare wire

Figure 60: Right-Angle, Bare Cable with Anderson Connector



1–Black wire–Positive (+)	3–White wire–Negative
2–Green wire-Ground	

WARNING: The AC power cord for the router is intended for use with the router only and not for any other use.

WARNING:

注意

附属の電源コードセットはこの製品専用です。
他の電気機器には使用しないでください。

g017253

Translation from Japanese: The attached power cable is only for this product. Do not use the cable for another product.

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). You can order AC power cords that are in compliance.

WARNING: The router is a pluggable type A equipment installed in restricted access location. It has a separate protective earthing terminal (Metric [–M6] and English [–¼-20] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.

CAUTION: Power cords and cables must not block access to device components or drape where people could trip on them.

RELATED DOCUMENTATION

MX960 AC Power Supply Description | **127**

Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies | **352**

Replacing an MX960 AC Power Supply Cord | **575**

3

PART

Initial Installation and Configuration

CHAPTER 17

Unpacking the MX960 Router

IN THIS CHAPTER

Tools and Parts Required to Unpack the MX960 Router

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

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

RELATED DOCUMENTATION

Unpacking the MX960 Router | 264

Verifying the MX960 Parts Received | 266

MX960 Router Overview | 2

Unpacking the MX960 Router

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 61 on page 266):

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.

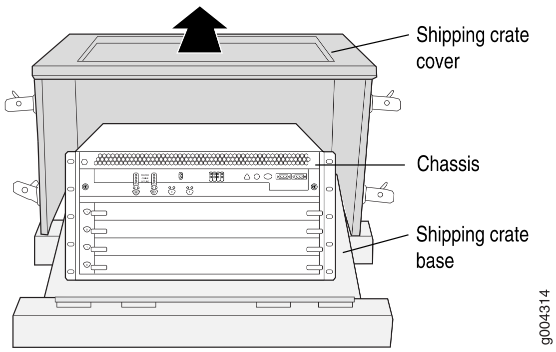
9. Remove the vapor corrosion inhibitor (VCI) packs attached to the pallet, being careful not to break the VCI packs open.

10. To remove the brackets holding the chassis on the pallet, use a 1/2-in. socket wrench and a number 2 Phillips screwdriver to remove the bolts and screws from the brackets.

11. Store the brackets and bolts inside the accessory box.

12. Save the shipping crate cover, pallet, and packing materials in case you need to move or ship the router at a later time.

Figure 61: Contents of the Shipping Crate



RELATED DOCUMENTATION

Verifying the MX960 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 123 on page 266, and an accessory box, which contains the parts listed in Table 124 on page 267. The parts shipped with your router can vary depending on the configuration you ordered.

Table 123: Parts List for a Fully Configured MX960 Router

Component	Quantity
Chassis, including midplane, craft interface, front-mounting flanges, and center-mounting brackets	1
DPCs	Up to 12
FPCs	Up to 6
MPCs	Up to 12

Table 123: Parts List for a Fully Configured MX960 Router *(continued)*

Component	Quantity
MICs	Up to 24
PICs	Up to 12
Routing Engines	1 or 2
SCBs	Up to 3
Power supplies	Up to 4
Fan trays	2
Air filter	1
Air filter tray	1
Quick start installation instructions	1
Large mounting shelf	1
Small mounting shelf	1
Blank panels for slots without components installed	One blank panel for each slot not occupied by a component

Table 124: Accessory Box Parts List

Part	Quantity
Screws to mount chassis	14
DC power terminal Lugs, 4-AWG	8
RJ-45 cable, with RJ-45 Jack to DB-9 socket, to connect the router through the serial port	1
Terminal block plug, 3 pole, 5.08 mm spacing, 12A, to connect the router alarms	2
Label, accessories contents, MX960	1

Table 124: Accessory Box Parts List *(continued)*

Part	Quantity
USB flash drive with Junos	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" x 5" pink bag	2
9" x 12" pink bag, ESD	2
Accessory Box, 19 x 12 x 3"	1
Ethernet cable, RJ-45/RJ-45, 4-pair stranded UTP, Category 5E, 15'	1
ESD wrist strap with cable	1

RELATED DOCUMENTATION

Tools and Parts Required to Unpack the MX960 Router | 264
Unpacking the MX960 Router | 264
MX960 Router Overview | 2

CHAPTER 18

Installing the Mounting Hardware

IN THIS CHAPTER

Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet

Before installing the router in a four-post rack or cabinet, install the large mounting shelf, followed by the small mounting shelf. You must also remove the mounting brackets from the chassis.

Table 125 on page 269 specifies the holes in which you insert cage nuts, if needed, and screws to install the mounting hardware required in a four-post or cabinet rack (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 0.04 in. (0.02 U) above a U division.

Table 125: Four-Post Rack or Cabinet Mounting Hole Locations

Hole	Distance Above U Division		Large Shelf	Small Shelf
3	1.51 in. (3.8 cm)	0.86 U		**X**
2	0.88 in. (2.2 cm)	0.50 U	**X**	**X**
1	0.25 in. (0.6 cm)	0.14 U		**X**

To install the mounting shelves (see Figure 62 on page 271):

1. On the front rack rails, install cage nuts, if needed, in the holes specified in Table 125 on page 269 for the large shelf and the spacer bars.

2. On the front of each front rack rail, partially insert a mounting screw into the hole containing the lowest cage nut.

3. Install the large shelf on the front rack rails. Rest the bottom slot of each flange of the large shelf on a mounting screw.

4. Partially insert a mounting screw into the top hole in each flange of the large shelf.

5. Tighten all the screws completely.

6. On the rear rack rails, install cage nuts, if needed, in the holes specified in Table 125 on page 269 for the small shelf.

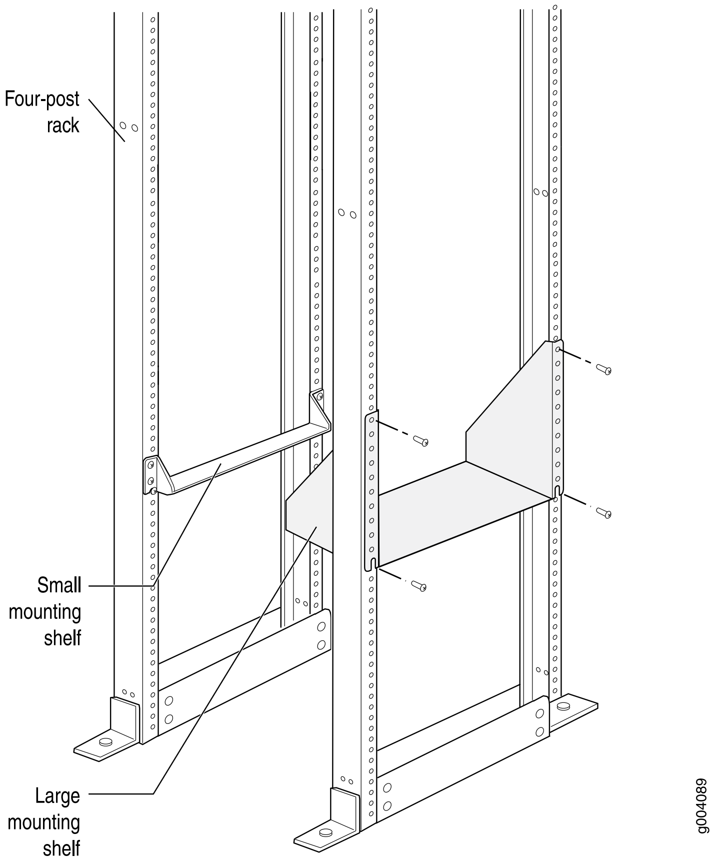
7. On the back of each rear rack rail, partially insert a mounting screw into the hole containing the lowest cage nut.

8. Install the small shelf on the back rack rails. Rest the bottom slot of each flange of the small shelf on a mounting screw. The small shelf installs on the back of the rear rails, extending toward the center of the rack. The bottom of the small shelf should align with the bottom of the large shelf.

9. Partially insert screws into the open holes in the flanges of the small shelf.

10. Tighten all the screws completely.

Figure 62: Installing the Mounting Hardware for a Four-Post Rack or Cabinet



After the mounting hardware is installed, proceed to "Installing the MX960 Router Using a Mechanical Lift" on page 290.

RELATED DOCUMENTATION

Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack | 274
Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack | 271
MX960 Rack-Mounting Hardware | 14

Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack

Before front-mounting the router in an open-frame rack, install the large mounting shelf on the rack, and remove the mounting brackets from the chassis. The small mounting shelf is not needed.

Table 126 on page 272 specifies the holes in which you insert screws to install the mounting hardware in an open-frame rack (an **X** indicates a mounting hole location). The hole distances are relative to one of the standard U divisions on the rack. For reference, the bottom of all mounting shelves is at 0.04 in. (0.02 U) above a U division.

Table 126: Mounting Hardware Hole Locations for Front-Mounting in an Open-Frame Rack

Hole	Distance Above U Division		Large Shelf
30	17.26 in. (43.8 cm)	9.86 U	**X**
27	15.51 in. (39.4 cm)	8.86 U	**X**
24	13.76 in. (34.9 cm)	7.86 U	**X**
21	12.01 in. (30.5 cm)	6.86 U	**X**
18	10.26 in. (26.0 cm)	5.86 U	**X**
15	8.51 in. (21.6 cm)	4.86 U	**X**
12	6.76 in. (17.1 cm)	3.86 U	**X**
9	5.01 in. (12.7 cm)	2.86 U	**X**
6	3.26 in. (8.3 cm)	1.86 U	**X**
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	

To install the large mounting shelf (see Figure 63 on page 273):

1. On the rear of each rack rail, install cage nuts, if needed, in the holes specified in Table 126 on page 272 for the large shelf.

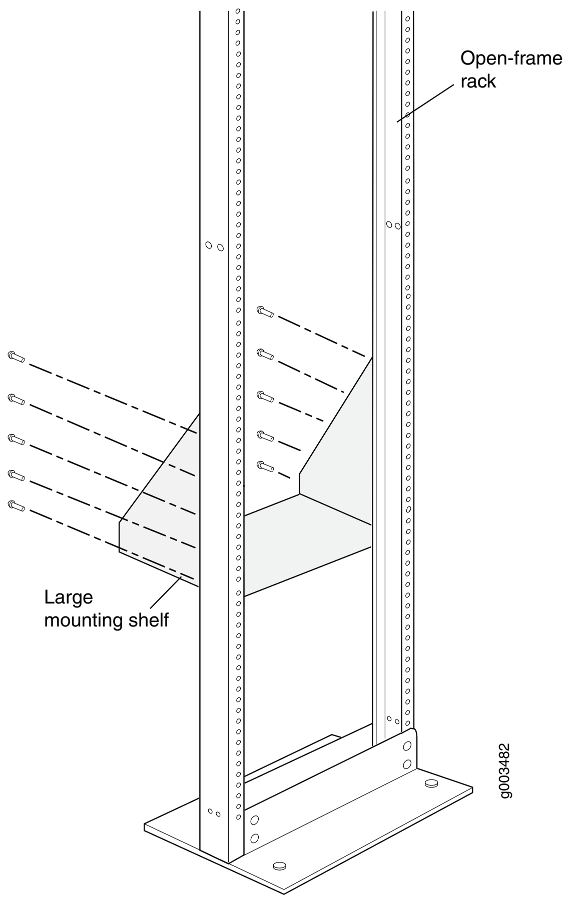
2. Partially insert a mounting screw into the highest hole specified in Table 126 on page 272.

3. Hange the shelf over the mounting screws using the keyhole slots located near the top of the large shelf flanges.

4. Partially insert screws into the open holes in the flanges of the large shelf.

5. Tighten all the screws completely.

Figure 63: Installing the Mounting Hardware for Front-Mounting in an Open-Frame Rack



After the mounting hardware is installed, proceed to "Installing the MX960 Router Using a Mechanical Lift" on page 290.

RELATED DOCUMENTATION

Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet | 269

Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack | 274

MX960 Rack-Mounting Hardware | 14

Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack

Before center-mounting the router in an open-frame rack, you must install the large mounting shelf on the rack. The small mounting shelf is not needed.

Table 127 on page 274 specifies the holes in which you insert screws to install the mounting hardware in an open-frame rack (an **X** indicates a mounting hole location). The hole distances are relative to one of the standard U divisions on the rack. For reference, the bottom of all mounting shelves is at 0.04 in. (0.02 U) above a U division.

Table 127: Mounting Hardware Hole Locations for Center-Mounting in an Open-Frame Rack

Hole	Distance Above U Division		Large Shelf
30	17.26 in. (43.8 cm)	9.86 U	**X**
27	15.51 in. (39.4 cm)	8.86 U	**X**
24	13.76 in. (34.9 cm)	7.86 U	**X**
21	12.01 in. (30.5 cm)	6.86 U	**X**
18	10.26 in. (26.0 cm)	5.86 U	**X**
15	8.51 in. (21.6 cm)	4.86 U	**X**
12	6.76 in. (17.1 cm)	3.86 U	**X**
9	5.01 in. (12.7 cm)	2.86 U	**X**
6	3.26 in. (8.3 cm)	1.86 U	**X**
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	

To install the large mounting shelf (see Figure 64 on page 275):

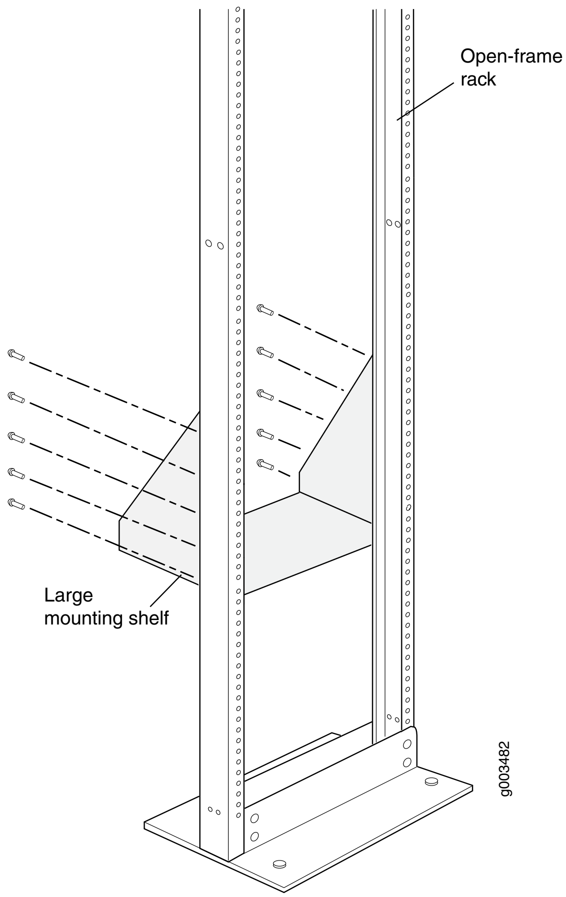
1. On the rear of each rack rail, partially insert a mounting screw into the highest hole specified in Table 127 on page 274 for the large shelf.

2. Install the large shelf on the rack. Hang the shelf over the mounting screws using the keyhole slots located near the top of the large shelf flanges.

3. Partially insert screws into the open holes in the flanges of the large shelf.

4. Tighten all the screws completely.

Figure 64: Installing the Mounting Hardware for Center-Mounting in an Open-Frame Rack



After the mounting hardware is installed, proceed to "Installing the MX960 Router Using a Mechanical Lift" on page 290.

RELATED DOCUMENTATION

Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet | 269

Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack | 271

MX960 Rack-Mounting Hardware | 14

CHAPTER 19

Installing the MX960 Router

IN THIS CHAPTER

Installing an MX960 Router Overview

To install the MX960 router:

1. Prepare your installation site.

   See "MX960 Site Preparation Checklist" on page 180.

2. Review the safety guidelines.

   - *General Safety Guidelines for Juniper Networks Devices*
   - *General Safety Warnings for Juniper Networks Devices*

3. Unpack the router and verify the parts.

   a. Unpacking the MX960 Router on page 264

   b. Verifying the MX960 Parts Received on page 266

4. Install the mounting hardware.

   - Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet on page 269
   - Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack on page 271
   - Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack on page 274

5. Lift the router on to the rack. Because of the weight of the router, we recommend that you use a mechanical lift.

   See "Installing the MX960 Router Using a Mechanical Lift" on page 290.

6. Connect cables to the network and external devices.

   See "Connecting the MX960 Router to Management and Alarm Devices" on page 383.

7. Connect the grounding cable

   See "Grounding the MX960 Router" on page 350.

8. Connect the AC power cord or DC power cables:

   - Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies on page 352
   - Connecting Power to an AC-Powered MX960 Router with High-Capacity Second-Generation Power Supplies on page 358
   - Connecting Power to an MX960 Router with High-Voltage Second-Generation Universal (HVAC or HVDC) Power Supplies on page 374
   - Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies on page 365

9. Power on the router:

   - Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies on page 363
   - Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies on page 372

10. Perform the initial system configuration.

    See "Initially Configuring the MX960 Router" on page 394.

RELATED DOCUMENTATION

MX960 Chassis Description | 5

Routine Maintenance Procedures for the MX960 Router | 608

Troubleshooting Resources for MX960 Routers | 671

Removing Components from the MX960 Router Chassis Before Installing It with a Lift

Before installing the router with a lift, you must first remove components from the chassis, and reinstall the components the router is installed in the rack. With components removed, the chassis weighs approximately 150 lb (68.04 kg).

Removing the Power Supplies Before Installing an MX960 Router with a Lift

Remove the leftmost power supply first and then work your way to the right. To remove the AC or DC, or universal (HVAC or HVDC) power supplies (see Figure 65 on page 280, Figure 66 on page 281, and Figure 67 on page 282):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an approved site ESD grounding point. See the instructions for your site.

2. On an AC-powered router, move the AC input switch in the chassis above each power supply to the off (**O**) position. On a DC-powered router, move the DC circuit breaker on each power supply faceplate to the off (**O**) position.

   We recommend this even though the power supplies are not connected to power sources.

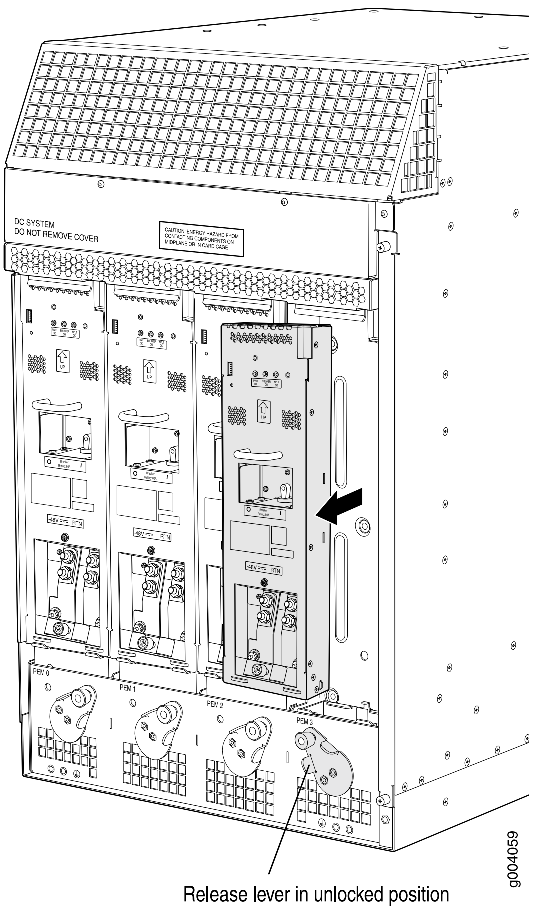
3. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.

4. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

5. Pull the power supply straight out of the chassis.

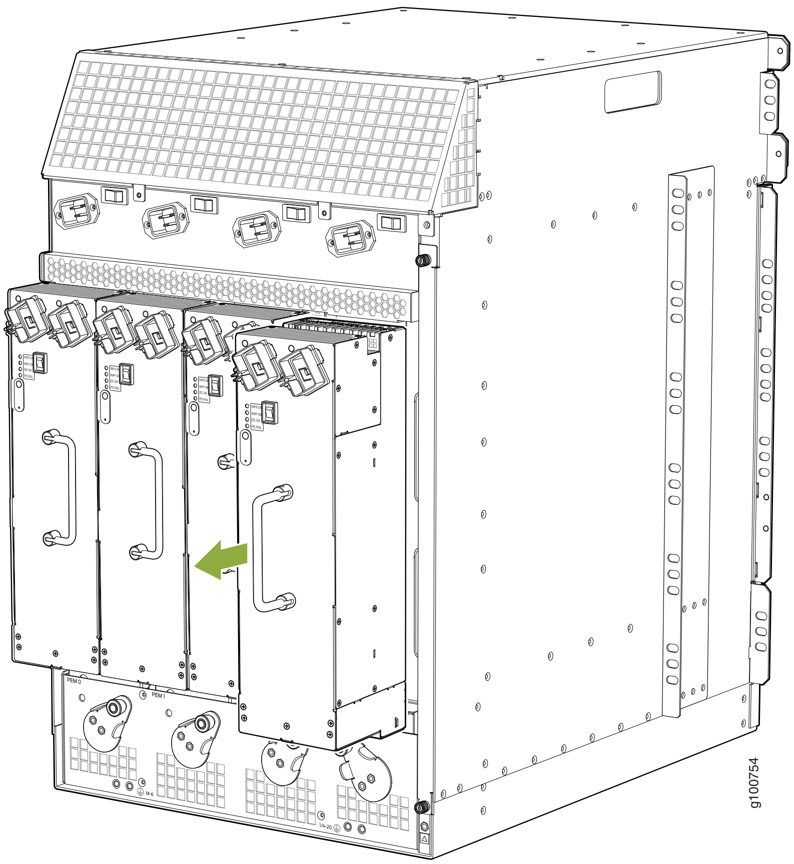
WARNING: Do not touch the power connector on the top of the power supply. It can contain dangerous voltages.

Figure 65: Removing a Power Supply Before Installing the MX960 Router



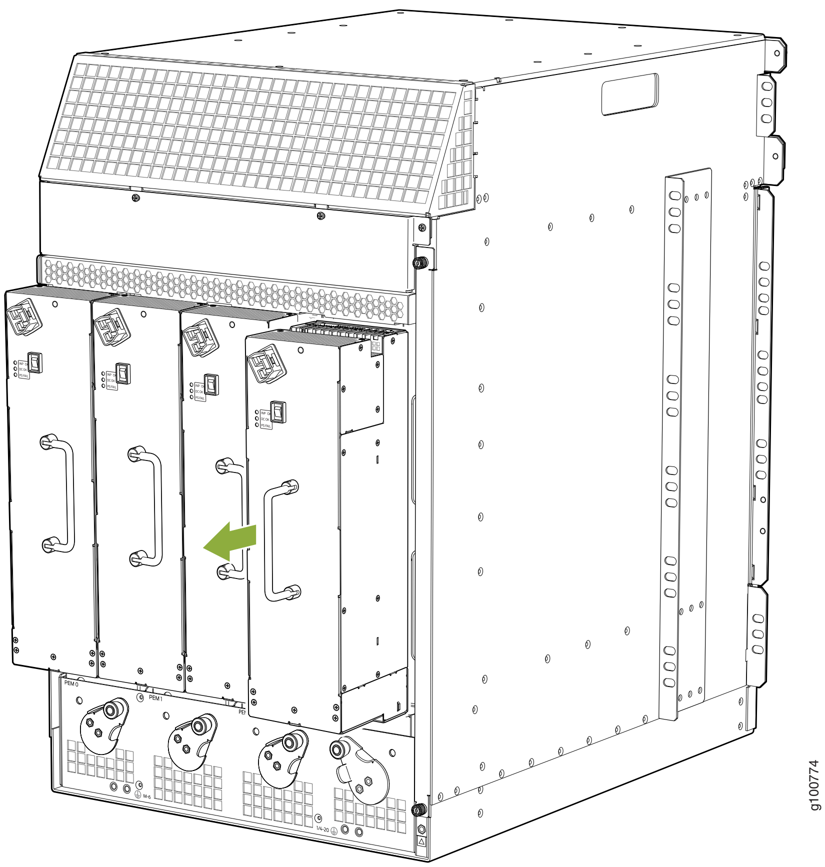
NOTE: The chassis is shown without the extended cable manager.

Figure 66: Removing a High-Capacity Second-Generation AC Power Supply Before Installing the MX960 Router



> **NOTE:** The chassis is shown without the extended cable manager.

Figure 67: Removing a High-Voltage Second-Generation Universal Power Supply Before Installing the MX960 Router



NOTE: The chassis is shown without the extended cable manager.

Removing the Standard Cable Manager Before Installing an MX960 Router with a Lift

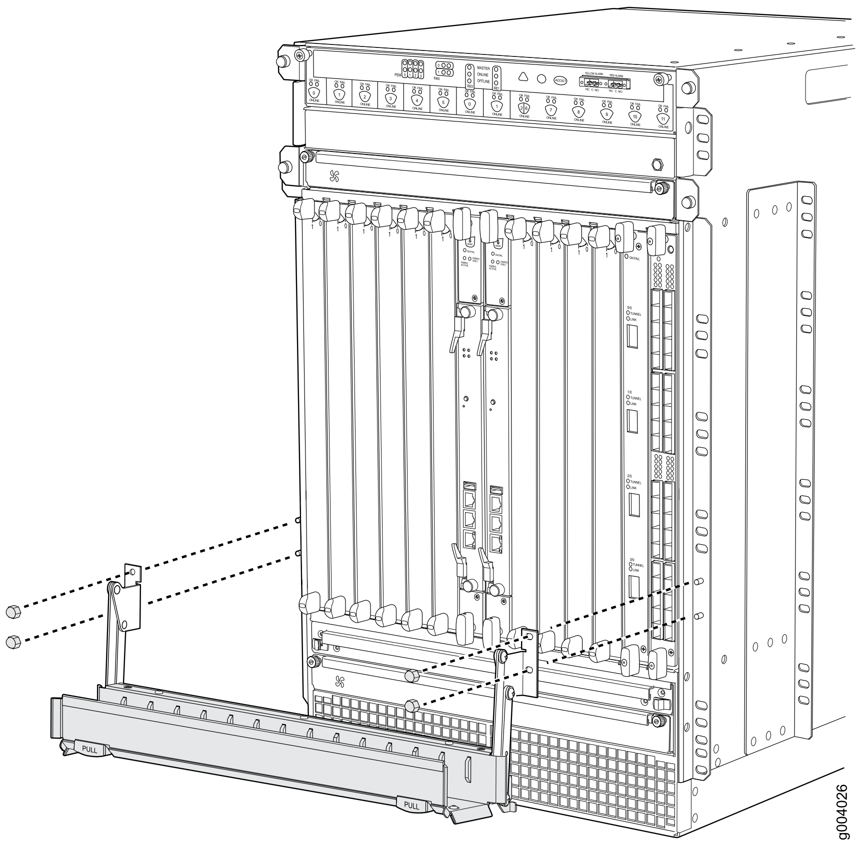
To remove the standard cable manager (see Figure 68 on page 283):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an approved site ESD grounding point. See the instructions for your site.

2. Using a 7/16-in. (11 mm) nut driver, unscrew the nuts on the corners of the standard cable manager.

3. Grasp the bottom of the standard cable manager, and pull it straight out from the studs on the front of the chassis.

Figure 68: Removing the Standard Cable Manager



Removing the Fan Trays Before Installing an MX960 Router with a Lift

To remove the upper or lower fan tray (see Figure 69 on page 284 and Figure 70 on page 285, which illustrate the upper and lower fan trays):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an approved site ESD grounding point. See the instructions for your site.

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. Press on the two latches located on the inside of the fan tray to release the fan tray 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 69: Removing an Upper Fan Tray

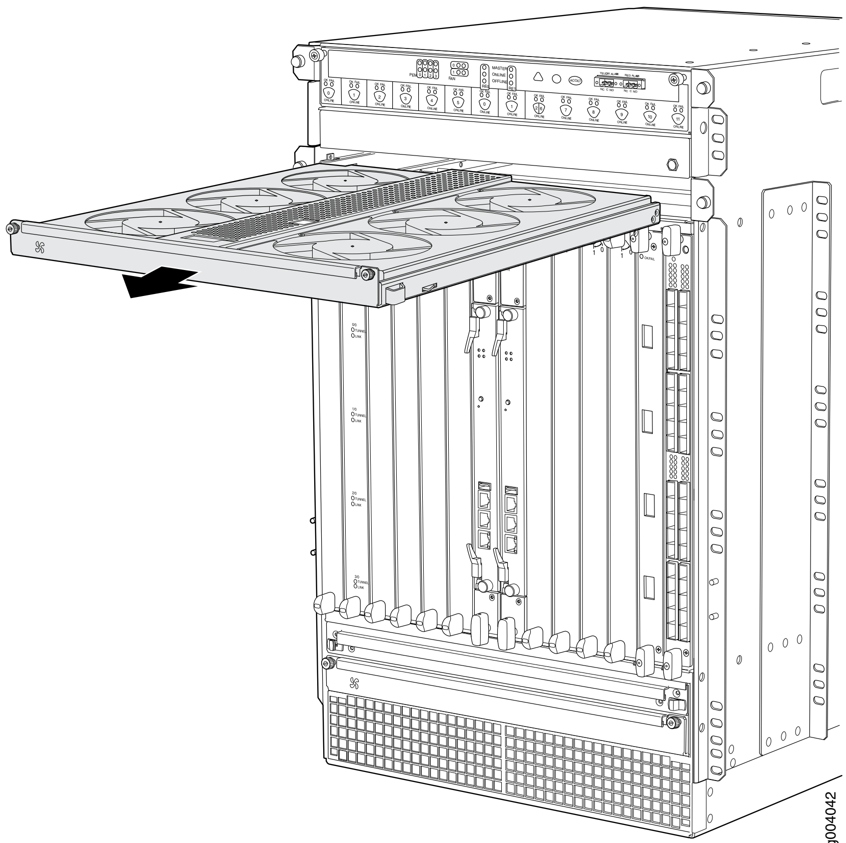
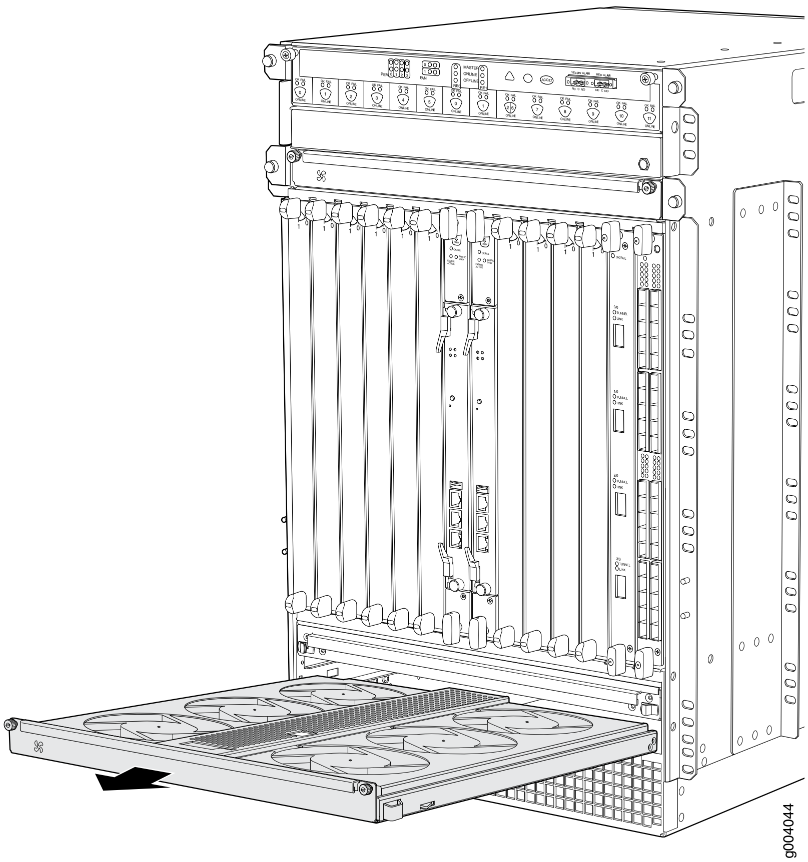


Figure 70: Removing a Lower Fan Tray



Removing the SCBs Before Installing an MX960 Router with a Lift

To remove the SCBs (see Figure 71 on page 286):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an approved site ESD grounding point. See the instructions for your site.

3. Rotate the ejector handles simultaneously counterclockwise to unseat the SCB.

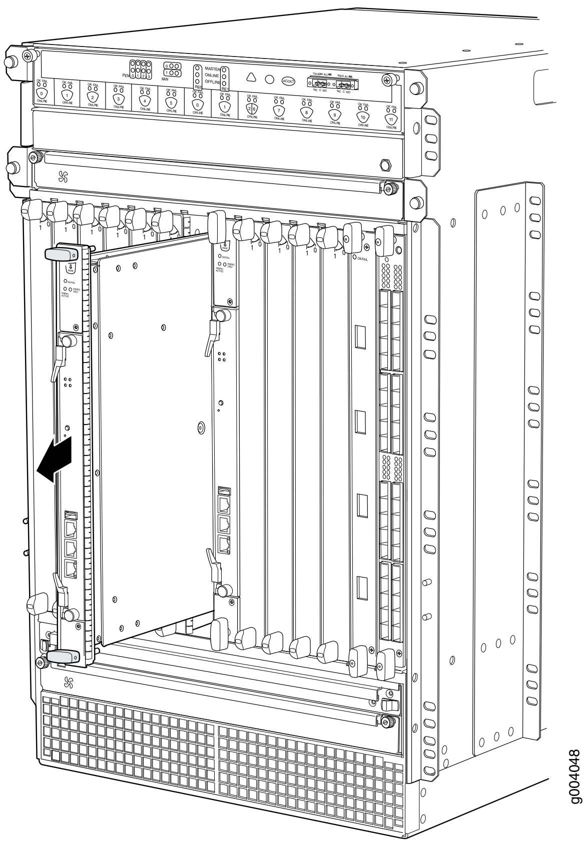
4. Grasp the ejector handles, and slide the SCB about halfway out of the chassis.

5. 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.

6. Repeat the procedure for each SCB.

Figure 71: Removing an SCB



Removing the DPCs Before Installing an MX960 Router with a Lift

To remove a DPC (see Figure 72 on page 287):

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 ESD grounding strap to your bare wrist, and connect the other end of the strap to an approved site ESD grounding point. See the instructions for your site.

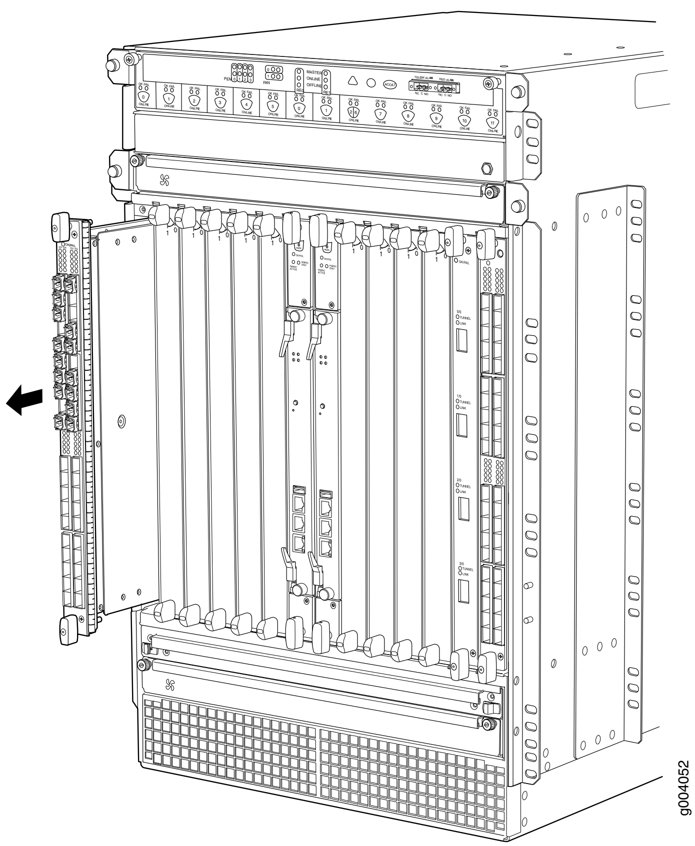
3. Simultaneously turn both the ejector handles counterclockwise to unseat the DPC.

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.

Figure 72: Removing a DPC



Removing the FPCs Before Installing the MX960 Router with a Lift

To remove an FPC (see Figure 73 on page 289):

1. Have ready an antistatic mat for the FPC. Also have ready rubber safety caps for each PIC using an optical interface on the PIC that you are removing.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an approved site ESD grounding point. See the instructions for your site.

3. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.

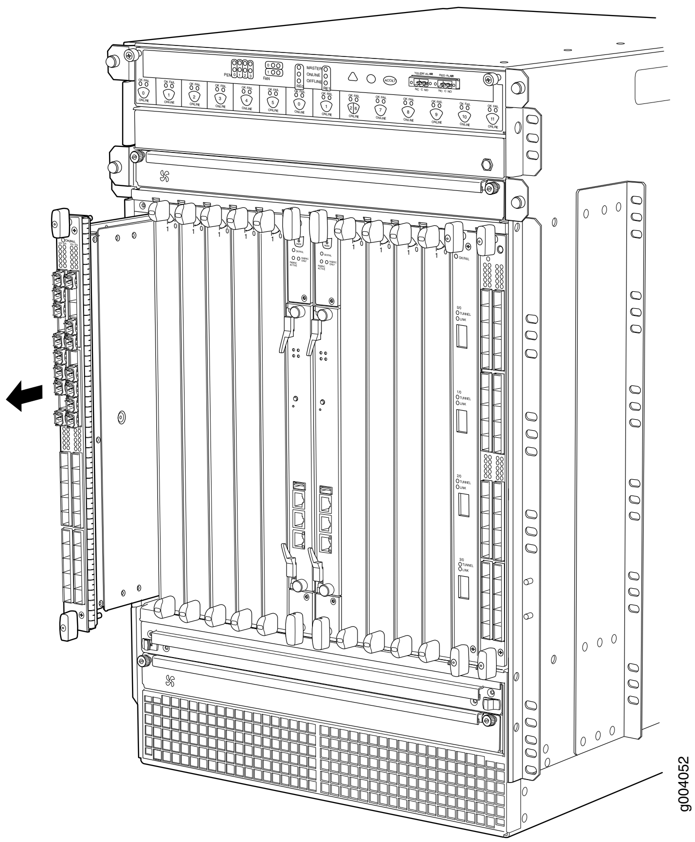
4. Grasp the handles, and slide the FPC straight out of the card cage halfway.

5. Place one hand around the front of the FPC and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.

   CAUTION: The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 18 lb (8.2 kg)—as you slide the FPC out of the chassis.

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

Figure 73: Removing an FPC



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 Site Preparation Checklist | 180

Tools Required to Install the MX960 Router with a Mechanical Lift | 289

Installing the MX960 Router Using a Mechanical Lift | 290

Reinstalling Components in the MX960 Chassis After Installing It with a Lift | 334

Tools Required to Install the MX960 Router with a Mechanical Lift

To install the router, you need the following tools:

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

- 7/16-in. (11 mm) nut driver
- ESD grounding wrist strap

RELATED DOCUMENTATION

Installing the MX960 Router Using a Mechanical Lift

Because of the router's size and weight—up to 350 lb (158.8 kg) depending on the configuration—you must use mechanical lift to install the router.

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

To install the router using a lift (see Figure 74 on page 291):

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.

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.

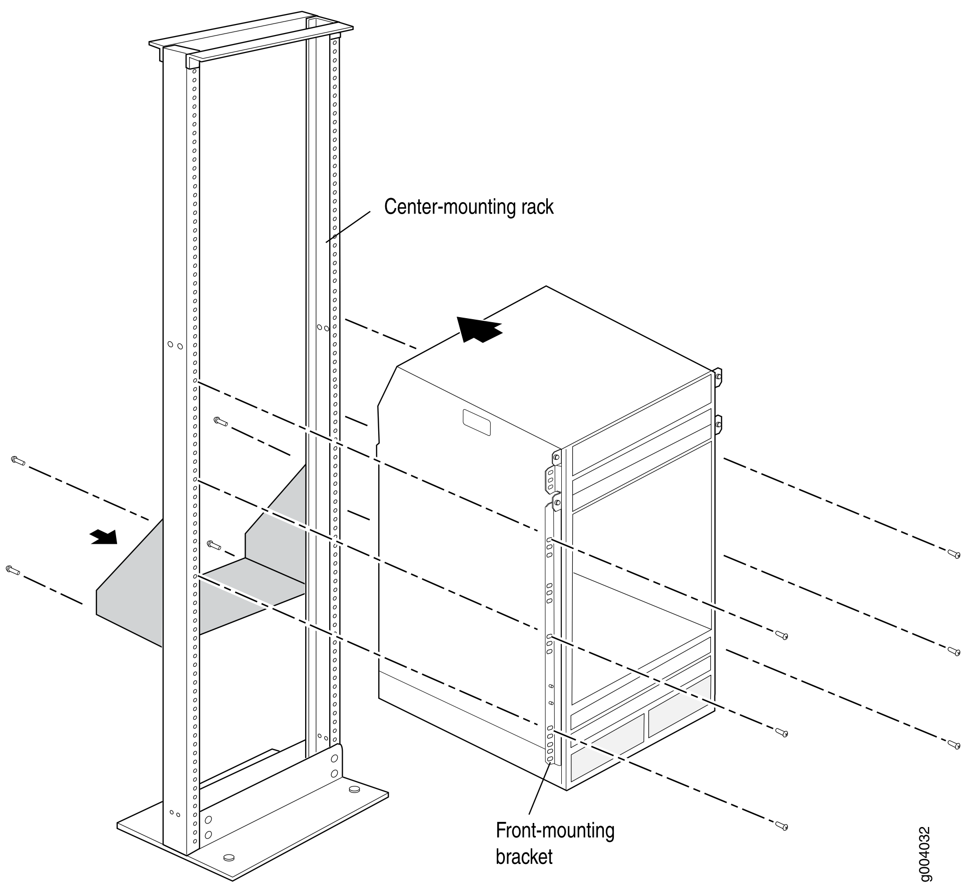
6. Slide the router onto the mounting shelves until the mounting brackets or front-mounting flanges contact the rack rails. The shelves ensure that the holes in the mounting brackets and the front-mounting flanges of the chassis align with the holes in the rack rails.

7. Move the lift away from the rack.

8. To install the router in an open-frame rack, install a mounting screw into each of the open mounting holes aligned with the rack, starting from the bottom.

9. Visually inspect the alignment of the router. To verify that the router is installed properly in the rack, verify that all the mounting screws on one side of the rack are aligned with the mounting screws on the opposite side and the router is level.

Figure 74: Installing the MX960 Router in the Rack



> **NOTE:** This illustration depicts the router being installed in an open-frame rack.

RELATED DOCUMENTATION

MX960 Site Preparation Checklist | 180
Tools Required to Install the MX960 Router with a Mechanical Lift | 289
Removing Components from the MX960 Router Chassis Before Installing It with a Lift | 279
Reinstalling Components in the MX960 Chassis After Installing It with a Lift | 334

MX960 Acoustic Cover Installation Instructions

IN THIS SECTION

This document describes how to remove and replace the acoustic noise covers on a Juniper Networks MX960 Universal Routing Platform. The upper fan tray cover and interface module cover make up the acoustic noise components. The two acoustic covers are designed to reduce the system sound level to comply with the Network Equipment Building System (NEBS). The covers and all associated mounting hardware are available as an optional upgrade kit.

Tools required:

- Number 2 Phillips screwdriver
- 7/16” wrench

Table 128: Parts List for Acoustic Noise Cover Kit

Component	Quantity
12–24 1 1/4 in. screws	4
12–24 nylon lock nuts	4

Table 128: Parts List for Acoustic Noise Cover Kit *(continued)*

Component	Quantity
Star washer	1
Card cage cover mounting bracket	2
Upper fan tray cover	1
DPC Card cage cove	1

Installing the Upper Fan Tray Cover

The upper fan tray cover is installed below the craft interface and covers the upper fan tray. To install the upper fan tray cover, use the following procedure (see Figure 75 on page 294).

NOTE: The upper fan tray cover obstructs the existing electrostatic discharge (ESD) jack located above the upper fan tray on the front of the chassis. A second ESD jack is located on the lower rear of the chassis. An optional ESD jack has been provided in the installation kit and may be installed in an available rack mounting hole. Ensure that the mounting surface is conductive and free of paint. Secure the optional ESD jack with the star washer and nut provided in the installation kit.

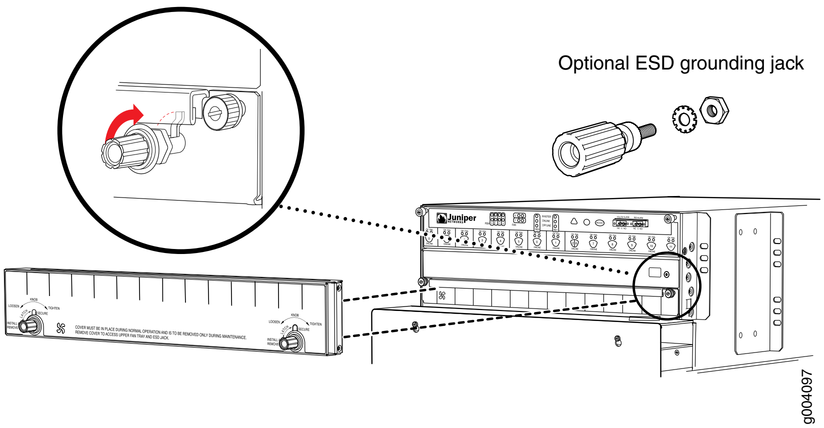
1. Before placing the cover onto the router, rotate the latch knobs counterclockwise until they stop turning. This will ensure that the latch is open enough to hook behind the lip of the fan tray.

2. Place the cover over the upper fan tray.

3. Secure the lip of the cover in the groove directly below the craft interface.

4. Rotate the latch knobs clockwise, and hand tighten them until they are secure.

Figure 75: Upper Fan Tray Cover and Optional ESD Grounding Jack



Installing the Interface Module Cage Cover Center-Mount Brackets

The interface module cage cover is installed directly over the interface module cage. The installation of the brackets depends on whether the router is center or front mounted.

To install the center-mount brackets for the interface module cage cover on routers that are center mounted, use the following procedure (see Figure 76 on page 295).

1. Locate the tab on the rear surface of the mounting bracket.

2. Place the rear surface of the bracket against the mounting flange. Vertical alignment is correct when the tab rests on top of the flange.

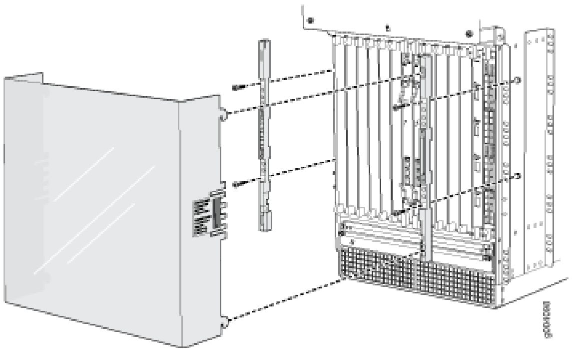
3. Locate the highest available mounting hole on the bracket and insert the first screw through the bracket and flange. Secure it with a nylock nut.

4. Locate the lowest available mounting hole on the bracket and insert the second screw through the bracket and flange. Secure it with a nylock nut.

5. Use a screwdriver and a wrench to hand tighten the screws and nylock nuts. Do not overtighten the screws. Overtightening may cause damage to the plastic bracket.

6. Repeat the above steps with the second bracket.

Figure 76: Installing the Interface Module Cage Cover



Installing the Interface Module Cage Cover Front-Mount Brackets

To install the brackets for the interface module cage cover on routers that are front-mounted, use the following procedure:

1. Locate the tab on the rear surface of the mounting bracket.
2. Place the rear surface of the bracket against the mounting flange. Vertical alignment is correct when the tab rests on top of the flange.
3. Locate the highest available mounting hole on the bracket and insert the first screw through the bracket and threaded rack flange.
4. Locate the lowest available mounting hole on the bracket and insert the second screw through the bracket and threaded rack flange.
5. Use a screwdriver to hand tighten the screw . Do not overtighten the screws; overtightening may cause damage to the plastic bracket.
6. Repeat the above steps with the second bracket.

Installing the Interface Module Cage Cover

To install the interface module cage cover, use the following procedure (see Figure 76 on page 295).

1. Look through the front of the cover and align the four hooks on either side of the acoustic cover with the rail slots on the outside of the card cage.
2. Slide the cover into the rail slots.

3. Gently push the cover down to secure it in place.

Removing the Upper Fan Tray Cover

The upper fan tray cover is installed below the craft interface and covers the upper fan tray. To remove the upper fan tray cover, use the following procedure (see Figure 75 on page 294).

1. Rotate the latch knobs counterclockwise until the cover is released or until the knobs stop turning.

2. Remove the cover.

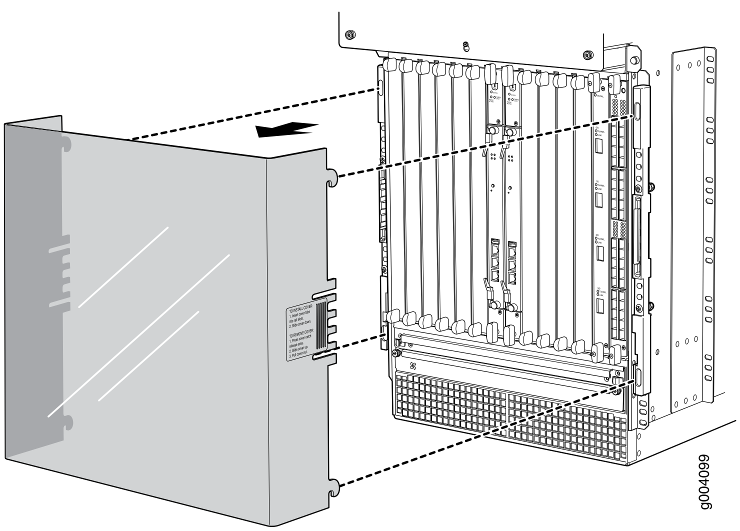
Removing the Interface Module Cage Cover

To remove the interface module cage cover, use the following procedure (see Figure 77 on page 296).

1. Press the cover catch release area marked with the instruction label on each side of the cover.

2. Slide the cover up until it stops; then pull the cover toward you to remove.

Figure 77: Removing the Interface Module Cage Cover



MX960 Extended Cable Manager Installation Instructions

IN THIS SECTION

This topic describes how to install the extended cable manager on a Juniper Networks MX960 Universal Routing Platform.

> **NOTE:** This installation procedure requires you to power down the router.
>
> Read this document completely before you install the extended cable manager.

Extended Cable Manager Description

The extended cable manager allows you to manage a large number of fiber-optic and copper cables attached to the Dense Port Concentrators (DPCs) installed in the router. It is installed in the top of the MX960 chassis.

The extended cable manager consists of the following parts (see Figure 78 on page 298 and Figure 79 on page 298):

- Top hat assembly—A sheet metal assembly that contains the cable routing channels and cable routing bay cover, the front panel ribbon cable, and the double-sided electrical connector for the upper fan tray.
- Rear air exhaust grate—Replaces the existing air exhaust grate and attaches to the rear of the top hat assembly and the chassis.
- Cable routing bay cover—Covers the cable routing channels and attaches to the front of the top hat assembly.
- Two 8-32 screws—Secure the top hat assembly to the rear of the chassis.

Figure 78: Extended Cable Manager With Cover Installed (Front View)

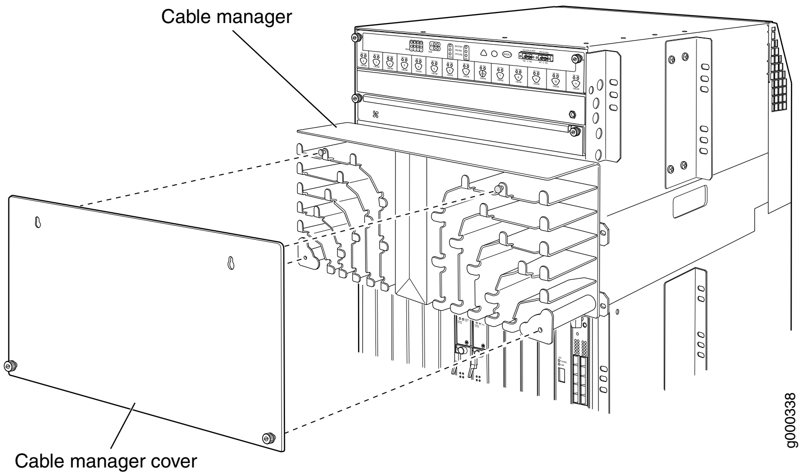
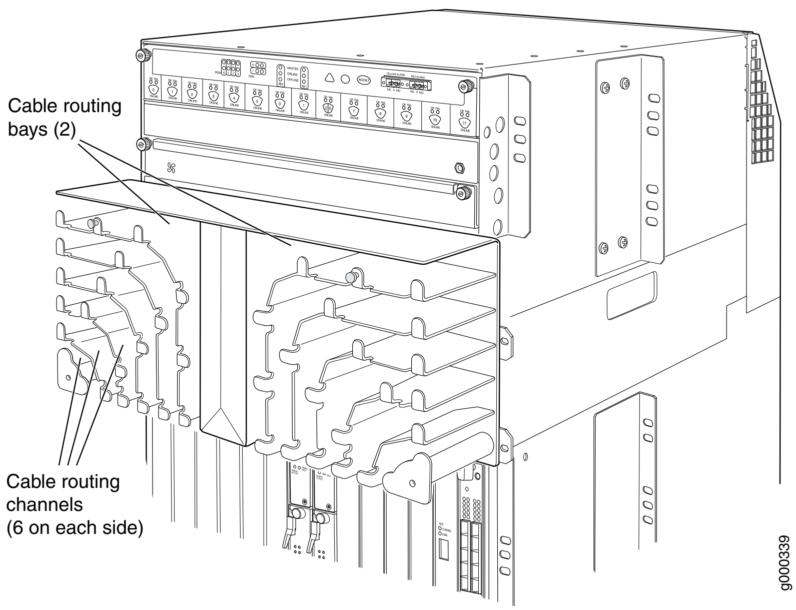


Figure 79: Extended Cable Manager (Rear View)

The extended cable manager contains two cable routing bays, and each bay contains six cable routing channels (see Figure 80 on page 299, which shows the extended cable manager with its cover removed). Each routing channel corresponds to a DPC below it. You route the cables from a DPC through the bottom of a routing channel and out the side of the bay. The retaining flanges on each channel keep the cables inside the channels.

The extended cable manager is used in conjunction with the standard cable manager attached to the bottom of the chassis. We recommend that you use the standard cable manager for fiber-optic cables that cannot fit in the extended cable manager and for cables that do not connect to a DPC (such as an out-of-band Ethernet cable connected to the Routing Engine). See "Dressing the Cables" on page 331 for more information about routing cables.

Figure 80: Extended Cable Manager With Cover Removed



Installing the Extended Cable Manager

IN THIS SECTION

Powering Off the Router

You must power off the router before installing the extended cable manager. To power off the router, follow this procedure:

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 CLI Explorer.

2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

3. On an AC-powered router, switch the circuit breaker in the chassis above each power supply to the off position (**O**). On a DC-powered router, switch the circuit breaker on each power supply faceplate to the off position (**OFF**).

Removing the Craft Interface

To remove the craft interface, follow this procedure (see Figure 81 on page 302):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. 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. Locate the latch on the inside of the craft interface. Grasp both sides of the latch on the inside of the craft interface and with your thumb and forefinger, gently press both sides of the latch to disengage it.

Removing the Upper Fan Tray

In the front of the chassis, the upper fan tray is located above the DPC card cage. The fan tray weighs about 13 lb (5.9 kg).

To remove the upper fan tray, follow this procedure (see Figure 82 on page 302):

NOTE: Figure 82 on page 302 shows the craft interface installed in the chassis. You have already removed the craft interface.

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Loosen the captive screw 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.

   CAUTION: 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 shortly after you power down the router.

4. When the fans stop spinning, press on the two latches located on the inside of the fan tray.

5. Place one hand under the fan tray to support it and pull the fan tray completely out of the chassis.

Figure 81: Removing the Craft Interface

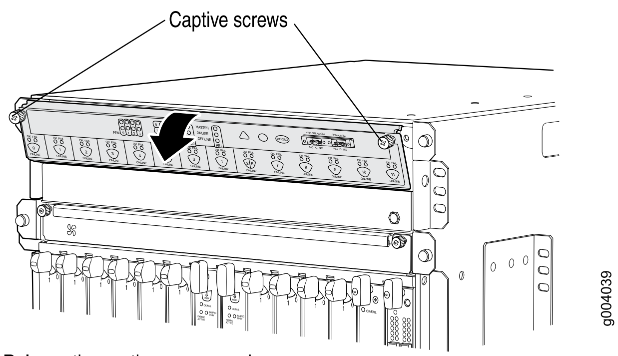
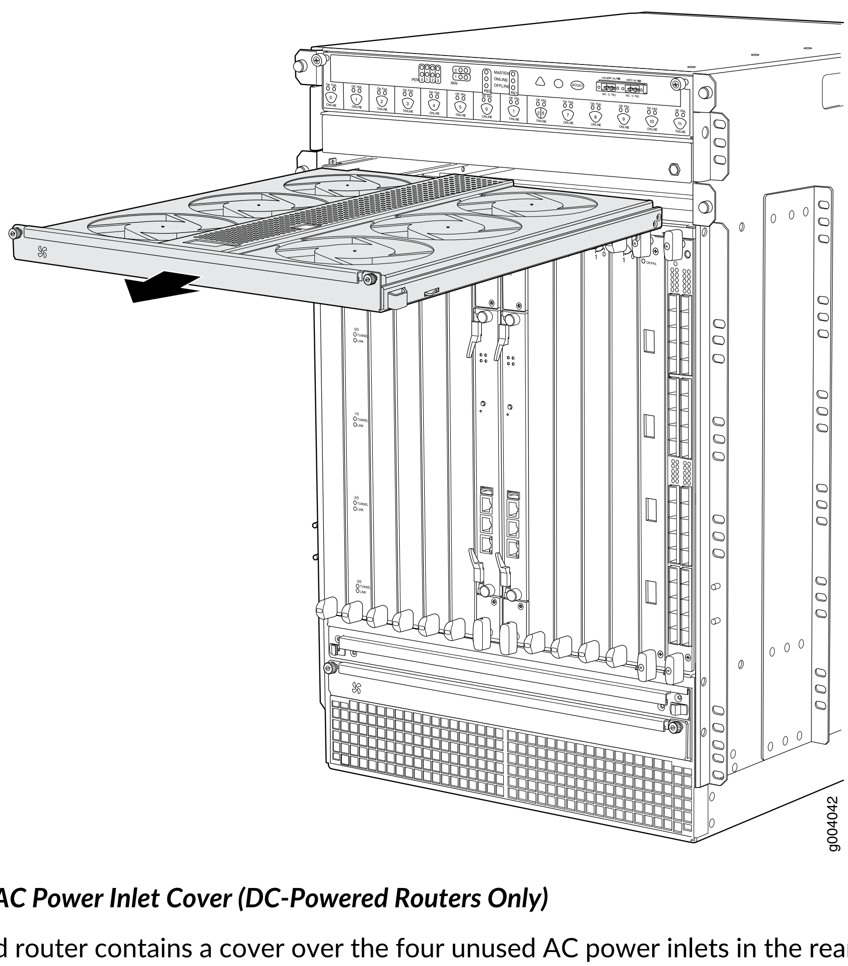


Figure 82: Removing the Upper Fan Tray



Removing the AC Power Inlet Cover (DC-Powered Routers Only)

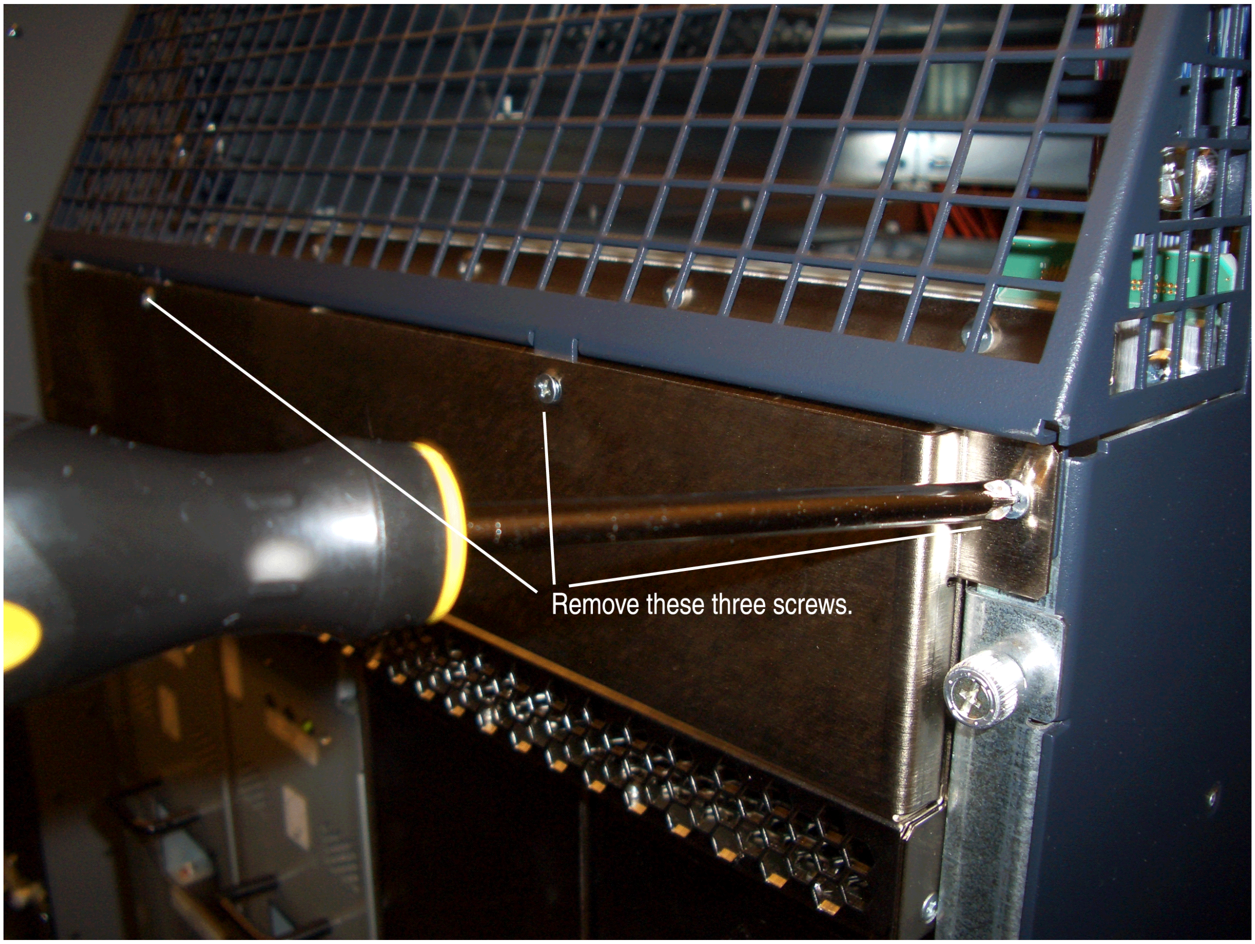
A DC-powered router contains a cover over the four unused AC power inlets in the rear of the chassis. If you have a DC-powered router, remove the cover by following this procedure:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. With a Phillips screwdriver, loosen the three screws that secure the cover to the back of the chassis (see Figure 83 on page 303). Take care to prevent the cover from falling off the chassis after you remove the last screw.

   Save the three screws, which will be needed later to secure the cover to the chassis.

Figure 83: Removing the AC Power Inlet Cover



3. Remove the cover and temporarily place it aside for later reinstallation.

Removing the Rear Air Exhaust Grate

To remove the rear air exhaust grate, follow this procedure:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. With a flatblade or Phillips screwdriver, loosen the two captive screws that secure the grate to the back of the chassis (see Figure 84 on page 304 and Figure 85 on page 305).

Figure 84: Removing the Right Captive Screw of the Rear Air Exhaust Grate

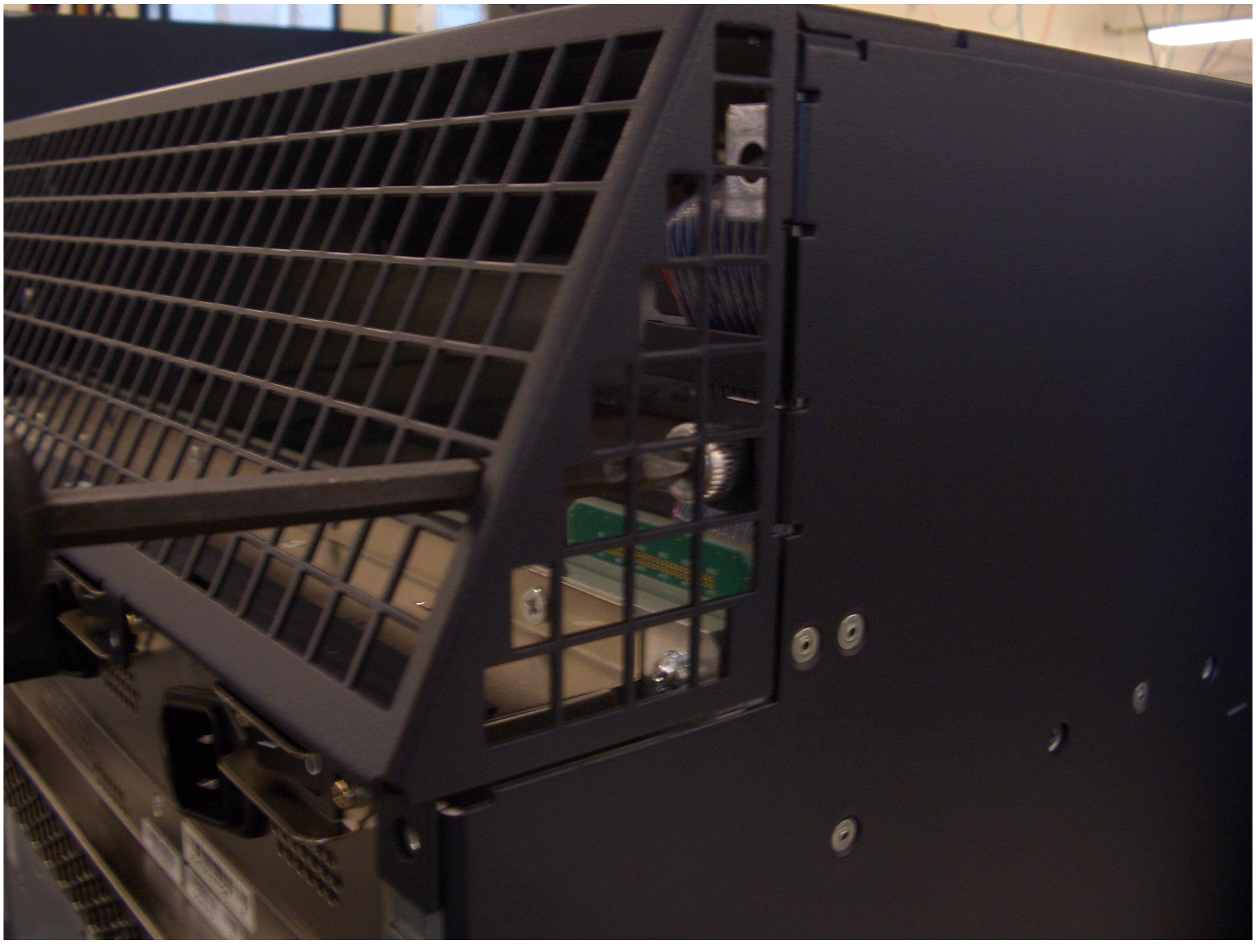


Figure 85: Removing the Left Captive Screw of the Rear Air Exhaust Grate

3. With a flatblade or Phillips screwdriver, remove the three screws that secure the grate to the top of the chassis (see Figure 86 on page 306 through Figure 88 on page 308). These three screws are no longer needed.

> **CAUTION:** To avoid damaging the router, take care to avoid dropping any screws into the router.

Figure 86: Removing the Top Right Screw of the Rear Air Exhaust Grate

Figure 87: Removing the Top Middle Screw of the Rear Air Exhaust Grate

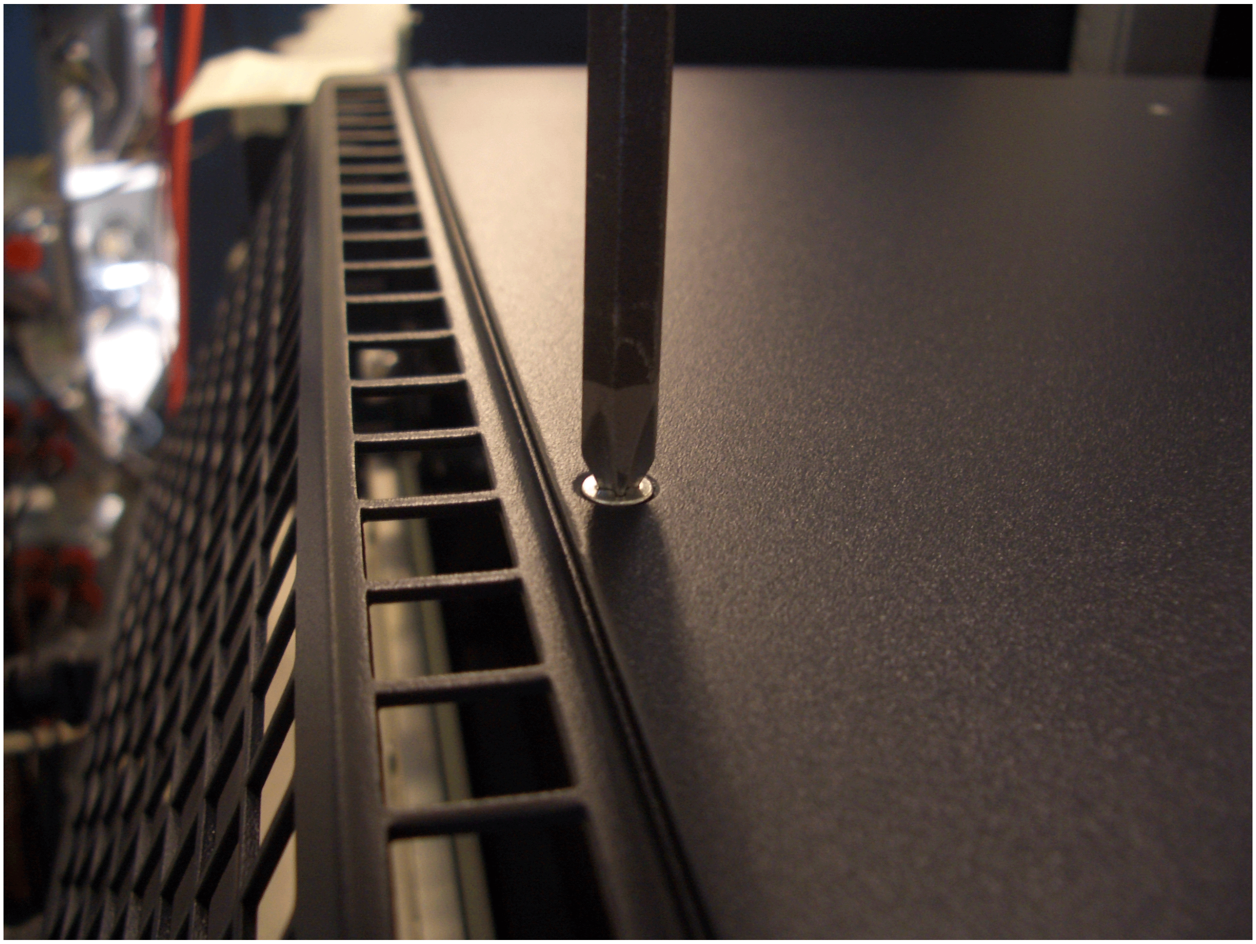
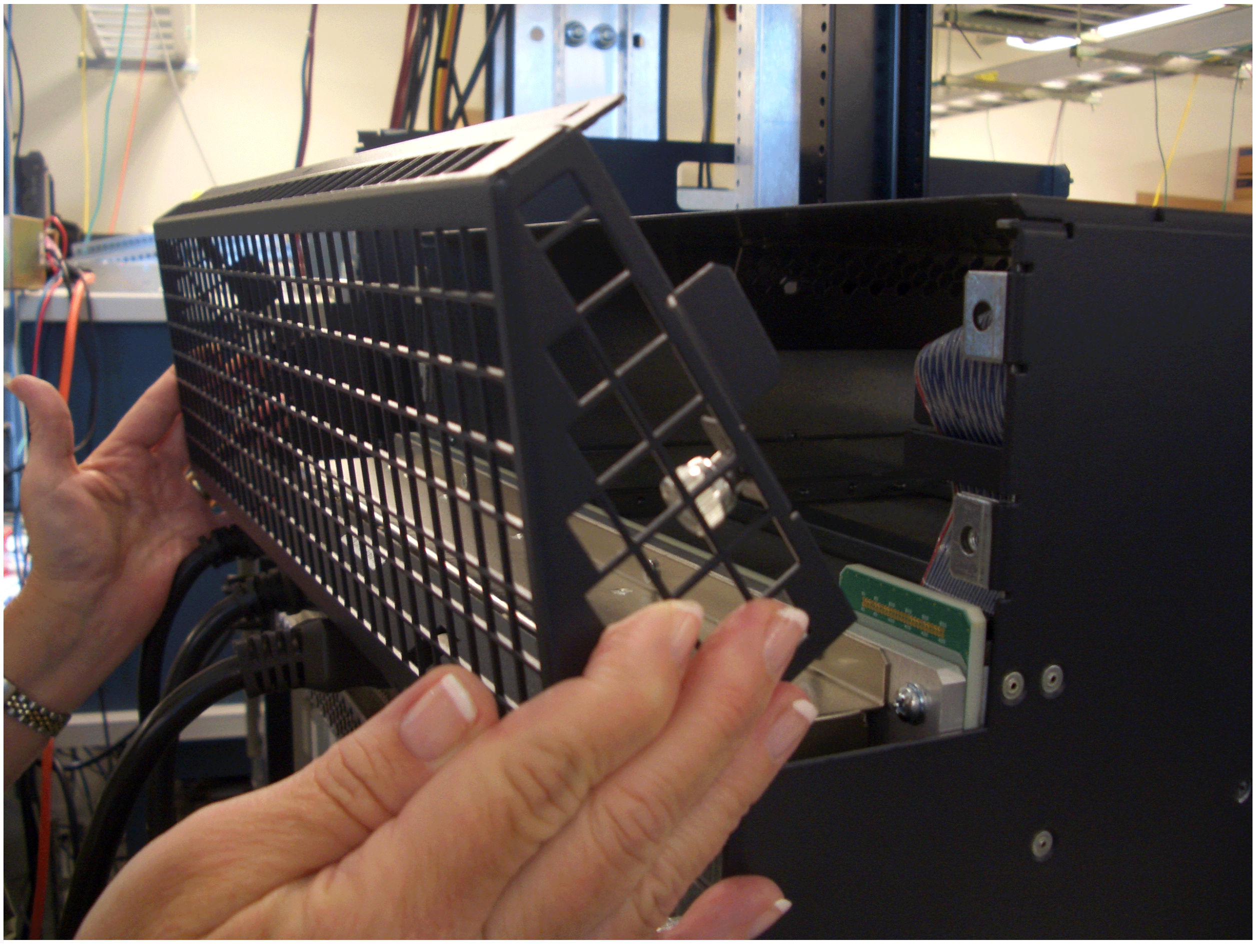


Figure 88: Removing the Top Left Screw of the Rear Air Exhaust Grate

4. With one hand on each side of the grate, remove the grate by pulling it away from the chassis (see Figure 89 on page 309).

5. Set the grate aside where it will not interfere with the remainder of the extended cable manager installation procedure. The grate is no longer needed.

Figure 89: Removing the Rear Air Exhaust Grate



Disconnecting the Craft Interface Ribbon Cable from the Chassis Midplane

The craft interface communicates with the router through a ribbon cable that is attached to the original top hat. Attached to the end of the ribbon cable is a socket connector that plugs into a plug connector on the chassis midplane. The socket connector contains a small mating clip on each of its sides. During normal operation, the socket connector is plugged inside the plug connector and is held into place by the mating clips. Figure 90 on page 311 shows the ribbon cable plugged into the plug connector (viewed from the front of the chassis).

The craft interface ribbon cable must be disconnected from the midplane connector before the top hat of the chassis can be removed (as described in "Removing the Original Top Hat of the Chassis" on page 311).

To disconnect the ribbon cable from the chassis midplane, follow this procedure (see Figure 90 on page 311):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

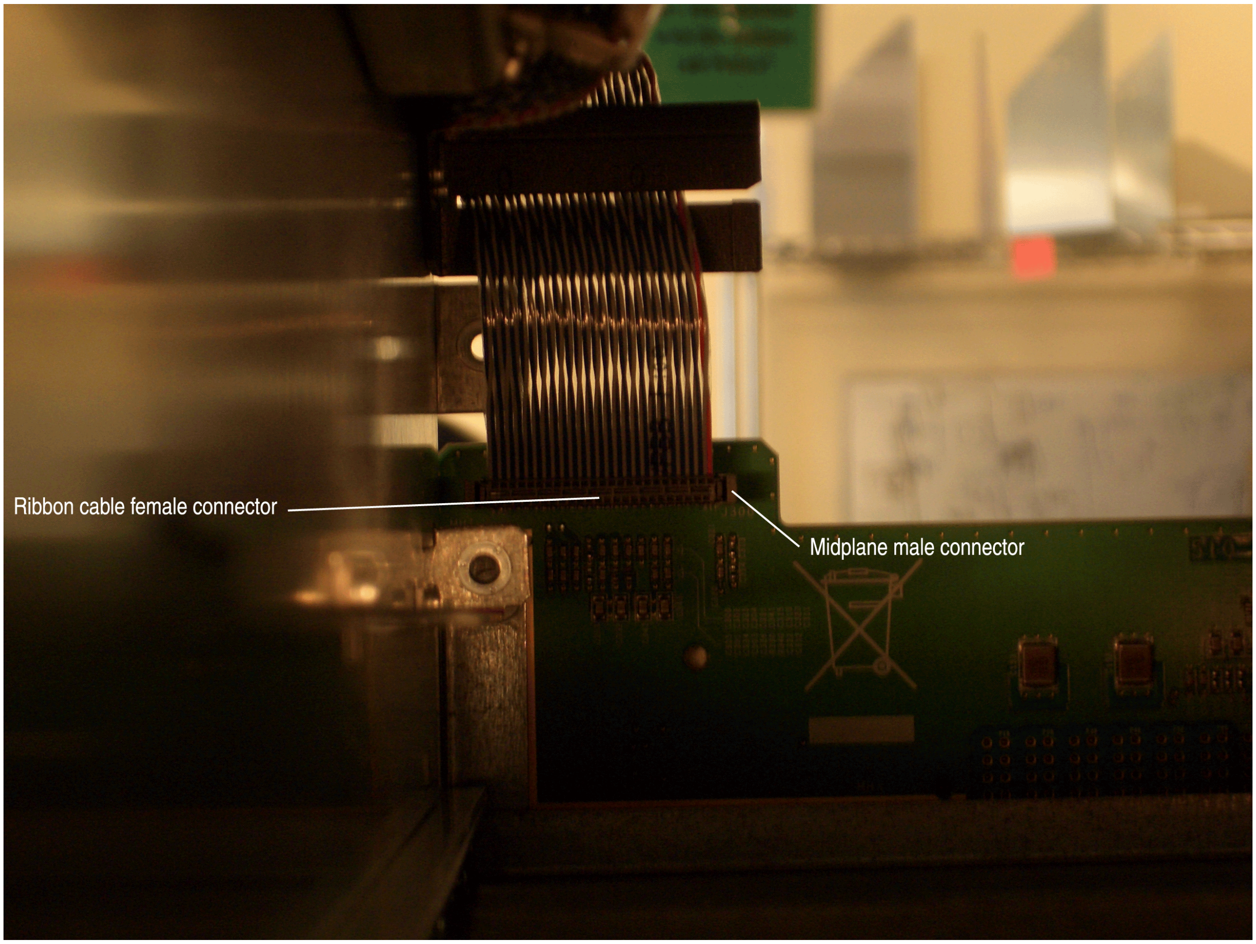
2. Standing at the rear of the chassis, use your left hand to reach into the top of the chassis and locate the socket connector and its mating clips at the end of the ribbon cable. If the chassis is mounted above your reach, stand on a ladder to comfortably access the ribbon cable.

3. Using your left hand, gently squeeze the clips on the socket connector together and slowly pull the connector straight out from the rear of the chassis.

   CAUTION: To avoid bending or breaking the pins in the male connector, make sure you keep the face of the female connector parallel to the face of the male connector while disconnecting them. You can gently rock the female connector from side to side as you pull it out.

   NOTE: The space between the mating clip and the chassis is narrow, so it might be difficult to get a good grip on that side of the connector with your fingers. You can use your right hand to gently push on the ribbon cable while using your left hand to pull on the connector.

Figure 90: Craft Interface Ribbon Cable Attached to the Chassis Midplane



Removing the Original Top Hat of the Chassis

To remove the original top hat from the chassis, follow this procedure:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. With a 3/8-in. hexagonal-head external drive socket wrench or nut driver, remove the four acorn nuts that secure the top hat to the chassis (see Figure 91 on page 312 and Figure 92 on page 313). Save these four nuts, which will be needed later to secure the extended cable manager top hat.

Figure 91: Removing the Two Right Acorn Nuts That Secure the Original Top Hat

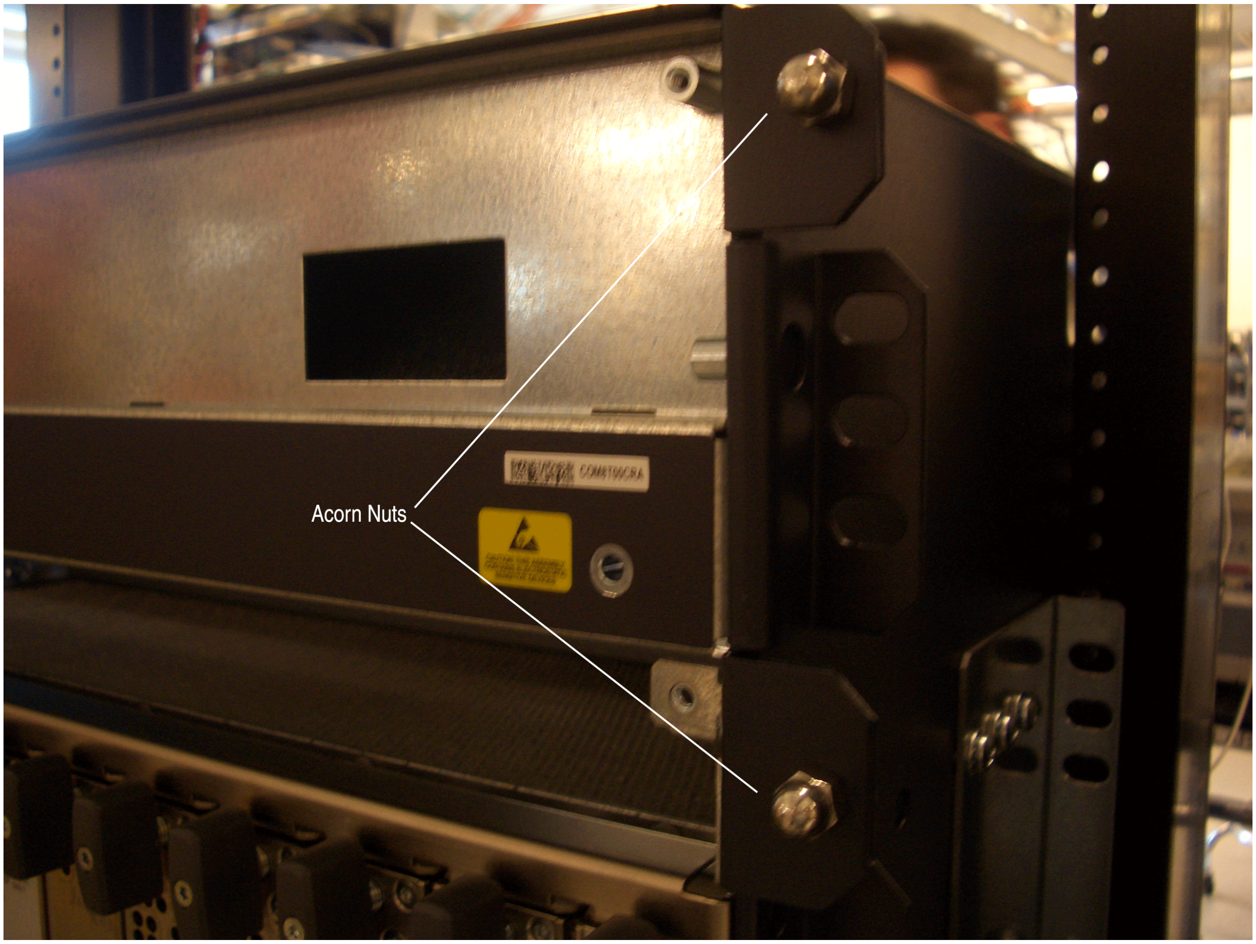
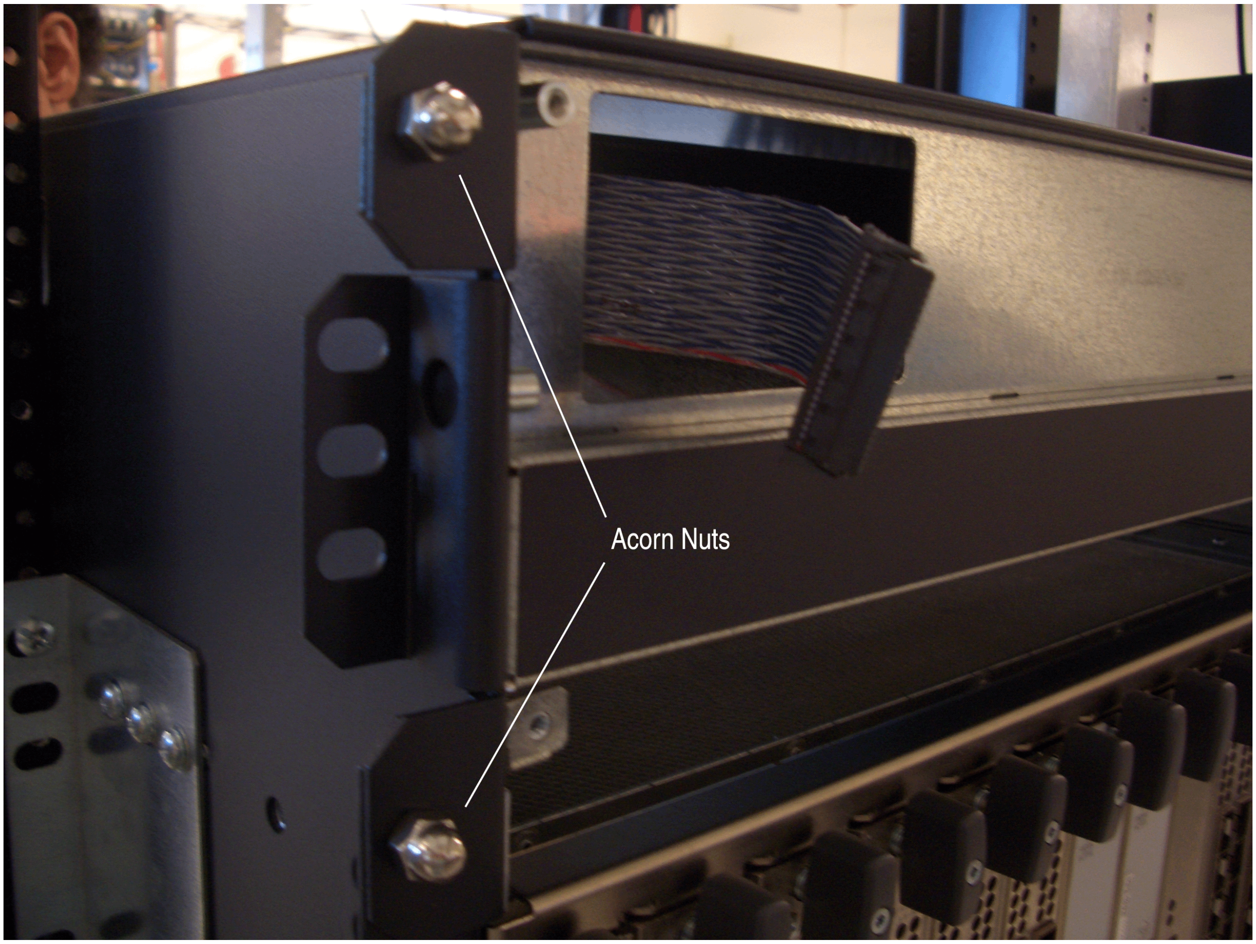


Figure 92: Removing the Two Left Acorn Nuts That Secure the Original Top Hat



3. With each hand on a front flange of the top hat, remove the top hat halfway by slowly sliding it straight away from the chassis (see Figure 93 on page 314).

   Be prepared to support the full weight of the top hat (40 lbs [18 kg]).

4. With one hand on each side of the top hat, remove the top hat completely by slowly sliding it straight away from the chassis (see Figure 94 on page 315).

5. Set the top hat aside where it will not interfere with the remainder of the extended cable manager installation procedure. The original top hat is no longer needed.

Figure 93: Sliding the Original Top Hat Halfway Out of the Chassis

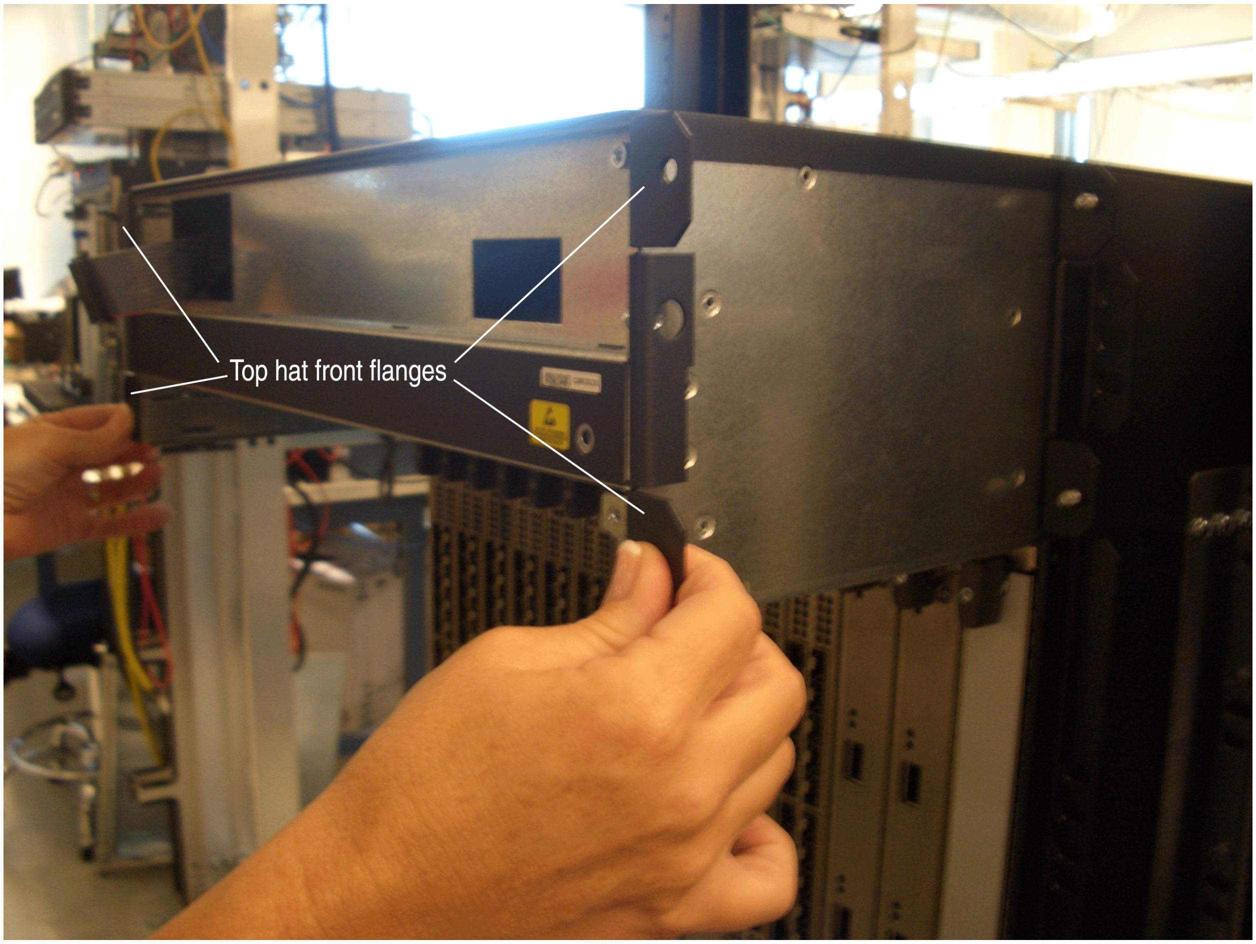
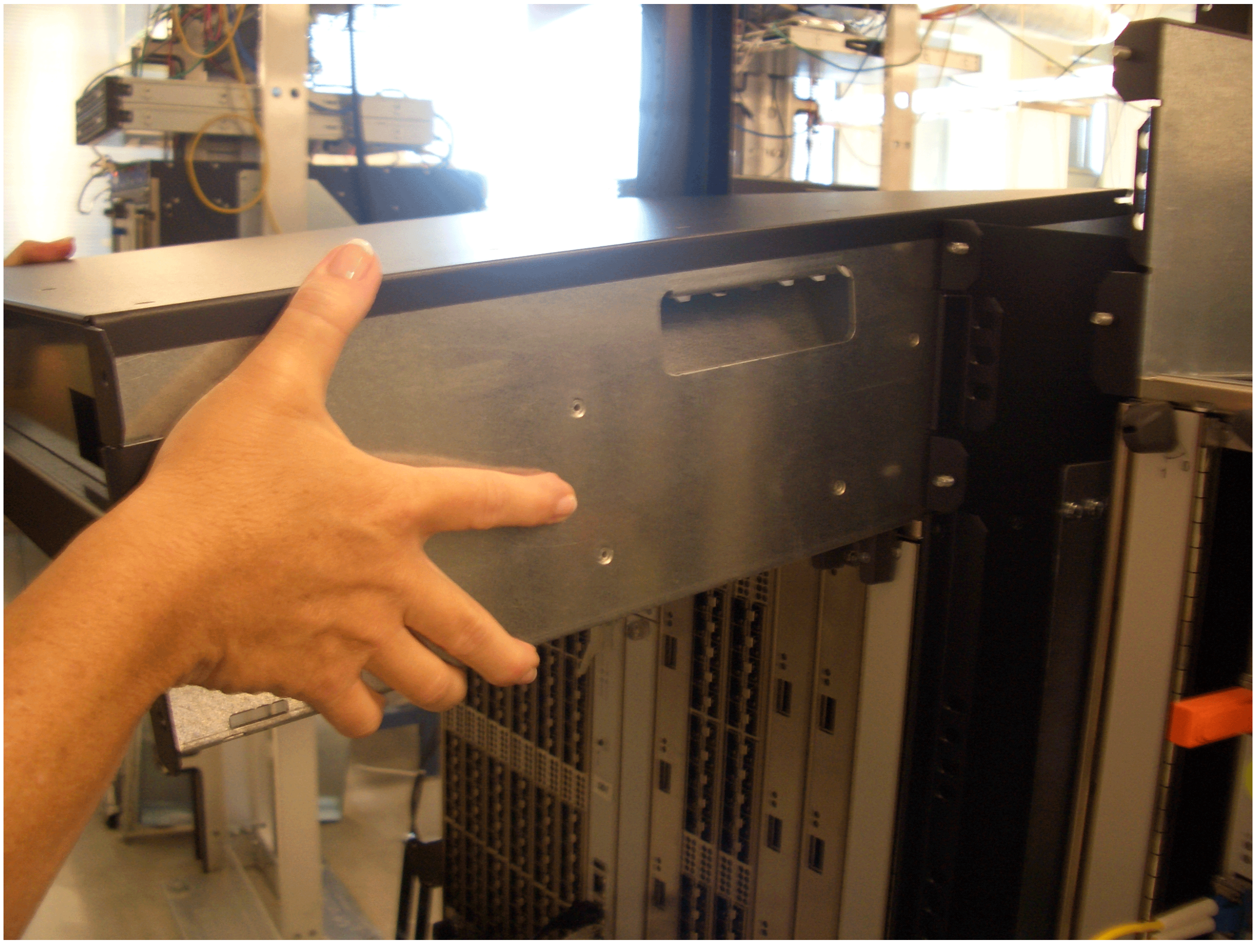


Figure 94: Sliding the Original Top Hat Completely Out of the Chassis



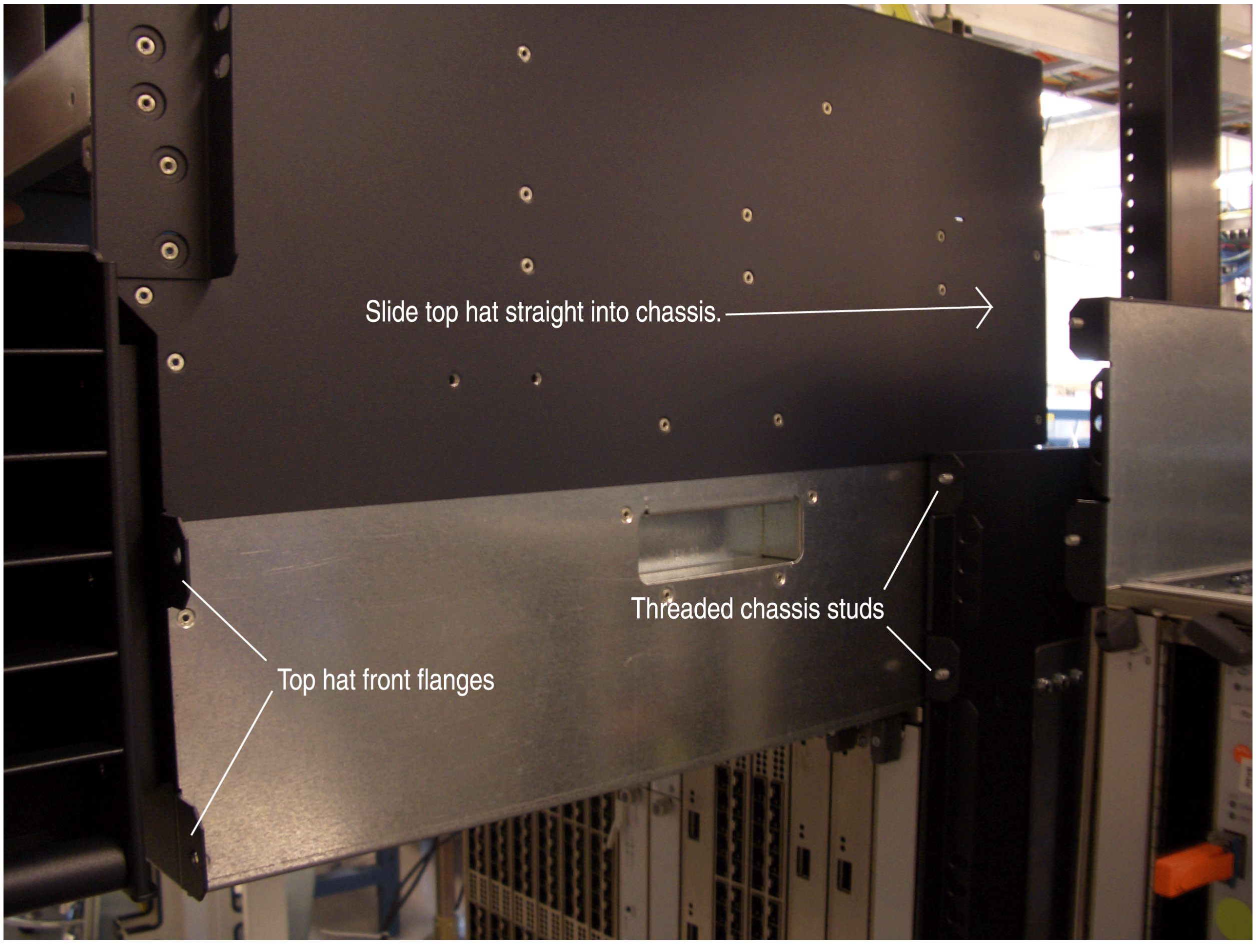
Installing the Extended Cable Manager Top Hat

To install the extended cable manager top hat in the chassis, follow this procedure (the top hat weighs (40 lbs [18 kg]):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Lift the top hat into place over the top of the chassis and rest it on the flanges along the side panels of the chassis (see Figure 95 on page 316).

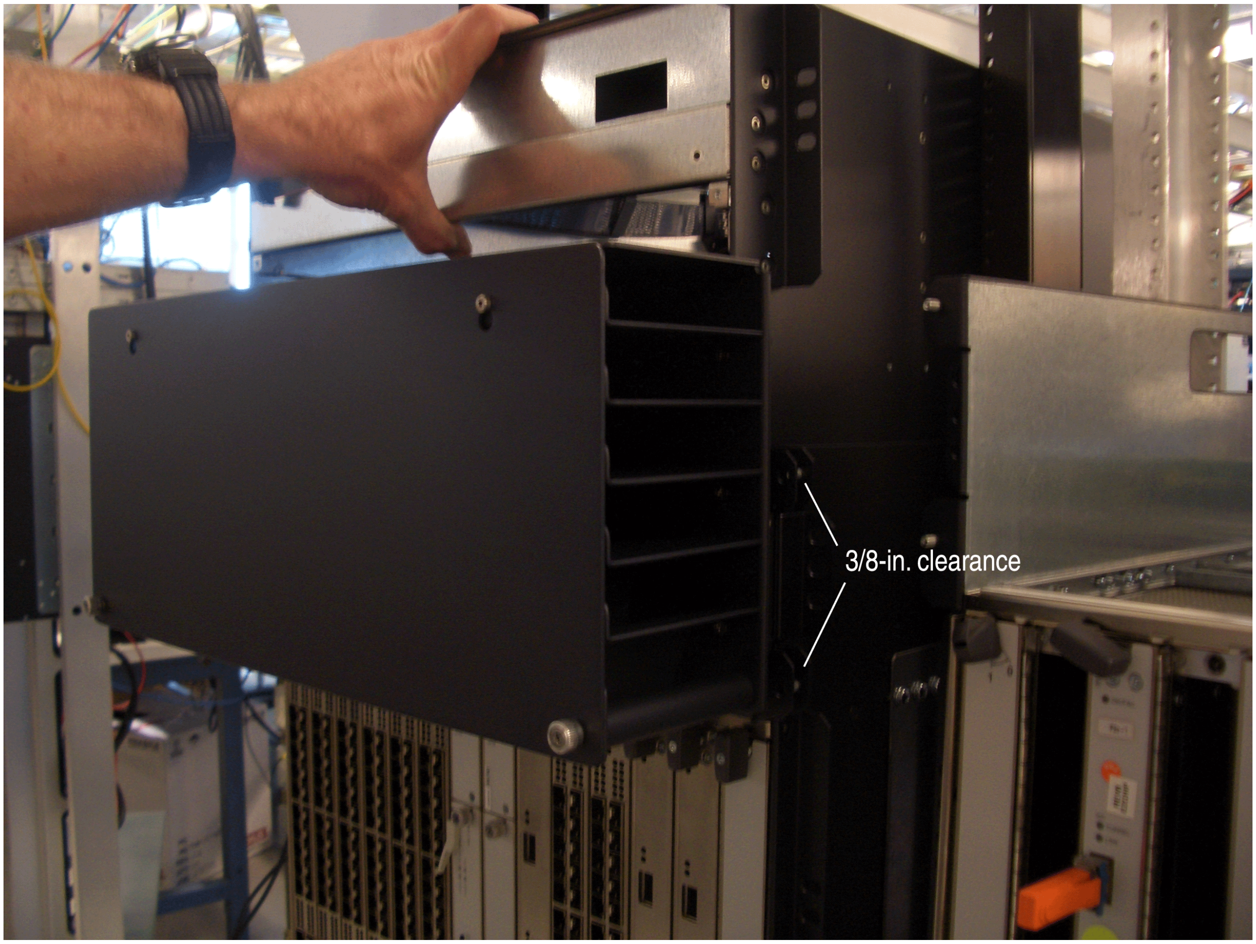
Figure 95: Resting the Top Hat on the Chassis



3. Slowly slide the top hat straight into the chassis until the front flanges are approximately 3/8-in. away from the corresponding chassis flanges. The threaded studs in the chassis flanges should be aligned with the center of the holes in the top hat front flanges (see Figure 96 on page 317).

   The 3/8-in. clearance is required to see the chassis midplane connector to which the craft interface ribbon cable connects. (The craft interface ribbon cable is attached to the extended cable manager top hat.)

Figure 96: Extended Cable Manager Top Hat Installed with 3/8-in. Clearance



4. Connect the craft interface ribbon cable:

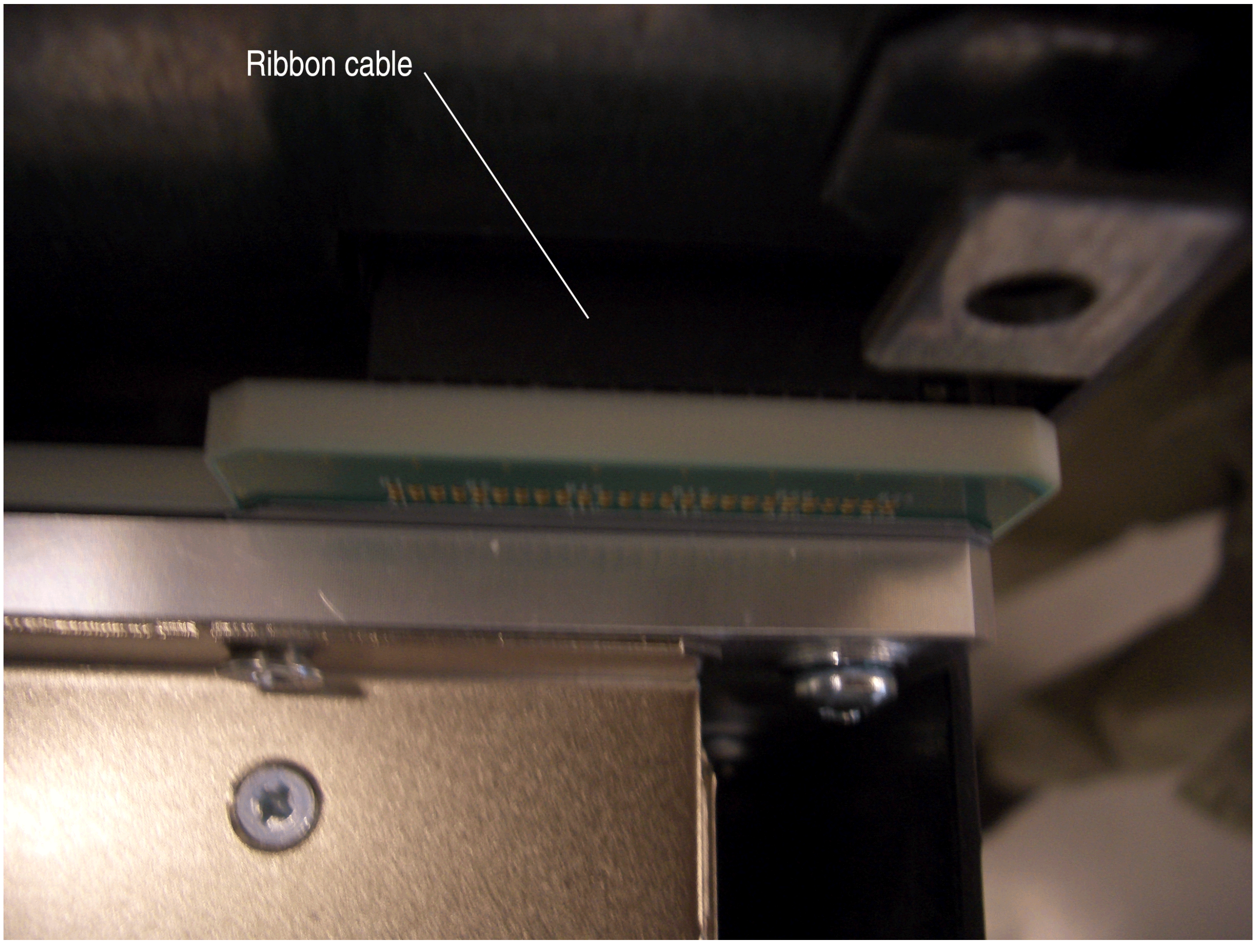
   a. Standing at the rear of the chassis, use your left hand to reach into the top of the chassis and locate the female connector and its mating clips at the end of the ribbon cable. If the chassis is mounted above your reach, stand on a ladder to comfortably access the ribbon cable.

   b. Using your left hand, gently squeeze the clips on the socket connector together and slowly plug the connector straight into the plug connector (see Figure 97 on page 319).

      CAUTION: To avoid bending or breaking the pins in the male connector, make sure you keep the face of the female connector parallel to the face of the male connector while connecting them. You can gently rock the female connector from side to side as you plug it in.

      NOTE: The space between the mating clip and the chassis is narrow, so it might be difficult to get a good grip on that side of the connector with your fingers.

Figure 97: Extended Cable Manager Craft Interface Ribbon Cable Connected to the Chassis Midplane



5. To close the 3/8-in. clearance, slide the top hat straight into the chassis until the front flanges are flush with the corresponding chassis flanges.

   When the top hat comes to a stop, a double-sided electrical connector on the rear of the top hat is mated with the midplane connector in which the upper fan tray used to mate (see Figure 98 on page 320, which is a view looking down into the chassis from the rear). The other side of the top hat connector is where the fan tray connector will mate when it is reinstalled in the chassis.

Figure 98: Fan Tray Connector on Extended Cable Manager Top Hat

6. Using the four acorn nuts saved in "Removing the Original Top Hat of the Chassis" on page 311, secure the top hat to the front of the chassis by tightening the nuts on the threaded studs inside the holes in the top hat front flanges (see Figure 99 on page 321). Use a 3/8-in. wrench to access the nuts between the top hat front flanges and the rear of the routing channel bays.

Figure 99: Tightening the Four Acorn Nuts That Secure the Extended Cable Manager Top Hat

7. Secure the top hat to the rear of the chassis by inserting and tightening two 8-32 screws into the upper threaded chassis holes, as shown in Figure 100 on page 322 and Figure 101 on page 323.

> **NOTE:** The threaded holes immediately below those used to secure the top hat are used to secure the new extended cable manager rear exhaust grate. Make sure that you use the correct holes for securing the top hat.

Figure 100: Tightening the Right 8-32 Screw for the Extended Cable Manager Top Hat

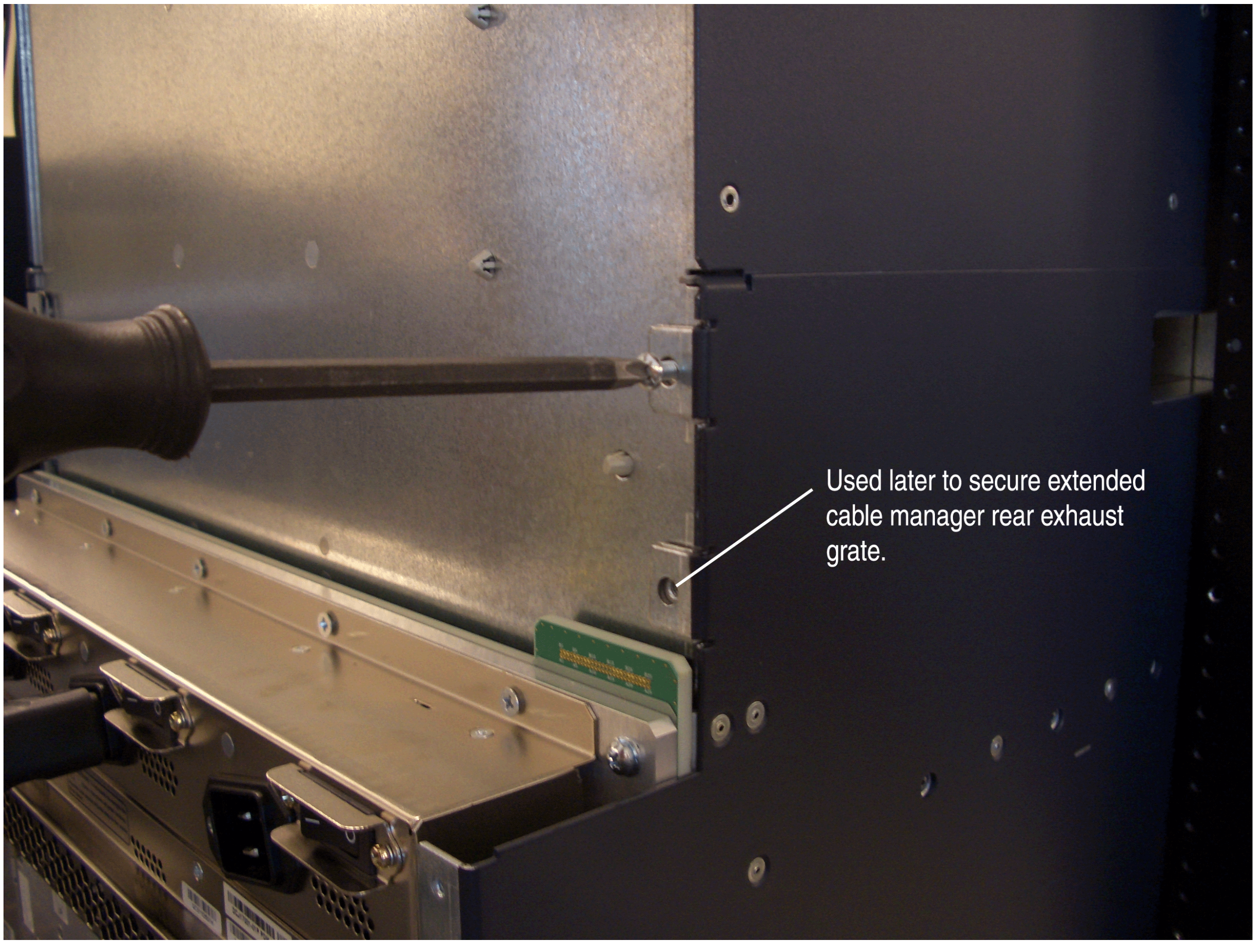
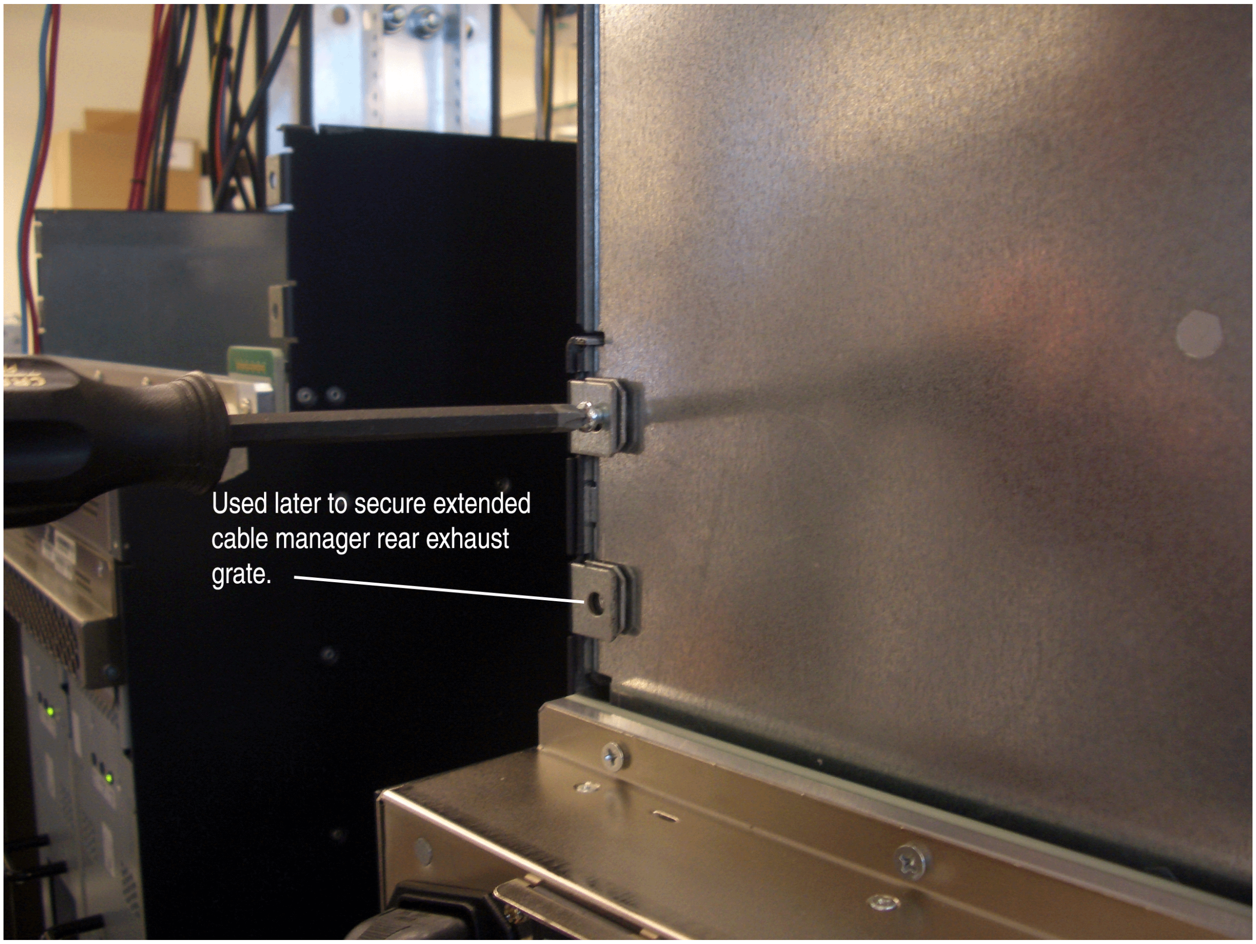


Figure 101: Tightening the Left 8-32 Screw for the Extended Cable Manager Top Hat



Installing the New Rear Air Exhaust Grate

To install the new rear air exhaust grate, follow this procedure:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Lift the grate into place at the top rear of the chassis. The sides and the top of the grate should be flush with the sides and top of the chassis (see Figure 102 on page 324).

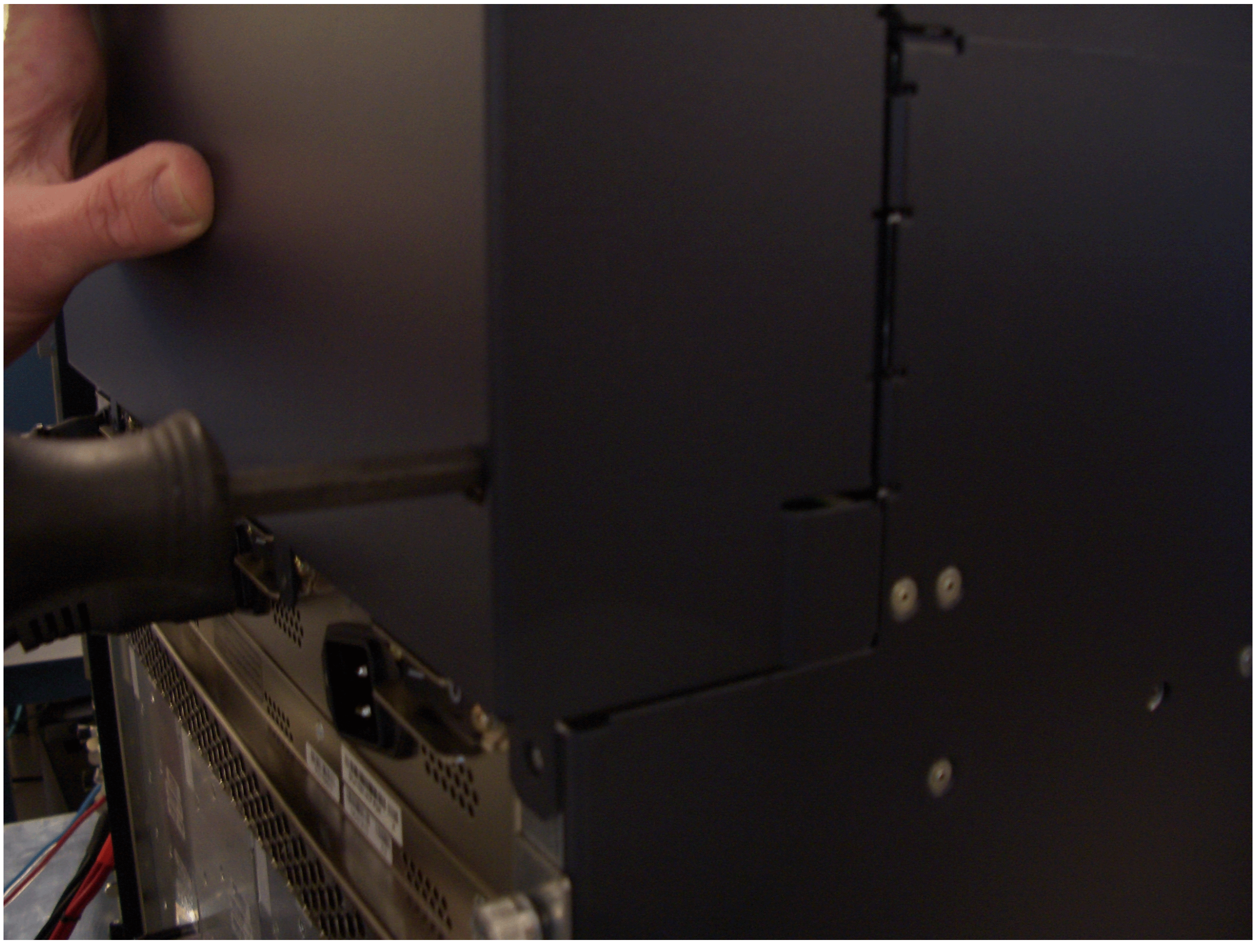
Figure 102: Installing the New Rear Air Exhaust Grate

3. With a flatblade or Phillips screwdriver, partly tighten the top two captive screws, then the bottom two captive screws, that secure the grate to the chassis.

   Figure 103 on page 325 and Figure 104 on page 326 show the top right and bottom right captive screws being tightened.

Figure 103: Tightening the Top Right Captive Screw of the New Rear Air Exhaust Grate

Figure 104: Tightening the Bottom Right Captive Screw of the New Rear Air Exhaust Grate



4. Fully tighten each of the four captive screws.

Reinstalling the AC Power Inlet Cover (DC-Powered Routers Only)

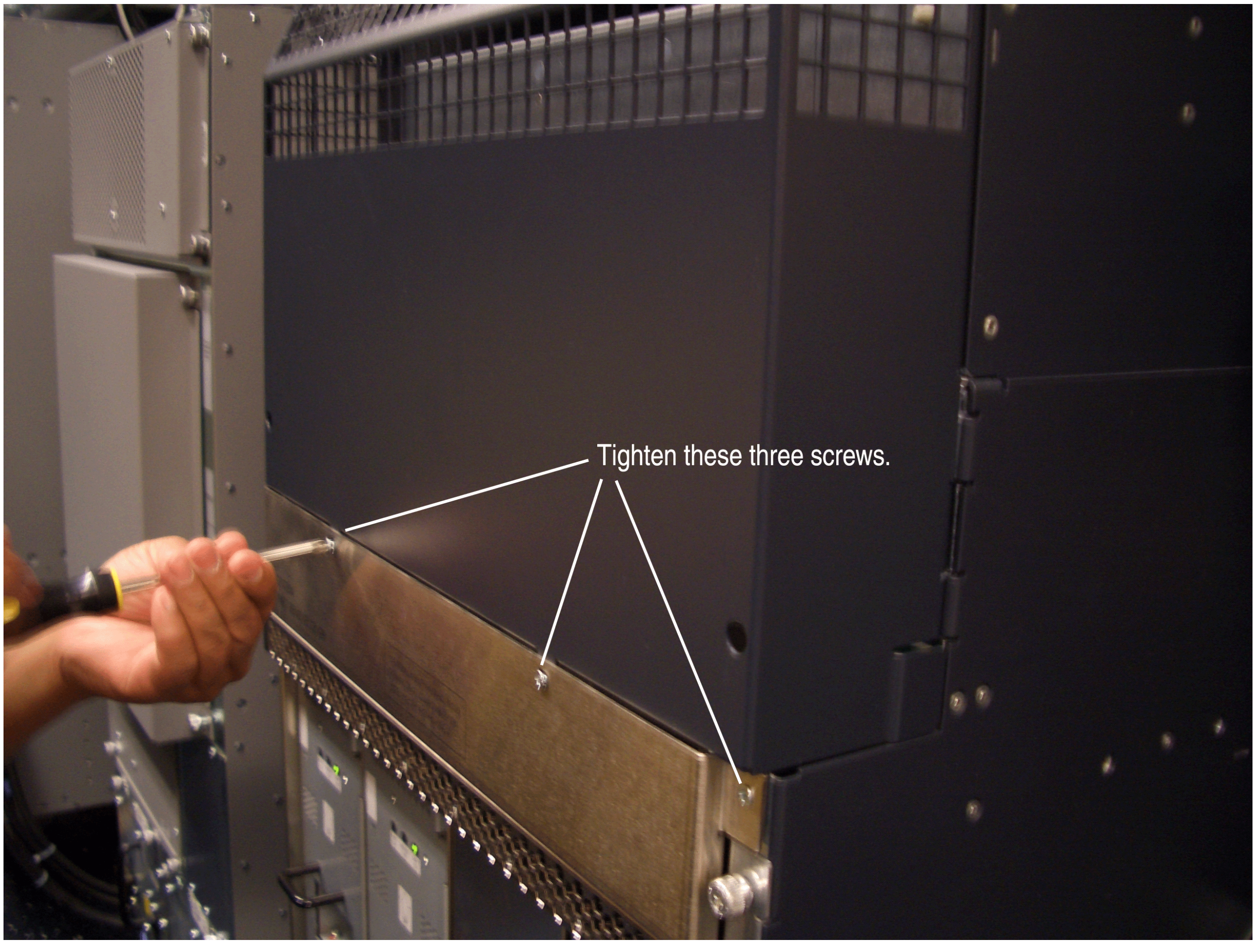
To reinstall the cover over the four unused AC power inlets in a DC-powered router, follow this procedure:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Place the cover directly below the new rear exhaust grate so that the three screw holes in the cover align with the corresponding threaded holes in the chassis.

3. Using the three screws saved in "Removing the AC Power Inlet Cover (DC-Powered Routers Only)" on page 302, secure the cover to the chassis by partly tightening each of the screws (see Figure 105 on page 327).

Figure 105: Removing the AC Power Inlet Cover



4. Fully tighten each of the three screws.

Reinstalling the Upper Fan Tray

To reinstall the upper fan tray, follow this procedure (see Figure 106 on page 328):

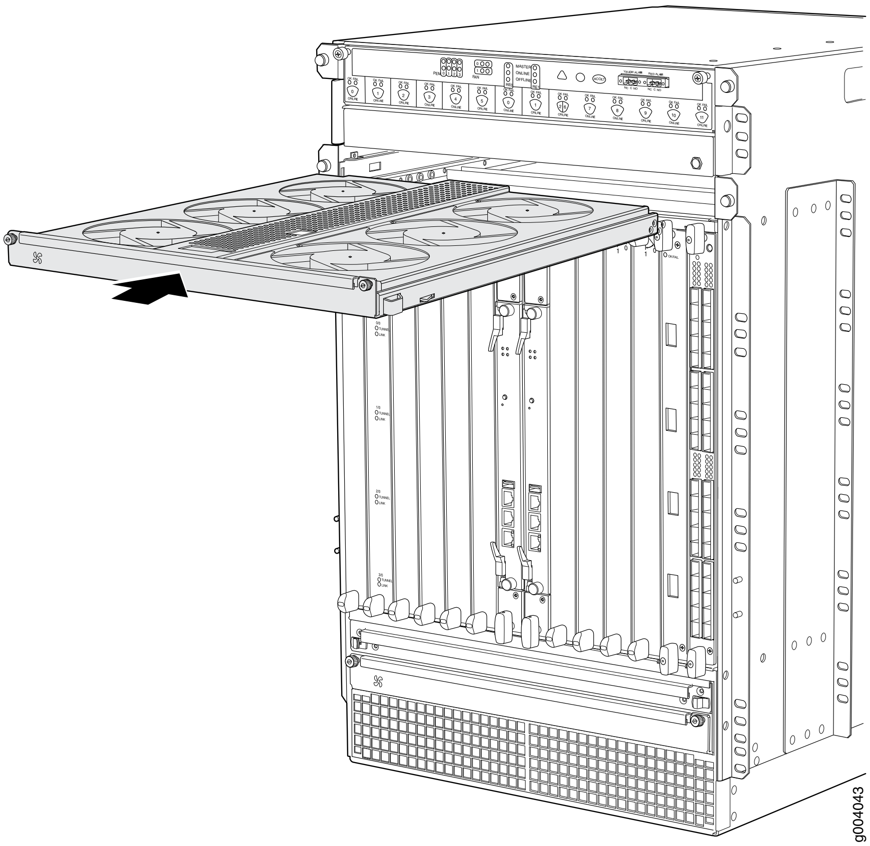
> **NOTE:** Figure 106 on page 328 does not show the extended cable manager and shows the craft interface installed in the chassis. You have not yet installed the craft interface.

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Grasp the fan tray 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 106: Installing an Upper Fan Tray



Reinstalling the Craft Interface

To reinstall the craft interface, follow this procedure (see Figure 107 on page 329):

> **NOTE:** Figure 107 on page 329 does not show the extended cable manager installed.

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Grasp the craft interface with one hand and hold the bottom edge of the craft interface with the other hand to support its weight.

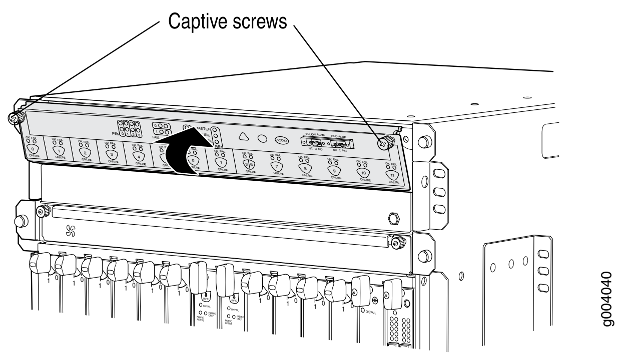
3. Align the red line along the bottom of the internal strap with the bottom of the connector and snap gently into place.

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 at the top left and right corners of the craft interface faceplate.

6. Reattach any external devices connected to the craft interface.

Figure 107: Installing a Craft Interface



Rest lower edge of the craft interface in the chassis bay, then tilt it toward the chassis, and secure the screws.

Powering On the Router

To power on the router, follow this procedure:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Verify that the power supplies are fully inserted in the chassis and that each of their release levers is locked into the chassis in the rightmost position.

3. For each power supply on an AC-powered router, verify that the source power cord is securely inserted into the appliance inlet. For each power supply on a DC-powered router, verify that the source power cables are connected to the appropriate terminal: the positive (+) source cable to the return terminal (labeled **RETURN**) and the negative (–) source cable to the input terminal (labeled **–48V**).

4. Verify that an external management device is connected to one of the Routing Engine ports on the Craft Interface (**AUX**, **CONSOLE**, or **ETHERNET**). For more information on connecting management devices, see the *MX960 3D Universal Edge Router Hardware Guide*.

5. Turn on the power to the external management device.

6. For an AC-powered router, switch the AC switch in the chassis above each power supply to the on position (—) and observe the status LEDs on each power supply faceplate. If an AC power supply is correctly installed and functioning normally, **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

   For a DC-powered router, 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, **PWR OK**, **BREAKER ON**, and **INPUT OK** LEDs light steadily.

   If any of the status LEDs indicates the power supply is not functioning normally, repeat the installation and cabling procedures described in the *MX960 3D Universal Edge Router Hardware Guide*.

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

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

Verifying the Extended Cable Manager Is Correctly Installed

To verify that the extended cable manager is correctly installed, follow this procedure:

1. Verify that air is flowing out of the rear air exhaust.

2. Verify that the appropriate LEDs on the craft interface are lit. For more information, see the *MX960 3D Universal Edge Router Hardware Guide*.

3. In Junos OS Release 8.5 or later, Issue the **show chassis hardware** command:

   `user@host>` **show chassis hardware**

```
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN107FC5DAFA      MX960
```

```
Midplane           REV 02   710-013698   CC6220             MX960 Midplane
FPM Board          REV 01   710-014974   JS4208             MX960 Front Panel
Display
PIM                Rev 02   740-013110   QCS10375009        Power Inlet Module
PEM 0              Rev 01   740-013682   QCS10374009        PS 1.7kW; 200-240VAC
in
PEM 1              Rev 01   740-013682   QCS10374029        PS 1.7kW; 200-240VAC
in
Routing Engine 0 REV 02   740-013063   1000639065         RE-S-2000
Routing Engine 1 REV 04   740-013063   1000664335         RE-S-2000
CB 0               REV 02.6 710-013385   JM7908             MX960 SCB
CB 1               REV 03   710-013385   JS9412             MX960 SCB
FPC 2              REV 03   710-013699   JS4284             MX960 40GE DPC
  CPU              REV 04   710-013713   JS9401             MX960 DPC PMB
  PIC 0                     BUILTIN      BUILTIN            10x 1GE
    ...
Fan Tray 0         REV 01   740-014971   FT0655             MX960 Fan Tray
Fan Tray 1         REV 01   740-014971   FT0653             MX960 Fan Tray
Fan Extender      REV 01   710-018051   JZ8674            Extended Cable Manager
```

Under the **Item** field, verify that you see all hardware components installed in the chassis, including the following:

- FPM Board
- Fan Tray 0
- Fan Extender (**Description** field is **Extended Cable Manager**)

NOTE: The extended cable manager is shown in command output only in Junos OS Release 8.5 or later.

Dressing the Cables

To dress the cables within the extended cable manager, follow this procedure:

1. With a flatblade or Phillips screwdriver, loosen the two captive screws at the bottom of the cable routing bay cover (see Figure 108 on page 333). The slots in the cover will rest on their supporting posts and keep the cover in place.

2. Holding the captive screws, lift the cover straight up and out to remove it from the supporting posts. Set the cover aside.

3. Carefully route all cables connected to the router as follows (see Figure 109 on page 334):

   - If a DPC has fiber-optic cables, use the extended cable manager to route up to 30 cables through the bottom of the corresponding routing channel and out the side of the routing bay. Route any additional fiber-optic cables through the standard cable manager.
   - If a DPC has copper cables, use the extended cable manager to route up to 40 cables through the bottom of the corresponding routing channel and out the side of the routing bay.
   - Route any cables that do not connect to a DPC, such as an out-of-band Ethernet cable connected to the Routing Engine, through the standard cable manager.

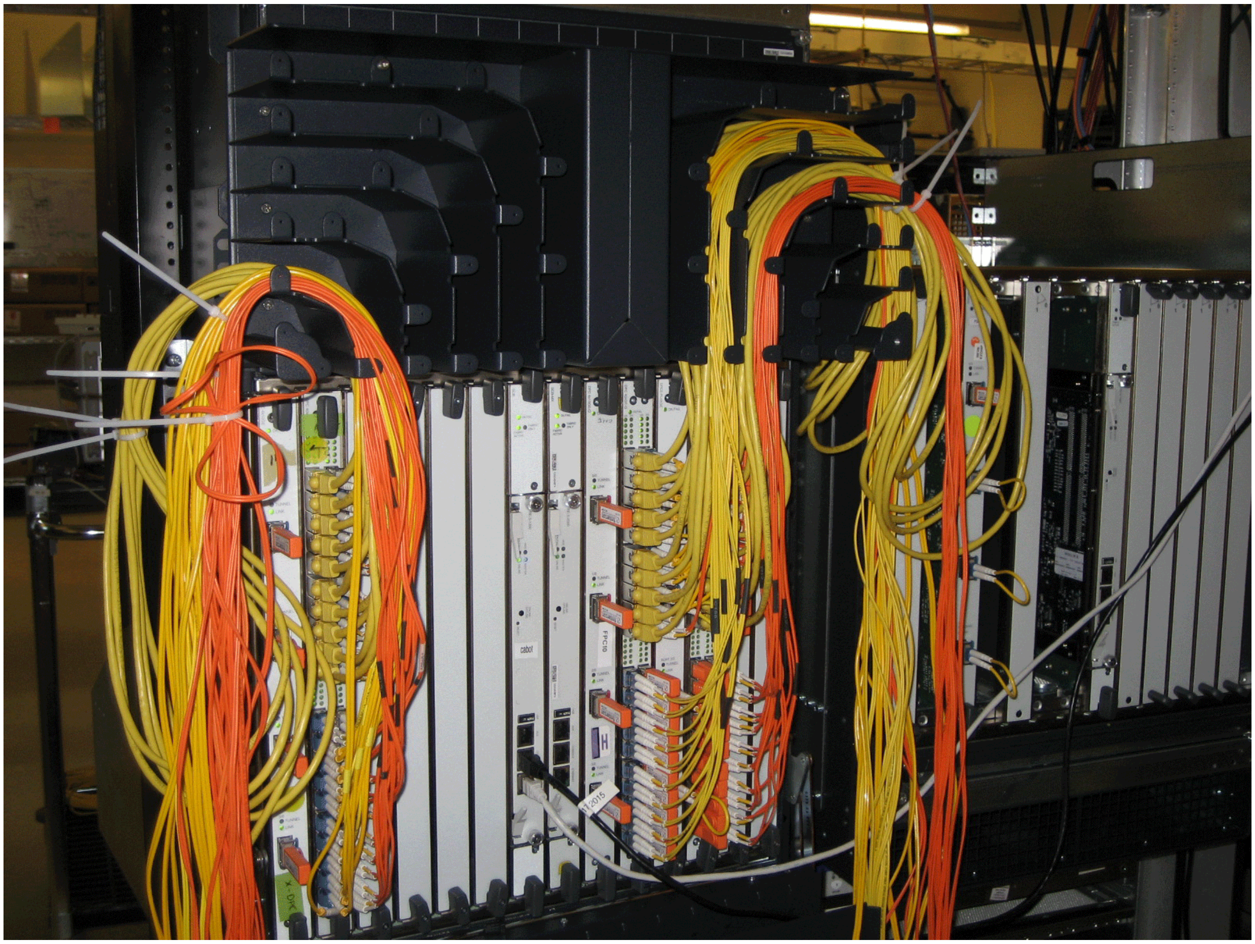
   Ensure that all cables routed through the extended cable manager are held inside the routing channels by the retaining flanges.

4. Place the cable routing bay cover over the cable bays by resting each of the cover slots on a supporting post.

5. With a flatblade or Phillips screwdriver, tighten the two captive screws at the bottom of the cover.

Figure 108: Cable Routing Bay Cover

Figure 109: Dressing the Cables Through the Routing Channels



Reinstalling Components in the MX960 Chassis After Installing It with a Lift

After the router is installed in the rack, reinstall the removed components before booting and configuring the router. You reinstall components first in the rear of the chassis, and then in the front:

Reinstalling the Power Supplies After Installing the MX960 Router with a Lift

Reinstall the rightmost power supply first and then work your way to the left.

To reinstall the AC and DC, or universal (HVAC or HVDC) power supplies, follow this procedure for each power supply (see Figure 110 on page 336, Figure 111 on page 337, and Figure 112 on page 338):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. For an AC-powered router, move the AC input switch in the chassis above the power supply slot to the off (**O**) position. For a DC-powered router, move the DC circuit breaker on the power supply to the off (**O**) position.

   We recommend this even though the power supplies are not connected to power sources.

3. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 110 on page 336).

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

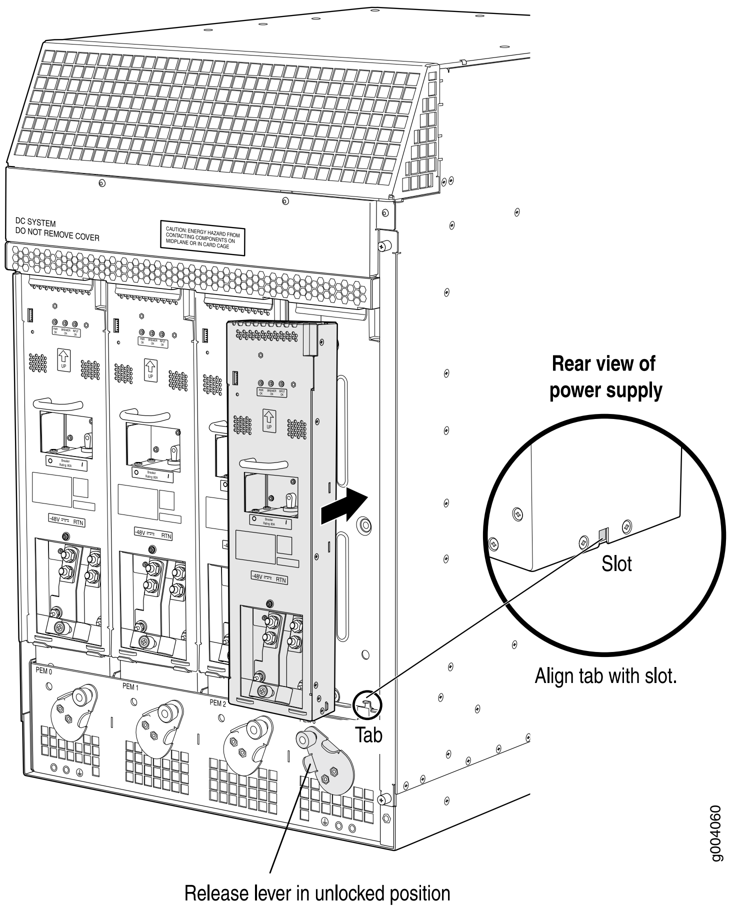
4. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplates.

   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply. This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

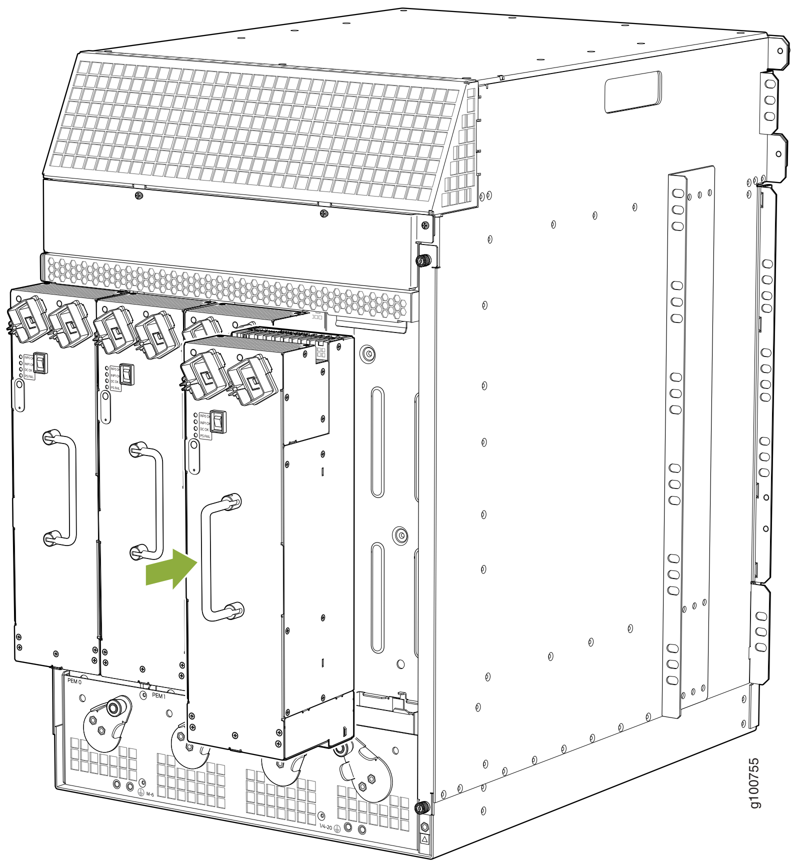
6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

Figure 110: Reinstalling a Power Supply



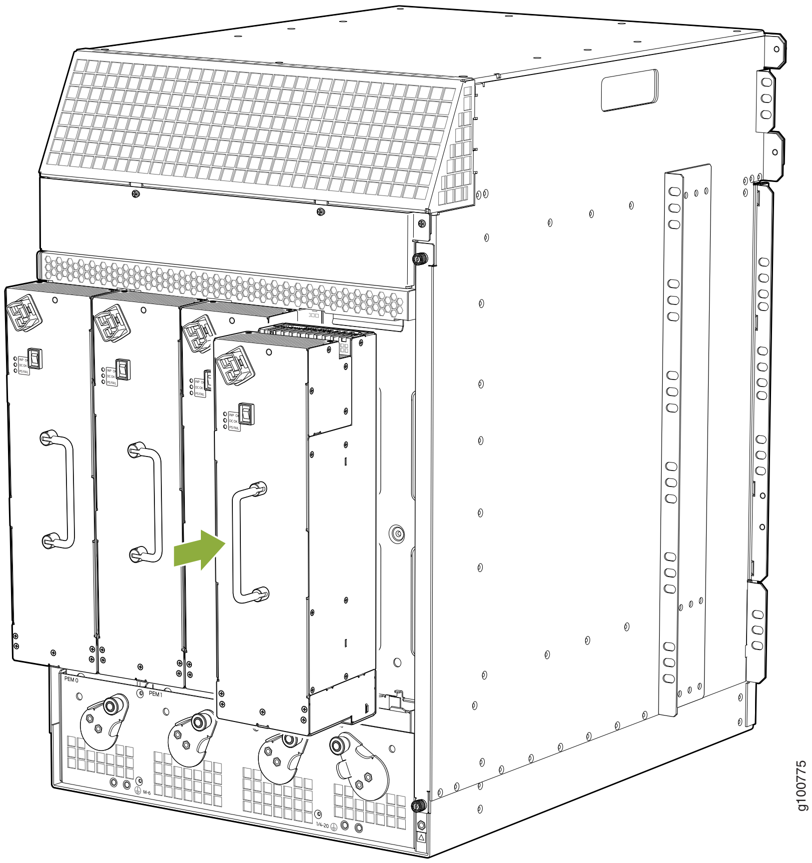
NOTE: The chassis is shown without the extended cable manager.

Figure 111: Reinstalling a High-Capacity Second-Generation Power Supply Before Installing the MX960 Router



NOTE: The chassis is shown without the extended cable manager.

Figure 112: Reinstalling a High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply Before Installing the MX960 Router



To install an AC or universal (HVAC/HVDC) power supply (see Figure 113 on page 339):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Move the AC input switch in the chassis above the empty power supply slot to the off (**O**) position.

3. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 113 on page 339).

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

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 faceplates.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 113 on page 339). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

7. Move the AC input switch in the chassis above 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 113: Installing an AC Power Supply

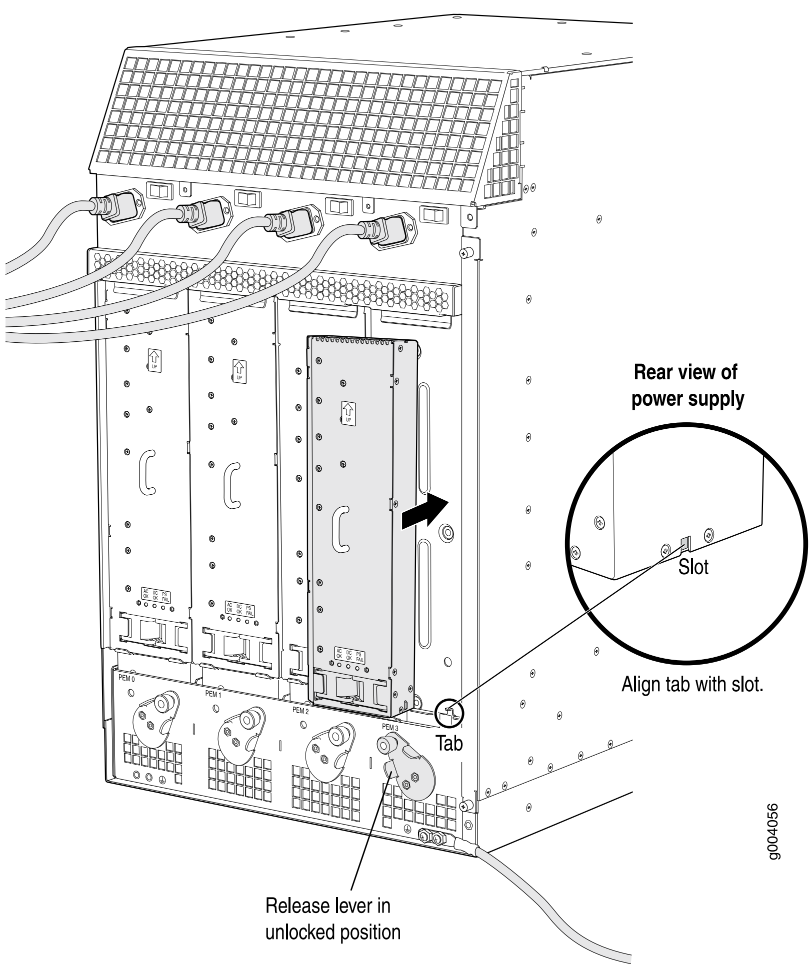
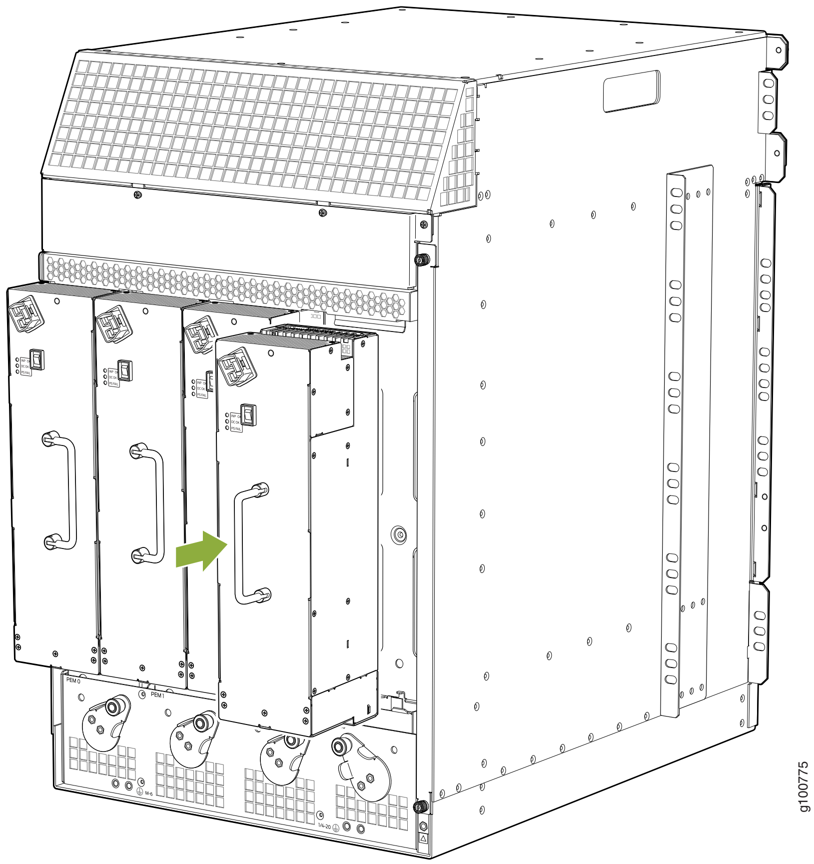


Figure 114: Installing a High-Voltage Second-Generation Universal (HVAC or HVDC) Power Supply



NOTE: The chassis is shown without the extended cable manager.

NOTE: If you are replacing the power supplies on an existing chassis, make sure to replace the agency label on the chassis with the new label. See "MX960 Chassis Serial Number and Agency Label" on page 696.

Reinstalling the Fan Trays After Installing the MX960 Router with a Lift

To reinstall the fan trays (see Figure 115 on page 341 and Figure 116 on page 342):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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.

4. Lower the standard cable manager back into position, if necessary.

Figure 115: Installing an Upper Fan Tray

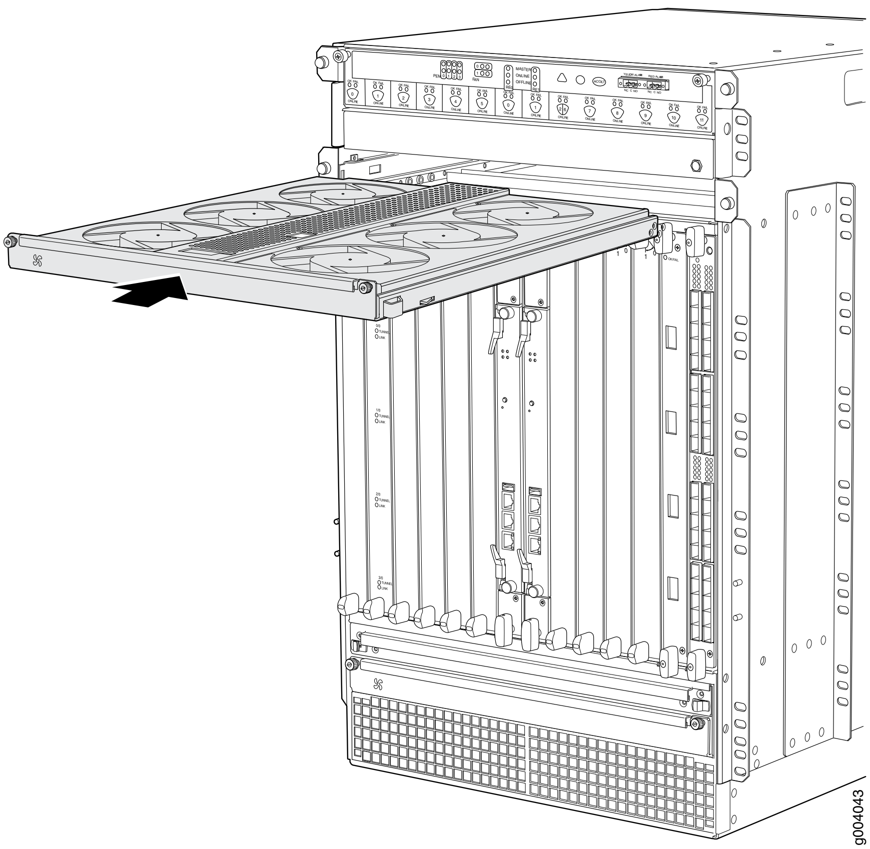
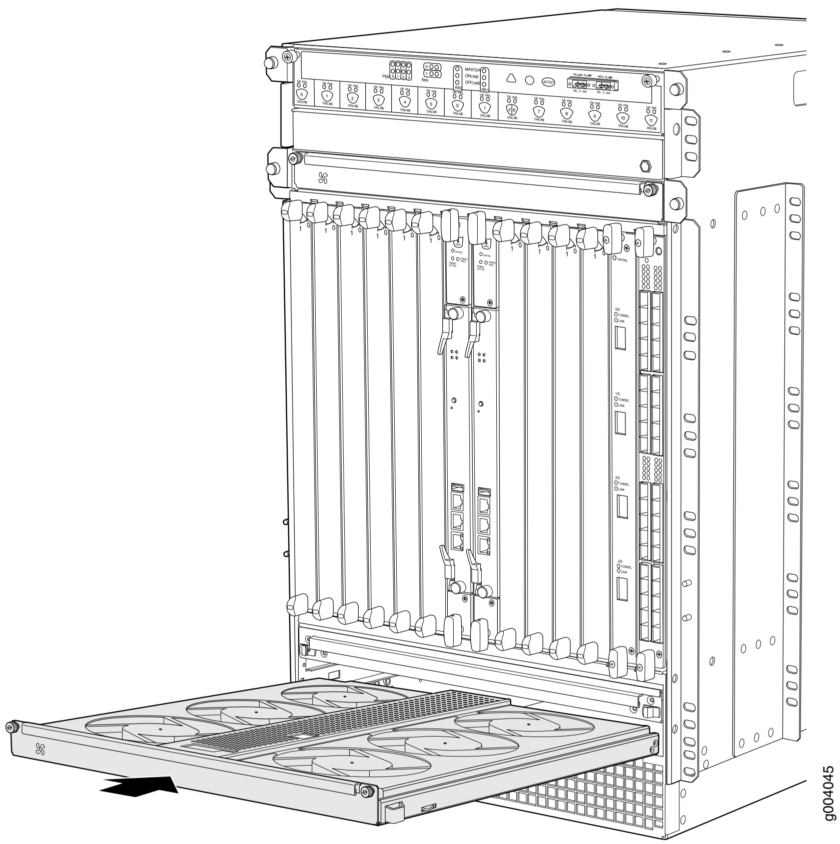


Figure 116: Installing a Lower Rear Fan Tray



Reinstalling the SCBs After Installing the MX960 Router with a Lift

To reinstall an SCB (see Figure 117 on page 343):

> **CAUTION:** Before removing or replacing an SCB, ensure that the ejector handles are stored horizontally and pressed toward the center of the SCB.

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

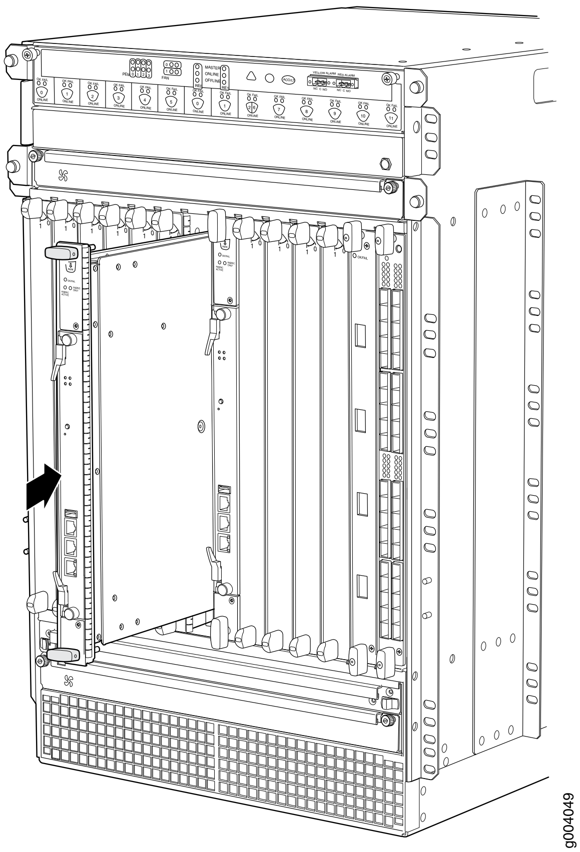
2. Carefully align the sides of the SCB with the guides inside the chassis.

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 their proper position, vertically and toward the center of the board. To avoid blocking the visibility of the LEDs position the ejectors over the PARK icon.

Figure 117: Reinstalling an SCB



Reinstalling the DPCs After Installing the MX960 Router with a Lift

To reinstall a DPC (see Figure 118 on page 344):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Take each DPC to be installed out of its electrostatic bag, and identify the slot on the DPC where it will be connected.

3. Verify that each fiber-optic DPC has a rubber safety cap covering the transceiver. If it does not, cover the transceiver with a safety cap.

4. Locate the slot in the DPC card cage in which you plan to install the DPC.

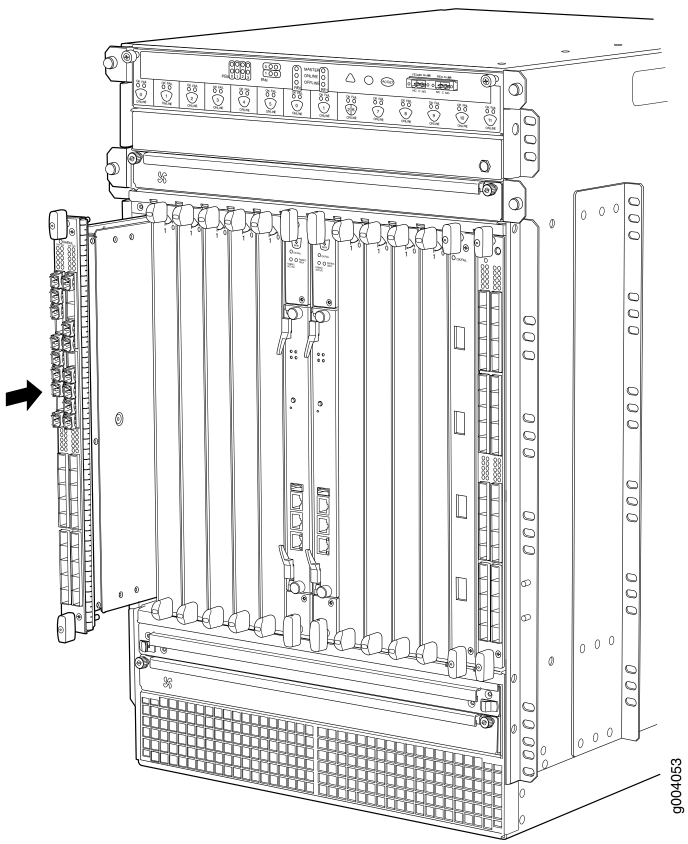
5. Ensure that the DPC is right-side up, with the text on the faceplate of the DPC facing upward.

6. Lift the DPC into place, and carefully align first the bottom, then the top 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 simultaneously clockwise until the DPC is fully seated.

Figure 118: Installing a DPC

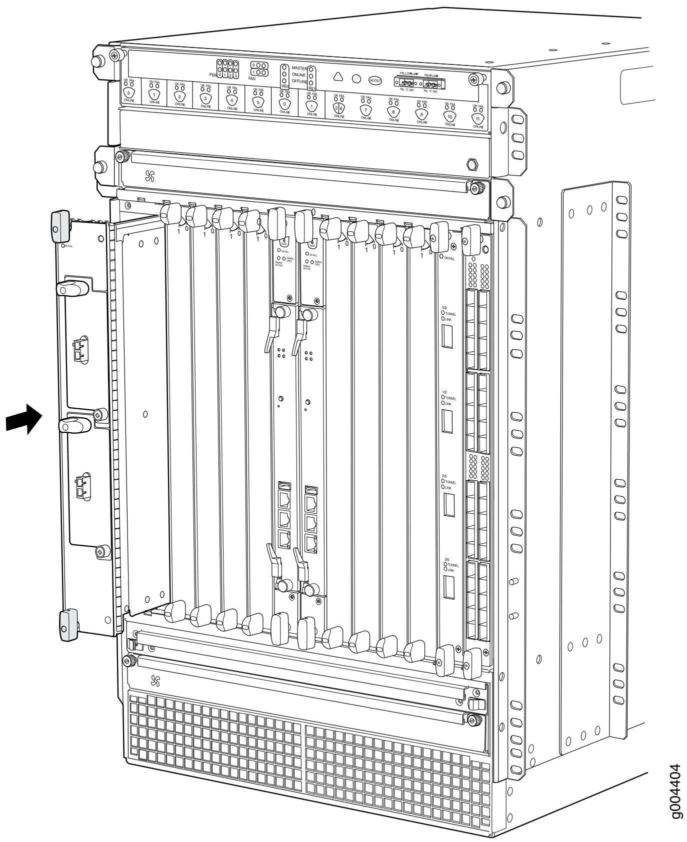


Reinstalling the FPCs After Installing the MX960 Router with a Lift

To reinstall an FPC (see Figure 119 on page 346):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Place the FPC on an antistatic mat, or remove it from its electrostatic bag.
3. Identify the two DPC slots on the router where the FPC will be installed.
4. Verify that each fiber-optic transceiver on the PIC is covered by a rubber safety cap. If it does not, cover the transceiver with a safety cap.
5. Orient the FPC so that the faceplate faces you.
6. Lift the FPC into place, and carefully align the sides of the FPC with the guides inside the card cage.
7. Slide the FPC all the way into the card cage until you feel resistance.
8. Grasp both ejector handles, and rotate them clockwise simultaneously until the FPC is fully seated.

Figure 119: Reinstalling an FPC



Reinstalling the Standard Cable Manager After Installing an MX960 Router with a Lift

To reinstall the standard cable manager (see Figure 120 on page 347):

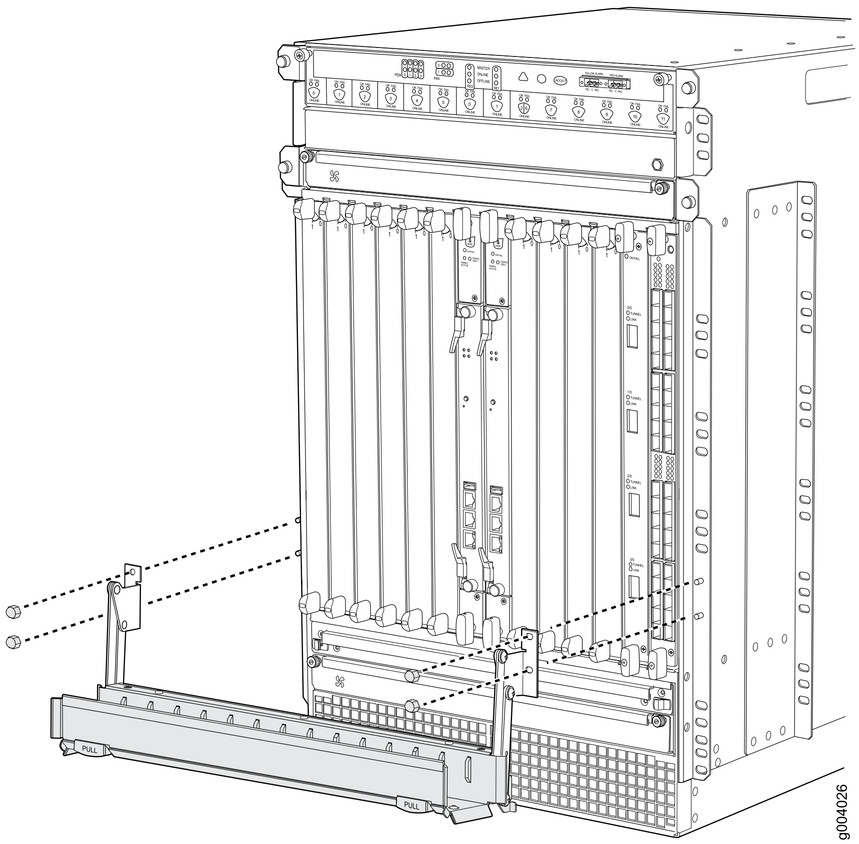
1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Position the cable manager on the studs on the lower front of the chassis.

3. Insert the nuts on the corners in the cable manager onto the studs on the chassis.

4. Using a 7/16-in. (11 mm) nut driver, tighten the nuts securely.

Figure 120: Reinstalling the Cable Manager



RELATED DOCUMENTATION

MX960 Site Preparation Checklist | 180
Tools Required to Install the MX960 Router with a Mechanical Lift | 289
Removing Components from the MX960 Router Chassis Before Installing It with a Lift | 279
Installing the MX960 Router Using a Mechanical Lift | 290

CHAPTER 20

Connecting the MX960 Router to Power

IN THIS CHAPTER

Tools and Parts Required for MX960 Router Grounding and Power Connections

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

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

> **CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs. Use an appropriately-sized driver or socket wrench. Ensure that the driver is undamaged and properly calibrated and that you have been trained in its use. You may wish to use a driver that is designed to prevent overtorque when the preset torque level is achieved.

RELATED DOCUMENTATION

Grounding the MX960 Router | **350**

MX960 Router Grounding Specifications | **194**

Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies | **352**

Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies | **365**

Grounding the MX960 Router

You ground the router by connecting a grounding cable to earth ground and then attaching it to the chassis grounding points using two screws. You must provide the grounding cables (the cable lugs are supplied with the router).

NOTE: You must install the MX960 router in a restricted-access location and ensure the chassisis properly grounded at all times. The chassis has a 2-hole protective grounding terminal provided on the chassis, see Figure 121 on page 351. Under all circumstances, use this grounding connection to ground the chassis. For AC powered systems, you must also use the grounding wire in the AC power cord along with the 2-hole lug ground connection. This tested system meets or exceeds all applicable EMC regulatory requirements with the 2-hole protective grounding terminal.

1. Verify that a licensed electrician has attached the cable lug provided with the router to the grounding cable.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of 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.

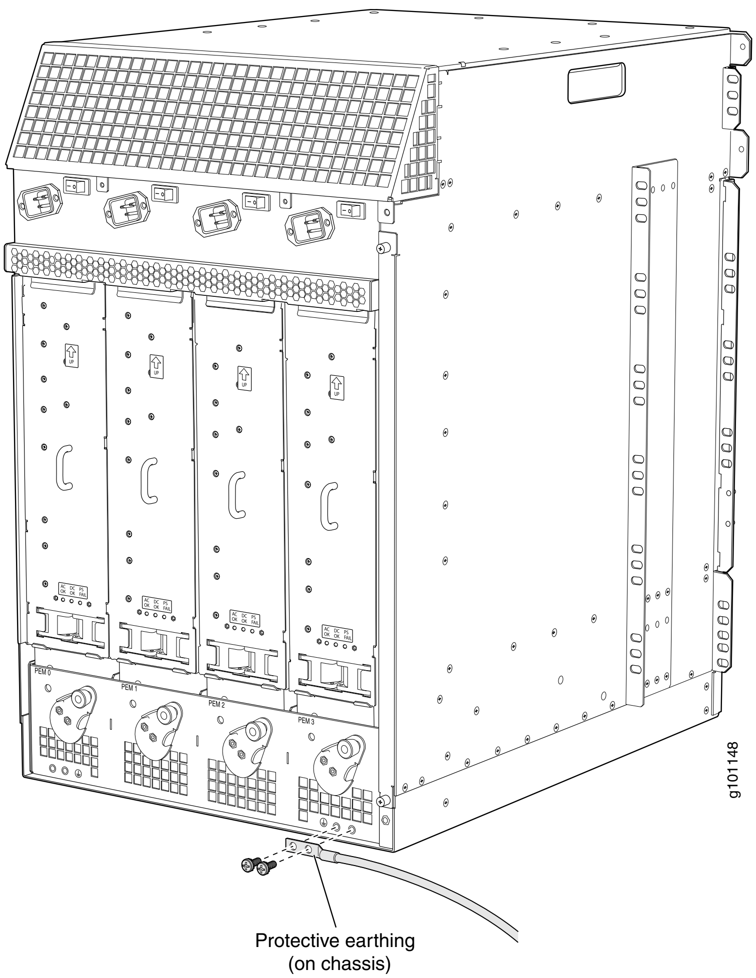
5. Detach the ESD grounding strap from the site ESD grounding point.

6. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

7. Place the grounding cable lug over the grounding points on the rear of the chassis. The left pair is sized for M6 screws, and the right pair is sized for UNC 1/4-20 screws.

8. Secure the grounding cable lug to the grounding points, first with the washers, then with the screws.

Figure 121: Connecting a Grounding Cable to the MX960 Router



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.

RELATED DOCUMENTATION

MX960 Router Grounding Specifications | 194

Preventing Electrostatic Discharge Damage to an MX960 Router

Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies | 352

Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies | 365

Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies

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

The AC appliance inlets are located in the chassis directly above the power supplies.

To connect the AC power cords to the router (see Figure 122 on page 353):

1. Locate the power cords shipped with the router, which should have a plug appropriate for your geographical location.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Move the AC input switch, which is to the right of the appliance inlet on the chassis, to the off (**O**) position.

4. Connect the power cord into the appliance inlet located in the chassis directly above the AC power supply.

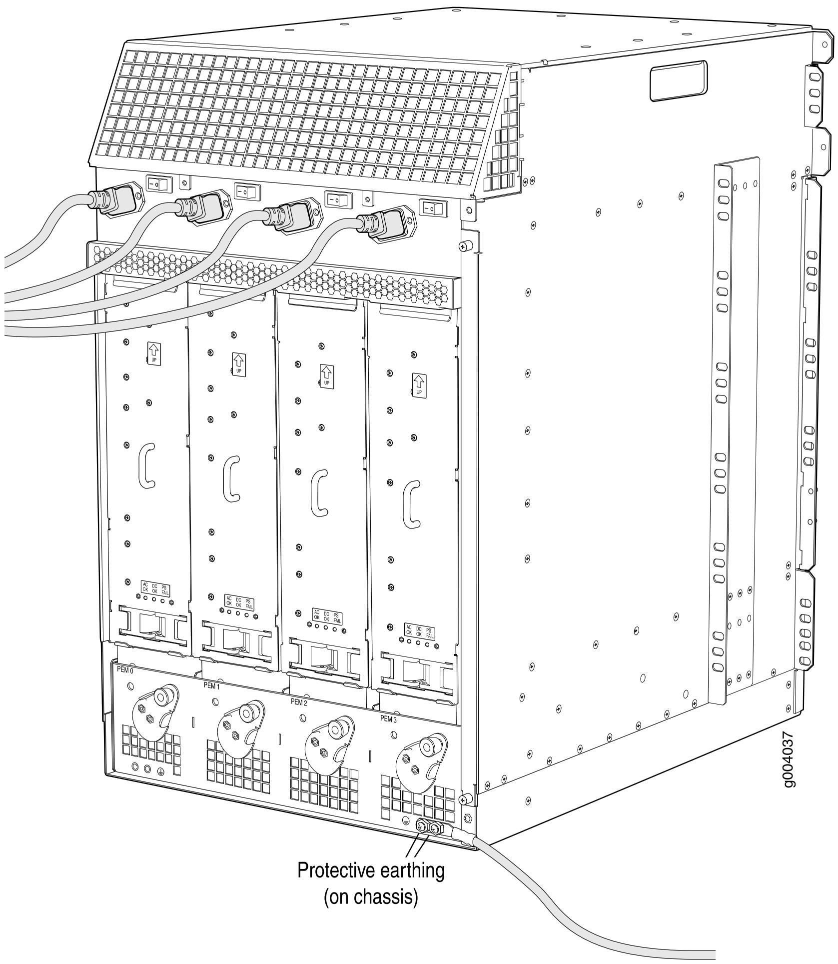
5. Insert the power cord plug into an external AC power source receptacle.

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

6. 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.

7. Repeat Step 3 through Step 6 for the remaining power supplies.

Figure 122: Connecting AC Power to the MX960 Router



RELATED DOCUMENTATION

Grounding the MX960 Router | 350

AC Power Cord Specifications for the MX960 Router | 217

Preventing Electrostatic Discharge Damage to an MX960 Router

Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies | 363

Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies | 354

Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies

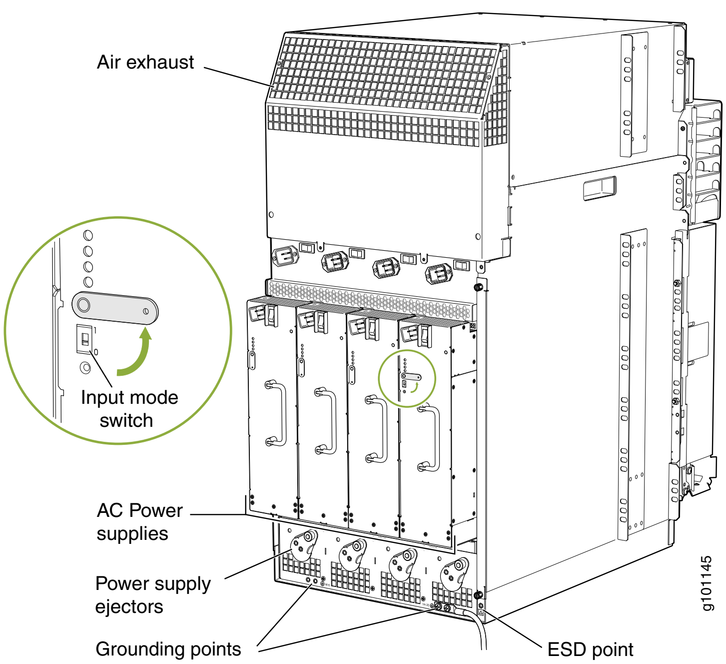
> **NOTE:** A minimum of two AC nominal 220 VAC 20 amp power cords are required for this procedure.

To connect the AC power cords to the router (see Figure 123 on page 354).

1. Verify that the power switch on the power supply is in the off (**O**) position.

2. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 123 on page 354).

Figure 123: MX960 with High-Capacity AC Power Supplies Installed



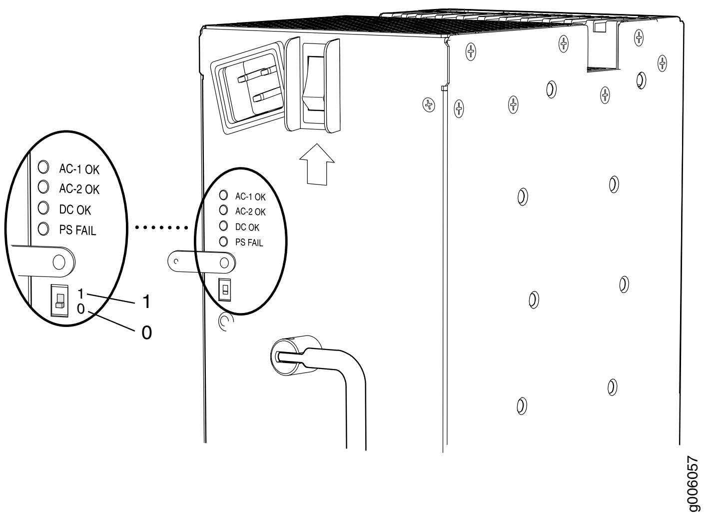
> **NOTE:** The chassis is shown with the extended cable manager.

If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

3. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

4. Move the input mode switch to position 0 if you plan to connect one feed, or position 1 if you plan to connect two feeds (see Figure 124 on page 355).

Figure 124: MX960 AC Power Input Mode Switch



> **CAUTION:** Do not use a pencil, because fragments can break off and cause damage to the power supply.

5. 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 will protrude beyond the chassis.

   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 124 on page 355). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

6. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

7. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

8. Make sure the grounding cable is attached, see "Grounding the MX960 Router" on page 350.

9. Locate a power cord with the type of plug appropriate for your geographical location (see “AC Power Cord Specifications for the MX960 Router” on page 217).

10. Plug the power cord into the corresponding appliance inlet located in the chassis directly above the power supply. This is the recommend receptacle when using the power supply in one-feed mode. If using the power supply in two-feed mode, plug the second power cord into the receptacle on the power supply.

    NOTE: Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker.

    NOTE: To use HC-PSs with full capacity you have to switch them to two feed mode and use two power cords per HC-PS.

11. Dress the power cords appropriately. Verify that the power cord does not block the air exhaust and access to router components, and that they do not drape where people could trip on them.

12. Move the AC input switch above the power supply to the on (—) position. This is the only switch you have to turn on if you are using the power supply in one feed mode. If using the power supply in two-feed mode, move the power switch on the power supply to the on position. Remember to turn on both switches when operating the power supply in two-feed mode.

13. If the power supply is correctly installed and functioning normally, the **AC1 OK**, **AC2 OK** (two-feed mode only) **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit. See Table 129 on page 356.

Table 129: MX960 High-Capacity AC Power Supply LEDs

Connected Inputs	DIP Switch Position	LEDs			
		AC-1 OK	**AC-2 OK**	**DC OK**	**PS FAIL**
PDM connected, power supply disconnected	0 (1 input)	Green	Off	Green	Off
PDM disconnected, power supply connected	0 (1 input)	Off	Green	Green	Off

Table 129: MX960 High-Capacity AC Power Supply LEDs *(continued)*

Connected Inputs	DIP Switch Position	LEDs			
		AC-1 OK	**AC-2 OK**	**DC OK**	**PS FAIL**
PDM connected, power supply connected	0 (1 input)	Green	Green	Green	Off
PDM connected, power supply disconnected	1 (2 inputs)	Green	Off	Off	Red
PDM disconnected, power supply connected	1 (2 inputs)	Off	Green	Off	Red
PDM connected, power supply connected	1 (2 inputs)	Green	Green	Green	Off

Note: The corresponding appliance inlet located in the chassis directly above the power supply is the recommend receptacle when using the power supply in one feed mode. If using the power supply in two-feed mode, plug the second power cord into the receptacle on the power supply

Note: PDM in the above table stands for Power Distribution Module.

14. Repeat steps 1-12 for installing power supplies in slots 1, 2, and 3, where required.

Connecting Power to an AC-Powered MX960 Router with High-Capacity Second-Generation Power Supplies

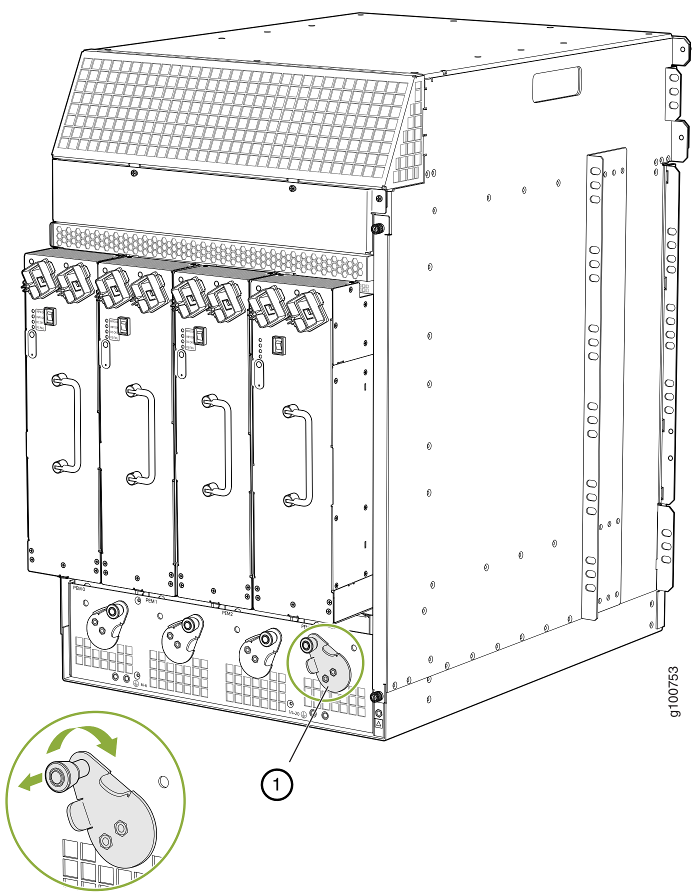
> **NOTE:** A minimum of two AC nominal 220 VAC 20 amp power cords are required for this procedure.

To install and power on an MX960 high-capacity second-generation AC (MX960-PSM-5K-AC) power supply, use the following procedure.

1. Verify that the power switch on the power supply is in the off (**O**) position.

2. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 125 on page 358).

Figure 125: MX960 with High-Capacity Second Generation AC Power Supplies Installed

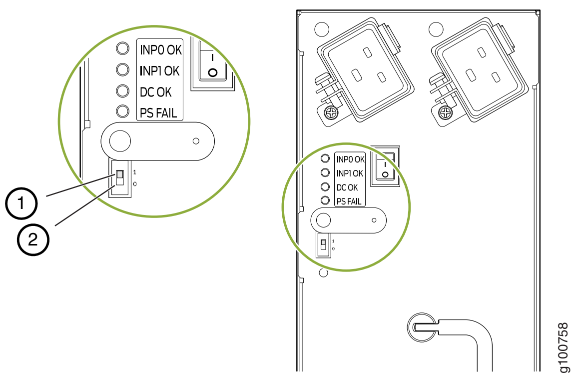


If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

3. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

4. Move the input mode switch to position 0 if you plan to connect one feed, or position 1 if you plan to connect two feeds (see Figure 126 on page 359).

Figure 126: MX960 High-Capacity Second-Generation AC Power Input Mode Switch



1–**1** (if you connect two feeds)	2–**0** (if you connect one feed)

> **CAUTION:** Do not use a pencil, because fragments can break off and cause damage to the power supply.

5. 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 will protrude beyond the chassis.

   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 125 on page 358). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

6. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

7. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

8. Make sure the cover is attached on the power distribution unit on the chassis.

9. Make sure the grounding cable is attached, see “Grounding the MX960 Router” on page 350.

10. Locate a power cord with the type of plug appropriate for your geographical location (see “AC Power Cord Specifications for the MX960 Router” on page 217).

11. Plug the power cord into the corresponding appliance inlet located in the chassis directly on the power supply. If using the power supply in two-feed mode, plug the second power cord into the receptacle on the power supply.

    Using a screwdriver, tighten the screw on the retainer to prevent the AC cord from getting lose. See Figure 127 on page 361.

    > **NOTE:** Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker.

    > **NOTE:** To use high-capacity second-generation AC power supplies with full capacity you have to switch them to two feed mode and use two power cords per power supply. See Figure 128 on page 361.

Figure 127: MX960 with One High-Capacity Second-Generation AC Power Feed Connected

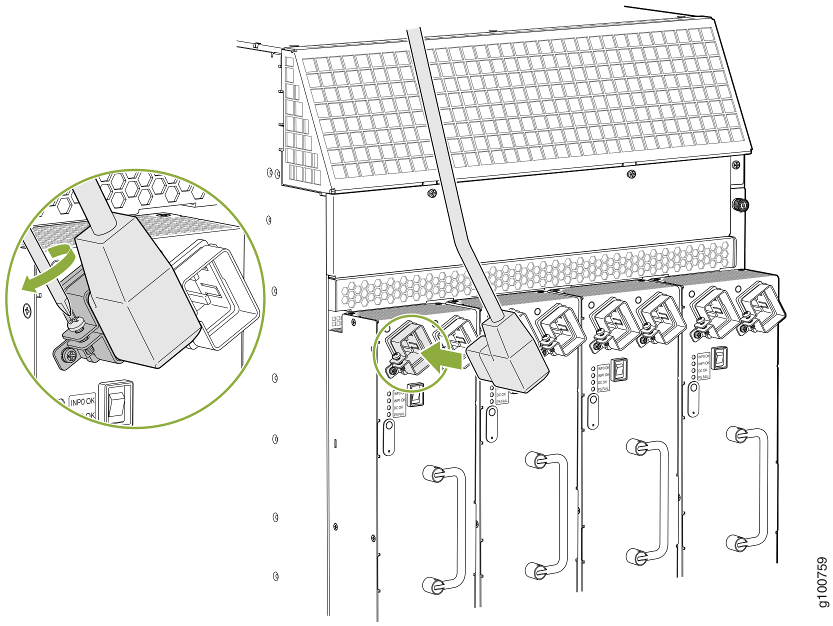
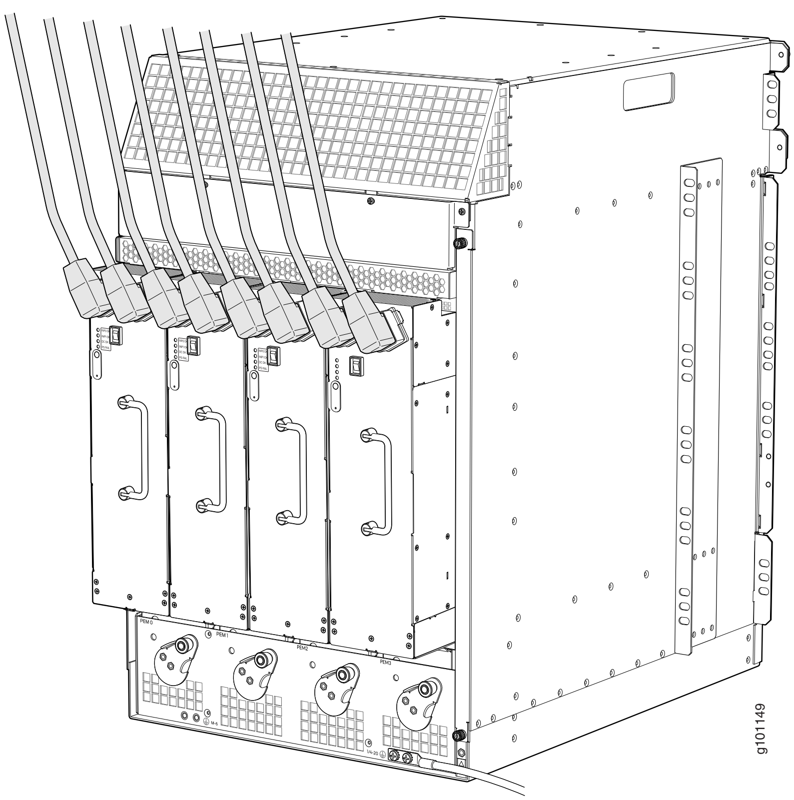


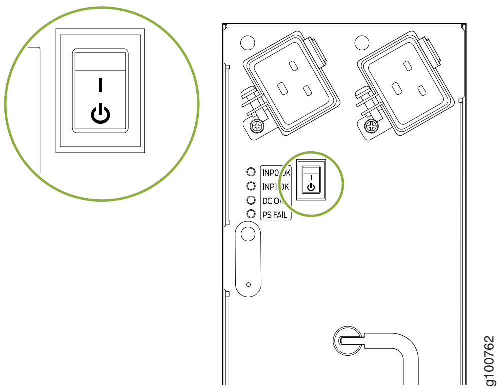
Figure 128: MX960 with Both High-Capacity Second-Generation AC Power Feeds Connected



12. Dress the power cords appropriately. Verify that the power cord does not block the air exhaust and access to router components, and that they do not drape where people could trip on them.

13. Move the AC input switch above the power supply to the on (—) position. See Figure 129 on page 362. This is the only switch you have to turn on.

Figure 129: MX960 with High-Capacity Second-Generation AC Power Supplies



14. If the power supply is correctly installed and functioning normally, the **AC1 OK**, **AC2 OK** (two-feed mode only) **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit. See Table 130 on page 362.

Table 130: MX960 or High-Capacity Second-Generation AC Power Supply LEDs

Connected Inputs	DIP Switch Position	LEDs			
		INP0 OK	**INP1 OK**	**DC OK**	**PS FAIL**
INP0 connected, INP1 disconnected	0 (1 input)	Green	Off	Green	Off
INP0 disconnected, INP1 connected	0 (1 input)	Off	Green	Green	Off
INP0 connected, INP1 connected	0 (1 input)	Green	Green	Green	Off
INP0 connected, INP1 disconnected	1 (2 inputs)	Green	Off	Off	Red

Table 130: MX960 or High-Capacity Second-Generation AC Power Supply LEDs *(continued)*

Connected Inputs	DIP Switch Position	LEDs			
		INP0 OK	**INP1 OK**	**DC OK**	**PS FAIL**
INP0 disconnected, INP1 connected	1 (2 inputs)	Off	Green	Off	Red
INP0 connected, INP1 connected	1 (2 inputs)	Green	Green	Green	Off

15. Repeat steps 1-12 for installing power supplies in the other slot as required.

Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies

To power on an AC-powered router:

1. Verify that the power supplies are fully inserted in the chassis other.
2. Verify that each AC power cord is securely inserted into its appliance inlet.
3. Verify that an external management device is connected to one of the Routing Engine ports (**AUX**, **CONSOLE**, or **ETHERNET**).
4. Turn on the power to the external management device.
5. Switch on the dedicated customer site circuit breakers. Follow the ESD and safety instructions for your site.
6. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
7. Switch the AC switch in the chassis above each power supply to the on (—) position.

8. Check that the AC power supply is correctly installed and functioning normally. Verify that the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

   > **NOTE:** 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.

   If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures.

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

   > **NOTE:** 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. Normally, the router boots from the Junos OS on the CompactFlash card.
   >
   > After powering on a power supply, wait at least 60 seconds before turning it off.

RELATED DOCUMENTATION

Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies | 354

Connecting the MX960 Router to Management and Alarm Devices | 383

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing an MX960 AC or High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | 557

Powering Off the MX960 Router | 377

Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies

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

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

To connect the DC source power cables to the router:

1. Switch off the dedicated customer site circuit breakers. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Move the DC circuit breaker on the power supply faceplate to the off (**O**) position.

4. Remove the clear plastic cover protecting the terminal studs on the faceplate.

5. Make sure the grounding cable is attached, see "Grounding the MX960 Router" on page 350.

6. 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 the resistance of the **–48V** and **RTN** DC cables to chassis ground:

   - The cable with very large resistance (indicating an open circuit) to chassis ground is **–48V**.
   - The cable with very low resistance (indicating a closed circuit) to chassis ground is **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.

7. Remove the nut and washer from each of the terminal studs. (Use a 7/16-in. [11 mm] nut driver or socket wrench.)

8. Secure each power cable lug to the terminal studs, first with the split washer, then with the nut (see Figure 130 on page 367). Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut. Do not overtighten the nut. (Use a 7/16-in. [11 mm] torque-controlled driver or socket wrench.)

   a. Secure each positive (+) DC source power cable lug to the **RTN** (return) terminal.

   b. Secure each negative (–) DC source power cable lug to the **–48V** (input) terminal.

CAUTION: Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.

CAUTION: The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

NOTE: The DC power supplies in slots **PEM0** and **PEM1** must be powered by dedicated power feeds derived from feed **A**, and the DC power supplies in slots **PEM2** and **PEM3** must be powered by dedicated power feeds derived from feed **B**. This configuration provides the commonly deployed **A/B** feed redundancy for the system.

9. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

10. Route the positive and negative DC power cables through the left and right sides of the cable restraint.

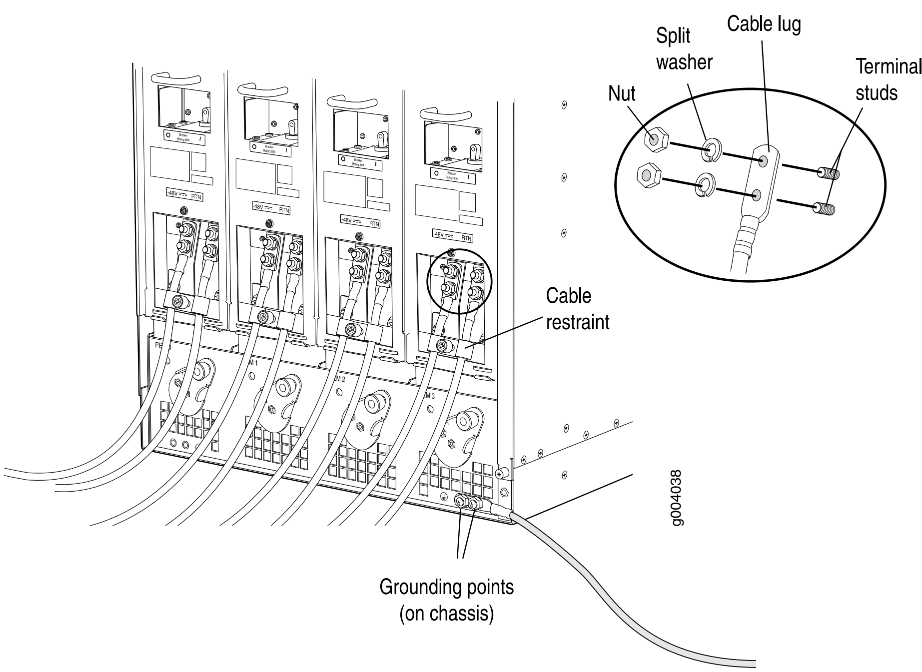
11. Tighten the cable restraint captive screw to hold the power cables in place.

12. Replace the clear plastic cover over the terminal studs on the faceplate.

13. 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.

14. Repeat Steps 3 through 13 for the remaining power supplies.

Figure 130: Connecting DC Power to the MX960 Router



RELATED DOCUMENTATION

DC Power Cable Specifications for the MX960 Router | 241

Preventing Electrostatic Discharge Damage to an MX960 Router

Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies | 372

Connecting Power to a DC-Powered MX960 Router with High-Capacity Power Supplies

To install an MX960 DC high-capacity DC power supply:

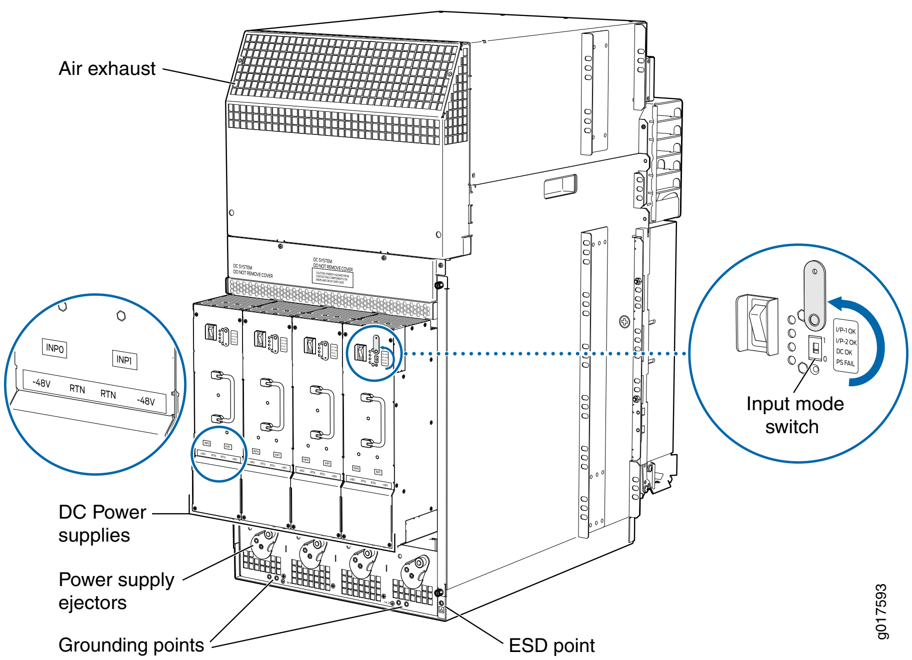
1. Verify that the power switch on the power supply is in the off (**O**) position.

2. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

3. Move the input mode switch to position 0 for one feed or position 1 for two feeds (see Figure 131 on page 368).

   NOTE: For a fully redundant configuration in two-feed mode, eight feeds are required. For a non-redundant configuration, four feeds are required.

Figure 131: MX960 with High-Capacity DC Power Supplies Installed



CAUTION: Do not use a pencil, because fragments can break off and cause damage to the power supply.

4. 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.

5. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position.

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

6. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot.

   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply. This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

7. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

8. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

9. Make sure the grounding cable is attached, see "Grounding the MX960 Router" on page 350.

10. Remove the cover protecting the terminal studs on the faceplate.

11. Remove the nut and washer from each of the terminal studs.

12. Secure each power cable lug to the terminal studs, first with the split washer, then with the nut. Apply between 23 in-lb. (2.6 Nm) and 25 in-lb. (2.8 Nm) of torque to each nut. Do not overtighten the nut. (Use a 7/16-in. [11-mm] torque-controlled driver or socket wrench.)

    a. On **INPUT 0**, attach the positive (+) DC source power cable lug to the **RTN** (return) terminal as shown in Figure 131 on page 368. Repeat this step for **INPUT 1** if using two feeds.

    b. On **INPUT 0** attach the negative (–) DC source power cable lug to the **–48V** (input) terminal. Repeat this step for **INPUT 1** if using two feeds.

CAUTION: Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.

CAUTION: The maximum torque rating of the terminal studs on the DC power supply is 36 in-lb. (4.0 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

NOTE: **INPUT 0** for all four power supplies must be powered by dedicated power feeds derived from feed **A**, and **INPUT 1** for all four power supplies must be powered by dedicated power feeds derived from feed **B**. This configuration provides the commonly deployed **A/B** feed redundancy for the system. For information about connecting to DC power sources, see *Electrical Specifications for the MX960 DC Power Supply*.

13. Verify that the power cabling is correct, that the cables are not touching, and that they do not block access to router components or drape where people could trip on them.

14. Replace the clear plastic cover over the terminal studs on the faceplate.

15. Switch on the dedicated customer site circuit breaker.

16. Verify that the **INPUT 0 OK** or **INPUT 1 OK** LEDs on the power supply are lit green steadily. If using two feeds, verify that both **INPUT 0 OK** and **INPUT 1 OK** LEDs on the power supply are lit steadily. The **INPUT OK** will be lit amber if that input's voltage is in reverse polarity. Check the polarity of the power cables to fix the condition (see Figure 132 on page 371 and Table 131 on page 371.

17. Move the switch to the on (**|**) position.

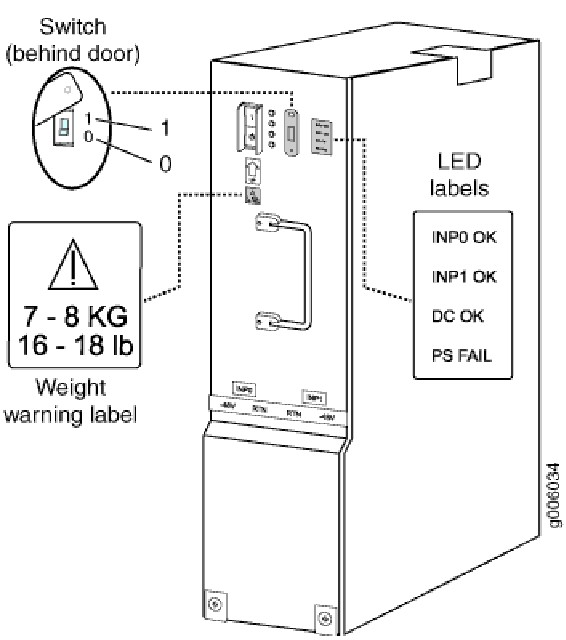
18. Verify that the **DC OK** LED is lit green steadily. See Table 131 on page 371 for information on MX960 high-capacity DC LEDs.

Table 131: MX960 High-Capacity DC Power Supply LEDs

Connected Inputs	DIP Switch Position	LEDs			
		INP-0 OK	**INP-1 OK**	**DC OK**	**PS FAIL**
INP0 connected, INP1 disconnected	0 (1 input)	Green	Off	Green	Off
INP0 disconnected, INP1 connected		Off	Green	Green	Off
INP0 connected, INP1 connected		Green	Green	Green	Off
INP0 connected, INP1 disconnected	1 (2 inputs)	Green	Off	Off	Red
INP0 disconnected, INP1 connected		Off	Green	Off	Red
INP0 connected, INP1 connected		Green	Green	Green	Off

19. Repeat steps 1-17 for installing power supplies in slots 1, 2, and 3, where required.

Figure 132: MX960 DC High-Capacity Power Supply Front View



20. Install a blank panel over the power distribution modules, if available.

Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies

1. Verify that an external management device is connected to one of the Routing Engine ports (**AUX**, **CONSOLE**, or **ETHERNET**).

2. Turn on the power to the external management device.

3. Verify that the power supplies are fully inserted in the chassis.

4. 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**).

5. Switch on the dedicated customer site circuit breakers to provide power to the DC power cables. Follow your site's procedures.

6. Check that the **INPUT OK** LED is lit steadily green to verify that power is present.

7. 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.

8. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

9. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (|) position.

   NOTE: The circuit breaker may bounce back to the off (**O**) position if you move the breaker too quickly.

10. Verify that the **BREAKER ON** LED is lit green steadily.

11. Verify that the **PWR OK** LED is lit green steadily, indicating the power supply is correctly installed and functioning normally.

NOTE: 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.

If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures.

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

NOTE: 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. Normally, the router boots from the Junos OS on the CompactFlash card.

After powering on a power supply, wait at least 60 seconds before turning it off. To power off the system after the Routing Engine finishes booting, see "Powering Off the MX960 Router" on page 377.

RELATED DOCUMENTATION

Connecting Power to a DC-Powered MX960 Router with High-Capacity Power Supplies | **368**

Connecting the MX960 Router to Management and Alarm Devices | **383**

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing an MX960 DC Power Supply | **566**

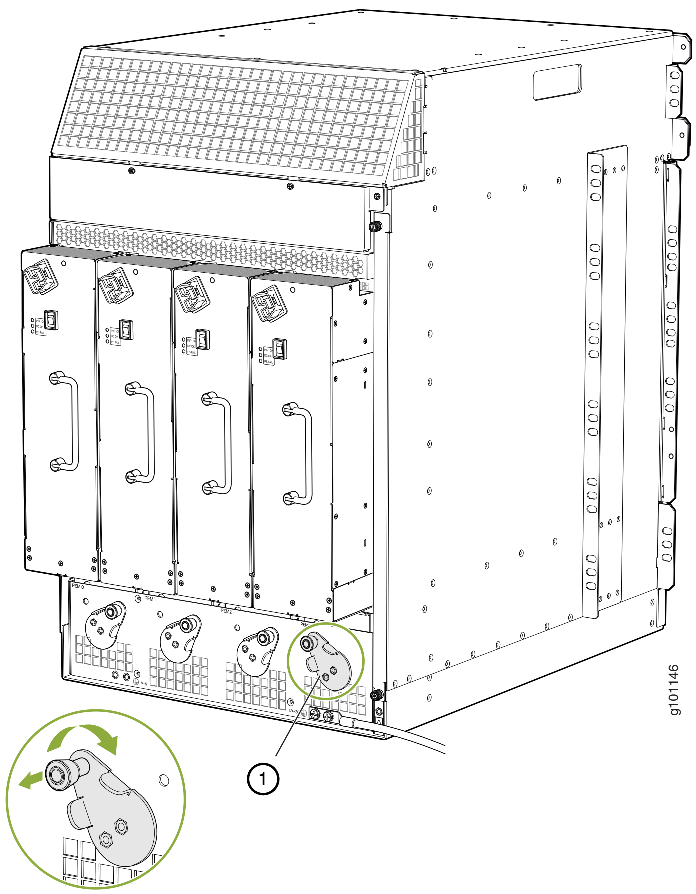
Connecting Power to an MX960 Router with High-Voltage Second-Generation Universal (HVAC or HVDC) Power Supplies

To install and power on an MX960 universal (HVAC or HVDC) power supply, use the following procedure.

1. Verify that the power switch on the power supply is in the off (**O**) position.

2. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 133 on page 374).

Figure 133: MX960 with High-Voltage Second Generation Power Supplies Installed



If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

3. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

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 protrudes beyond the chassis.

   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply. This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

7. Make sure the cover is attached on the power distribution unit on the chassis on the high-voltage second-generation universal (HVAC or HVDC) power supply.

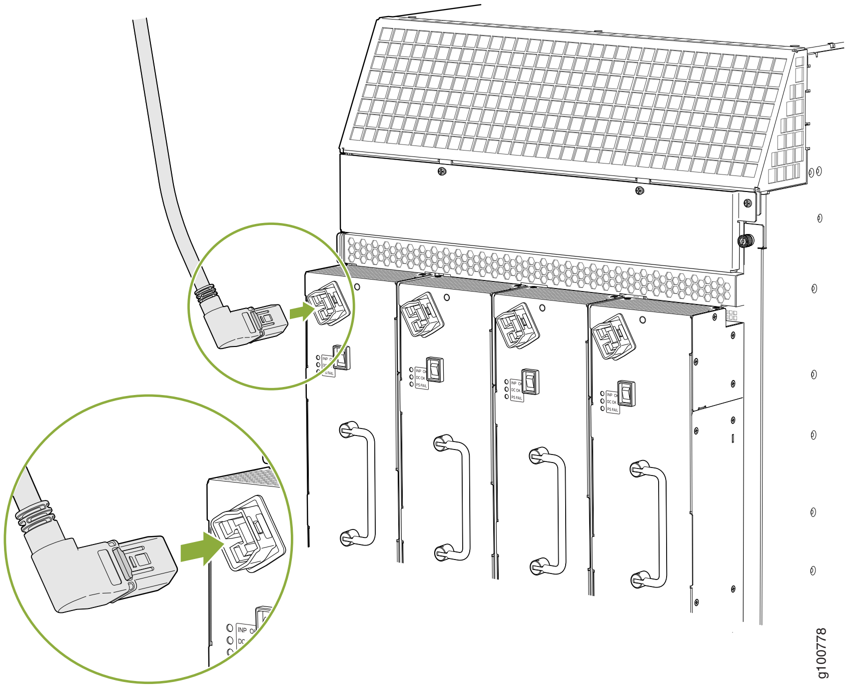
8. Make sure the grounding cable is attached, see "Grounding the MX960 Router" on page 350.

9. Locate a power cord with the type of plug appropriate for your geographical location (see "High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router" on page 260).

10. Plug the power cord into the corresponding appliance inlet located in the chassis directly on the power supply.

    NOTE: Each power supply must be connected to a dedicated power feed and a dedicated customer site circuit breaker.

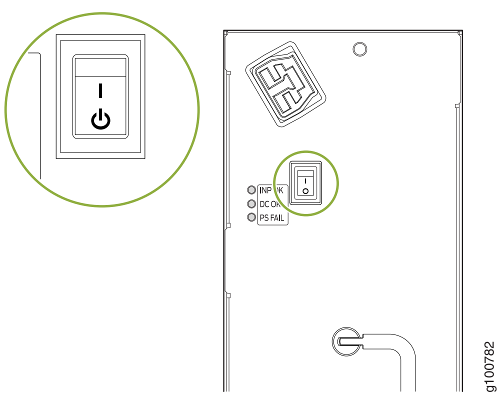
Figure 134: MX960 with One High-Voltage Second-Generation (HVAC or HVDC) Power Feed Connected



11. Dress the power cords appropriately. Verify that the power cord does not block the air exhaust and access to router components, and that they do not drape where people could trip on them.

12. Move the input switch above the power supply to the on (—) position.

Figure 135: MX960 AC Power Input Mode Switch



13. If the power supply is correctly installed and functioning normally, the **INP OK**, **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

14. Repeat steps 1-12 for installing power supplies in slots 1, 2, and 3, where required.

Powering Off the MX960 Router

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

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**

2. Wait until a message appears on the console confirming that the operating system has halted. For more information about the command, see the CLI Explorer.

3. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

4. Move the AC input switch on the chassis above the AC power supply or the DC circuit breaker on each DC power supply faceplate to the off (**0**) position.

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router
Grounding the MX960 Router | **350**
Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies | **363**
Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies | **372**

Connecting an MX960 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 for the MX960 Router" on page 217 and "High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router" on page 260).

2. Plug the replacement power cord into the corresponding appliance inlet located in the chassis directly above the power supply.

   For enhanced power supplies, also plug the replacement power cord into the corresponding power supply inlet.

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 customer site circuit breaker. We recommend that you use a 15 A (250 VAC) minimum, or as required by local code.

   > **NOTE:** For the high-capacity second-generation AC power supply, use a screwdriver to tighten the screw on the AC receptacle retainer to prevent the AC power cord from getting lose.

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. Move the AC input switch in the chassis above 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.

RELATED DOCUMENTATION

MX960 AC Power Supply Description | 127

Disconnecting an MX960 AC Power Supply Cord | 575

MX960 AC Power Electrical Safety Guidelines and Warnings

Replacing an MX960 AC or High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | 557

Connecting an MX960 DC Power Supply Cable

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

To connect a power cable for a DC power supply:

1. Locate a replacement power cable that meets the specifications defined in *Electrical Specifications for the MX960 DC Power Supply*.

2. Verify that a licensed electrician has attached a cable lug to the replacement power cable.

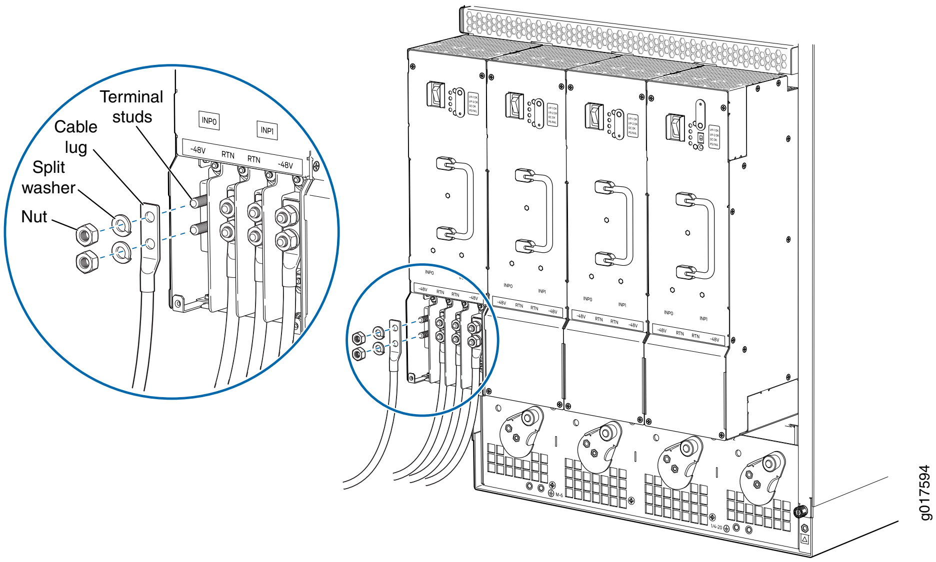
3. Verify that the **INPUT OK** LED is off.

4. Secure the power cable lug to the terminal studs, first with the split 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 136 on page 380). Do not overtighten the nut. (Use a 7/16-in. (11 mm) torque-controlled driver or socket wrench.)

   > **CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.

   > **CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

Figure 136: Connecting Power Cables to the DC Power Supply



5. Route the power cable through the cable restraint. Make sure that the cable does not touch or obstruct any router components.

6. Tighten the cable restraint captive screw to hold the power cables in place.

7. 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.

8. Replace the clear plastic cover over the terminal studs on the faceplate.

9. Attach the power cable to the DC power source.

10. Turn on the dedicated customer site circuit breaker to the power supply.

11. Verify that the **INPUT OK** LED on the power supply is lit steadily.

12. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (**|**) position.

> **NOTE:** The circuit breaker may bounce back to the off (**O**) position if you move the breaker too quickly.

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.

RELATED DOCUMENTATION

DC Power Cable Specifications for the MX960 Router | **241**

Disconnecting an MX960 DC Power Supply Cable | **577**

MX960 DC Power Supply | **138**

MX960 DC Power Electrical Safety Guidelines

CHAPTER 21

Connecting the MX960 Router to the Network

IN THIS CHAPTER

Tools and Parts Required for MX960 Router Connections

To connect the router to management devices and line cards, 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

RELATED DOCUMENTATION

Connecting the MX960 Router to a Network for Out-of-Band Management | 383
Connecting the MX960 Router to a Management Console or Auxiliary Device | 384
Connecting an MX960 Router to an External Alarm-Reporting Device | 385

Connecting the MX960 Router to Management and Alarm Devices

IN THIS SECTION

Connecting the MX960 Router to a Network for Out-of-Band Management

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

1. Turn off the power to the management device.

2. Plug one end of the Ethernet cable (Figure 138 on page 383 shows the connector) into the **ETHERNET** port on the Routing Engine. Figure 137 on page 383 shows the port.

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

Figure 137: Ethernet Port

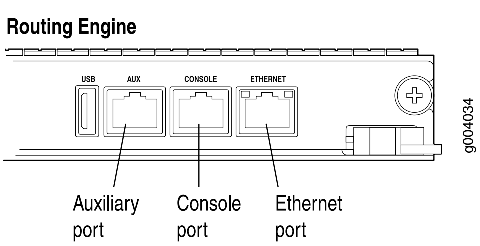
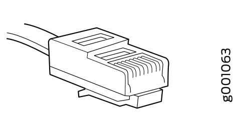


Figure 138: Routing Engine Ethernet Cable Connector



SEE ALSO

Connecting the MX960 Router to a Management Console or Auxiliary Device

To use a system console to configure and manage the Routing Engine, connect it to the appropriate **CONSOLE** port on the 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. To connect a device to the **CONSOLE** port and another device to the **AUX** port, you must supply an additional cable.

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 140 on page 385 shows the connector) into the **AUX** port or **CONSOLE** port on the Routing Engine. Figure 139 on page 385 shows the ports.

3. Plug the female DB-9 end into the device's serial port.

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

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

Figure 139: Auxiliary and Console Ports

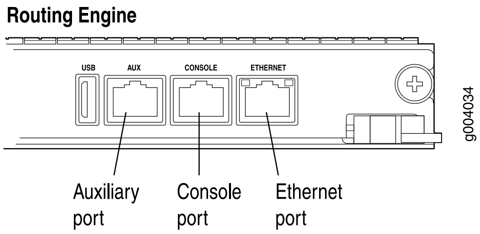
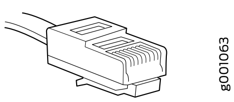


Figure 140: Routing Engine Console and Auxiliary Cable Connector



SEE ALSO

Routing Engine Interface Cable and Wire Specifications for MX Series Routers | 193

Tools and Parts Required for MX960 Router Connections | 382

Replacing Connections to MX960 Routing Engine Interface Ports | 495

Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router | 390

Connecting an MX960 Router to an External Alarm-Reporting Device | 385

Connecting an MX960 Router 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 141 on page 386.) 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^2), 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 141 on page 386):

1. Prepare the required length of wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm^2).

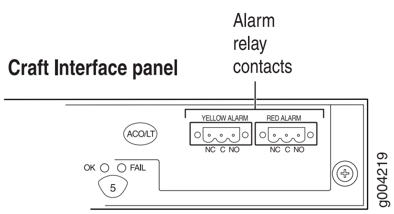
2. While the terminal block is not plugged into the relay contact, use a 2.5-mm flat-blade screwdriver to loosen the small screws on its side. With the small screws on its side facing left, insert wires into the slots in the front of the block based on the wiring for the external device. Tighten the 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 141: Alarm Relay Contacts



SEE ALSO

Tools and Parts Required for MX960 Router Connections | 382
Replacing Connections to MX960 Routing Engine Interface Ports | 495
Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router | 390
Connecting the MX960 Router to a Management Console or Auxiliary Device | 384
Connecting the MX960 Router to a Network for Out-of-Band Management | 383

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Tools and Parts Required for MX960 Router Connections | 382
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Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router | 390
Routing Engine Interface Cable and Wire Specifications for MX Series Routers | 193

Connecting the MX960 Router to a Network for Out-of-Band Management

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

1. Turn off the power to the management device.

2. Plug one end of the Ethernet cable (Figure 138 on page 383 shows the connector) into the **ETHERNET** port on the Routing Engine. Figure 137 on page 383 shows the port.

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

Figure 142: Ethernet Port

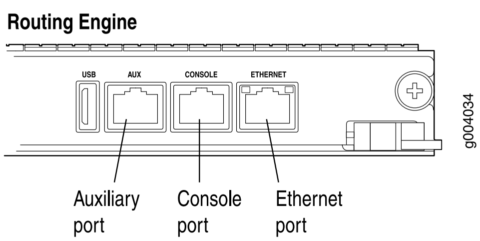
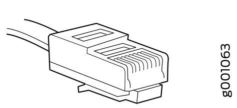


Figure 143: Routing Engine Ethernet Cable Connector



RELATED DOCUMENTATION

Routing Engine Interface Cable and Wire Specifications for MX Series Routers | 193
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Connecting an MX960 Router to an External Alarm-Reporting Device | 385

Connecting the MX960 Router to a Management Console or Auxiliary Device

To use a system console to configure and manage the Routing Engine, connect it to the appropriate **CONSOLE** port on the 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. To connect a device to the **CONSOLE** port and another device to the **AUX** port, you must supply an additional cable.

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 140 on page 385 shows the connector) into the **AUX** port or **CONSOLE** port on the Routing Engine. Figure 139 on page 385 shows the ports.

3. Plug the female DB-9 end into the device's serial port.

> **NOTE:**
> For console devices, configure the serial port to the following values:
>
> - Baud rate—9600
> - Parity—N
> - Data bits—8
> - Stop bits—1
> - Flow control—none

Figure 144: Auxiliary and Console Ports

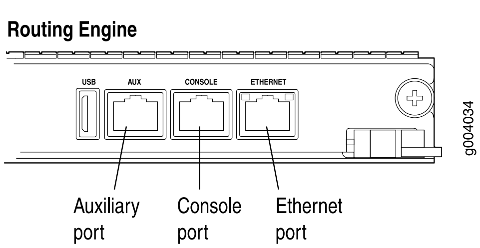
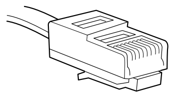


Figure 145: Routing Engine Console and Auxiliary Cable Connector



RELATED DOCUMENTATION

Connecting an MX960 Router 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 141 on page 386.) 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^2), 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 141 on page 386):

1. Prepare the required length of wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm^2).

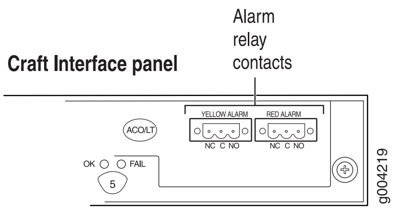
2. While the terminal block is not plugged into the relay contact, use a 2.5-mm flat-blade screwdriver to loosen the small screws on its side. With the small screws on its side facing left, insert wires into the slots in the front of the block based on the wiring for the external device. Tighten the 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 146: Alarm Relay Contacts



RELATED DOCUMENTATION

Tools and Parts Required for MX960 Router Connections | 382
Replacing Connections to MX960 Routing Engine Interface Ports | 495
Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router | 390
Connecting the MX960 Router to a Management Console or Auxiliary Device | 384
Connecting the MX960 Router to a Network for Out-of-Band Management | 383

Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router

To connect the DPCs, MPCs, MICs, or PICs to the network (see Figure 147 on page 391 and Figure 148 on page 392):

1. Have ready a length of the type of cable used by the component. For cable specifications, see the *MX Series Interface Module Reference*.

2. Remove the rubber safety plug from the cable connector port.

   > **WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables 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 a 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 faceplate.

NOTE: The XFP cages and optics on the components 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 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.

CAUTION: Avoid bending a 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 cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

Figure 147: Attaching a Cable to a DPC

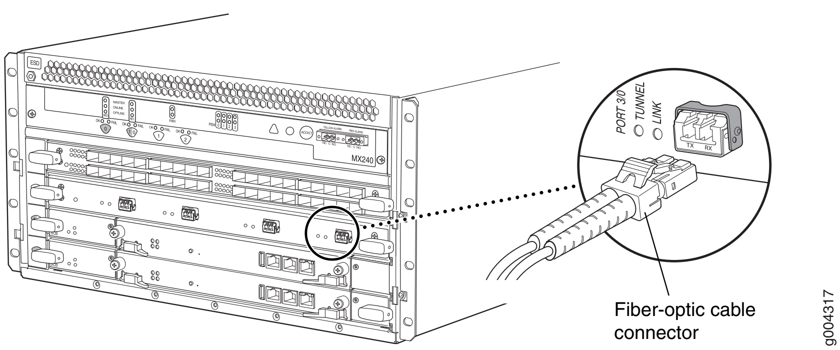
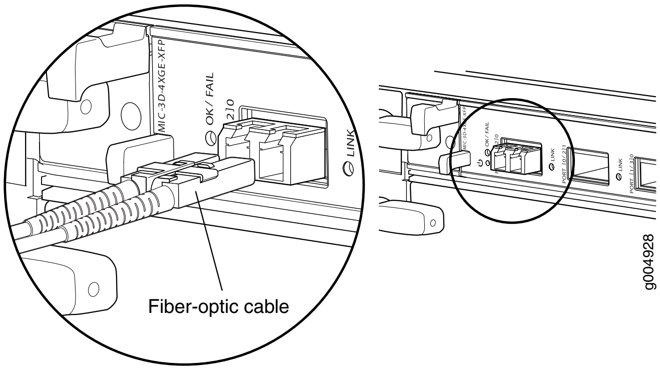


Figure 148: Attaching a Cable to a MIC



RELATED DOCUMENTATION

Connecting the MX960 Router to Management and Alarm Devices | 383
Tools and Parts Required for MX960 Router Connections | 382
Grounding the MX960 Router | 350

Connecting the Alarm Relay Wires to the MX960 Craft Interface

To connect the alarm relay wires between a router and an alarm-reporting device (see Figure 149 on page 393):

1. Prepare the required length of replacement wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm^2).

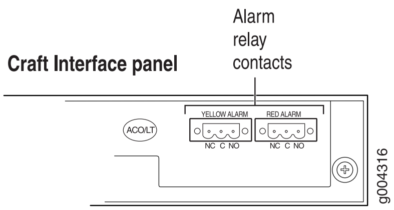
2. Insert the replacement wires into the slots in the front of the block. Use a 2.5-mm flat-blade screwdriver to tighten the screws and secure the wire.

3. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

4. 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.

5. Attach the other end of the wires to the external device.

Figure 149: Alarm Relay Contacts



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Disconnecting the Alarm Relay Wires from the MX960 Craft Interface | **455**

Removing the MX960 Craft Interface | **456**

Installing the MX960 Craft Interface | **404**

MX960 Craft Interface Overview | **15**

CHAPTER 22

Initially Configuring the MX960 Router

IN THIS CHAPTER

Initially Configuring the MX960 Router

The T320 router is shipped with Junos OS preinstalled and ready to be configured when the T320 router is powered on. There are three copies of the software: one on a CompactFlash card in the Routing Engine, one on a rotating 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 OS 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 the router will use on the network
- Domain name the router will use
- IP address and prefix length information for the Ethernet interface
- IP address of a default router
- IP address of a DNS server
- Password for the root user

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 OS configuration guides.

To configure the software:

1. Verify that the router is powered on.

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. Create a management console user account.

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

7. Set the user account class to super-user.

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

8. Configure the router's domain name.

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

9. 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
```

10. 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
```

11. Configure the IP address of a DNS server.

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

12. 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
```

13. (Optional) Configure the static routes to remote subnets with access to the management port. Access to the management port is limited to the local subnet. To access the management port from a remote subnet, you need to add a static route to that subnet within the routing table. For more information about static routes, see the *Junos OS Administration Library*.

```
[edit]
root@# set routing-options static route remote-subnet next-hop destination-IP retain no-readvertise
```

14. Configure the telnet service at the [edit system services] hierarchy level.

```
[edit]
root@# set system services telnet
```

15. (Optional) 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;
            }
        }
    }
}
```

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

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

17. (Optional) Configure additional properties by adding the necessary configuration statements. Then commit the changes to activate them on the router.

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

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

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

NOTE: To reinstall Junos OS, you boot the router from the removable media. Do not insert the removable media during normal operations. The router does not operate normally when it is booted from the removable media.

When the router boots from the storage media (removable media, CompactFlash card, or hard disk) it expands its search in the **/config** directory of the routing platform for the following files in the following order: **juniper.conf** (the main configuration file), **rescue.conf** (the rescue configuration file), and **juniper.conf.1** (the first rollback configuration file). When the search finds the first configuration file that can be loaded properly, the file loads and the search ends. If none of the file can be loaded properly, the routing platform does not function properly. If the router boots from an alternate boot device, Junos OS displays a message indication this when you log in to the router.

RELATED DOCUMENTATION

Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies | 363
Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies | 372
Grounding the MX960 Router | 350
Routine Maintenance Procedures for the MX960 Router | 608

4

PART

Installing and Replacing Components

CHAPTER 23

Overview of Installing and Replacing Components

IN THIS CHAPTER

MX960 Field-Replaceable Units

Field-replaceable units (FRUs) are router components that can be replaced at the customer site. Replacing most FRUs requires minimal router downtime. The router uses the following types of FRUs:

- Hot-removable and hot-insertable FRUs—You can remove and replace these components without powering off the router or disrupting the routing functions.
- Hot-pluggable FRUs—You can remove and replace these components without powering off the router, but the routing functions of the system are interrupted when the component is removed.

Table 132 on page 401 lists the FRUs for the MX960 router. Before you replace an SCB or a Routing Engine, you must take the host subsystem offline.

Table 132: Field-Replaceable Units

Hot-Removable and Hot-Insertable FRUs	Hot-Pluggable FRUs
• Air filter • Craft interface • Backup Switch Control Board (SCB) (if redundant) • Primary Switch Control Board (SCB) (if nonstop active routing is configured) • Backup Routing Engine (if redundant) • Primary Routing Engine (if nonstop active routing is configured) • Dense Port Concentrators (DPCs) • Flexible PIC Concentrators (FPCs) • Modular Port Concentrators (MPCs) • Modular Interface Cards (MICs) • PICs • AC, DC, and HVDC/HVAC power supplies (if redundant) • Fan tray	• Primary Switch Control Board (SCB) (if nonstop active routing is not configured) • Primary Routing Engine (if nonstop active routing is not configured) • Switch Control Board (SCB) (nonredundant) • Routing Engine (nonredundant) • Solid-state drives (SSDs) of Routing Engines

RELATED DOCUMENTATION

Taking an MX960 Host Subsystem Offline
Tools and Parts Required to Replace MX960 Hardware Components
Replacing the MX960 Craft Interface | 455
Replacing an MX960 Fan Tray | 478
Replacing the MX960 Air Filter | 475

Tools and Parts Required for MX960 Router Connections

To connect the router to management devices and line cards, 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

RELATED DOCUMENTATION

Connecting the MX960 Router to a Network for Out-of-Band Management | 383
Connecting the MX960 Router to a Management Console or Auxiliary Device | 384
Connecting an MX960 Router to an External Alarm-Reporting Device | 385

CHAPTER 24

Installing Components

IN THIS CHAPTER

Installing the MX960 Craft Interface

To install the craft interface (see Figure 107 on page 329):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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.

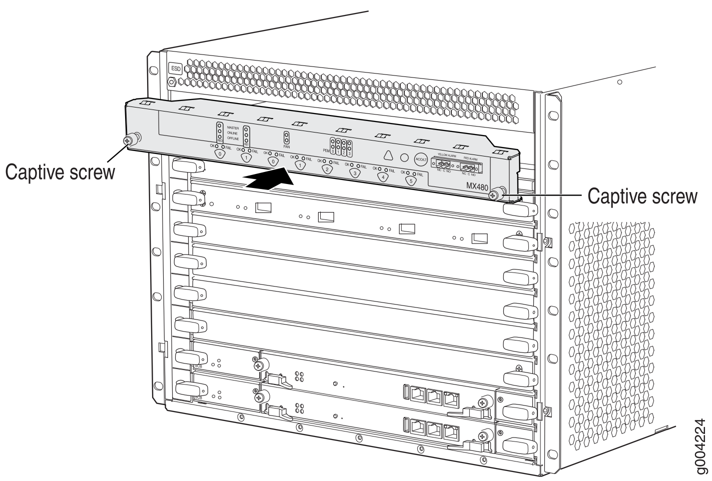
3. Orient the ribbon cable so that it plugs into the connector socket. The connector is keyed and can be inserted only one way.

4. Align the bottom of the craft interface with the sheet metal above the 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 150: Installing the Craft Interface



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Disconnecting the Alarm Relay Wires from the MX960 Craft Interface | 455

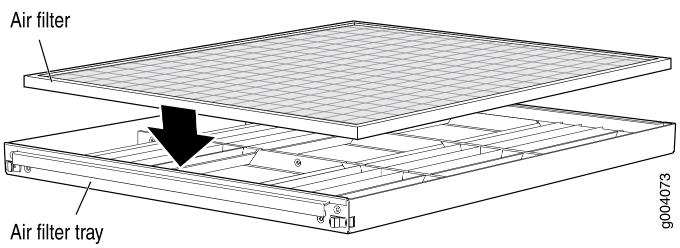
Removing the MX960 Craft Interface | 456

Installing the MX960 Air Filter

To install the air filter (see Figure 151 on page 405):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Ensure that the air filter is right side up.
3. Place the air filter into the air filter tray.
4. Insert the air filter tray into the chassis by sliding it straight into the chassis until it stops.
5. Lower the cable manager back into position.
6. Rearrange the cables in the cable manager.

Figure 151: Installing the Air Filter



RELATED DOCUMENTATION

Installing an MX960 Fan Tray

To install a fan tray (see Figure 152 on page 406 and Figure 153 on page 407):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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.

4. Lower the cable manager back into position, if necessary.

Figure 152: Installing an Upper Fan Tray

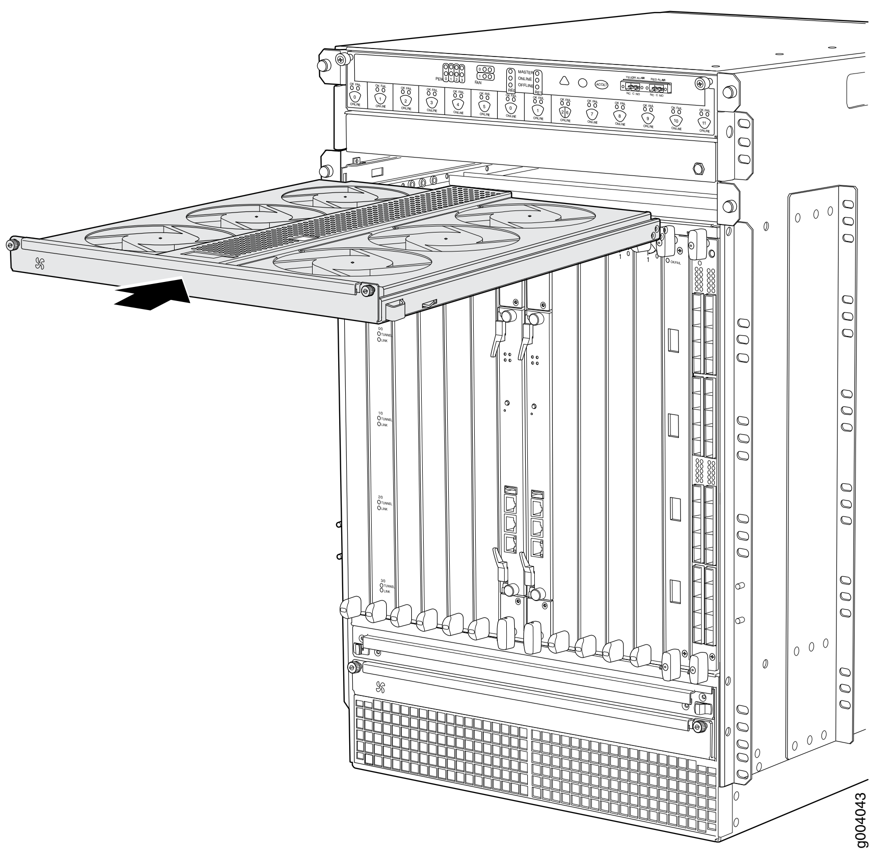
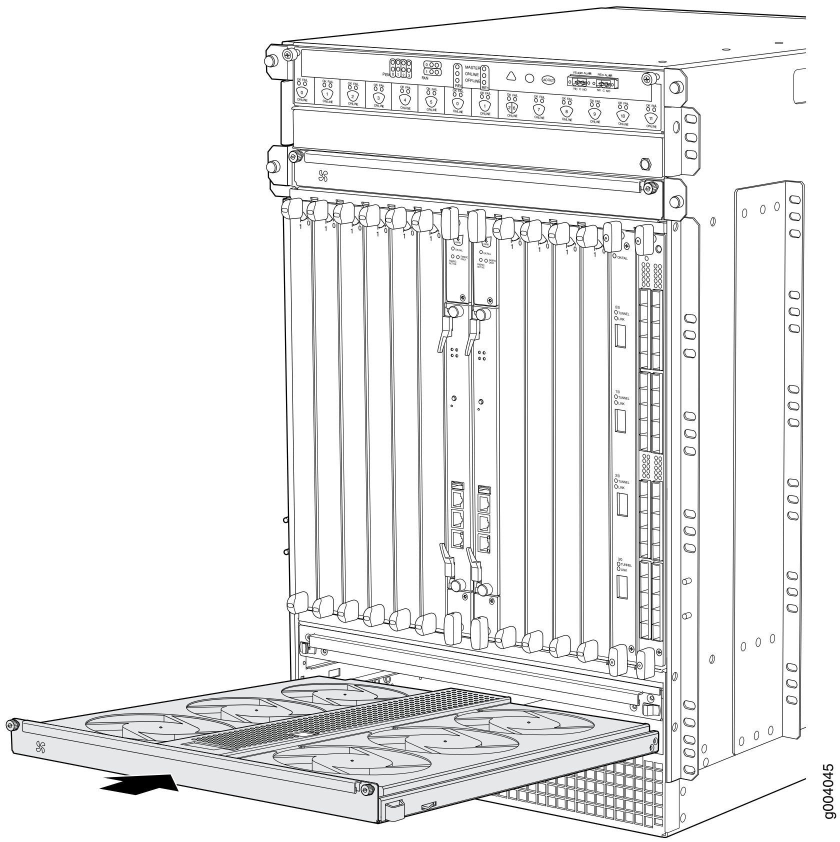


Figure 153: Installing a Lower Fan Tray



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Removing an MX960 Fan Tray | 478

Maintaining the MX960 Fan Trays | 610

Installing an MX960 Routing Engine

To install a Routing Engine into an SCB (Figure 154 on page 409):

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.

   CAUTION: Align the Routing Engine correctly to avoid damaging it.

5. Press both of the ejector handles inward to seat the Routing Engine.

6. Tighten the captive screws on the top and bottom of the Routing Engine.

7. Connect the management device cables to 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 **FAIL**, **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. 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:

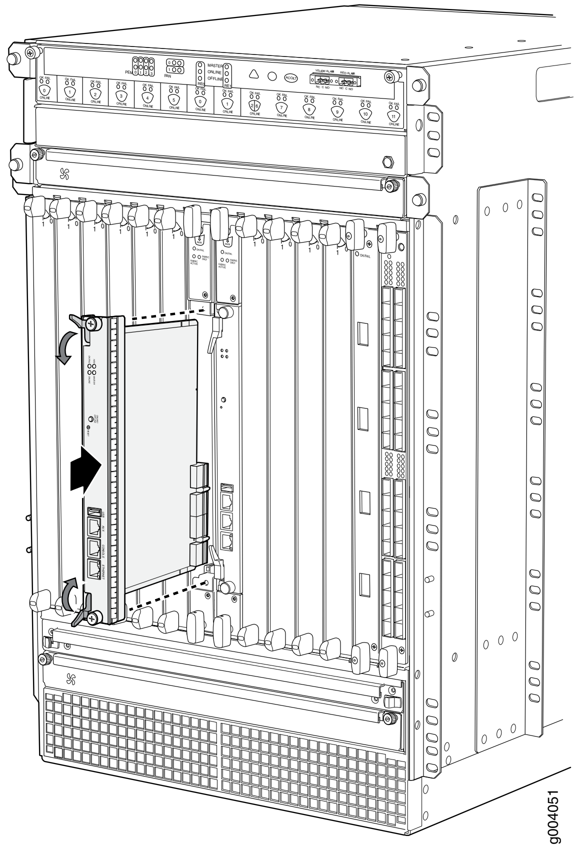
`user@host>` **show chassis routing-engine**

```
Routing Engine status:      Slot 0:     Current state                  Master ...
```

For more information about using the CLI, see the Junos OS documentation.

NOTE: If enhanced IP network services is configured on the chassis, all routing engines must be rebooted after synchronizing the routing engines. For more information on synchronizing the routing engines, see *Synchronizing Routing Engines*.

Figure 154: Installing a MX960 Routing Engine



RELATED DOCUMENTATION

Installing an MX960 Switch Control Board

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

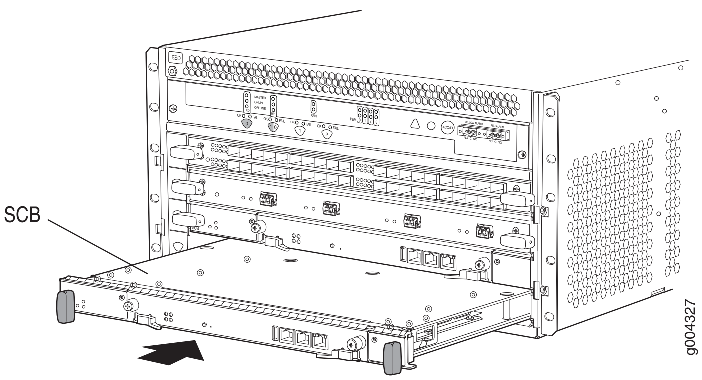
2. Carefully align the sides of the Switch Control Board with the guides inside the chassis.

3. Slide the Switch Control Board 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 Switch Control Board is fully seated.

5. Place the ejector handles in the proper position, horizontally and toward the center of the board.

Figure 155: Installing a Switch Control Board in the MX480



6. Check the LEDs on the Switch Control Board faceplate to verify that it is functioning normally.
   - The green **OK/FAIL** LED should light steadily a few minutes after the Switch Control Board is installed.
   - If the **OK/FAIL** LED is red, remove and install the Switch Control Board again. If the **OK/FAIL** LED still lights steadily, the Switch Control Board is not functioning properly. Contact your customer support representative.
7. Check the status of the Switch Control Board using the **show chassis environment cb** 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
```

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Operating and Positioning the MX960 SCB Ejectors

Installing an MX960 DPC

A DPC weighs up to 14.5 lb (6.6 kg). Be prepared to accept its full weight.

To install a DPC (see Figure 156 on page 414):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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. Remove the rubber safety cap from each fiber-optic 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 cables connected to a transceiver emit laser light that can damage your eyes.

10. Insert the cables into the cable connector ports on each DPC (see Figure 157 on page 414).

11. Arrange the cable 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.

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

> **CAUTION:** Avoid bending a 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.

12. 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 CLI Explorer.

> **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.

Figure 156: Installing a DPC

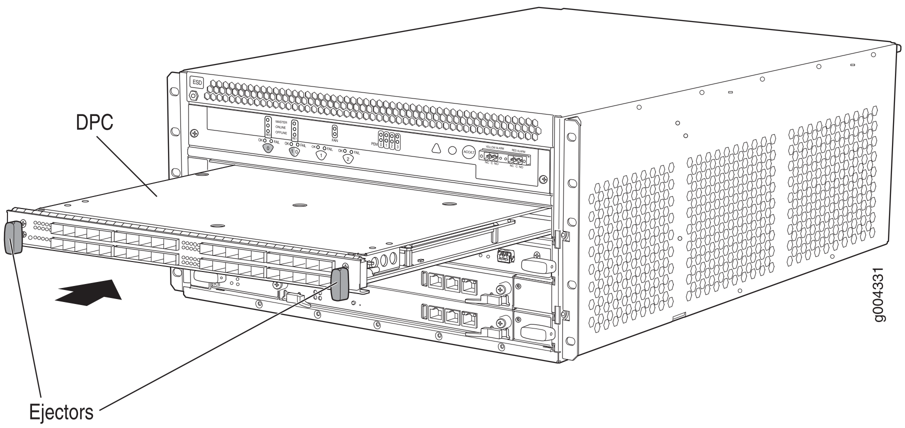
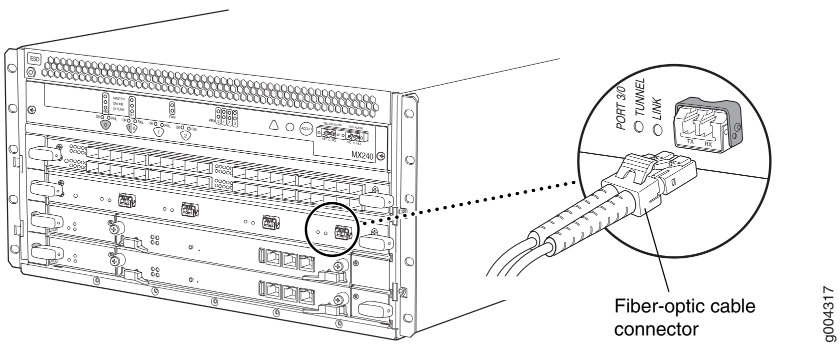


Figure 157: Attaching a Cable to a DPC



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Holding an MX960 DPC | **618**

Storing an MX960 DPC | **620**

MX960 DPC Terminology

Removing an MX960 DPC | **507**

Maintaining MX960 DPCs | **616**

Troubleshooting the MX960 DPCs | **675**

Installing an MX960 FPC

An FPC takes up two DPC slots on the MX960 router. Up to six FPCs can be installed vertically in the front of the router. The FPCs are hot-insertable and hot-removable. An empty FPC3 weighs 14 lb (6.5 kg). A fully configured FPC can weigh up to 18 lb (8.2 kg). Be prepared to accept its full weight.

To install an FPC (see Figure 158 on page 417):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Place the FPC on an antistatic mat.

3. Take each PIC to be installed in the replacement FPC out of its electrostatic bag, and identify the slot on the FPC where it will be connected.

4. Verify that each fiber-optic PIC has a rubber safety cap covering the PIC transceiver. If it does not, cover the transceiver with a safety cap.

5. Install each PIC into the appropriate slot on the FPC.

6. Locate the two slots in the card cage in which you plan to install the FPC.

7. Orient the FPC so that the faceplate faces you.

8. Lift the FPC into place, and carefully align the sides of the FPC with the guides inside the card cage.

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

9. Slide the FPC all the way into the card cage until you feel resistance.

10. Grasp both ejector handles, and rotate them clockwise simultaneously until the FPC is fully seated.

11. If any of the PICs on the FPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.

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

12. Insert the appropriate cable into the cable connector ports on each PIC on the FPC.

13. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

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

CAUTION: Avoid bending a 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.

14. Use one of the following methods to bring the FPC online:

- Press and hold the FPC online/offline button until the green **OK** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
- Issue the following CLI command:

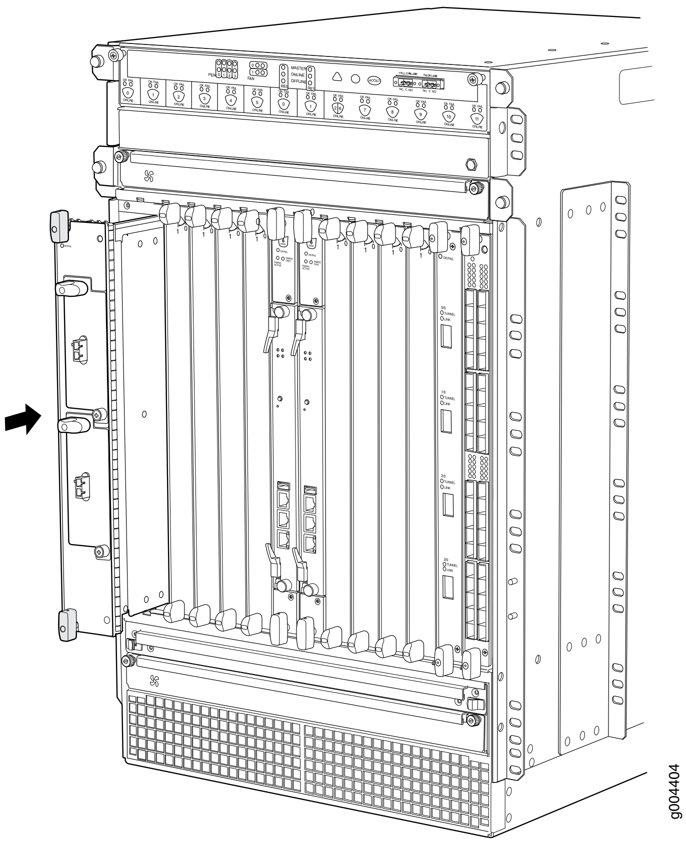
  `user@host>`**request chassis fpc slot** *`slot-number`* **online**

  For more information about the command, see the CLI Explorer.

CAUTION: After the **OK** LED lights steadily, wait at least 30 seconds before removing the FPC again, removing an FPC from a different slot, or inserting an FPC in a different slot.

You can also verify correct FPC and PIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands described in "Maintaining MX960 FPCs" on page 621 and "Maintaining MX960 PICs" on page 634.

Figure 158: Installing an FPC



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 PIC | **428**

Removing an MX960 FPC | **514**

Maintaining MX960 FPCs | **621**

Holding an MX960 FPC | **624**

Storing an MX960 FPC | **629**

Installing an MX960 MIC

To install a MIC (see Figure 160 on page 420):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. If you have used a dual-wide MIC and are now replacing it with two “single” MICs, install the septum (see Figure 159 on page 418):

   a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in “Removing an MX960 MPC” on page 532).

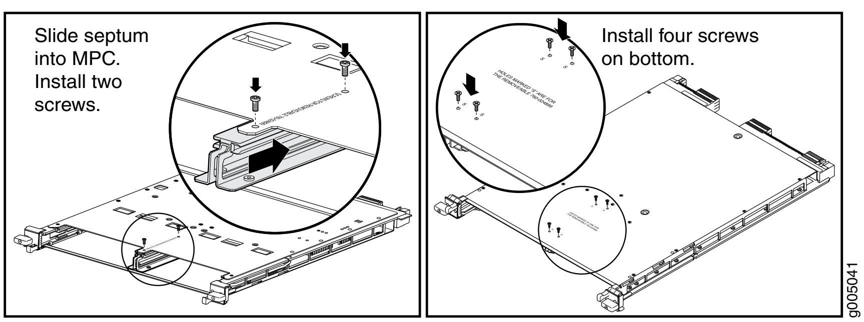
   b. Position the septum in the center of the MPC so that it lines up with holes labeled **S** on the top of the MPC.

   c. Insert a screw into each of the two holes labeled **S**, and then tighten completely.

   d. On the bottom of the MPC, insert a screw into each of the four holes labeled **S**, and then tighten completely.

   e. Install the MPC as described in “Installing an MX960 MPC” on page 425.

Figure 159: Installing the Septum



3. If the MIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.

4. On the MPC, pull the ejector lever that is adjacent to the MIC you are installing away from the MPC faceplate.

5. Align the rear of the MIC with the guides located at the corners of the MIC slot.

6. Slide the MIC into the MPC until it is firmly seated in the MPC.

> **CAUTION:** Slide the MIC straight into the slot to avoid damaging the components on the MIC.

7. Verify that the ejector lever is engaged by pushing it towards the MPC faceplate.

8. If the MIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.

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

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

9. Insert the appropriate cables into the cable connectors on the MIC.

10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.

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

> **CAUTION:** Avoid bending a 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 MIC online:

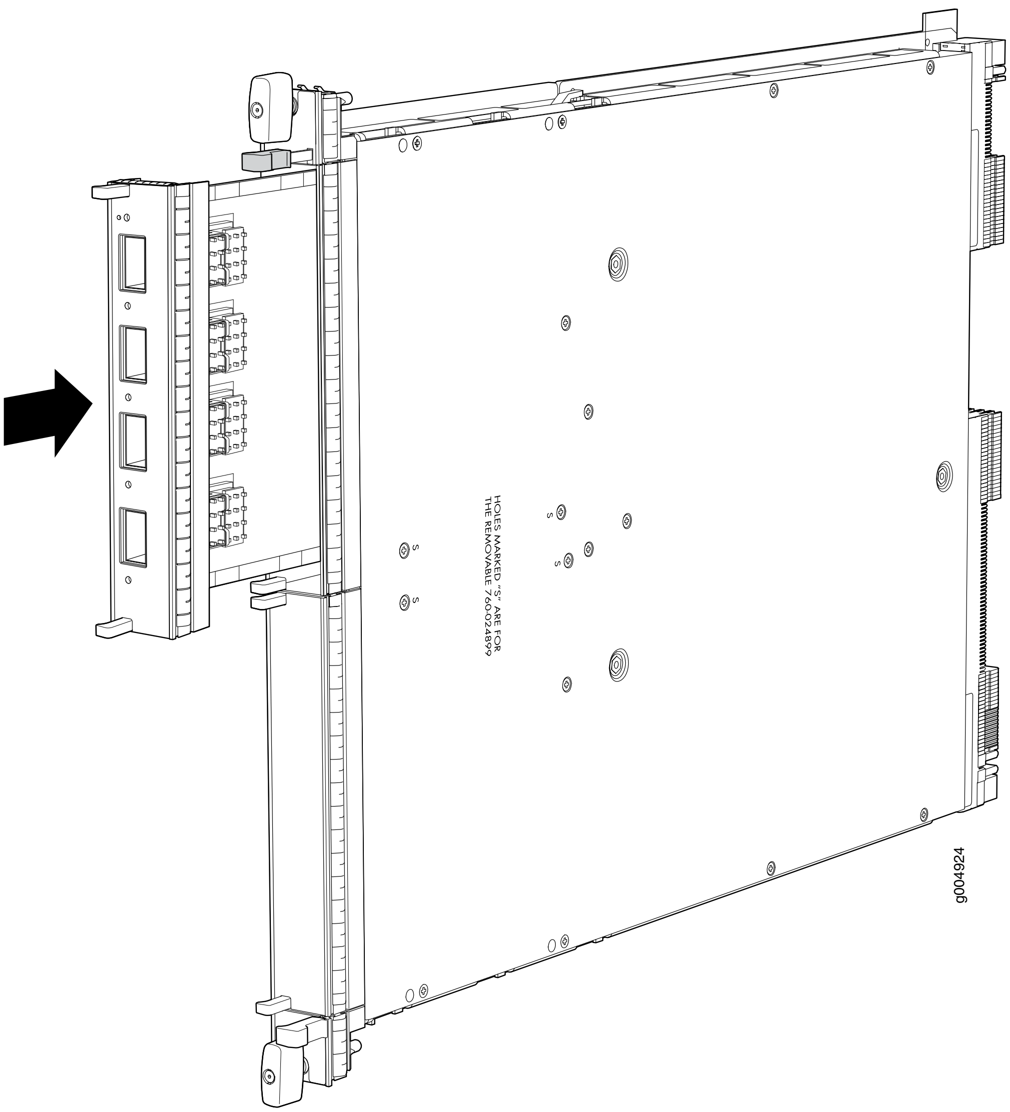
- Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED lights green.
- Issue the following CLI command:

  `user@host>` **request chassis mic fpc-slot *mpc-slot* mic-slot *mic-slot* online**

  For more information about the command, see the CLI Explorer.

The normal functioning status LED confirms that the MIC is online. You can also verify correct MIC functioning by issuing the **show chassis fpc pic-status** command described in “Maintaining MX960 MICs” on page 630.

Figure 160: Installing a MIC



RELATED DOCUMENTATION

MX960 Modular Interface Card Description | 93

Maintaining MX960 MICs | 630

Troubleshooting the MX960 MICs | 680

Removing an MX960 MPC | 532

Removing an MX960 MIC | 521

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 Dual-Wide MIC

To install a dual-wide MIC (see Figure 162 on page 424):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Remove the septum, if necessary (see Figure 161 on page 422):

   a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in "Removing an MX960 MPC" on page 532).

   b. Remove the four screws labeled **S** on the bottom of the MPC.

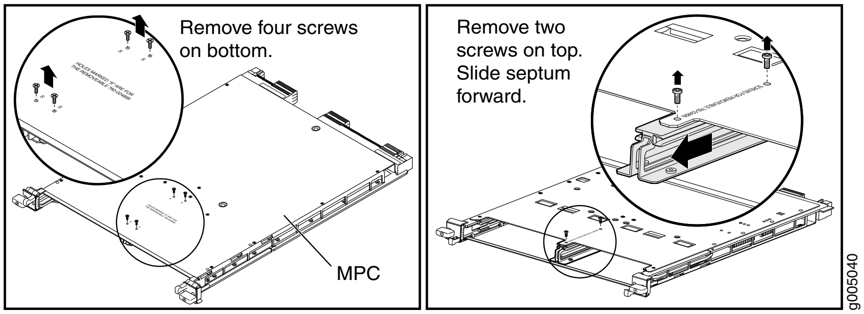
   c. Remove the two screws labeled **S** on the top of the MPC.

   d. Slide the septum towards you and out of the MPC.

   e. Store the septum and screws for later use.

   f. Install the MPC as described in "Installing an MX960 MPC" on page 425.

Figure 161: Removing the Septum



3. If the MIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.

4. Pull the ejector lever above both MIC slots away from the router.

5. Align the rear of the MIC with the guides located at the corners of the MIC slot.

6. Slide the MIC into the MIC slot until it is firmly seated in the chassis.

> **CAUTION:** Slide the MIC straight into the slot to avoid damaging the components on the MIC.

7. Verify that the ejector levers are engaged by pushing them toward the router.

8. If the MIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.

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

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

9. Insert the appropriate cables into the cable connectors on the MIC.

10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.

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

    CAUTION: Avoid bending a 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.

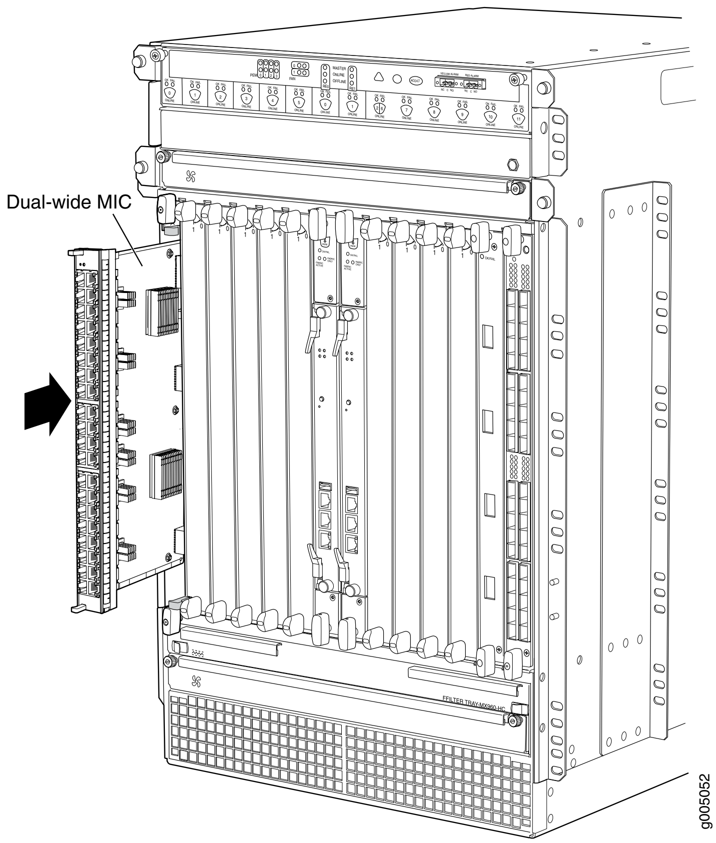
11. Use one of the following methods to bring the MIC online:

    - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED lights green.
    - Issue the following CLI command:

      `user@host>` **request chassis mic fpc-slot *mpc-slot* mic-slot *mic-slot* online**

    The normal functioning status LED confirms that the MIC is online. You can also verify correct MIC functioning by issuing the **show chassis fpc pic-status** command described in "Maintaining MX960 MICs" on page 630.

Figure 162: Installing a Dual-Wide MIC



RELATED DOCUMENTATION

MX960 Modular Interface Card Description | 93

Maintaining MX960 MICs | 630

Troubleshooting the MX960 MICs | 680

Removing an MX960 MPC | 532

Removing an MX960 MIC | 521

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 MPC

An MPC installs vertically in the front of the router. The MPCs are hot-insertable and hot-removable. A fully configured MPC can weigh up to 18.35 lb (8.3 kg). Be prepared to accept its full weight.

To install an MPC (see Figure 163 on page 427):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Place the MPC on an antistatic mat.

3. Take each MIC to be installed in the replacement MPC out of its electrostatic bag, and identify the slot on the MPC where it will be connected.

4. Verify that each fiber-optic MIC has a rubber safety cap covering the MIC transceiver. If it does not, cover the transceiver with a safety cap.

5. Install each MIC into the appropriate slot on the MPC.

6. Locate the slot in the card cage in which you plan to install the MPC.

7. Orient the MPC so that the faceplate faces you.

8. Lift the MPC into place, and carefully align the sides of the MPC with the guides inside the card cage.

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

9. Slide the MPC all the way into the card cage until you feel resistance.

10. Grasp both ejector handles, and rotate them clockwise simultaneously until the MPC is fully seated.

11. If any of the MICs on the MPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.

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

12. Insert the appropriate cable into the cable connector ports on each MIC on the MPC. 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 cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

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

13. Use one of the following methods to bring the MPC online:

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

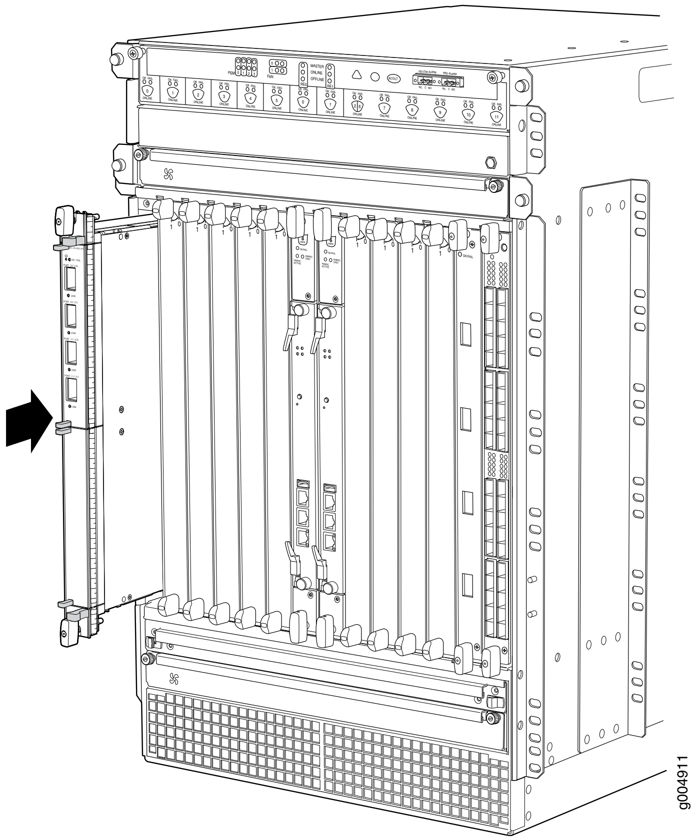
      `user@host>`**request chassis fpc slot** *`slot-number`* **online**

      For more information about the command, see the CLI Explorer.

    CAUTION: After the **OK/FAIL** LED lights steadily, wait at least 30 seconds before removing the MPC again, removing an MPC from a different slot, or inserting an MPC in a different slot.

You can also verify correct MPC and MIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands described in "Maintaining MX960 MPCs" on page 631 and "Maintaining MX960 MICs" on page 630.

Figure 163: Installing an MPC



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 Modular Port Concentrator Description | 108

Removing an MX960 MPC | 532

Installing an MX960 MIC | 418.

Maintaining MX960 MPCs | 631

Troubleshooting the MX960 MPCs | 682

Installing an MX960 PIC

To install a PIC (see Figure 164 on page 430):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. If the PIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.

3. Align the notches in the connector at the rear of the PIC with the notches in the PIC slot in the FPC and then slide the PIC in until it lodges firmly in the FPC.

   CAUTION: Slide the PIC straight into the slot to avoid damaging the components on the bottom of the PIC.

4. For an FPC3 PIC, turn the ejector handle at the top of the PIC faceplate clockwise, then tighten the captive screw at the bottom of the faceplate to secure the PIC in the FPC.

5. If the PIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.

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

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

6. Insert the appropriate cables into the cable connectors on the PIC.

7. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

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

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

8. Use one of the following methods to bring the PIC online:

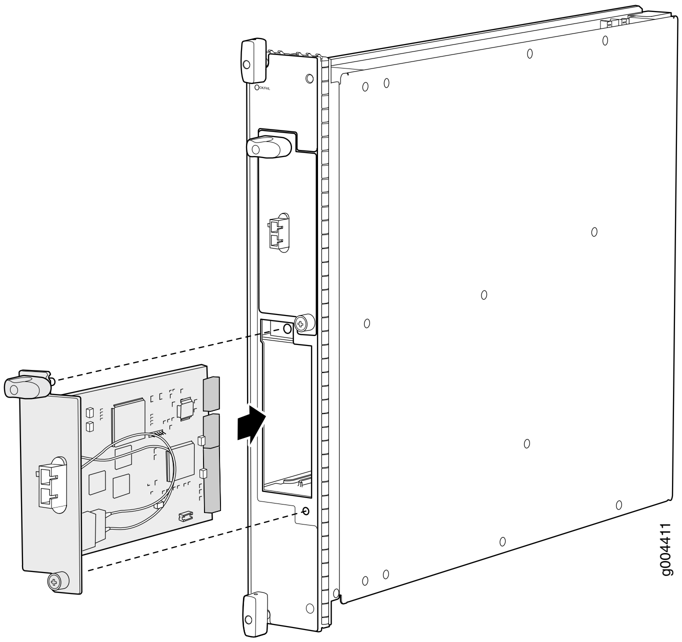
   - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.
   - Issue the following CLI command:

     `user@host>` **request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **online**

     For more information about the command, see the CLI Explorer.

   The normal functioning status LED confirms that the PIC is online. You can also verify correct PIC functioning by issuing the **show chassis fpc pic-status** command described in "Maintaining MX960 PICs" on page 634.

Figure 164: Installing a PIC



RELATED DOCUMENTATION

Installing a Cable on an MX960 DPC, MPC, MIC, or PIC

To install a cable:

1. Have ready a length of the type of cable used by the component. For cable specifications, see the *MX Series Interface Module Reference*.

2. If the cable connector port is covered by a rubber safety cap, remove the cap.

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

> **CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are 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 component faceplate.

4. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

> **CAUTION:** Avoid bending a 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 cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

5. Insert the other end of the cable into the destination port.

6. Repeat the previous steps for any additional cables.

7. If the component is offline (its failure indicator LED is lit), use one of the following methods to bring it online.

   - To bring a DPC or MPC online:

     - Press and hold the corresponding 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 CLI Explorer.

- To bring a PIC online:
  - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.
  - Issue the following CLI command:

    user@host>**request chassis pic fpc-slot** *fpc-slot* **pic-slot** *pic-slot* **online**

    For more information about the command, see the CLI Explorer.
- To bring a MIC online:
  - Press the MIC offline/online button until the MIC LED lights green.
  - Issue the following CLI command:

    user@host>**request chassis mic fpc-slot** *mpc-slot* **pic-slot** *mic-slot* **online**

    For more information about the command, see the CLI Explorer.

The normal functioning indicator LED confirms that the component is online. You can also verify correct DPC or MPC functioning by issuing the **show chassis fpc** command or the correct PIC or MIC functioning by issuing the **show chassis fpc pic-status** command.

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router
Removing a Cable on an MX960 DPC, MPC, MIC, or PIC | 544
Maintaining Cables That Connect to MX960 DPCs, MPCs, MICs, or PICs | 635

Installing a MX960 AC Power Supply or High-Voltage Second-Generation Universal (HVAC or HVDC)

To install an AC or universal (HVAC/HVDC) power supply (see Figure 113 on page 339):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Move the AC input switch in the chassis above the empty power supply slot to the off (**O**) position.

   > **NOTE:** When upgrading to enhanced power supplies, always upgrade power supplies in adjacent slots.

3. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 113 on page 339).

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

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 faceplates.

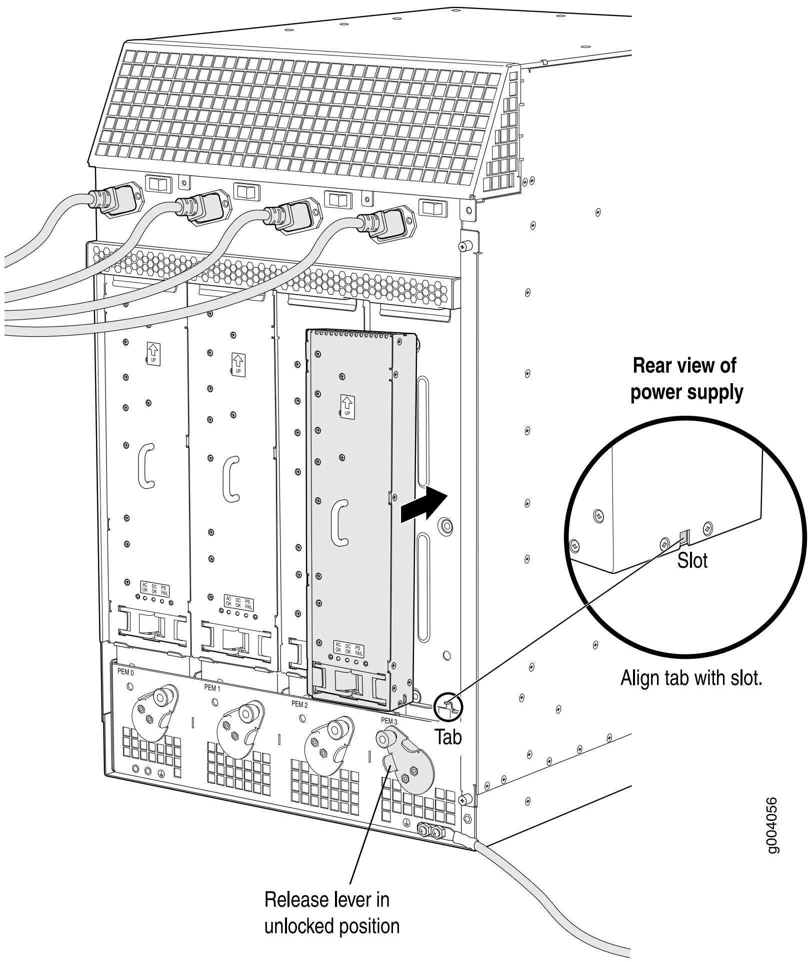
   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 113 on page 339). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

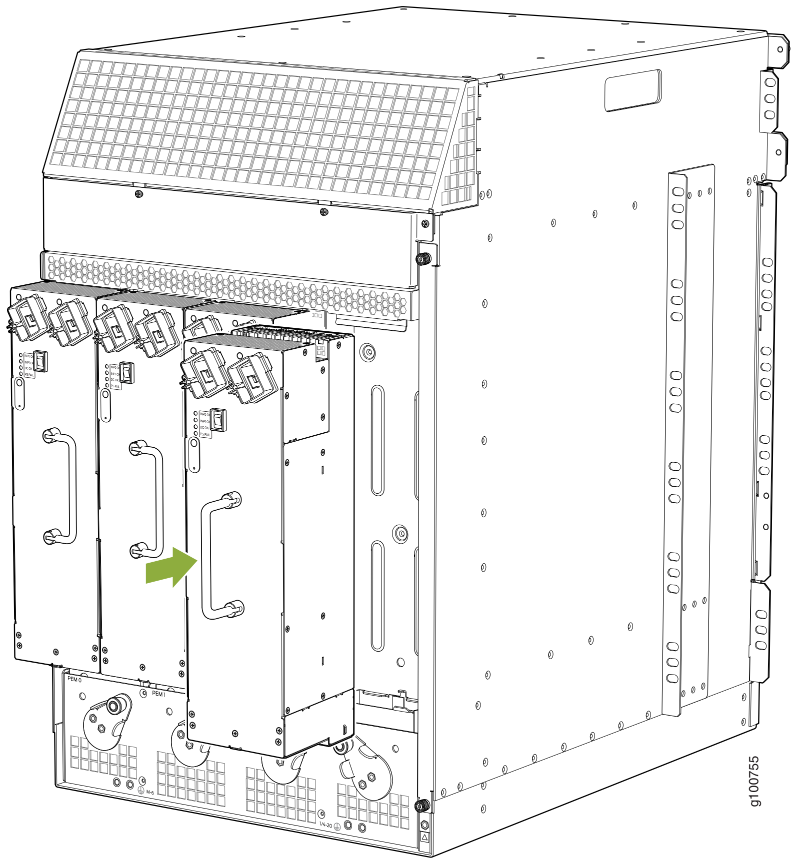
7. Move the AC input switch in the chassis above the power supply to the on (—) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

Figure 165: Installing an AC Power Supply



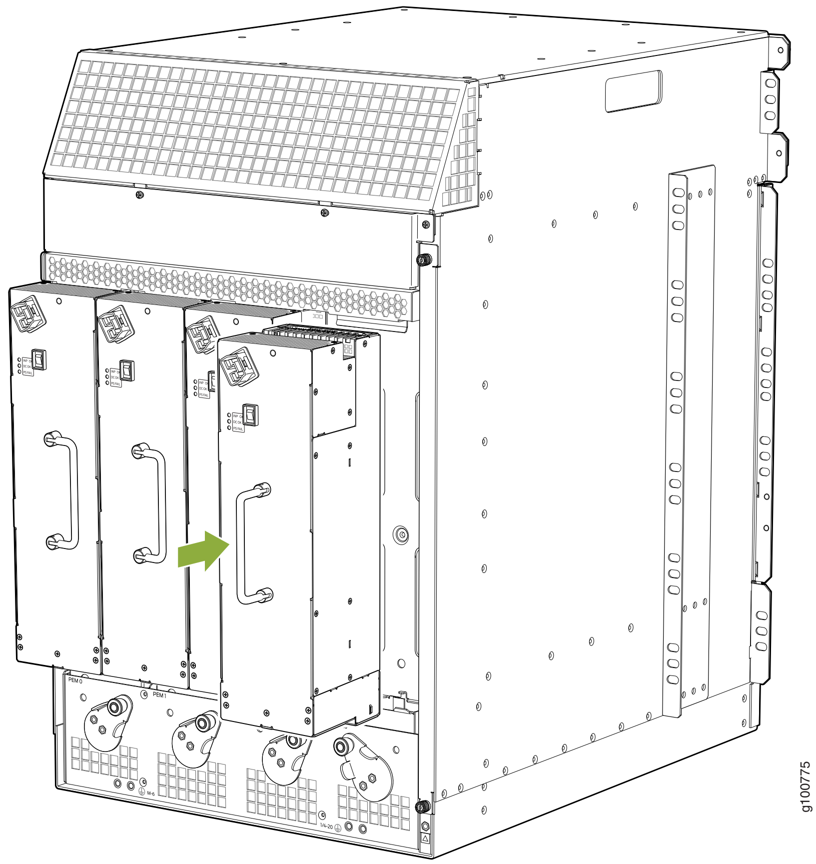
NOTE: The chassis is shown without the extended cable manager.

Figure 166: Installing a High-Capacity Second-Generation AC Power Supply



NOTE: The chassis is shown without the extended cable manager.

Figure 167: Installing a High-Voltage Second-Generation Universal (HVAC or HVDC) Power Supply



NOTE: The chassis is shown without the extended cable manager.

NOTE: If you are replacing the MX960-PSM-5K-AC or MX960-PSM-HV power supplies on an existing chassis, make sure to replace the agency label on the chassis with the new label. See "MX960 Chassis Serial Number and Agency Label" on page 696.

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 AC Power Supply Description | 127

MX960 AC Power Electrical Safety Guidelines and Warnings

Installing an MX960 DC Power Supply

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

To install a DC power supply (see Figure 168 on page 440):

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 ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Move the DC circuit breaker on the power supply faceplate to the off (**O**) position.

4. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 168 on page 440).

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

5. 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 faceplates.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 168 on page 440). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

6. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

7. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

8. Remove the clear plastic cover protecting the terminal studs on the faceplate.

9. Remove the nut and washer from each of the terminal studs.

10. Secure each power cable lug to the terminal studs, first with the split 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 169 on page 441). Do not overtighten the nut. (Use a 7/16-in. (11 mm) torque-controlled driver or socket wrench.)

    a. Attach the positive (+) DC source power cable lug to the **RTN** (return) terminal.

    b. Attach the negative (–) DC source power cable lug to the **–48V** (input) terminal.

CAUTION: Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.

CAUTION: The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

> **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:** The DC power supplies in slots **PEM0** and **PEM1** must be powered by dedicated power feeds derived from feed **A**, and the DC power supplies in **PEM2** and **PEM3** must be powered by dedicated power feeds derived from feed **B**. This configuration provides the commonly deployed **A/B** feed redundancy for the system. For information about connecting to DC power sources, see *Electrical Specifications for the MX960 DC Power Supply*.

11. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

12. Route the positive and negative DC power cables through the left and right sides of the cable restraint.

13. Tighten the cable restraint captive screw to hold the power cables in place.

> **WARNING:** Once the DC power supply is connected, the cable will be blocking the PEM slot label. Make sure and note or mark the PEM slot once the power supply is connected.

14. Replace the clear plastic cover over the terminal studs on the faceplate.

15. Verify that the power cabling is correct, that the cables are not touching, and that they do not block access to router components or drape where people could trip on them.

16. Switch on the dedicated customer site circuit breaker.

17. Verify that the **INPUT OK** LED on the power supply is lit steadily.

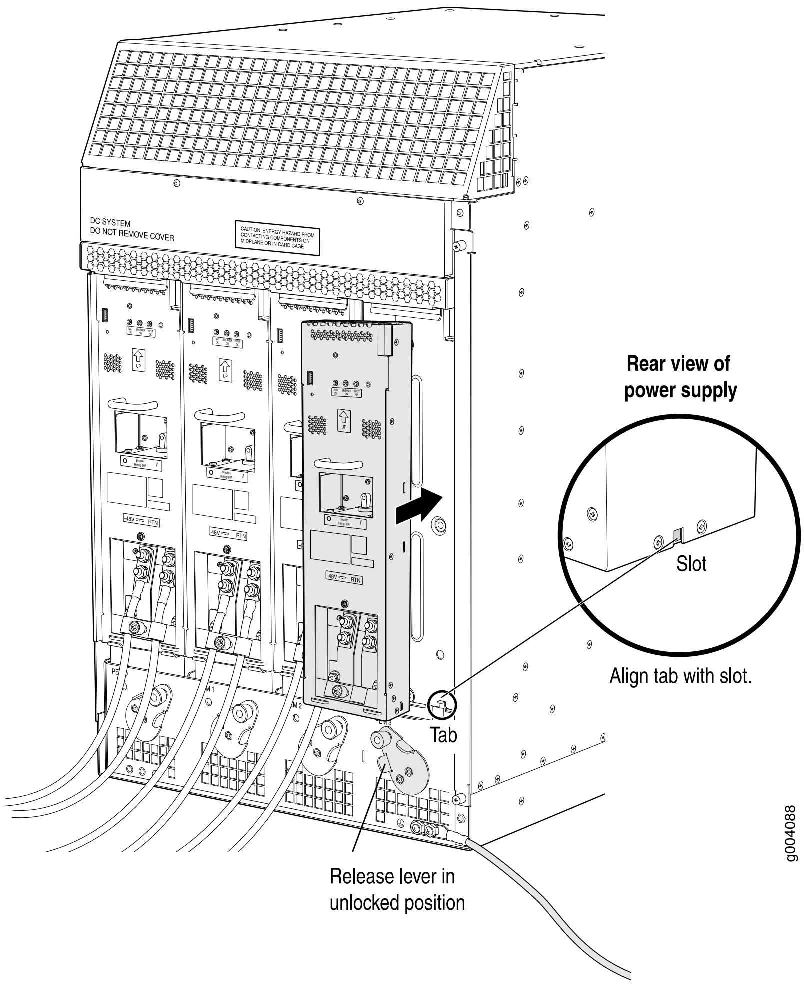
18. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (|) position.

NOTE: The circuit breaker may bounce back to the off (**O**) position if you move the breaker too quickly.

19. Verify that the **BREAKER ON** LED is lit steadily.

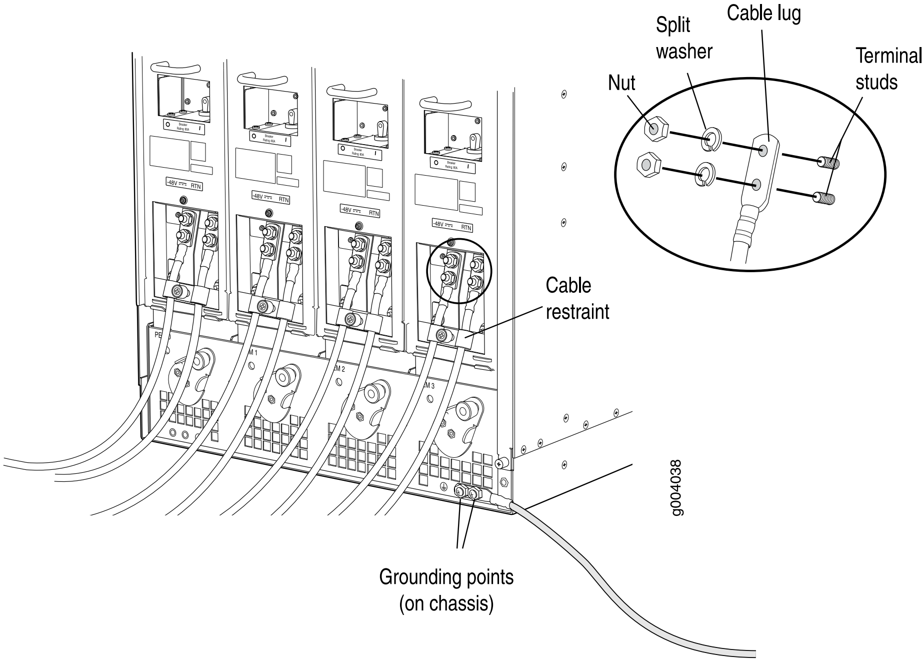
20. Verify that the **PWR OK** LED is lit steadily.

Figure 168: Installing a DC Power Supply



NOTE: The chassis is shown without the extended cable manager.

Figure 169: Connecting DC Power to the MX960 Router



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 DC Power Supply | 138

MX960 DC Power Electrical Safety Guidelines

Removing an MX960 DC Power Supply | 566

Connecting an MX960 DC Power Supply Cable | 379

Disconnecting an MX960 DC Power Supply Cable | 577

Installing an MX960 AS MLC

You can install up to eight Application Services Modular Line Cards (AS MLCs) vertically in the front of the MX960 router. The AS MLCs are hot-insertable and hot-removable. An empty AS MLC weighs 10.5 lb (4.76 kg). A fully configured AS MLC can weigh up to 15.27 lb (6.93 kg). Be prepared to accept its full weight.

To install an AS MLC (see Figure 170 on page 443):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Place the AS MLC on an antistatic mat.

3. Take the AS MSC and AS MXC (the modular cards) to be installed in the AS MLC out of its electrostatic bag. The AS MSC must be inserted in the top slot and the AS MXC in the bottom slot.

4. Install the AS MSC and AS MXC into the appropriate slot on the AS MLC.

5. Locate the slots in the card cage in which you plan to install the AS MLC.

6. Orient the AS MLC so that the faceplate faces you.

7. Lift the AS MLC into place, and carefully align the sides of the AS MLC with the guides inside the card cage.

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

8. Slide the AS MLC all the way into the card cage until you feel resistance.

9. Grasp both ejector handles, and rotate them clockwise simultaneously until the AS MLC is fully seated.

10. Use one of the following methods to bring the AS MLC online:

    - Press and hold the AS MLC online/offline button until the green **OK** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each AS MLC are located directly above it on the craft interface.

    - Issue the following CLI command:

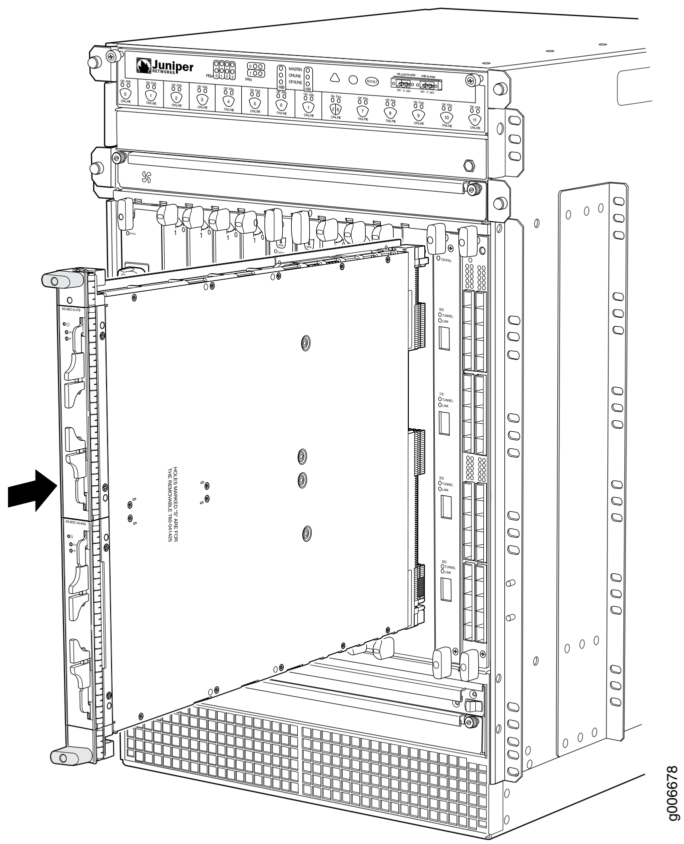
`user@host>`**request chassis fpc slot** *`slot-number`* **online**

For more information about the command, see the CLI Explorer.

> **CAUTION:** After the **OK** LED lights steadily, wait at least 30 seconds before removing the AS MLC again, removing an AS MLC from a different slot, or inserting an AS MLC in a different slot.

You can also verify correct AS MLC and AS MSC or AS MXC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status**.

Figure 170: Installing an AS MLC



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 AS MSC | 444

Installing an MX960 AS MSC

To install an AS MSC (see Figure 171 on page 445):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Align the notches in the connector at the rear of the AS MSC with the notches in the AS MSC slot (slot **0**—the top slot in the AS MLC), and then slide the AS MSC in until it lodges firmly in the AS MLC.

   CAUTION: Slide the AS MSC straight into the slot to avoid damaging the components on the bottom of the AS MSC.

3. Use one of the following methods to bring the AS MSC online:

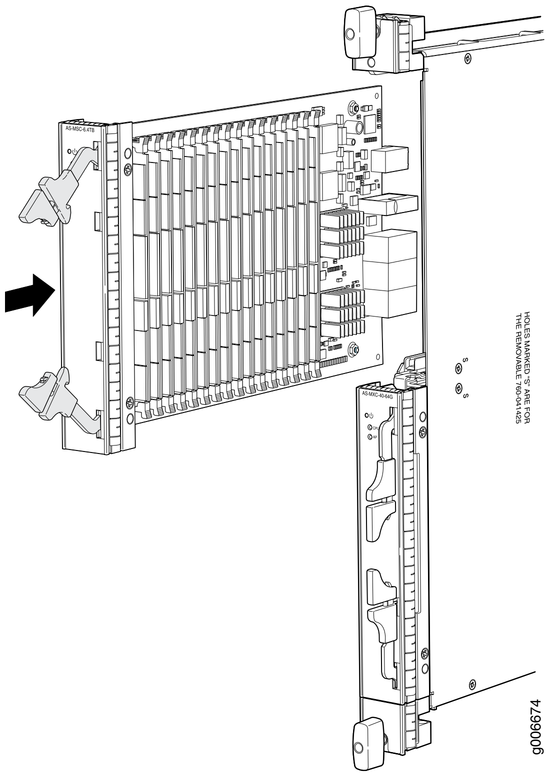
   - Press the AS MSC offline/online button until the LED light turns green.
   - Issue the following CLI command:

     `user@host>` **request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **online**

     For more information about the command, see the CLI Explorer.

   The normal functioning status LED confirms that the AS MSC is online. You can also verify correct AS MSC functioning by issuing the **show chassis fpc pic-status** command..

Figure 171: Installing an AS MSC



RELATED DOCUMENTATION

MX960 Application Services Modular Storage Card Description | 81
Removing an MX960 AS MSC | 468

Installing an MX960 AS MXC

To install an AS MXC (see Figure 172 on page 446):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Align the notches in the connector at the rear of the AS MXC with the notches in the AS MXC slot (slot 1—the bottom slot in the AS MLC), and then slide the AS MXC in until it lodges firmly in the AS MLC.

> **CAUTION:** Slide the AS MXC straight into the slot to avoid damaging the components on the bottom of the AS MXC.

3. Use one of the following methods to bring the AS MXC online:

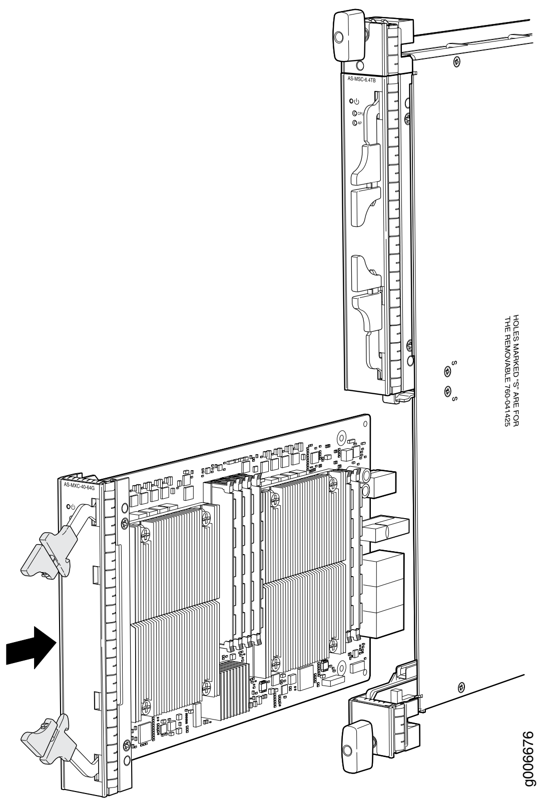
   - Press the AS MXC offline/online button until the LED light turns green.
   - Issue the following CLI command:

     `user@host>` **request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **online**

     For more information about the command, see the CLI Explorer.

   The normal functioning status LED confirms that the AS MXC is online. You can also verify correct AS MXC functioning by issuing the **show chassis fpc pic-status** command.

Figure 172: Installing an AS MXC



RELATED DOCUMENTATION

Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC

To install an SFP or XFP:

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Take each transceiver to be installed out of its electrostatic bag, and identify the slot on the component 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 component. The connectors should face the component.

5. Slide the transceiver until the connector is seated in the component 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.

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

8. Verify that the status LEDs on the component faceplate indicate that the SFP or XFP is functioning correctly. For more information about the component LEDs, see the *MX Series Interface Module Reference*.

RELATED DOCUMENTATION

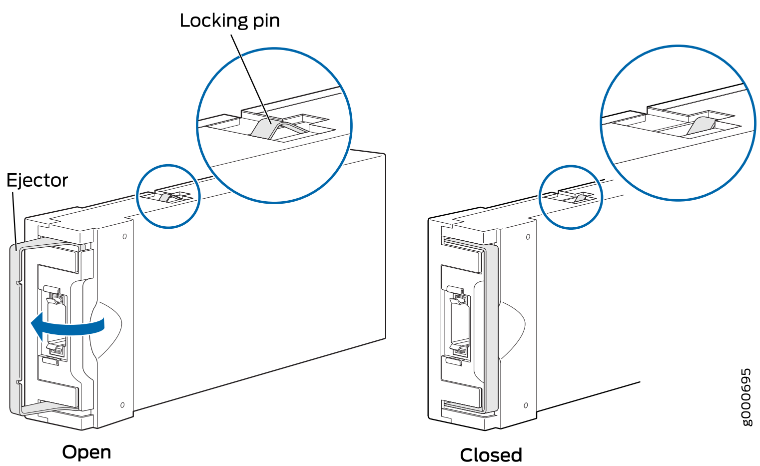
Replacing a CFP2 Transceiver

IN THIS SECTION

Removing a CFP2 Transceiver

C form-factor pluggables (CFPs) are transceivers that can be removed from a PIC. CFP2 transceivers are hot-insertable and hot-removable. Removing a CFP2 transceiver does not interrupt PIC functioning, but the removed CFP2 transceiver no longer receives or transmits data.

Figure 173: Form-Factor Pluggable (CFP2)



To remove a CFP2 transceiver (see Figure 173 on page 449):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the CFP transceiver. Have ready a rubber safety cap for the CFP2 transceiver and the cable.

2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

3. Label the cable connected to the CFP2 transceiver so that you can later reconnect it to the correct CFP2 transceiver.

4. Disconnect the cable from the CFP2 transceiver. Immediately cover the transceiver and the end of the cable with a rubber safety cap.

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

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

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

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

6. Pull the ejector latch to the extreme end away from the CFP2 transceiver faceplate to unseat the CFP2 transceiver from the PIC. Pull the CFP2 transceiver out of the PIC and place it on the antistatic mat or in the electrostatic bag.

   > **NOTE:** You cannot remove the transceiver until you move the ejector latch to the extreme end.

Installing a CFP2 Transceiver

To install a replacement CFP2:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Verify that a rubber safety cap covers the CFP transceiver, installing one if necessary.

3. Orient the CFP2 over the port in the PIC so that the connector end will enter the slot first and the CFP2 connector faces the appropriate direction.

4. Slide the CFP2 into the slot. If there is resistance, remove the CFP2 and flip it so that the connector faces the other direction.

5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.

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

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

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

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

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

7. Verify that the status LEDs on the PIC faceplate indicate that the CFP2 is functioning correctly. You can also verify PIC functioning by issuing the **show chassis fpc pic-status** command.

Replacing a CFP Transceiver

IN THIS SECTION

C form-factor pluggable (CFP) transceivers are hot-insertable and hot-removable. Removing a transceiver does not interrupt line card functioning, but the removed transceiver no longer receives or transmits data.

You can use the Hardware Compatibility Tool to find information about the pluggable transceivers supported on your Juniper Networks device.

Removing a CFP Transceiver

To remove a CFP transceiver:

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the CFP transceiver. Have ready a rubber safety cap for the CFP transceiver and the cable.

2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to the ESD point on the chassis.

3. Label the cable connected to the CFP transceiver so that you can later reconnect it to the correct CFP transceiver.

4. Disconnect the cable from the CFP transceiver. Immediately cover the transceiver and the end of the cable with a rubber safety cap.

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

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

5. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor.

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

6. Unscrew the screws from the CFP transceiver faceplate to unseat the CFP transceiver from the line card. Pull the CFP transceiver out of the line card and place it on the antistatic mat or in the electrostatic bag.

Installing a CFP Transceiver

To install a replacement CFP transceiver:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to the ESD point on the chassis.

2. Verify that a rubber safety cap covers the CFP transceiver, installing one if necessary.

3. Orient the CFP over the port in the line card so that the connector end will enter the slot first and the CFP connector faces the appropriate direction.

4. Slide the CFP into the slot. If there is resistance, remove the CFP and flip it so that the connector faces the other direction.

5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.

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

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

6. Arrange the cable in the cable management system to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor.

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

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

7. Verify that any status LEDs on the line card faceplate indicate that the CFP is functioning correctly. For more information about the line card LEDs, see the *MX Series 5G Universal Routing Platform Interface Module Reference*. You can also verify line card functioning by issuing the **show chassis fpc pic-status** command.

RELATED DOCUMENTATION

MICs Supported by MX Series Routers | 94
MPCs Supported by MX Series Routers | 112

CHAPTER 25

Replacing Chassis Components

IN THIS CHAPTER

Replacing the MX960 Craft Interface

Disconnecting the Alarm Relay Wires from the MX960 Craft Interface

To disconnect the alarm relay wires from the router and an alarm-reporting device (see Figure 174 on page 456):

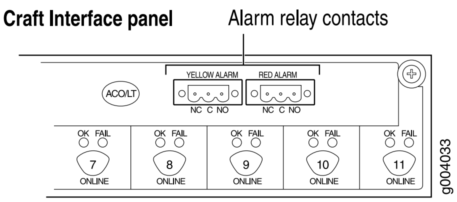
1. Disconnect the existing wire at the external device.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Using a 2.5-mm flat-blade screwdriver, loosen the small screws on the face of the terminal block and remove the block from the relay contact.

4. Using the 2.5-mm flat-blade screwdriver, loosen the small screws on the side of the terminal block. Remove existing wires from the slots in the front of the block.

Figure 174: Alarm Relay Contacts



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Removing the MX960 Craft Interface | 456

Installing the MX960 Craft Interface | 404

Connecting the Alarm Relay Wires to the MX960 Craft Interface | 392

Removing the MX960 Craft Interface

To remove the craft interface (see Figure 81 on page 302):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

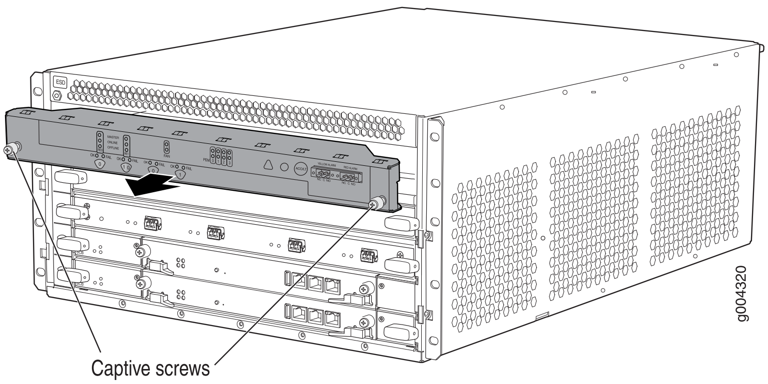
2. Detach any external devices connected to the craft interface.

3. Loosen the captive screws at the 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 175: Removing the Craft Interface



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Disconnecting the Alarm Relay Wires from the MX960 Craft Interface | 455
Installing the MX960 Craft Interface | 404
Connecting the Alarm Relay Wires to the MX960 Craft Interface | 392
MX960 Craft Interface Overview | 15

Installing the MX960 Craft Interface

To install the craft interface (see Figure 107 on page 329):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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.

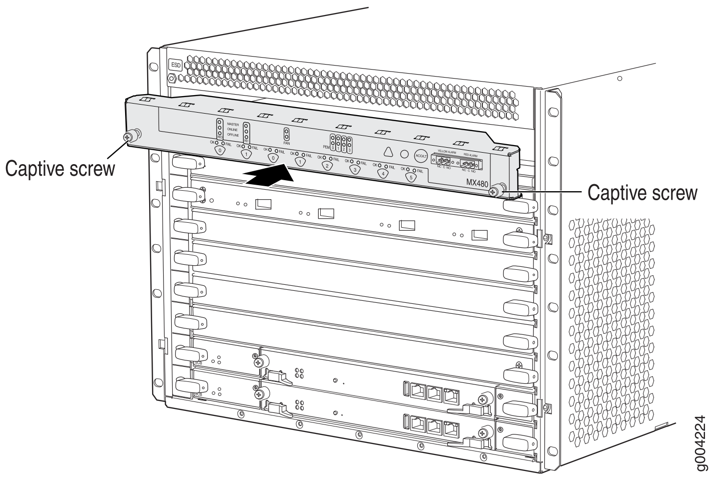
3. Orient the ribbon cable so that it plugs into the connector socket. The connector is keyed and can be inserted only one way.

4. Align the bottom of the craft interface with the sheet metal above the 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 176: Installing the Craft Interface



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
Disconnecting the Alarm Relay Wires from the MX960 Craft Interface | 455
Removing the MX960 Craft Interface | 456
Connecting the Alarm Relay Wires to the MX960 Craft Interface | 392
MX960 Craft Interface Overview | 15

Connecting the Alarm Relay Wires to the MX960 Craft Interface

To connect the alarm relay wires between a router and an alarm-reporting device (see Figure 149 on page 393):

1. Prepare the required length of replacement wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm^2).

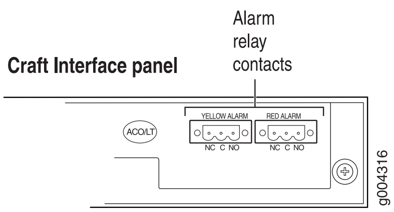
2. Insert the replacement wires into the slots in the front of the block. Use a 2.5-mm flat-blade screwdriver to tighten the screws and secure the wire.

3. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

4. 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.

5. Attach the other end of the wires to the external device.

Figure 177: Alarm Relay Contacts



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Disconnecting the Alarm Relay Wires from the MX960 Craft Interface | **455**

Removing the MX960 Craft Interface | **456**

Installing the MX960 Craft Interface | **404**

MX960 Craft Interface Overview | **15**

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 Craft Interface Overview | **15**

MX960 Craft Interface Serial Number Label | **699**

Replacing the MX960 Cable Manager

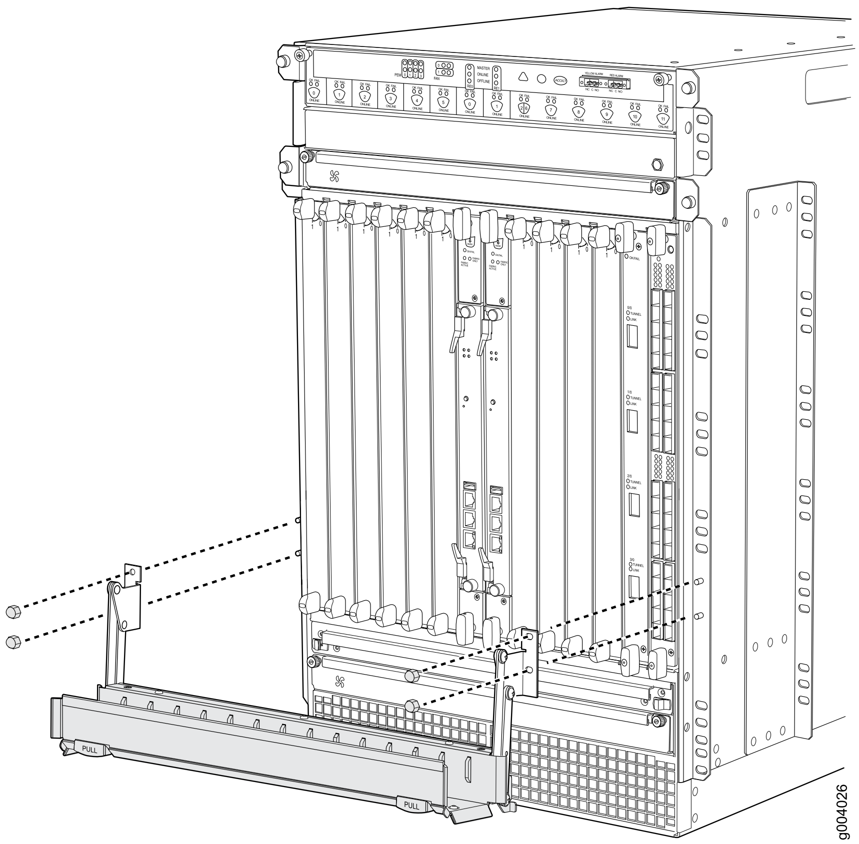
To remove the standard cable manager (see Figure 178 on page 460):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Using a 7/16-in. (11 mm) nut driver, unscrew the nuts on the corners of the standard cable manager.

3. Grasp the bottom of the standard cable manager, and pull it straight out from the studs on the front of the chassis.

Figure 178: Removing the Standard Cable Manager



To install the standard cable manager (see Figure 178 on page 460):

1. Position the standard cable manager on the studs on the lower front of the chassis.

2. Insert the nuts on the corners in the standard cable manager onto the studs on the chassis.

3. Using a 7/16-in. (11 mm) nut driver, tighten the nuts securely.

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 Cable Manager Description | 20

Verifying the Version of the MX960 Cable Manager | 644

Replacing the Console or Auxiliary Cable on an MX960 Router

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

To replace a cable connected to a management console or auxiliary device:

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

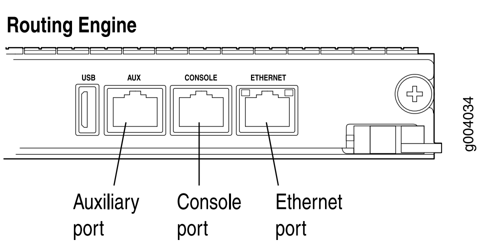
2. Press the tab on the connector, and pull the connector straight out of the port.

3. Disconnect the cable from the console or auxiliary device.

4. Plug the RJ-45 end of the replacement serial cable into the **CONSOLE** or **AUX** port. Figure 179 on page 461 shows the external device ports on the Routing Engine.

5. Plug the female DB-9 end into the console or auxiliary device's serial port.

Figure 179: Auxiliary and Console Ports



RELATED DOCUMENTATION

Replacing the Management Ethernet Cable on an MX Series Router

One Ethernet cable with RJ-45 connectors is provided with the router. To replace the cable connected to the **ETHERNET** port:

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Press the tab on the connector, and pull the connector straight out of the port. Figure 180 on page 462 shows the connector.

3. Disconnect the cable from the network device.

4. Plug one end of the replacement cable into the **ETHERNET** port. Figure 181 on page 462 shows the port.

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

Figure 180: Cable Connector

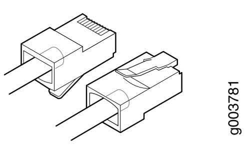
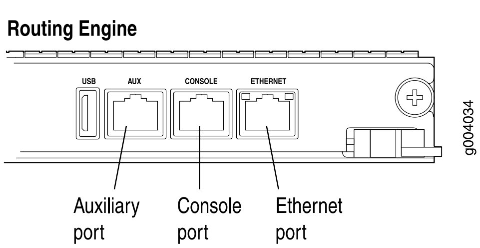


Figure 181: Ethernet Port



RELATED DOCUMENTATION

Replacing an MX960 Routing Engine | 483

Replacing an MX960 AS MLC

Removing an MX960 AS MLC

When you remove an Application Services Modular Line Card (AS MLC), the router continues to function, although the modular cards (AS MXC and AS MSC) installed on the AS MLC being removed no longer function.

Up to eight AS MLCs can be installed vertically in the front of the MX960 router. The AS MLCs are hot-insertable and hot-removable. An empty AS MLC weighs 10.5 lb (4.76 kg). A fully configured AS MLC can weigh up to 15.27 lb (6.93 kg). Be prepared to accept its full weight.

To remove an AS MLC (See Figure 182 on page 465):

1. Have ready a replacement AS MLC or an AS MLC blank panel and an antistatic mat for the AS MLC.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Use one of the following methods to take the AS MLC offline:

   - Press and hold the AS MLC online/offline button. The green **OK** LED next to the button begins to blink. Hold the button down until the LED goes out. The online/offline button for each AS MLC is located directly above it on the craft interface.
   - Issue the following CLI command:

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

     For more information about the command, see the CLI Explorer.

     > **NOTE:** The slot number corresponds to the lowest numbered slot for which the AS MLC is installed.

4. Simultaneously turn both the ejector handles counterclockwise to unseat the AS MLC.

5. Grasp the handles, and slide the AS MLC straight out of the card cage halfway.

6. Place one hand around the front of the AS MLC (the modular card housing) and the other hand under it to support it. Slide the AS MLC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.

   CAUTION: The weight of the AS MLC is concentrated in the back end. Be prepared to accept the full weight—up to 15.27 lb (6.93 kg)—as you slide the AS MLC out of the chassis.

   When the AS MLC 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 AS MLCs on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

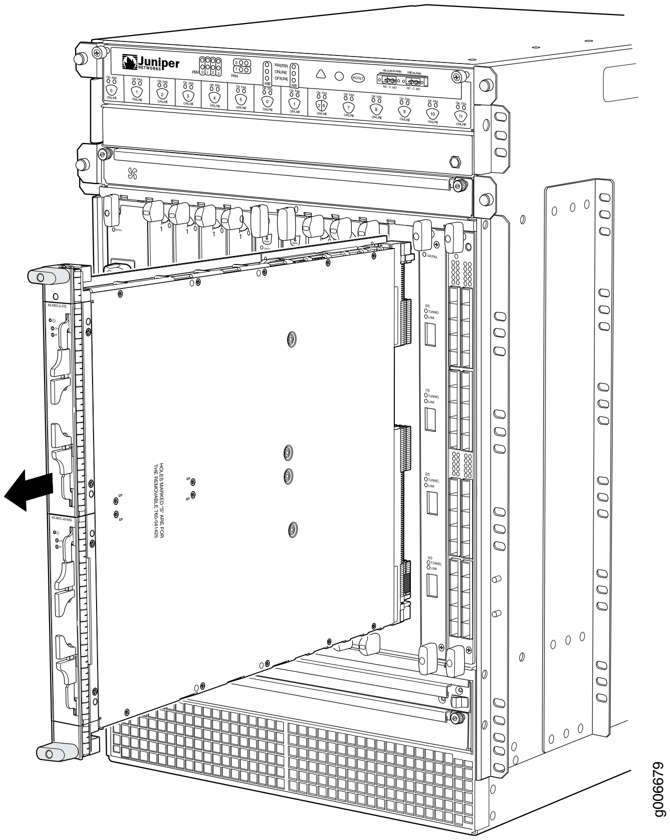
7. If necessary, remove each installed AS MSC and AS MXC from the AS MLC.

8. After you remove each modular card, immediately place it on an antistatic mat or in an electrostatic bag.

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

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

Figure 182: Removing an AS MLC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
Removing an MX960 AS MSC | 468
Removing an MX960 AS MXC | 471
Installing an MX960 AS MLC | 442

Installing an MX960 AS MLC

You can install up to eight Application Services Modular Line Cards (AS MLCs) vertically in the front of the MX960 router. The AS MLCs are hot-insertable and hot-removable. An empty AS MLC weighs 10.5 lb (4.76 kg). A fully configured AS MLC can weigh up to 15.27 lb (6.93 kg). Be prepared to accept its full weight.

To install an AS MLC (see Figure 170 on page 443):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Place the AS MLC on an antistatic mat.

3. Take the AS MSC and AS MXC (the modular cards) to be installed in the AS MLC out of its electrostatic bag. The AS MSC must be inserted in the top slot and the AS MXC in the bottom slot.

4. Install the AS MSC and AS MXC into the appropriate slot on the AS MLC.

5. Locate the slots in the card cage in which you plan to install the AS MLC.

6. Orient the AS MLC so that the faceplate faces you.

7. Lift the AS MLC into place, and carefully align the sides of the AS MLC with the guides inside the card cage.

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

8. Slide the AS MLC all the way into the card cage until you feel resistance.

9. Grasp both ejector handles, and rotate them clockwise simultaneously until the AS MLC is fully seated.

10. Use one of the following methods to bring the AS MLC online:

    - Press and hold the AS MLC online/offline button until the green **OK** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each AS MLC are located directly above it on the craft interface.
    - Issue the following CLI command:

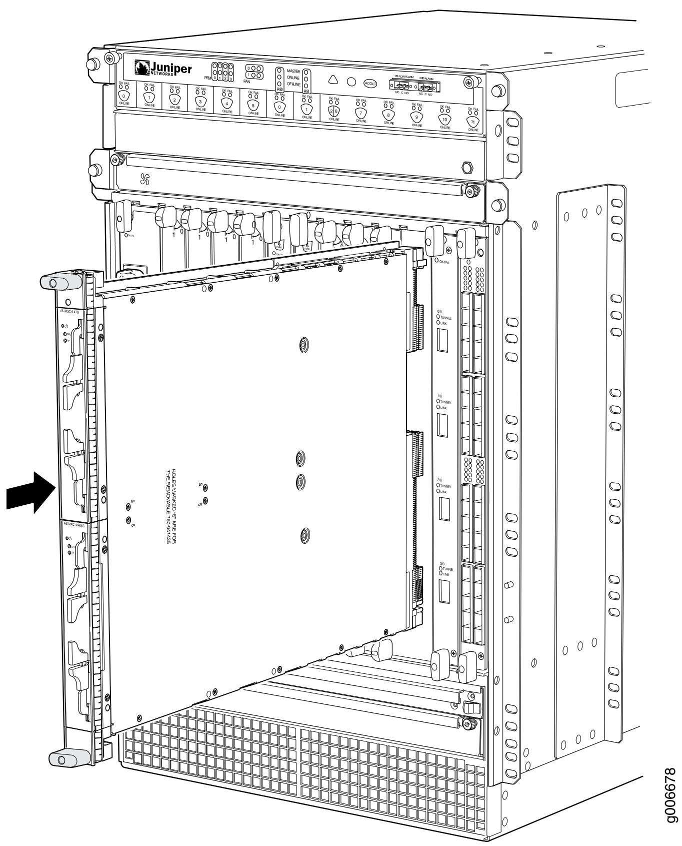
      `user@host>`**request chassis fpc slot** *`slot-number`* **online**

For more information about the command, see the CLI Explorer.

> **CAUTION:** After the **OK** LED lights steadily, wait at least 30 seconds before removing the AS MLC again, removing an AS MLC from a different slot, or inserting an AS MLC in a different slot.

You can also verify correct AS MLC and AS MSC or AS MXC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status**.

Figure 183: Installing an AS MLC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 AS MSC | 444

Installing an MX960 AS MXC | 445

RELATED DOCUMENTATION

Replacing an MX960 AS MSC

Removing an MX960 AS MSC

AS MSCs are hot-insertable and hot-removable. When you remove an AS MSC, the router continues to function.

The AS MSCs are located in the AS MLCs installed in the front of the router. An AS MSC weighs 1.4 lb (0.6 kg).

To remove an AS MSC (see Figure 184 on page 469):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the AS MSC.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Use one of the following methods to take the AS MSC offline:

   - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the AS MSC LED goes out (about 5 seconds).
   - Issue the following CLI command:

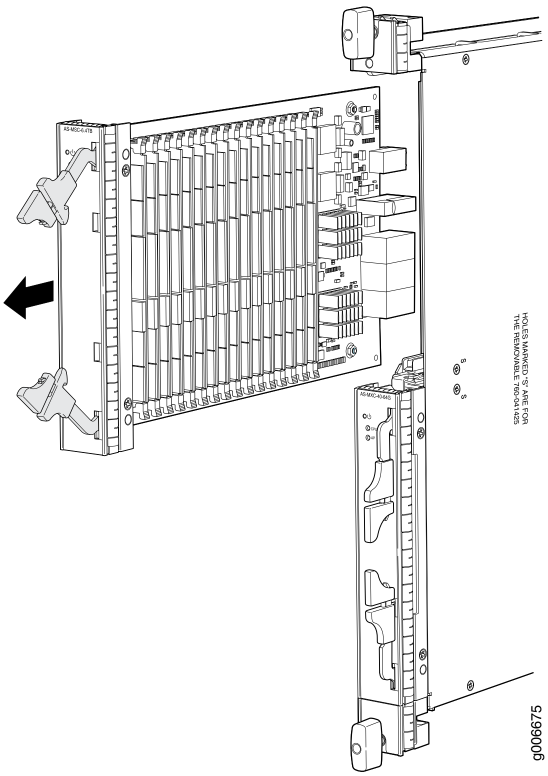
     `user@host>` **request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **offline**

     For more information about the command, see the CLI Explorer.

4. Slide the AS MSC out of the AS MLC card carrier by pulling the handles, and place it in the electrostatic bag or on the antistatic mat.

5. If you are not reinstalling an AS MSC into the emptied AS MSC slot within a short time, install a blank AS MSC panel over the slot to maintain proper airflow in the AS MLC card cage.

Figure 184: Removing an AS MSC



SEE ALSO

MX960 Application Services Modular Storage Card Description | 81

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 AS MSC | 444

Installing an MX960 AS MSC

To install an AS MSC (see Figure 171 on page 445):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Align the notches in the connector at the rear of the AS MSC with the notches in the AS MSC slot (slot **0**—the top slot in the AS MLC), and then slide the AS MSC in until it lodges firmly in the AS MLC.

> **CAUTION:** Slide the AS MSC straight into the slot to avoid damaging the components on the bottom of the AS MSC.

3. Use one of the following methods to bring the AS MSC online:

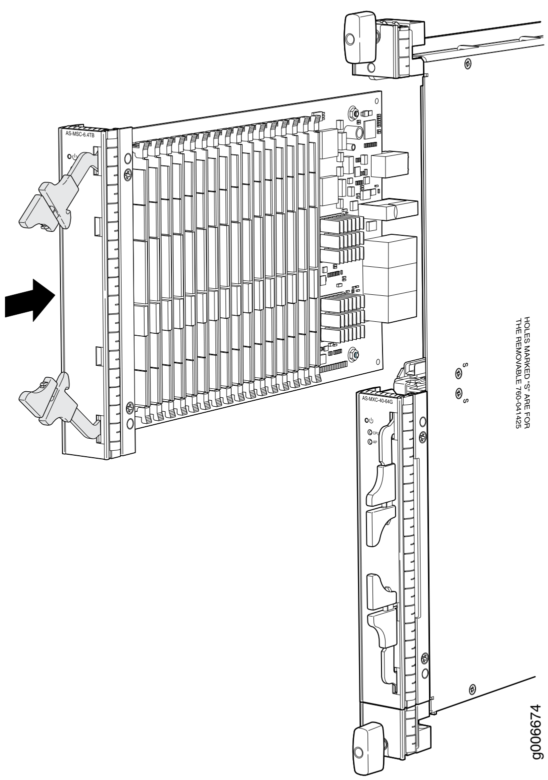
   - Press the AS MSC offline/online button until the LED light turns green.
   - Issue the following CLI command:

     `user@host>` **request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **online**

     For more information about the command, see the CLI Explorer.

   The normal functioning status LED confirms that the AS MSC is online. You can also verify correct AS MSC functioning by issuing the **show chassis fpc pic-status** command..

Figure 185: Installing an AS MSC



SEE ALSO

MX960 Application Services Modular Storage Card Description | 81
Removing an MX960 AS MSC | 468

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router
Replacing an MX960 AS MLC | 463
MX960 Application Services Modular Storage Card Description | 81

Replacing an MX960 AS MXC

Removing an MX960 AS MXC

AS MXCs are hot-insertable and hot-removable. When you remove an AS MXC, the router continues to function.

The AS MXCs are located in the AS MLCs installed in the front of the router. An AS MXC weighs less than 2 lb (0.9 kg).

To remove an AS MXC (see Figure 186 on page 472):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the AS MXC.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Use one of the following methods to take the AS MXC offline:

   - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the AS MXC LED goes out (about 5 seconds).
   - Issue the following CLI command:

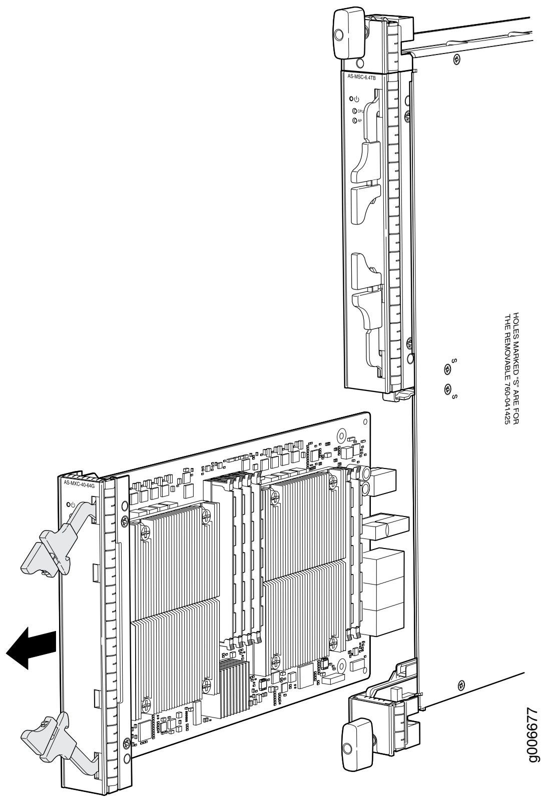
     `user@host>` **request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **offline**

     For more information about the command, see the CLI Explorer.

5. Slide the AS MXC out of the AS MLC card carrier by pulling the handles, and place it in the electrostatic bag or on the antistatic mat.

6. If you are not reinstalling an AS MXC into the emptied AS MXC slot within a short time, install a blank AS MXC panel over the slot to maintain proper airflow in the AS MLC card cage.

Figure 186: Removing an AS MXC



SEE ALSO

[MX960 Application Services Modular Processing Card Description | 82]

Preventing Electrostatic Discharge Damage to an MX960 Router

[Installing an MX960 AS MXC | 445]

Installing an MX960 AS MXC

To install an AS MXC (see Figure 172 on page 446):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Align the notches in the connector at the rear of the AS MXC with the notches in the AS MXC slot (slot 1—the bottom slot in the AS MLC), and then slide the AS MXC in until it lodges firmly in the AS MLC.

   CAUTION: Slide the AS MXC straight into the slot to avoid damaging the components on the bottom of the AS MXC.

3. Use one of the following methods to bring the AS MXC online:

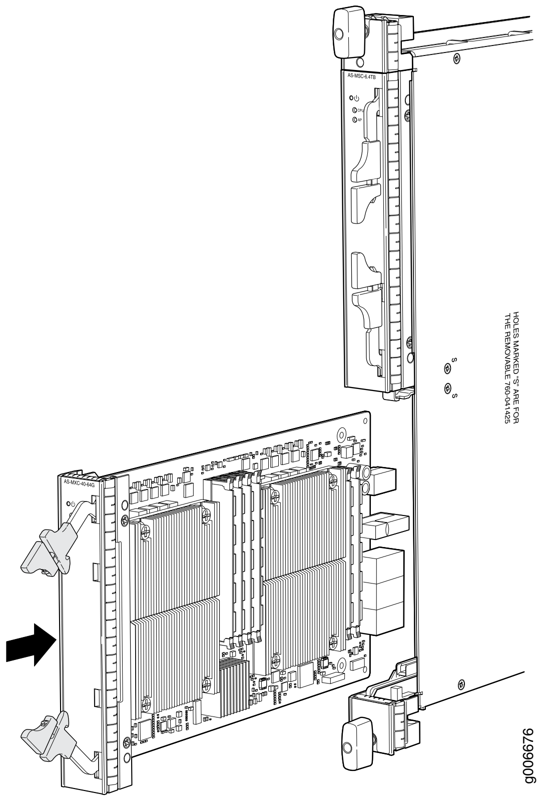
   - Press the AS MXC offline/online button until the LED light turns green.
   - Issue the following CLI command:

     `user@host>` **request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **online**

     For more information about the command, see the CLI Explorer.

   The normal functioning status LED confirms that the AS MXC is online. You can also verify correct AS MXC functioning by issuing the **show chassis fpc pic-status** command.

Figure 187: Installing an AS MXC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 Application Services Modular Processing Card Description | 82

Removing an MX960 AS MXC | 471

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing an MX960 AS MLC | 463

MX960 Application Services Modular Processing Card Description | 82

CHAPTER 26

Replacing Cooling System Component

IN THIS CHAPTER

Replacing the MX960 Air Filter

Removing the Normal-Capacity MX960 Air Filter

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

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

To remove the normal-capacity air filter tray, use the following procedure.

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Unwrap any cables on the standard cable manager and remove the cables from the tray. Arrange the cables so that they do not block the front of the cable manager and tray, and secure them with temporary fasteners so that they are not supporting their own weight as they hang from the connector.

> **NOTE:** Removing the cables from the extended cable manager is not necessary to access the air filter.

> **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.

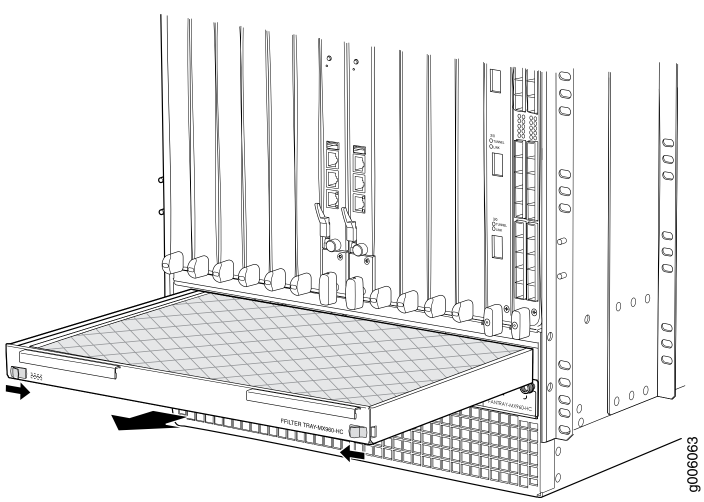
> **CAUTION:** Do not run the router for more than two minutes without the air filter in place.

3. Simultaneously pull the two releases labeled **PULL** on the standard cable manager. Lift it up and outward to lock it in place to access the air filter.

4. Pull the filter tray release on both sides of the filter tray.

5. Slide the air filter tray out of the chassis as shown in Figure 188 on page 476.

Figure 188: Removing the Normal-Capacity Air Filter Tray from the Chassis



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

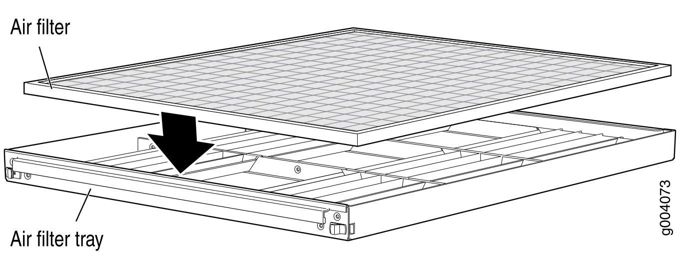
Installing the MX960 Air Filter | 405
Maintaining the MX960 Air Filter | 610

Installing the MX960 Air Filter

To install the air filter (see Figure 151 on page 405):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Ensure that the air filter is right side up.
3. Place the air filter into the air filter tray.
4. Insert the air filter tray into the chassis by sliding it straight into the chassis until it stops.
5. Lower the cable manager back into position.
6. Rearrange the cables in the cable manager.

Figure 189: Installing the Air Filter



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Removing the Normal-Capacity MX960 Air Filter | 475
Maintaining the MX960 Air Filter | 610

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing an MX960 Fan Tray

Removing an MX960 Fan Tray

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

To remove the upper or lower fan tray (see Figure 82 on page 302 and Figure 191 on page 480):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Reposition the standard cable manager before removing the lower front fan tray:

   > **NOTE:** This step is not required for the extended cable manager.

   a. Unwrap any cables on the standard cable manager and remove the cables from the tray. Arrange the cables so that they do not block the front of the cable manager and tray, and secure them with temporary fasteners so that they are not supporting their own weight as they hang from the connector.

   b. Simultaneously pull the two releases labelled PULL on the cable manager. Lift it up and outward to lock it in place.

3. Loosen the captive screw on each side of the fan tray faceplate.

4. Grasp both sides of the fan tray, 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 module out of the device. The fans might still be spinning.

5. Pause for approximately 15 seconds to allow the fans to stop spinning.

6. When the fans stop spinning, press on the two latches located on the inside of the fan tray.

7. Place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.

Figure 190: Removing an Upper Fan Tray

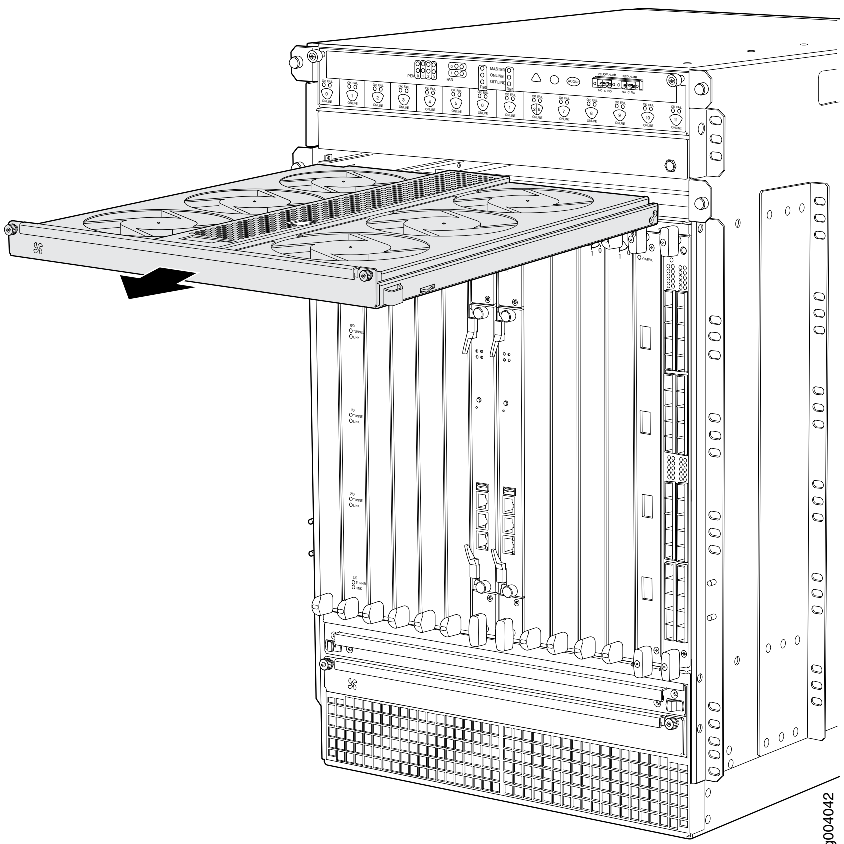
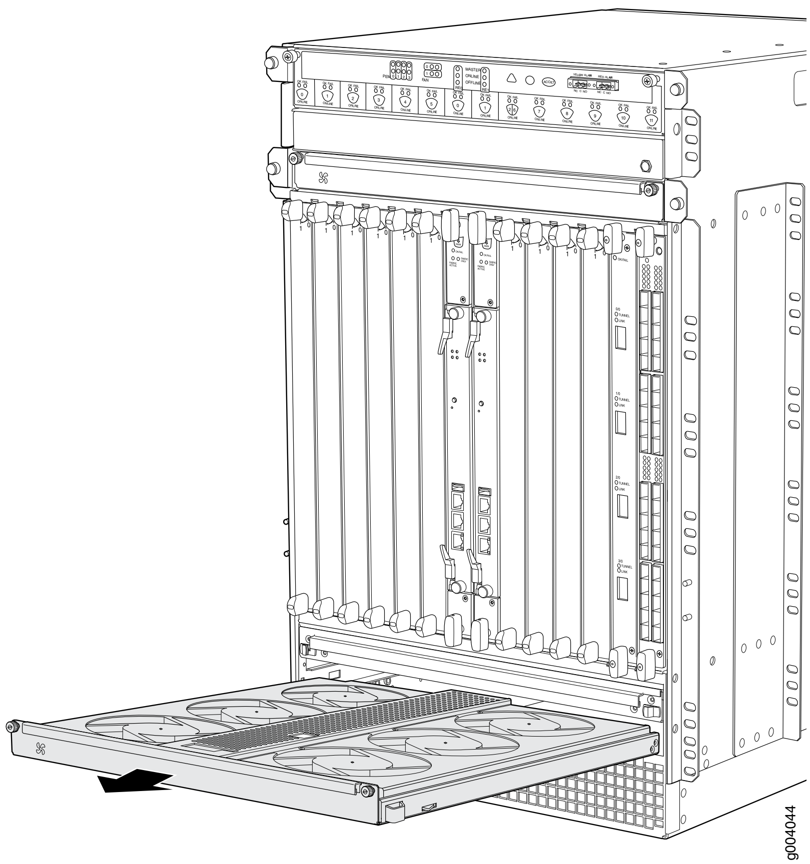


Figure 191: Removing a Lower Fan Tray



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
Installing an MX960 Fan Tray | **406**
Maintaining the MX960 Fan Trays | **610**

Installing an MX960 Fan Tray

To install a fan tray (see Figure 152 on page 406 and Figure 153 on page 407):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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.

4. Lower the cable manager back into position, if necessary.

Figure 192: Installing an Upper Fan Tray

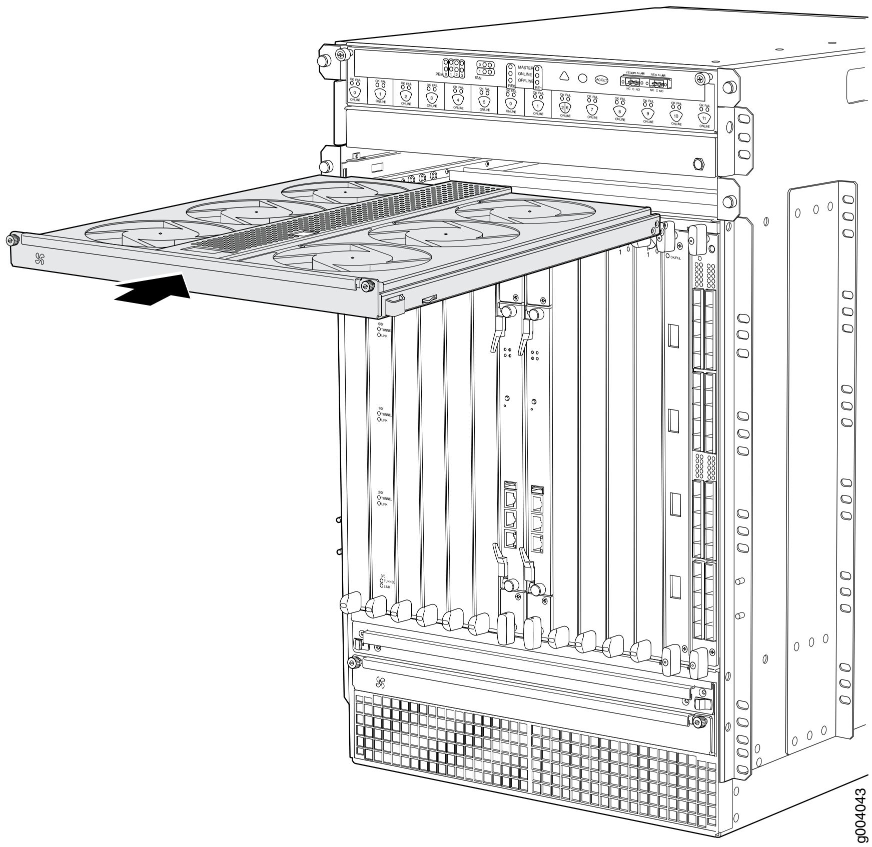
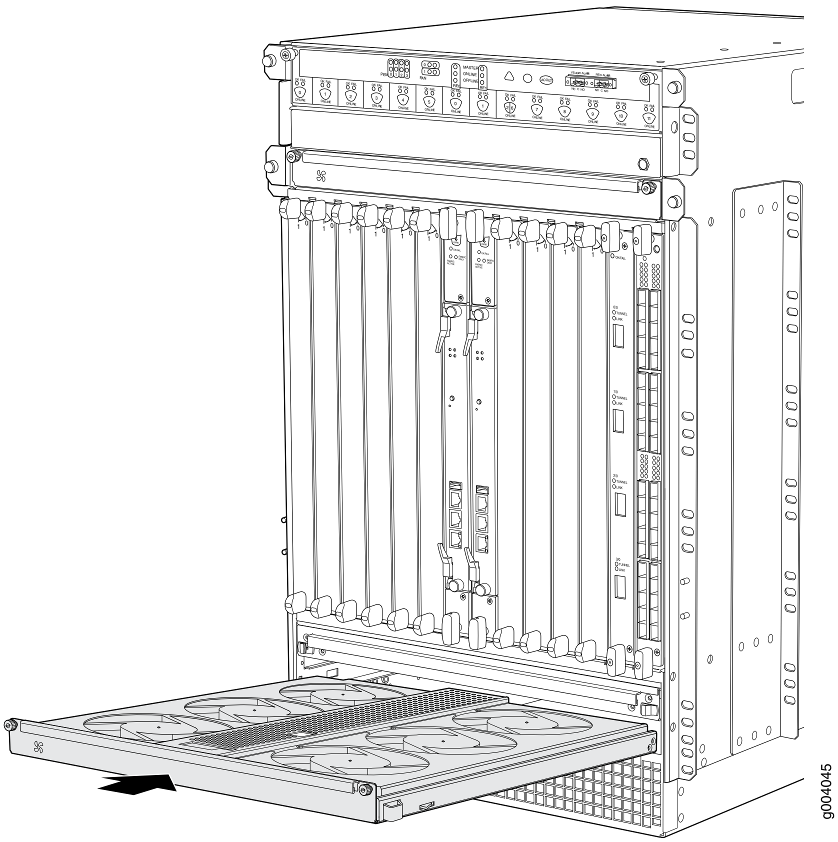


Figure 193: Installing a Lower Fan Tray



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Removing an MX960 Fan Tray | 478

Maintaining the MX960 Fan Trays | 610

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Maintaining the MX960 Fan Trays | 610

CHAPTER 27

Replacing Host Subsystem Components

IN THIS CHAPTER

Replacing an MX960 Routing Engine

Removing an MX960 Routing Engine

Before you remove a Routing Engine, remove the cables that connect to it.

CAUTION: Before you replace a Routing Engine, you must take the host subsystem offline. If there is only one host subsystem, taking the host subsystem offline shuts down the router.

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

To remove a Routing Engine from an SCB (see Figure 194 on page 485):

1. Take the Routing Engine offline gracefully.

2. Place an electrostatic bag or antistatic mat on a flat, stable surface.

3. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

4. Verify that the Routing Engine LEDs are off.

5. Loosen the captive screws on the top and bottom of the Routing Engine.

6. Flip the ejector handles outward to unseat the Routing Engine.

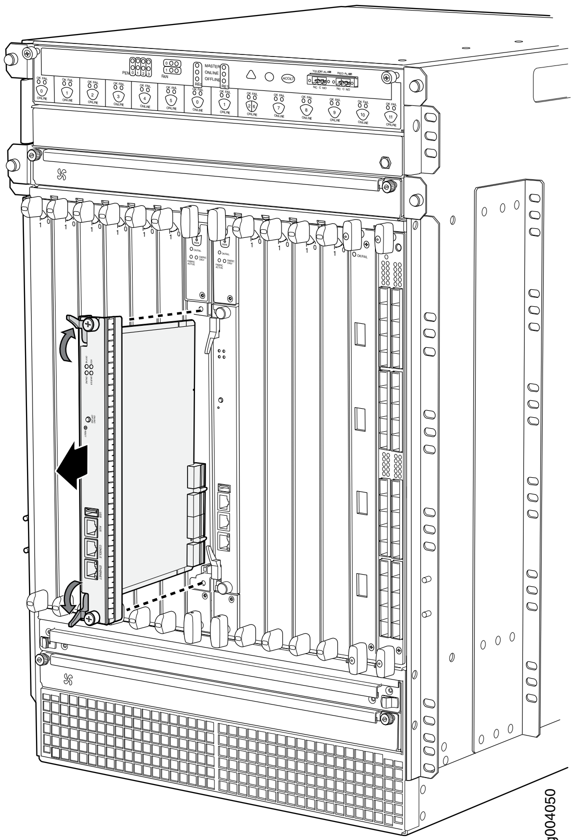
7. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.

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 194: Removing a Routing Engine



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
MX960 Routing Engine Description | 28
Installing an MX960 Routing Engine | 407
Replacing Connections to MX960 Routing Engine Interface Ports | 495
Routing Engine Interface Cable and Wire Specifications for MX Series Routers | 193

Installing an MX960 Routing Engine

To install a Routing Engine into an SCB (Figure 154 on page 409):

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.

   CAUTION: Align the Routing Engine correctly to avoid damaging it.

5. Press both of the ejector handles inward to seat the Routing Engine.

6. Tighten the captive screws on the top and bottom of the Routing Engine.

7. Connect the management device cables to 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 **FAIL**, **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. 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:

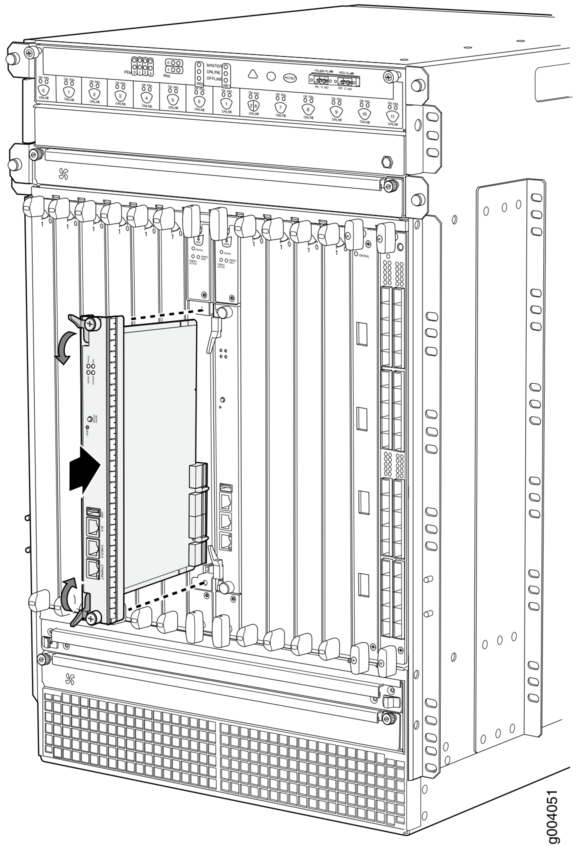
`user@host>` **show chassis routing-engine**

```
Routing Engine status:      Slot 0:     Current state                Master ...
```

For more information about using the CLI, see the Junos OS documentation.

NOTE: If enhanced IP network services is configured on the chassis, all routing engines must be rebooted after synchronizing the routing engines. For more information on synchronizing the routing engines, see *Synchronizing Routing Engines*.

Figure 195: Installing a MX960 Routing Engine



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing Connections to MX960 Routing Engine Interface Ports | 495

Removing an MX960 Routing Engine | 483

MX960 Routing Engine Description | 28

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing Connections to MX960 Routing Engine Interface Ports | 495

MX960 Routing Engine Description | 28

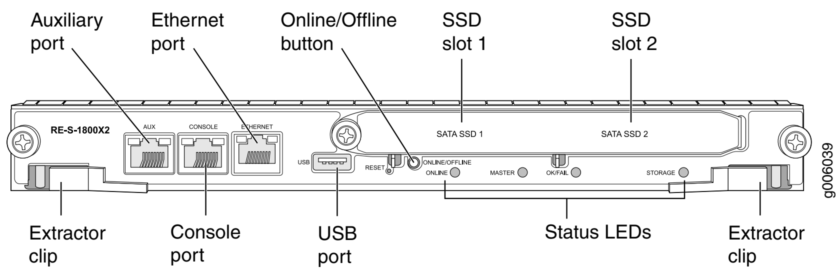
Routing Engine Interface Cable and Wire Specifications for MX Series Routers | 193

Synchronizing Routing Engines

Replacing an SSD Drive on an RE-S-1800

Each RE-S-1800 Routing Engine supports two solid-state drives (SSD) specified by Juniper Networks. The RE-S-1800 ships with one SSD installed in the slot labeled **SATA SSD 1**. The spare SSD is Juniper part number SSD-32G-RE-S. Figure 196 on page 488 shows the arrangement of storage drive slots on a RE-S-1800 Routing Engine.

Figure 196: RE-S-1800 Storage Drive Slots



The following drive has been verified to work in the RE-S-1800 Routing Engine:

- SSD-32G-RE-S

To replace a storage drive:

1. Disable and deactivate the storage drive.

2. Remove the storage drive.

   a. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an ESD point on the appliance.

      For more information about ESD, see *Preventing Electrostatic Discharge Damage* in the hardware guide for your router.

   b. Unfasten the thumbscrew that secures the access door in front of the storage drive slots, and open the door.

   c. Slide the lock on the ejector to the unlocked position.

   d. Carefully slide the drive out of the slot.

3. Reinstall a storage drive.

   a. Carefully align the sides of the drive with the guides in the slot.

   b. Slide the drive into the slot until you feel resistance, carefully ensuring that it is correctly aligned.

   c. Close the access door and tighten the thumbscrew to secure the door.

RELATED DOCUMENTATION

How to Return a Hardware Component to Juniper Networks, Inc. | **714**

Replacing an SSD Drive on an RE-S-X6-64G

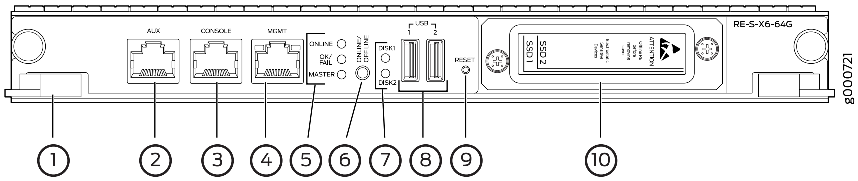
Each RE-S-X6-64G Routing Engine supports two solid-state drives (SSD) specified by Juniper Networks. The RE-S-X6-64G ships with two SSDs installed in the slot labeled **DISK1** and **DISK2**. Figure 197 on page 490 shows the arrangement of storage drive slots on a RE-S-X6-64G Routing Engine.

Replacing an SSD drive in a RE-S-X6-64G Routing Engine consists of the following two stages:

1. Replacing the SSD Drive in the Routing Engine.

2. Copying vmhost and Junos OS to the replaced SSD.

Figure 197: RE-S-X6-64G Storage Drive Slots



The following drive has been verified to work in the RE-S-X6-64G Routing Engine:

- 64GB slim SATA SSD

Replacing the SSDs:

1. To replace an SSD in the slot labeled **Disk2**:

   a. Make sure that there is no **VMHost %d Boot from alternate disk** alarm in the output:

      user@host>**show chassis alarm**

   To replace an SSD in the slot labeled **Disk1**:

   a. Make sure that the router is booted up and running from an image from disk1.

      Back up the currently running vmhost and Junos OS on disk1 to ensure that both disk1 and disk2 have the same version of vmhost and Junos OS:

      user@host> **request vmhost snapshot [partition]**

      > **NOTE:** Partitioning the target media is optional.

   b. Reboot the router from disk2:

      user@host> **request vmhost reboot disk2**

   c. Check for the presence of the **VMHost %d Boot from alternate disk** alarm in the output:

      user@host>**show chassis alarm**

2. Offline the Routing Engine by pressing the **ONLINE/OFFLINE** button.

3. Remove the SSD.

   a. Attach an ESD grounding strap to your bare wrist, and connect the strap to an ESD point on the appliance.

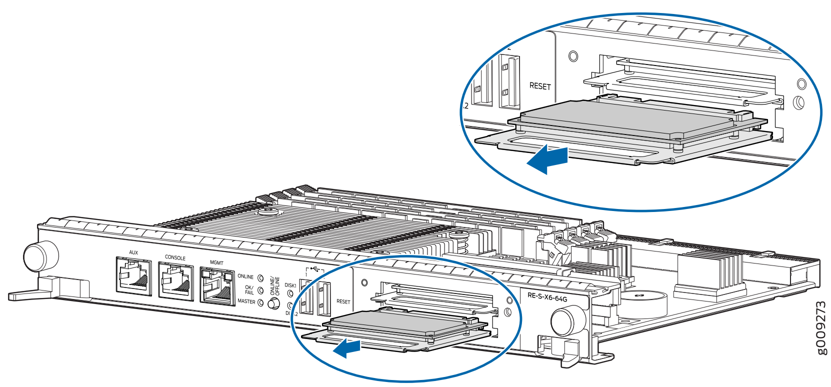
      For more information about ESD, see *Preventing Electrostatic Discharge Damage* in the hardware guide for your router.

   b. Unfasten the thumbscrew that secures the access door in front of the storage drive slots, and open the door.

   c. Slide the lock on the ejector to the unlocked position.

   d. Carefully slide the drive out of the slot.

Figure 198: Removing an SSD in the Routing Engine RE-S-X6-64G



4. Reinstall an SSD:

   a. Carefully align the sides of the drive with the guides in the slot.

   b. Slide the drive into the slot until you feel resistance, carefully ensuring that it is correctly aligned.

   c. Close the access door and tighten the thumbscrew to secure the door.

1. Copy Junos OS to the newly replaced SSD:

   If both the SSDs are replaced together:

   a. Install using an USB disk:

      1. Insert the USB disk in the **USB** slot on the Routing Engine.
      2. After the Routing Engine boots from the USB, press **y** when you are prompted to confirm **Install vmhost and Junos software on Primary and Secondary disk [y/N?** on the console.
      3. After the installation is completed, press **y** when prompted to confirm **Reboot now? [y/N]?** to reboot from the SSD disk.

      NOTE: To prepare a bootable USB disk, see *Creating an Emergency Boot Device for Routing Engines with VM Host Support*.

   b. Install vmhost using the PXEBoot method:

      1. Set up the PXEBoot server. See *Copying VM Host Installation Package to the PXE Boot Server*.
      2. Bring the Routing Engine online by pressing the ONLINE/OFFLINE button
      3. During the boot, when you see the message **Press Esc for boot options** press **Esc** key to enter into the BIOS menu boot options.

         After the **Esc** key is pressed, **Esc is pressed. Go to boot options.** is displayed on the screen.
      4. Using **Up** or **Down** arrow keys, navigate to **Boot Manager** and press the **Enter** key.
      5. Using **Up** or **Down** arrow keys, navigate through the EFI boot devices listed and select **EFI Network 0 for IPv4** to boot from the PXEboot server and press the **Enter** key.
      6. **Booting `net boot console** is displayed and PXEBoot continues.

         NOTE: The booting process may take several minutes.

      7. After the Routing Engine boots, press **y** when you are prompted to confirm **Install vmhost and Junos software on Primary and Secondary disk [y/N?** on the console.
      8. After the installation is completed, press **y** when prompted to confirm **Reboot now? [y/N]?** to reboot from the SSD disk.

   If only disk2 is replaced:

   a. Bring the Routing Engine online by pressing the ONLINE/OFFLINE button.

   b. The router boots from disk1. To be able to boot from disk2:

user@host> **request vmhost snapshot partition**

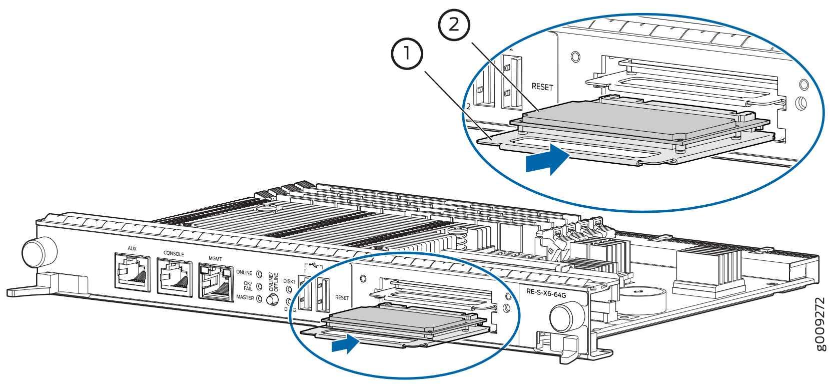
If only disk1 is replaced:

a. Bring the Routing Engine online by pressing the ONLINE/OFFLINE button.

b. The router boots from disk2 . To be able to boot from disk1:

user@host> **request vmhost snapshot partition**

Figure 199: Installing an SSD in the Routing Engine RE-S-X6-64G



1—Carrier	2—SSD card

Copying vmhost and Junos OS from an USB disk when both the SSDs are replaced together:

> **NOTE:** To prepare a bootable USB disk, see Creating an Emergency Boot Device for RE-MX-X6, RE-MX-X8 and RE-PTX-X8 Routing Engines.

1. Insert the USB disk in the **USB** slot on the Routing Engine.

2. After the Routing Engine boots from the USB, press **y** when you are prompted to confirm **Install vmhost and Junos software on Primary and Secondary disk [y/N]?** on the console.

3. After the installation is completed, press **y** when prompted to confirm **Reboot now? [y/N]?** to reboot from the SSD disk.

Copying vmhost and Junos OS to the SSDs from the PXEBoot server:

1. Set up the PXEBoot server. See *Copying VM Host Installation Package to the PXE Boot Server*.

2. Bring the Routing Engine online by pressing the **ONLINE/OFFLINE** button.

3. During the boot, when you see the message **Press Esc for boot options** press **Esc** key to enter into the BIOS menu boot options.

   After the **Esc** key is pressed, **Esc is pressed. Go to boot options.** is displayed on the screen.

4. Using **Up** or **Down** arrow keys, navigate to **Boot Manager** and press the **Enter** key.

5. Using **Up** or **Down** arrow keys, navigate through the EFI boot devices listed and select **EFI Network 0 for IPv4** to boot from the PXEboot server and press the **Enter** key.

6. **Booting `net boot console** is displayed and PXEBoot continues.

   > **NOTE:** The booting process may take several minutes.

7. After the Routing Engine boots, press **y** when you are prompted to confirm **Install vmhost and Junos software on Primary and Secondary disk [y/N]?** on the console.

8. After the installation is completed, press **y** when prompted to confirm **Reboot now? [y/N]?** to reboot from the SSD disk.

Copying vmhost and Junos OS when only one disk is replaced:

a. Bring the Routing Engine online by pressing the **ONLINE/OFFLINE** button.

b. The router boots from disk1 if disk2 is replaced. To be able to boot from disk2:

   user@host> **request vmhost snapshot partition**

   The router boots from disk2 if disk1 is replaced. To be able to boot from disk1:

   user@host> **request vmhost snapshot recovery partition**

RELATED DOCUMENTATION

How to Return a Hardware Component to Juniper Networks, Inc. | 714

Upgrading the SSD Firmware on Routing Engines with VM Host Support

Replacing Connections to MX960 Routing Engine Interface Ports

IN THIS SECTION

Replacing the Management Ethernet Cable on an MX Series Router

One Ethernet cable with RJ-45 connectors is provided with the router. To replace the cable connected to the **ETHERNET** port:

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Press the tab on the connector, and pull the connector straight out of the port. Figure 180 on page 462 shows the connector.

3. Disconnect the cable from the network device.

4. Plug one end of the replacement cable into the **ETHERNET** port. Figure 181 on page 462 shows the port.

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

Figure 200: Cable Connector

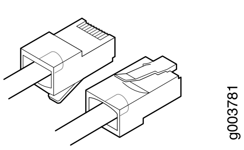
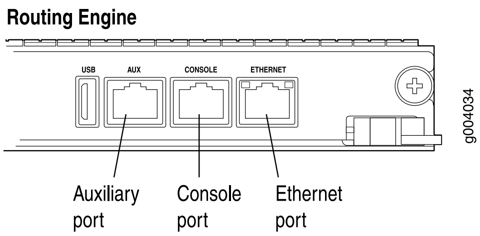


Figure 201: Ethernet Port



SEE ALSO

Replacing an MX960 Routing Engine | 483

Replacing the Console or Auxiliary Cable on an MX960 Router

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

To replace a cable connected to a management console or auxiliary device:

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

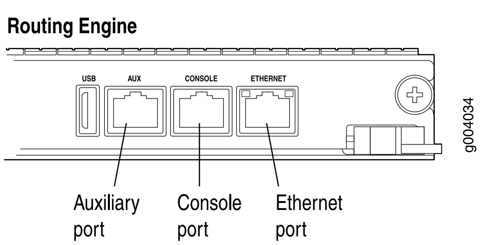
2. Press the tab on the connector, and pull the connector straight out of the port.

3. Disconnect the cable from the console or auxiliary device.

4. Plug the RJ-45 end of the replacement serial cable into the **CONSOLE** or **AUX** port. Figure 179 on page 461 shows the external device ports on the Routing Engine.

5. Plug the female DB-9 end into the console or auxiliary device's serial port.

Figure 202: Auxiliary and Console Ports



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing the Management Ethernet Cable on an MX Series Router | 462

Routing Engine Interface Cable and Wire Specifications for MX Series Routers | 193

Replacing an MX960 Routing Engine | 483

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Routing Engine Interface Cable and Wire Specifications for MX Series Routers | 193

Replacing an MX960 Routing Engine | 483

Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem

A redundant host subsystem consists of a primary Routing Engine (RE0) and a backup Routing Engine (RE1). To upgrade the host subsystem to use the RE-S-X6-64G Routing Engine, you must first uninstall the backup Routing Engine and install the RE-S-X6-64G Routing Engine, which then becomes the backup Routing Engine. You then switch over this backup Routing Engine to make it the primary Routing Engine. Replace the other Routing Engine and configure it as the backup Routing Engine.

Ensure that the Switch Control Board in the chassis is SCBE2 because the RE-S-X6-64G Routing Engine is not compatible with the Switch Control Boards SCB or SCBE. To upgrade the Switch Control Board to SCBE2, see *Upgrading an MX240 to Use the SCBE2-MX*, *Upgrading an MX480 to Use the SCBE2-MX*or "Upgrading an MX960 to Use the SCBE2-MX" on page 597, depending on the chassis on which the Routing Engine is being upgraded.

NOTE: Save the router configuration before proceeding with the Routing Engine upgrade.

NOTE: Nonstop active routing (NSR) and graceful Routing Engine switchover (GRES) are not supported during the upgrade and they must be temporarily disabled. Disable NSR by removing the **nonstop-routing** statement from the [**edit routing-options**] hierarchy level and by removing the **graceful-switchover** statement from the [**edit chassis redundancy**] hierarchy level .

Removing the Routing Engine

To remove the backup Routing Engine from the chassis (see Figure 203 on page 499, Figure 204 on page 499, and Figure 205 on page 500):

1. On the external management device connected to the Routing Engine, shut down the host subsystem by using the **request system power-off** command.

2. Wait until a message appears on the console confirming that the operating system has halted.

3. Remove the cables connected to the Routing Engine.

4. Place an electrostatic bag or antistatic mat on a flat, stable surface. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

5. Verify that the Routing Engine LEDs are off. Loosen the captive screws on the top and bottom of the Routing Engine.

6. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.

7. Place one hand underneath the Routing Engine to support it, and slide it completely out of the chassis. 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 203: Removing a Routing Engine from an MX240 Router

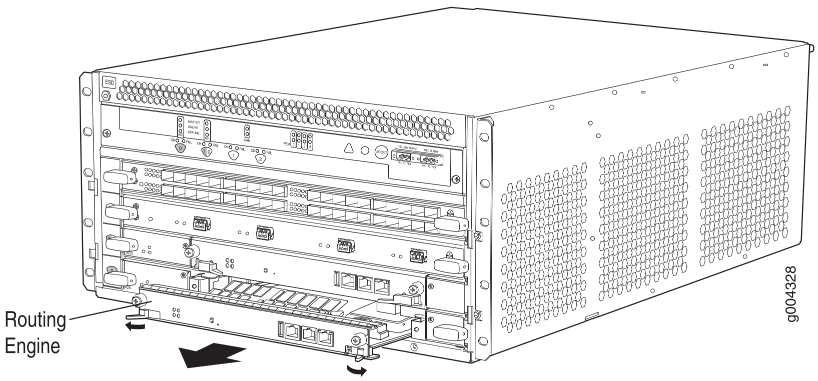


Figure 204: Removing a Routing Engine from an MX480 Router

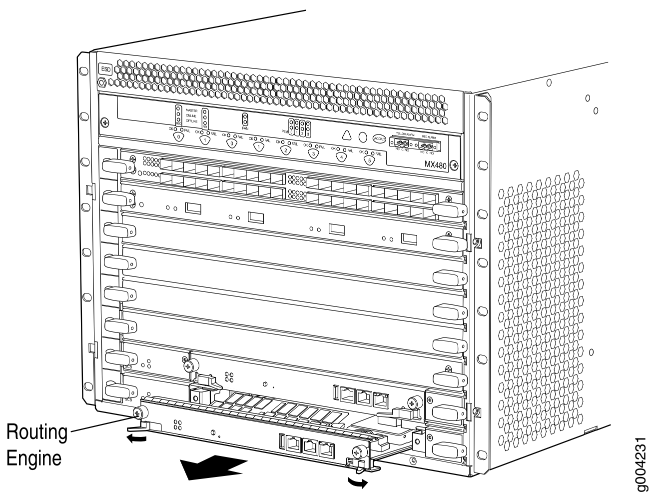
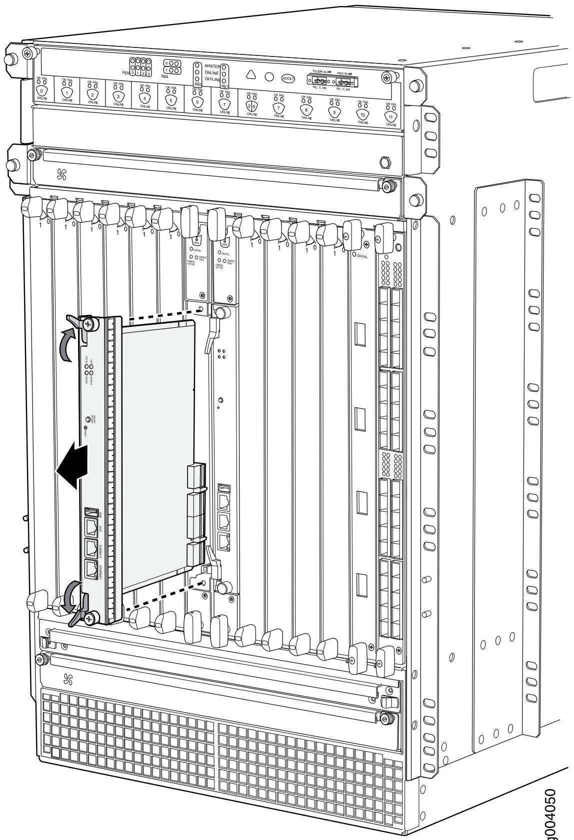


Figure 205: Removing a Routing Engine from an MX960 Router



Installing the Routing Engine RE-S-X6-64G

To install the Routing Engine RE-S-X6-64G:

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

2. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.

3. Place one hand underneath the Routing Engine to support it and carefully align the sides of the Routing Engine with the guides inside the opening on the Switch Control Board SCBE2.

   NOTE: The Routing Engine RE-S-X6-64G is supported only on the SCBE2. RE-S-X6-64G is not compatible with the SCB or the SCBE.

4. Slide the Routing Engine into the SCBE2 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. Tighten the captive screws on the top and bottom of the Routing Engine.

6. Connect the management device cables to the Routing Engine. After the Routing Engine is installed, the **ONLINE** LED starts blinking green slowly.

7. Replace the former primary Routing Engine, RE0, with the Routing Engine RE-S-X6-64G.

   NOTE: The Routing Engine RE-S-X6-64G is supported only on the SCBE2. RE-S-X6-64G is not compatible with the SCB or the SCBE.

The Routing Engine might require several minutes to boot. After the Routing Engine boots, verify that it is installed correctly by checking the **FAIL**, **RE0**, and **RE1** LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **ONLINE** LED on the Routing Engine lights steadily. If the red **FAIL** LED on the Routing Engine lights steadily instead, remove and install the Routing Engine again. If the red **FAIL** LED still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.

Figure 206: Installing a Routing Engine in an MX240 Router

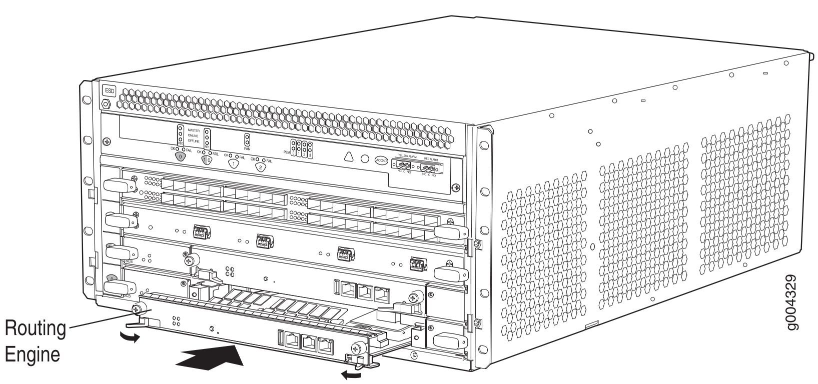


Figure 207: Installing a Routing Engine in an MX480 Router

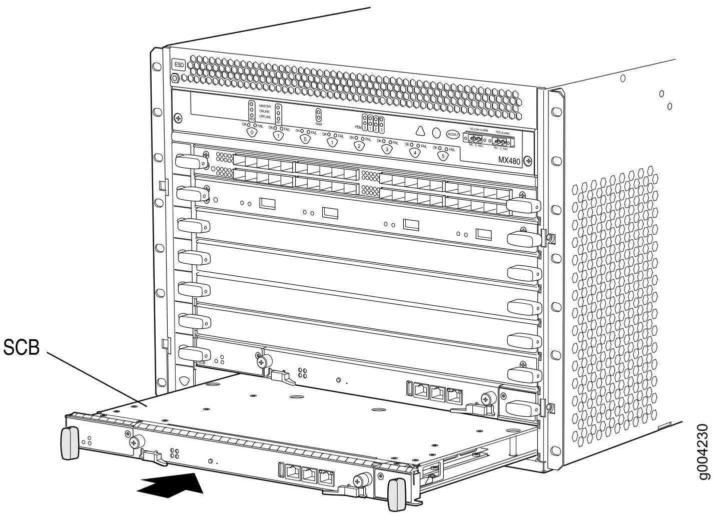
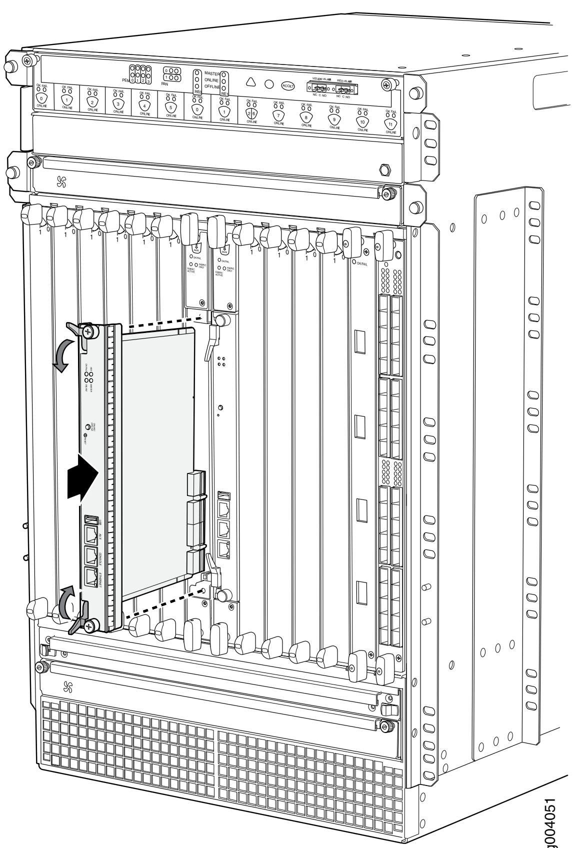


Figure 208: Installing a Routing Engine in an MX960 Router



Verifying and Configuring the Upgraded Routing Engine as the Primary

After replacing the backup Routing Engine with the RE-S-X6-64G Routing Engine, perform the following steps:

1. Verify that the SCBE2 and RE-S-X6-64G Routing Engine are online by issuing the **show chassis hardware** command.

2. After you install the RE-S-X6-64G Routing Engine into the SCBE2, the Routing Engine gets automatically powered on and comes up in *amnesiac* mode as it is loaded with factory defaults. After the Routing Engine comes up in *amnesiac* mode, load the base configuration and commit.

3. Configure the backup Routing Engine by using the **commit synchronize** command to copy the configuration to the backup Routing Engine.

4. Use the **request chassis routing-engine master switch** command to make the Routing Engine RE-S-X6-64G (RE1) the primary Routing Engine. All FPCs reboot after this step.

Verifying and Configuring the Upgraded Routing Engine as the Backup

1. Use the **request chassis routing-engine master switch** command to make newly installed RE-S-X6-64G (RE0) the backup Routing Engine.

2. Use the **commit synchronize** command to copy the active configuration from the primary Routing Engine to the backup Routing Engine.

RELATED DOCUMENTATION

RE-S-X6-64G Routing Engine Description

Upgrading to the RE-S-X6-64G Routing Engine in a Nonredundant Host Subsystem

In a nonredundant host subsystem, only one Routing Engine and one Switch Control Board are present in the chassis. When you are upgrading the Routing Engine, taking the host subsystem offline shuts down the router. To upgrade the host subsystem with the RE-S-X6-64G Routing Engine, you must uninstall the existing Routing Engine and install the RE-S-X6-64G Routing Engine. Ensure that the Switch Control Board in the chassis is SCBE2 because the RE-S-X6-64G Routing Engine is not compatible with the Switch Control

Boards SCB or SCBE. To upgrade the Switch Control Board to SCBE2, see *Upgrading an MX240 to Use the SCBE2-MX*, *Upgrading an MX480 to Use the SCBE2-MX*or “Upgrading an MX960 to Use the SCBE2-MX” on page 597, depending on the chassis on which the Routing Engine is being upgraded. .

> **NOTE:** Save the router configuration before proceeding with the Routing Engine upgrade.

Removing the Routing Engine

To remove the Routing Engine from the chassis:

1. On the external management device connected to the Routing Engine, shut down the host subsystem by using the **request system power-off** command.

2. Wait until a message appears on the console confirming that the operating system has halted.

3. Remove the cables connected to the Routing Engine.

4. Place an electrostatic bag or antistatic mat on a flat, stable surface. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

5. Verify that the Routing Engine LEDs are off. Loosen the captive screws on the top and bottom of the Routing Engine.

6. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.

7. Place one hand underneath the Routing Engine to support it, and slide it completely out of the chassis. 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.

Installing the Routing Engine RE-S-X6-64G

To install the new Routing Engine (RE-S-X6-64G):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

2. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.

3. Place one hand underneath the Routing Engine to support it and carefully align the sides of the Routing Engine with the guides inside the opening on the SCBE2.

   NOTE: The Routing Engine RE-S-X6-64G is supported only on the SCBE2. RE-S-X6-64G is not compatible with the SCB or the SCBE.

4. Slide the Routing Engine into the SCBE2 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. Tighten the captive screws on the top and bottom of the Routing Engine.

6. Connect the management device cables to the Routing Engine. After the Routing Engine is installed, the **ONLINE** LED starts blinking green slowly.

7. Verify that the SCBE2 and RE-S-X6-64G Routing Engine are online by issuing the **show chassis hardware** command.

8. After you install the RE-S-X6-64G Routing Engine into the SCBE2, the Routing Engine gets automatically powered on and comes up in *amnesiac* mode as it is loaded with factory defaults. After the Routing Engine comes up in *amnesiac* mode, load the base configuration and commit.

The Routing Engine might require several minutes to boot. After the Routing Engine boots, verify that it is installed correctly by checking the **FAIL**, **RE0**, and **RE1** LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **ONLINE** LED on the Routing Engine lights steadily. If the red **FAIL** LED lights steadily instead, remove the Routing Engine and reinstall it. If the red **FAIL** LED on the Routing Engine still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.

RELATED DOCUMENTATION

RE-S-X6-64G Routing Engine Description

Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem | **497**

CHAPTER 28

Replacing Line Card Components

IN THIS CHAPTER

Replacing an MX960 DPC

Removing an MX960 DPC

A DPC weighs up to 13.1 lb (5.9 kg). Be prepared to accept its full weight.

To remove a DPC (see Figure 209 on page 510):

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 ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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 CLI Explorer.

5. Disconnect the cables from the DPC.

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

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

   > **CAUTION:** Avoid bending a 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. Immediately cover each optical transceiver and the end of each fiber-optic cable with a rubber safety cap.

7. Arrange the disconnected cables in the standard or extended cable manager to prevent the cables from developing stress points.

8. Simultaneously turn both of the ejector handles counterclockwise to unseat the DPC.

9. Grasp the handles, and slide the DPC straight out of the card cage halfway.

10. 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.

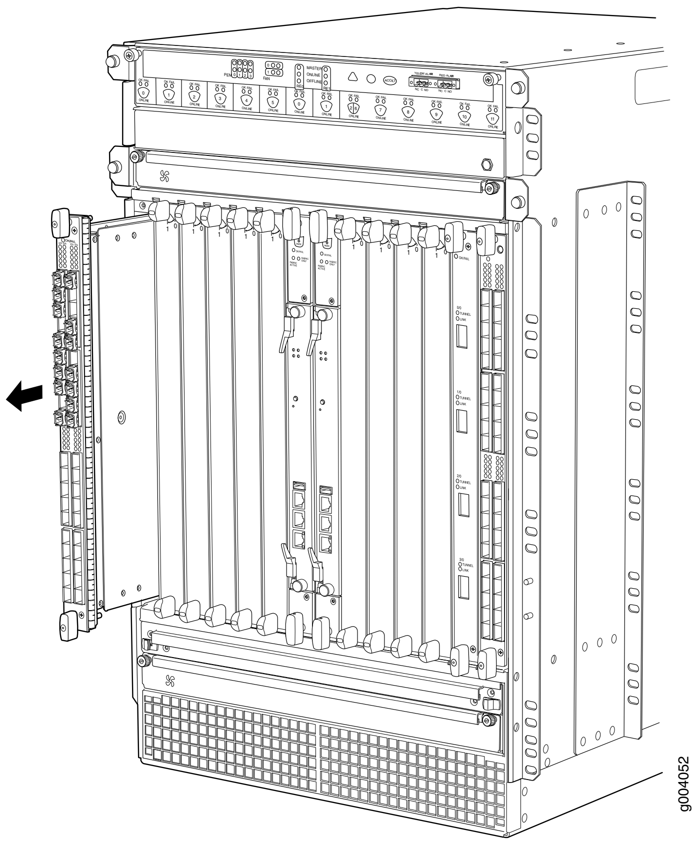
When the DPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

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.

11. 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 209: Removing a DPC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Holding an MX960 DPC | 618

Storing an MX960 DPC | 620

MX960 DPC Terminology

Installing an MX960 DPC | 412

Maintaining MX960 DPCs | 616

Troubleshooting the MX960 DPCs | 675

Installing an MX960 DPC

A DPC weighs up to 14.5 lb (6.6 kg). Be prepared to accept its full weight.

To install a DPC (see Figure 156 on page 414):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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. Remove the rubber safety cap from each fiber-optic 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 cables connected to a transceiver emit laser light that can damage your eyes.

10. Insert the cables into the cable connector ports on each DPC (see Figure 157 on page 414).

11. Arrange the cable 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.

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

> **CAUTION:** Avoid bending a 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.

12. 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 CLI Explorer.

> **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.

Figure 210: Installing a DPC

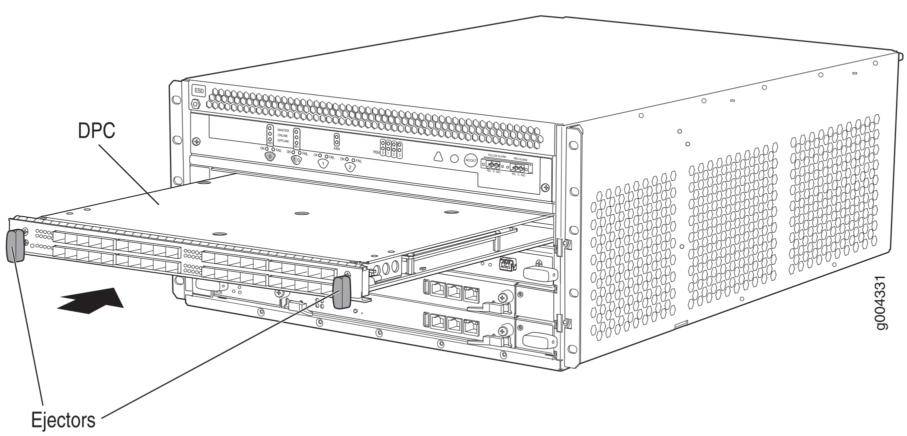
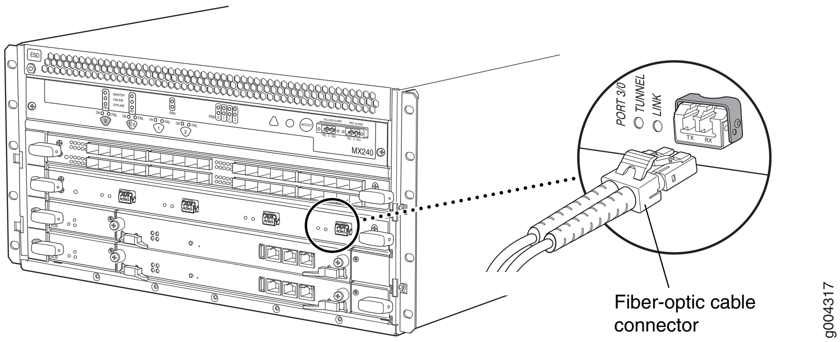


Figure 211: Attaching a Cable to a DPC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Holding an MX960 DPC | **618**

Storing an MX960 DPC | **620**

MX960 DPC Terminology

Removing an MX960 DPC | **507**

Maintaining MX960 DPCs | **616**

Troubleshooting the MX960 DPCs | **675**

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Holding an MX960 DPC | **618**

Storing an MX960 DPC | **620**

MX960 DPC Terminology

Maintaining MX960 DPCs | **616**

Troubleshooting the MX960 DPCs | **675**

Replacing an MX960 FPC

IN THIS SECTION

Removing an MX960 FPC

When you remove an FPC, the router continues to function, although the PIC interfaces installed on the FPC being removed no longer function.

An FPC takes up two DPC slots on the MX960 router. Up to six FPCs can be installed vertically in the front of the MX960 router. The FPCs are hot-insertable and hot-removable. An empty FPC3 weighs 14 lb (6.5 kg). A fully configured FPC can weigh up to 18 lb (8.2 kg). Be prepared to accept its full weight.

To remove an FPC (see Figure 212 on page 517):

1. Have ready a replacement FPC or FPC blank panel and an antistatic mat for the FPC. Also have ready rubber safety caps for each PIC using an optical interface on the FPC that you are removing.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Label the cables connected to each PIC on the FPC so that you can later reconnect the cables to the correct PICs.

4. Use one of the following methods to take the FPC offline:

   - Press and hold the FPC online/offline button. The green **OK** LED next to the button begins to blink. Hold the button down until the LED goes out. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.

   - Issue the following CLI command:

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

     For more information about the command, see the CLI Explorer.

NOTE: The slot number corresponds to the lowest numbered slot for which the FPC is installed.

5. Disconnect the cables from the PICs installed in the FPC.

   WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables 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 a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

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

6. If a PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap. Arrange the disconnected cables in the cable manager to prevent the cables from developing stress points.

7. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.

8. Grasp the handles, and slide the FPC straight out of the card cage halfway.

9. Place one hand around the front of the FPC (the PIC housing) and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.

CAUTION: The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 18 lb (8.2 kg)—as you slide the FPC out of the chassis.

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

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

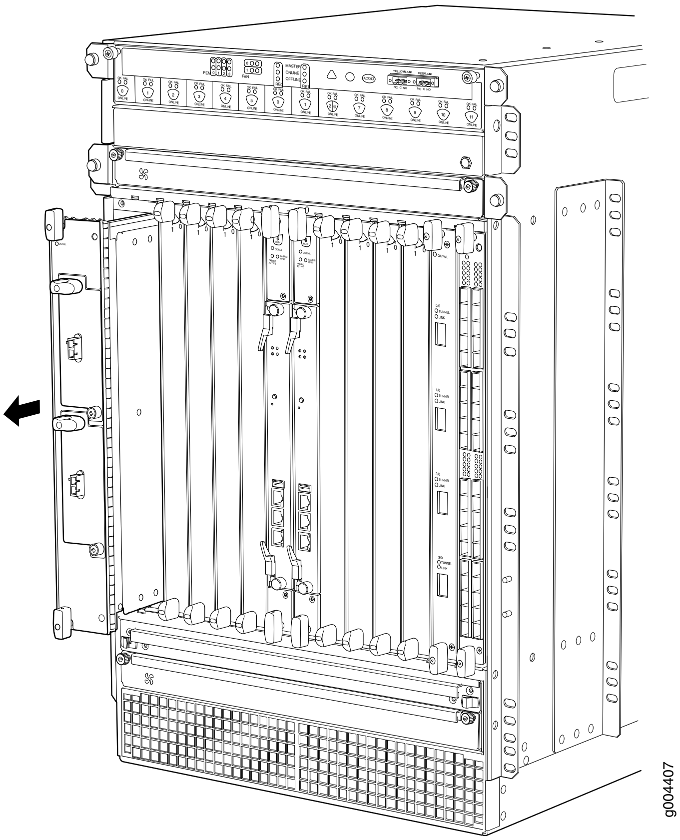
10. If necessary, remove each installed PIC from the FPC.

11. After you remove each PIC, immediately place it on an antistatic mat or in an electrostatic bag.

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

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

Figure 212: Removing an FPC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
Removing an MX960 PIC | 538
Maintaining MX960 FPCs | 621
Installing an MX960 FPC | 415
Holding an MX960 FPC | 624
Storing an MX960 FPC | 629

Installing an MX960 FPC

An FPC takes up two DPC slots on the MX960 router. Up to six FPCs can be installed vertically in the front of the router. The FPCs are hot-insertable and hot-removable. An empty FPC3 weighs 14 lb (6.5 kg). A fully configured FPC can weigh up to 18 lb (8.2 kg). Be prepared to accept its full weight.

To install an FPC (see Figure 158 on page 417):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Place the FPC on an antistatic mat.

3. Take each PIC to be installed in the replacement FPC out of its electrostatic bag, and identify the slot on the FPC where it will be connected.

4. Verify that each fiber-optic PIC has a rubber safety cap covering the PIC transceiver. If it does not, cover the transceiver with a safety cap.

5. Install each PIC into the appropriate slot on the FPC.

6. Locate the two slots in the card cage in which you plan to install the FPC.

7. Orient the FPC so that the faceplate faces you.

8. Lift the FPC into place, and carefully align the sides of the FPC with the guides inside the card cage.

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

9. Slide the FPC all the way into the card cage until you feel resistance.

10. Grasp both ejector handles, and rotate them clockwise simultaneously until the FPC is fully seated.

11. If any of the PICs on the FPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.

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

12. Insert the appropriate cable into the cable connector ports on each PIC on the FPC.

13. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

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

CAUTION: Avoid bending a 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.

14. Use one of the following methods to bring the FPC online:

- Press and hold the FPC online/offline button until the green **OK** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
- Issue the following CLI command:

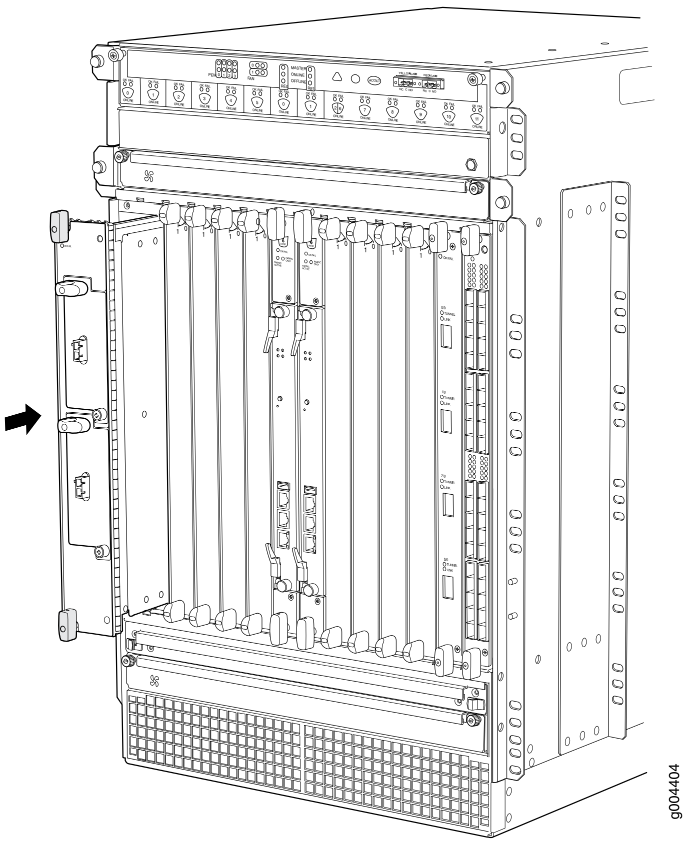
  `user@host>`**request chassis fpc slot** *`slot-number`* **online**

  For more information about the command, see the CLI Explorer.

CAUTION: After the **OK** LED lights steadily, wait at least 30 seconds before removing the FPC again, removing an FPC from a different slot, or inserting an FPC in a different slot.

You can also verify correct FPC and PIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands described in "Maintaining MX960 FPCs" on page 621 and "Maintaining MX960 PICs" on page 634.

Figure 213: Installing an FPC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 PIC | **428**

Removing an MX960 FPC | **514**

Maintaining MX960 FPCs | **621**

Holding an MX960 FPC | **624**

Storing an MX960 FPC | **629**

RELATED DOCUMENTATION

Replacing an MX960 MIC

Removing an MX960 MIC

MICs are hot-insertable and hot-removable. When you remove a MIC, the router continues to function, although the MIC interfaces being removed no longer function.

The MICs are located in the MPCs installed in the front of the router. A MIC weighs less than 2 lb (0.9 kg).

To remove a MIC (see Figure 214 on page 523 and Figure 215 on page 524):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the MIC. If the MIC connects to fiber-optic cable, have ready a rubber safety cap for each transceiver and cable.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Use one of the following methods to take the MIC offline:

   - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED goes off.
   - Issue the following CLI command:

     `user@host>` **request chassis mic fpc-slot *mpc-slot* mic-slot *mic-slot* offline**

     For more information about the command, see the CLI Explorer.

4. Label the cables connected to the MIC so that you can later reconnect each cable to the correct MIC.

5. Disconnect the cables from the MIC. If the MIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.

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

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

6. Arrange the cable 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.

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

7. On the MPC, pull the ejector lever that is adjacent to the MIC you are removing away from the MPC faceplate. This disconnects the MIC from the MPC.

   NOTE: To remove a dual-wide MIC that takes up both MIC slots, you must pull both ejector levers away from the MPC faceplate.

8. Grasp the handles on the MIC faceplate, and slide the MIC out of the MPC card carrier. Place it in the electrostatic bag or on the antistatic mat.

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

Figure 214: Removing a MIC

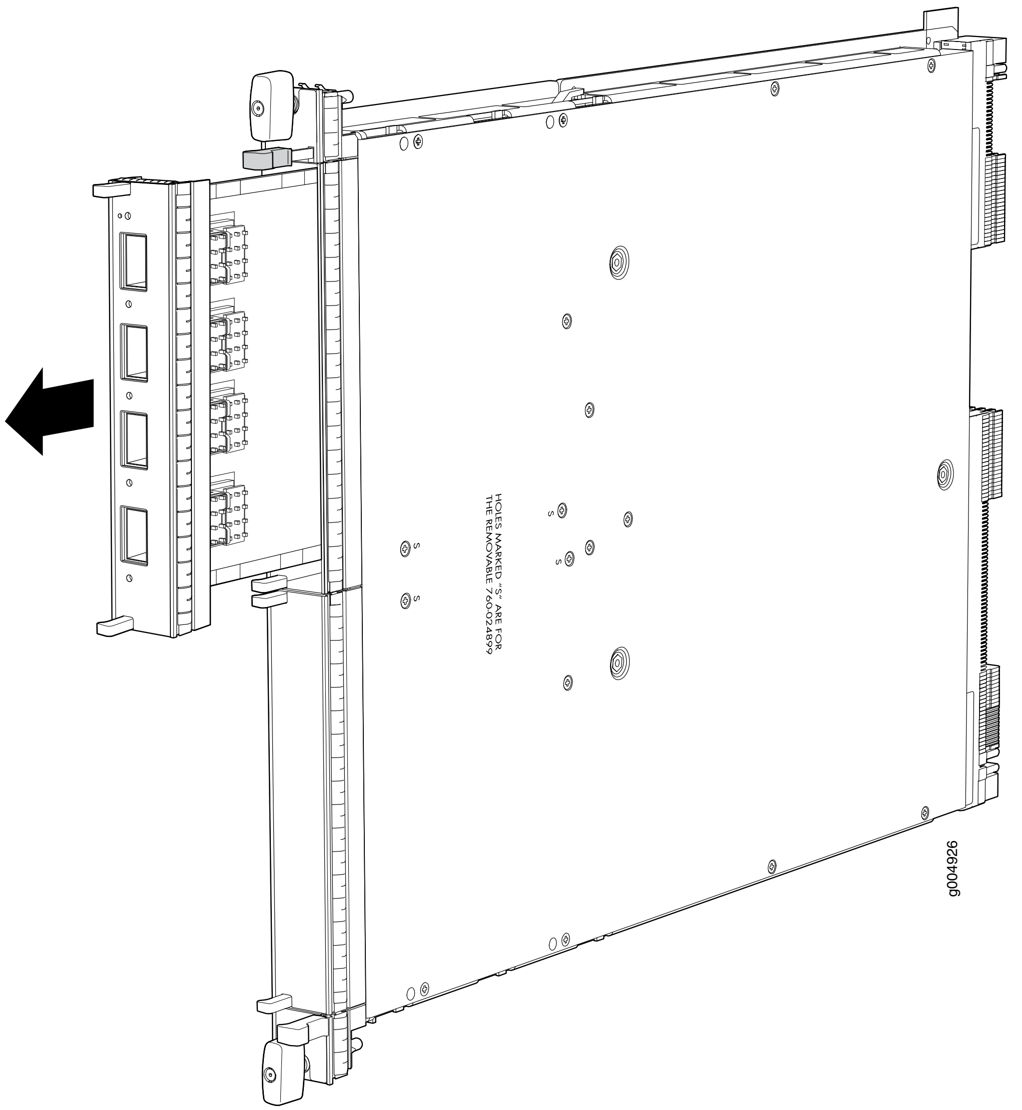
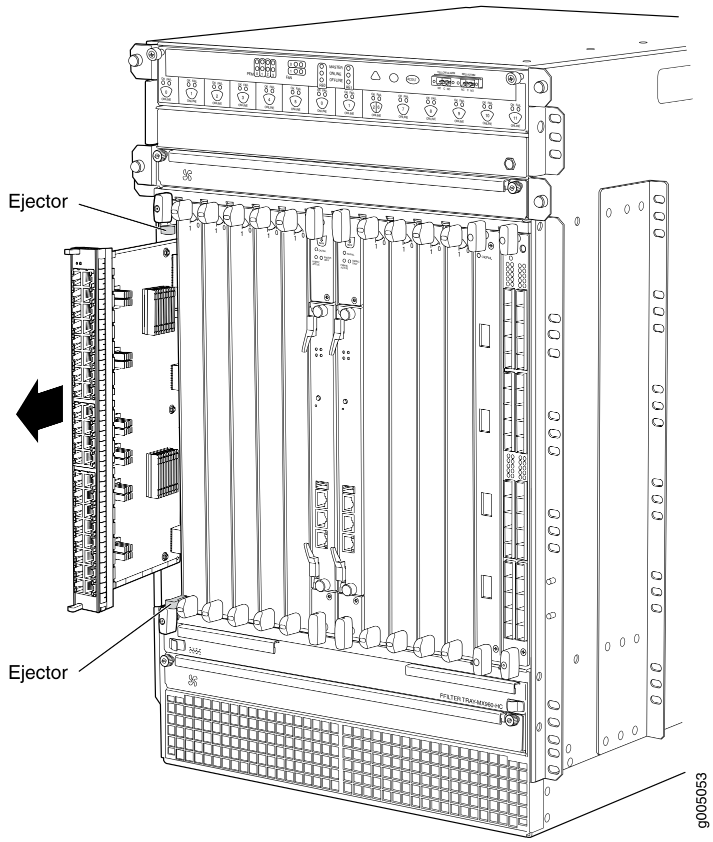


Figure 215: Removing a Dual-Wide MIC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 MIC

To install a MIC (see Figure 160 on page 420):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. If you have used a dual-wide MIC and are now replacing it with two “single” MICs, install the septum (see Figure 159 on page 418):

   a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in “Removing an MX960 MPC” on page 532).

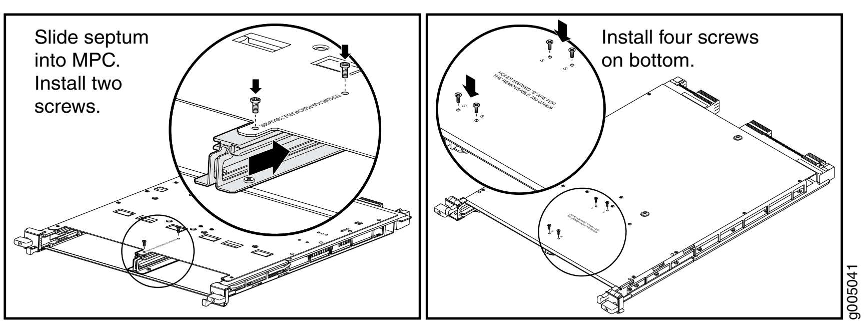
   b. Position the septum in the center of the MPC so that it lines up with holes labeled **S** on the top of the MPC.

   c. Insert a screw into each of the two holes labeled **S**, and then tighten completely.

   d. On the bottom of the MPC, insert a screw into each of the four holes labeled **S**, and then tighten completely.

   e. Install the MPC as described in “Installing an MX960 MPC” on page 425.

Figure 216: Installing the Septum



3. If the MIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.

4. On the MPC, pull the ejector lever that is adjacent to the MIC you are installing away from the MPC faceplate.

5. Align the rear of the MIC with the guides located at the corners of the MIC slot.

6. Slide the MIC into the MPC until it is firmly seated in the MPC.

   CAUTION: Slide the MIC straight into the slot to avoid damaging the components on the MIC.

7. Verify that the ejector lever is engaged by pushing it towards the MPC faceplate.

8. If the MIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.

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

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

9. Insert the appropriate cables into the cable connectors on the MIC.

10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.

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

    CAUTION: Avoid bending a 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 MIC online:

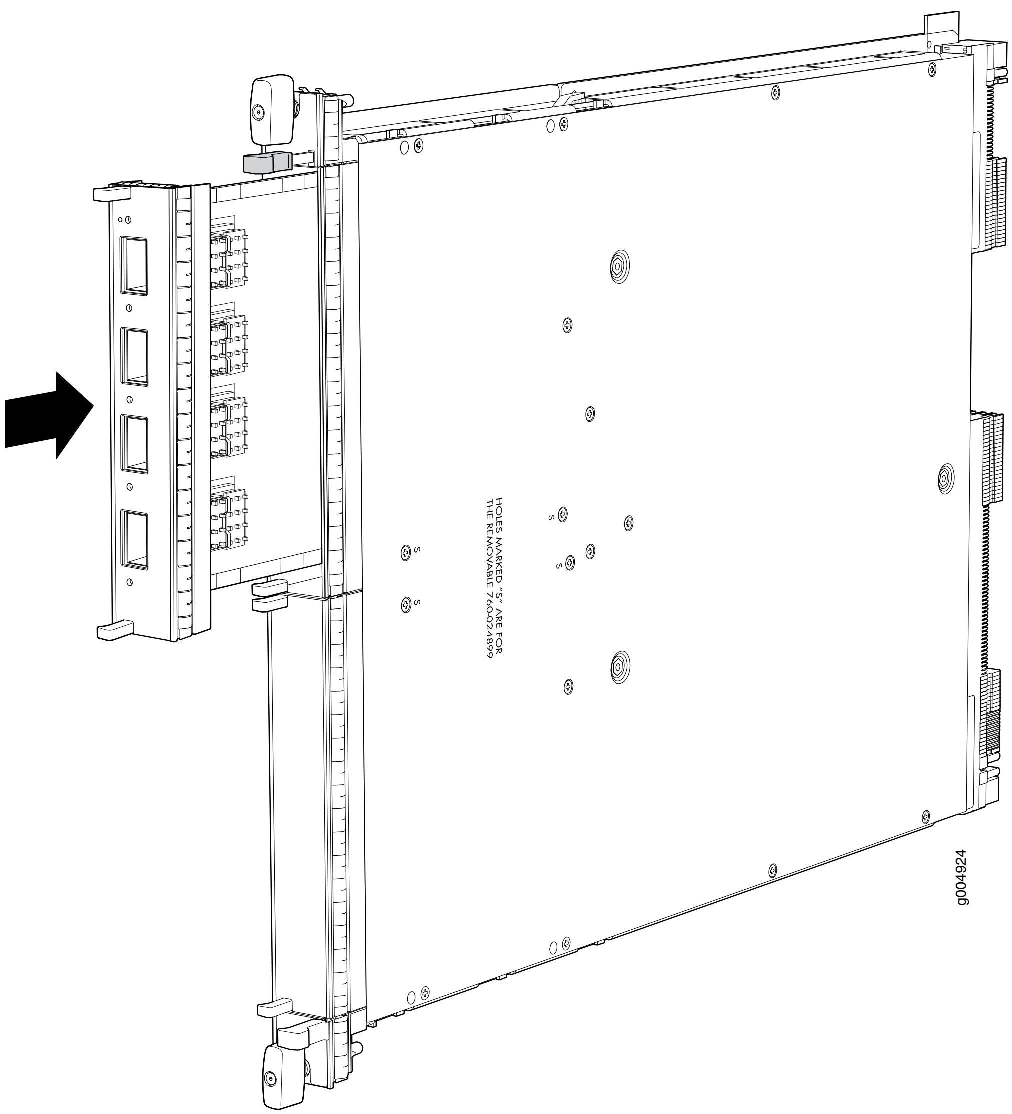
- Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED lights green.
- Issue the following CLI command:

  `user@host>` **request chassis mic fpc-slot *mpc-slot* mic-slot *mic-slot* online**

  For more information about the command, see the CLI Explorer.

The normal functioning status LED confirms that the MIC is online. You can also verify correct MIC functioning by issuing the **show chassis fpc pic-status** command described in "Maintaining MX960 MICs" on page 630.

Figure 217: Installing a MIC



SEE ALSO

Installing an MX960 Dual-Wide MIC

To install a dual-wide MIC (see Figure 162 on page 424):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Remove the septum, if necessary (see Figure 161 on page 422):

   a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in "Removing an MX960 MPC" on page 532).

   b. Remove the four screws labeled **S** on the bottom of the MPC.

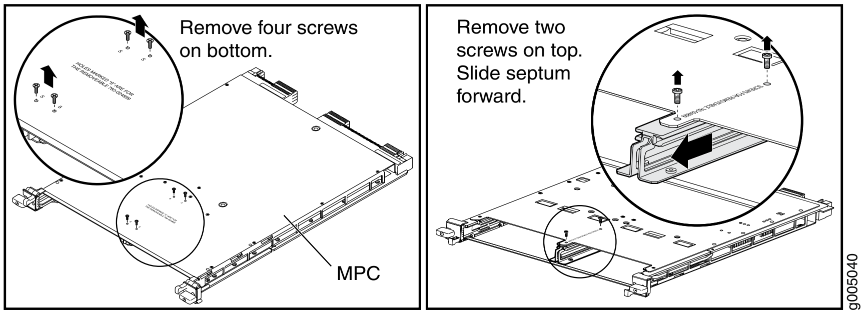
   c. Remove the two screws labeled **S** on the top of the MPC.

   d. Slide the septum towards you and out of the MPC.

   e. Store the septum and screws for later use.

   f. Install the MPC as described in "Installing an MX960 MPC" on page 425.

Figure 218: Removing the Septum



3. If the MIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.

4. Pull the ejector lever above both MIC slots away from the router.

5. Align the rear of the MIC with the guides located at the corners of the MIC slot.

6. Slide the MIC into the MIC slot until it is firmly seated in the chassis.

> **CAUTION:** Slide the MIC straight into the slot to avoid damaging the components on the MIC.

7. Verify that the ejector levers are engaged by pushing them toward the router.

8. If the MIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.

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

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

9. Insert the appropriate cables into the cable connectors on the MIC.

10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.

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

    CAUTION: Avoid bending a 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.

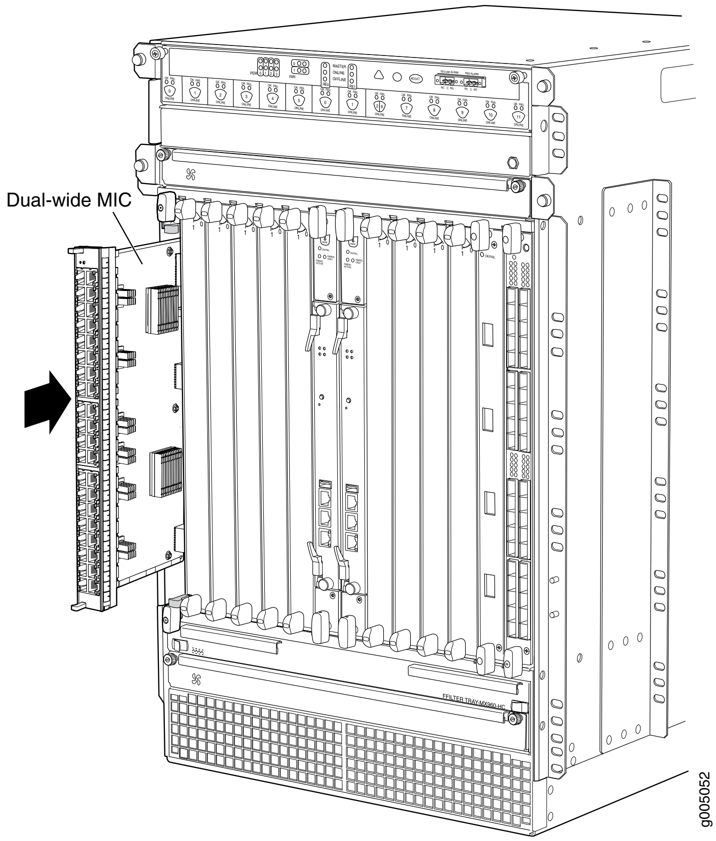
11. Use one of the following methods to bring the MIC online:

    - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED lights green.
    - Issue the following CLI command:

      `user@host>` **request chassis mic fpc-slot *mpc-slot* mic-slot *mic-slot* online**

    The normal functioning status LED confirms that the MIC is online. You can also verify correct MIC functioning by issuing the **show chassis fpc pic-status** command described in "Maintaining MX960 MICs" on page 630.

Figure 219: Installing a Dual-Wide MIC



SEE ALSO

MX960 Modular Interface Card Description | 93

Maintaining MX960 MICs | 630

Troubleshooting the MX960 MICs | 680

Removing an MX960 MPC | 532

Removing an MX960 MIC | 521

Preventing Electrostatic Discharge Damage to an MX960 Router

RELATED DOCUMENTATION

MX960 Modular Interface Card Description | 93

Maintaining MX960 MICs | 630

Troubleshooting the MX960 MICs | 680

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing an MX960 MPC

Removing an MX960 MPC

When you remove an MPC, the router continues to function, although the MIC interfaces installed on the MPC being removed no longer function.

An MPC installs vertically in the front of the router. The MPCs are hot-insertable and hot-removable. A fully configured MPC can weigh up to 18.35 lb (8.3 kg). Be prepared to accept its full weight.

To remove an MPC (see Figure 220 on page 534):

1. Have ready a replacement MPC or DPC blank panel and an antistatic mat for the MPC. Also have ready rubber safety caps for each MIC using an optical interface on the MPC that you are removing.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Label the cables connected to each MIC on the MPC so that you can later reconnect the cables to the correct MICs.

4. Use one of the following methods to take the MPC offline:

   - Press and hold the corresponding online button on the craft interface. The green **OK/FAIL** 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 CLI Explorer.

5. Disconnect the cables from the MICs installed in the MPC.

WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables 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 a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

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

6. If a MIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.

7. Arrange the disconnected cables in the cable manager to prevent the cables from developing stress points.

8. Simultaneously turn both the ejector handles counterclockwise to unseat the MPC.

9. Grasp the handles, and slide the MPC straight out of the card cage halfway.

10. Place one hand around the front of the MPC (the MIC housing) and the other hand under it to support it. Slide the MPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.

CAUTION: The weight of the MPC is concentrated in the back end. Be prepared to accept the full weight—up to 18.35 lb (8.3 kg)—as you slide the MPC out of the chassis.

When the MPC 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 MPCs 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.

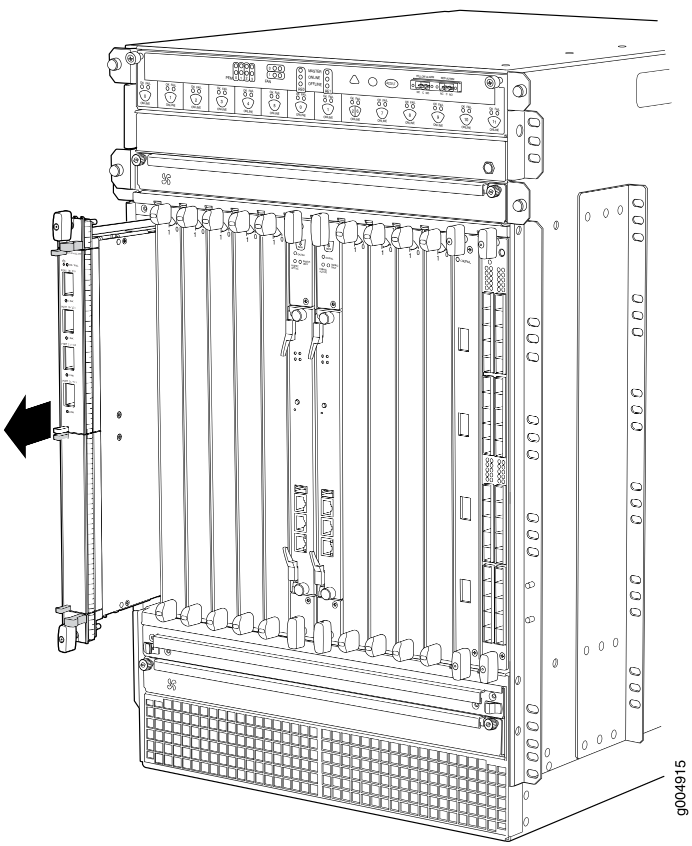
11. If necessary, remove each installed MIC from the MPC.

12. After you remove each MIC, immediately place it on an antistatic mat or in an electrostatic bag.

13. If you are not reinstalling an MPC into the emptied line card slots within a short time, install a blank DPC panel over each slot to maintain proper airflow in the card cage.

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

Figure 220: Removing an MPC



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 Modular Port Concentrator Description | 108

Installing an MX960 MPC

An MPC installs vertically in the front of the router. The MPCs are hot-insertable and hot-removable. A fully configured MPC can weigh up to 18.35 lb (8.3 kg). Be prepared to accept its full weight.

To install an MPC (see Figure 163 on page 427):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Place the MPC on an antistatic mat.

3. Take each MIC to be installed in the replacement MPC out of its electrostatic bag, and identify the slot on the MPC where it will be connected.

4. Verify that each fiber-optic MIC has a rubber safety cap covering the MIC transceiver. If it does not, cover the transceiver with a safety cap.

5. Install each MIC into the appropriate slot on the MPC.

6. Locate the slot in the card cage in which you plan to install the MPC.

7. Orient the MPC so that the faceplate faces you.

8. Lift the MPC into place, and carefully align the sides of the MPC with the guides inside the card cage.

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

9. Slide the MPC all the way into the card cage until you feel resistance.

10. Grasp both ejector handles, and rotate them clockwise simultaneously until the MPC is fully seated.

11. If any of the MICs on the MPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.

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

12. Insert the appropriate cable into the cable connector ports on each MIC on the MPC. 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 cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

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

13. Use one of the following methods to bring the MPC online:

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

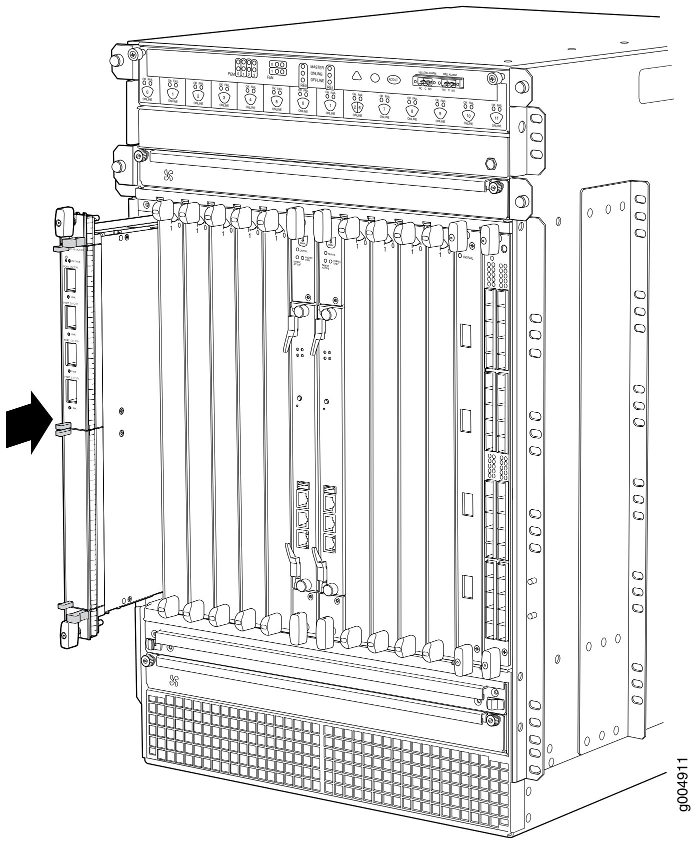
  `user@host>`**request chassis fpc slot** *`slot-number`* **online**

  For more information about the command, see the CLI Explorer.

> **CAUTION:** After the **OK/FAIL** LED lights steadily, wait at least 30 seconds before removing the MPC again, removing an MPC from a different slot, or inserting an MPC in a different slot.

You can also verify correct MPC and MIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands described in “Maintaining MX960 MPCs” on page 631 and “Maintaining MX960 MICs” on page 630.

Figure 221: Installing an MPC



SEE ALSO

- *Preventing Electrostatic Discharge Damage to an MX960 Router*
- MX960 Modular Port Concentrator Description | **108**
- Removing an MX960 MPC | **532**
- Installing an MX960 MIC | **418**.
- Maintaining MX960 MPCs | **631**
- Troubleshooting the MX960 MPCs | **682**

RELATED DOCUMENTATION

- *Preventing Electrostatic Discharge Damage to an MX960 Router*
- MX960 Modular Port Concentrator Description | **108**
- Replacing an MX960 MIC | **521**.

Replacing an MX960 PIC

IN THIS SECTION

Removing an MX960 PIC

PICs are hot-insertable and hot-removable. When you remove a PIC, the router continues to function, although the PIC interfaces being removed no longer function.

The PICs are located in the FPCs installed in the front of the router. A PIC weighs less than 2 lb (0.9 kg).

To remove a PIC (see Figure 222 on page 540):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the PIC. If the PIC connects to fiber-optic cable, have ready a rubber safety cap for each transceiver and cable.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Use one of the following methods to take the PIC offline:

   - Press its online/offline button. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the PIC LED goes out (about 5 seconds).

   - Issue the following CLI command:

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

     For more information about the command, see the CLI Explorer.

4. Label the cables connected to the PIC so that you can later reconnect each cable to the correct PIC.

5. Disconnect the cables from the PIC. If the PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.

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

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

6. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

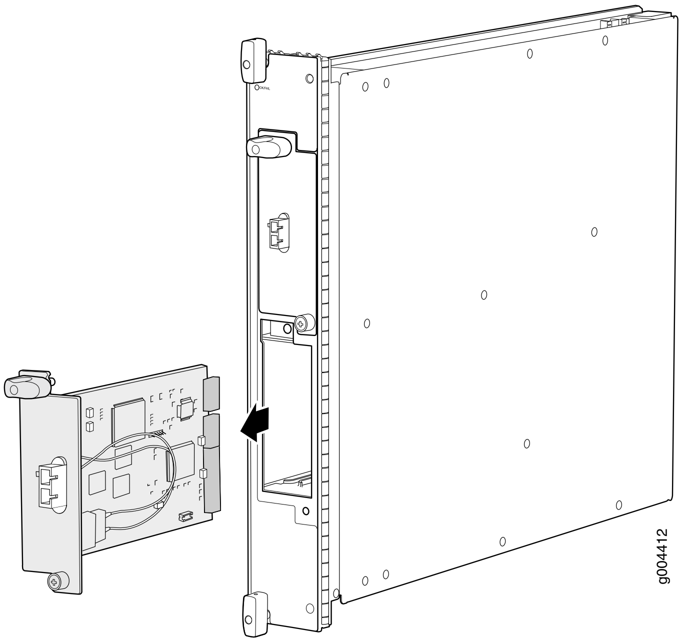
   CAUTION: Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

7. For an FPC3 PIC, loosen the captive screw at the bottom of the PIC faceplate, then twist the ejector handle at the top of the faceplate counterclockwise to unseat the PIC.

8. Slide the PIC out of the FPC card carrier and place it in the electrostatic bag or on the antistatic mat.

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

Figure 222: Removing a PIC



SEE ALSO

MX960 PIC Description | 72

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing an MX960 PIC | 428

Troubleshooting the MX960 PICs | 680

Maintaining MX960 PICs | 634

MX960 PIC Serial Number Label | 706

Installing an MX960 PIC

To install a PIC (see Figure 164 on page 430):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. If the PIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.

3. Align the notches in the connector at the rear of the PIC with the notches in the PIC slot in the FPC and then slide the PIC in until it lodges firmly in the FPC.

CAUTION: Slide the PIC straight into the slot to avoid damaging the components on the bottom of the PIC.

4. For an FPC3 PIC, turn the ejector handle at the top of the PIC faceplate clockwise, then tighten the captive screw at the bottom of the faceplate to secure the PIC in the FPC.

5. If the PIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.

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

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

6. Insert the appropriate cables into the cable connectors on the PIC.

7. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

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

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

8. Use one of the following methods to bring the PIC online:

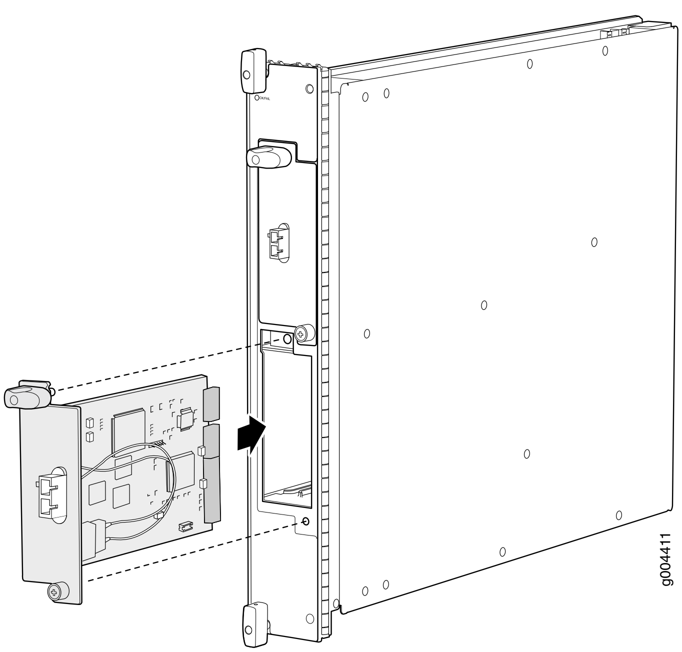
   - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.
   - Issue the following CLI command:

     `user@host>` **request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **online**

     For more information about the command, see the CLI Explorer.

   The normal functioning status LED confirms that the PIC is online. You can also verify correct PIC functioning by issuing the **show chassis fpc pic-status** command described in "Maintaining MX960 PICs" on page 634.

Figure 223: Installing a PIC



SEE ALSO

RELATED DOCUMENTATION

Replacing a Cable on an MX960 DPC, MPC, MIC, or PIC

IN THIS SECTION

Removing a Cable on an MX960 DPC, MPC, MIC, or PIC

Removing and installing cables on a DPC, MPC, MIC, or PIC does not affect router function, except that the component does not receive or transmit data while its cable is disconnected.

To remove a fiber-optic cable:

1. If the component connects to fiber-optic cable, have ready a rubber safety cap for each cable and transceiver.

2. If removing all cables connected to the component, use one of the following methods to take the component offline:

   - To take a DPC or an MPC offline:

     - Press and hold the corresponding 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 CLI Explorer.

   - To take a PIC offline:

     - Press the online/offline button on the PIC. For a PIC installed in an FPC3, use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the PIC LED goes out (about 5 seconds).

     - Issue the following CLI command:

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

       For more information about the command, see the CLI Explorer.

   - To take a MIC offline:

     - Press the online/offline button on the MIC. Use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the MIC LED goes off (about 5 seconds).

     - Issue the following CLI command:

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

       For more information about the command, see the CLI Explorer.

3. Unplug the cable from the cable connector port. If the PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.

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

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

4. Remove the cable from the cable manager and detach it from the destination port.

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Installing a Cable on an MX960 DPC, MPC, MIC, or PIC | **430**

Replacing an MX960 PIC | **538**

Replacing an SFP or XFP Transceiver on an MX960 DPC, MPC, MIC, or PIC | **547**

Installing a Cable on an MX960 DPC, MPC, MIC, or PIC

To install a cable:

1. Have ready a length of the type of cable used by the component. For cable specifications, see the *MX Series Interface Module Reference*.

2. If the cable connector port is covered by a rubber safety cap, remove the cap.

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

> **CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are 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 component faceplate.

4. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

   CAUTION: Avoid bending a 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 cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

5. Insert the other end of the cable into the destination port.

6. Repeat the previous steps for any additional cables.

7. If the component is offline (its failure indicator LED is lit), use one of the following methods to bring it online.

   - To bring a DPC or MPC online:
     - Press and hold the corresponding 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 CLI Explorer.

   - To bring a PIC online:
     - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.
     - Issue the following CLI command:

       `user@host>`**request chassis pic fpc-slot** *`fpc-slot`* **pic-slot** *`pic-slot`* **online**

       For more information about the command, see the CLI Explorer.

- To bring a MIC online:
  - Press the MIC offline/online button until the MIC LED lights green.
  - Issue the following CLI command:

    `user@host>`**request chassis mic fpc-slot** *`mpc-slot`* **pic-slot** *`mic-slot`* **online**

    For more information about the command, see the CLI Explorer.

The normal functioning indicator LED confirms that the component is online. You can also verify correct DPC or MPC functioning by issuing the **show chassis fpc** command or the correct PIC or MIC functioning by issuing the **show chassis fpc pic-status** command.

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Removing a Cable on an MX960 DPC, MPC, MIC, or PIC | **544**

Maintaining Cables That Connect to MX960 DPCs, MPCs, MICs, or PICs | **635**

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Replacing an MX960 PIC | **538**

Replacing an MX960 DPC | **507**

Replacing an SFP or XFP Transceiver on an MX960 DPC, MPC, MIC, or PIC | **547**

Replacing an SFP or XFP Transceiver on an MX960 DPC, MPC, MIC, or PIC

Small form-factor pluggable (SFPs) and XFPs are optical transceivers that are installed in a DPC or PIC. SFPs and XFPs are hot-insertable and hot-removable.

Removing an SFP or XFP Transceiver from an MX960 DPC, MPC, MIC, or PIC

Removing an SFP or XFP does not interrupt DPC, MPC, MIC, or PIC functioning, but the removed SFP or XFP no longer receives or transmits data.

To remove an SFP or XFP transceiver (see Figure 224 on page 549):

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 grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

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 ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

4. Remove the cable connector from the transceiver.

5. Pull the ejector handle out from the transceiver to unlock the transceiver.

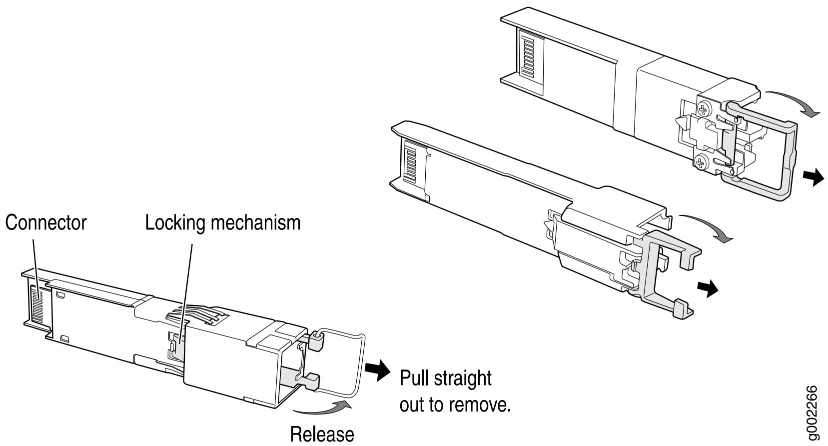
   CAUTION: Make sure that you open the ejector handle completely until you hear it click. This prevents damage to the transceiver.

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

6. Grasp the transceiver ejector handle, and pull the transceiver approximately 0.5 in. (1.3 cm) out of the DPC, MPC, MIC, or PIC.

7. Using your fingers, grasp the body of the transceiver, and pull it the rest of the way out of the DPC, MPC, MIC, or PIC.

Figure 224: Removing SFPs or XFPs



8. Place a rubber safety cap over the transceiver.

9. Place the removed transceiver on an antistatic mat or in an electrostatic bag.

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

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC | 447
Replacing an MX960 PIC | 538
Replacing an MX960 DPC | 507

Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC

To install an SFP or XFP:

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Take each transceiver to be installed out of its electrostatic bag, and identify the slot on the component 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 component. The connectors should face the component.

5. Slide the transceiver until the connector is seated in the component 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.

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

8. Verify that the status LEDs on the component faceplate indicate that the SFP or XFP is functioning correctly. For more information about the component LEDs, see the *MX Series Interface Module Reference*.

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
Removing an SFP or XFP Transceiver from an MX960 DPC, MPC, MIC, or PIC | **548**
Replacing an MX960 PIC | **538**
Replacing an MX960 DPC | **507**

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router
Replacing an MX960 PIC | **538**
Replacing an MX960 DPC | **507**

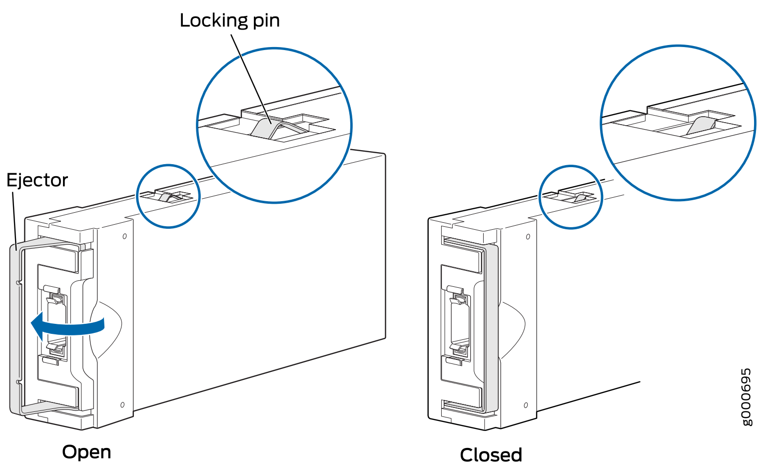
Replacing a CFP2 Transceiver

IN THIS SECTION

Removing a CFP2 Transceiver

C form-factor pluggables (CFPs) are transceivers that can be removed from a PIC. CFP2 transceivers are hot-insertable and hot-removable. Removing a CFP2 transceiver does not interrupt PIC functioning, but the removed CFP2 transceiver no longer receives or transmits data.

Figure 225: Form-Factor Pluggable (CFP2)



To remove a CFP2 transceiver (see Figure 173 on page 449):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the CFP transceiver. Have ready a rubber safety cap for the CFP2 transceiver and the cable.

2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

3. Label the cable connected to the CFP2 transceiver so that you can later reconnect it to the correct CFP2 transceiver.

4. Disconnect the cable from the CFP2 transceiver. Immediately cover the transceiver and the end of the cable with a rubber safety cap.

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

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

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

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

6. Pull the ejector latch to the extreme end away from the CFP2 transceiver faceplate to unseat the CFP2 transceiver from the PIC. Pull the CFP2 transceiver out of the PIC and place it on the antistatic mat or in the electrostatic bag.

   NOTE: You cannot remove the transceiver until you move the ejector latch to the extreme end.

Installing a CFP2 Transceiver

To install a replacement CFP2:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Verify that a rubber safety cap covers the CFP transceiver, installing one if necessary.

3. Orient the CFP2 over the port in the PIC so that the connector end will enter the slot first and the CFP2 connector faces the appropriate direction.

4. Slide the CFP2 into the slot. If there is resistance, remove the CFP2 and flip it so that the connector faces the other direction.

5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.

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

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

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

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

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

7. Verify that the status LEDs on the PIC faceplate indicate that the CFP2 is functioning correctly. You can also verify PIC functioning by issuing the **show chassis fpc pic-status** command.

Replacing a CFP Transceiver

IN THIS SECTION

C form-factor pluggable (CFP) transceivers are hot-insertable and hot-removable. Removing a transceiver does not interrupt line card functioning, but the removed transceiver no longer receives or transmits data.

You can use the Hardware Compatibility Tool to find information about the pluggable transceivers supported on your Juniper Networks device.

Removing a CFP Transceiver

To remove a CFP transceiver:

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the CFP transceiver. Have ready a rubber safety cap for the CFP transceiver and the cable.

2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to the ESD point on the chassis.

3. Label the cable connected to the CFP transceiver so that you can later reconnect it to the correct CFP transceiver.

4. Disconnect the cable from the CFP transceiver. Immediately cover the transceiver and the end of the cable with a rubber safety cap.

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

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

5. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor.

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

6. Unscrew the screws from the CFP transceiver faceplate to unseat the CFP transceiver from the line card. Pull the CFP transceiver out of the line card and place it on the antistatic mat or in the electrostatic bag.

Installing a CFP Transceiver

To install a replacement CFP transceiver:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to the ESD point on the chassis.

2. Verify that a rubber safety cap covers the CFP transceiver, installing one if necessary.

3. Orient the CFP over the port in the line card so that the connector end will enter the slot first and the CFP connector faces the appropriate direction.

4. Slide the CFP into the slot. If there is resistance, remove the CFP and flip it so that the connector faces the other direction.

5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.

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

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

6. Arrange the cable in the cable management system to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor.

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

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

7. Verify that any status LEDs on the line card faceplate indicate that the CFP is functioning correctly. For more information about the line card LEDs, see the *MX Series 5G Universal Routing Platform Interface Module Reference*. You can also verify line card functioning by issuing the **show chassis fpc pic-status** command.

RELATED DOCUMENTATION

MICs Supported by MX Series Routers | 94
MPCs Supported by MX Series Routers | 112

CHAPTER 29

Replacing Power System Components

IN THIS CHAPTER

Replacing an MX960 AC or High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply

Removing an MX960 AC or High-Voltage Second-Generation Universal (HVAC or HVDC) Power Supply

Before you remove a power supply, be aware of the following:

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

CAUTION: 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.

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

To remove an AC or universal (HVAC/HVDC) power supply (see Figure 226 on page 559):

1. Switch off the dedicated customer site circuit breaker for the power supply, and remove the power cord from the power source. If there is more than one cord, remove both. Follow the ESD and disconnection instructions for your site.

   NOTE: If removing a universal (HVAC/HVDC) power supply from a DC source, 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. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Move the AC input switch in the chassis above the power supply to the off (**O**) position.

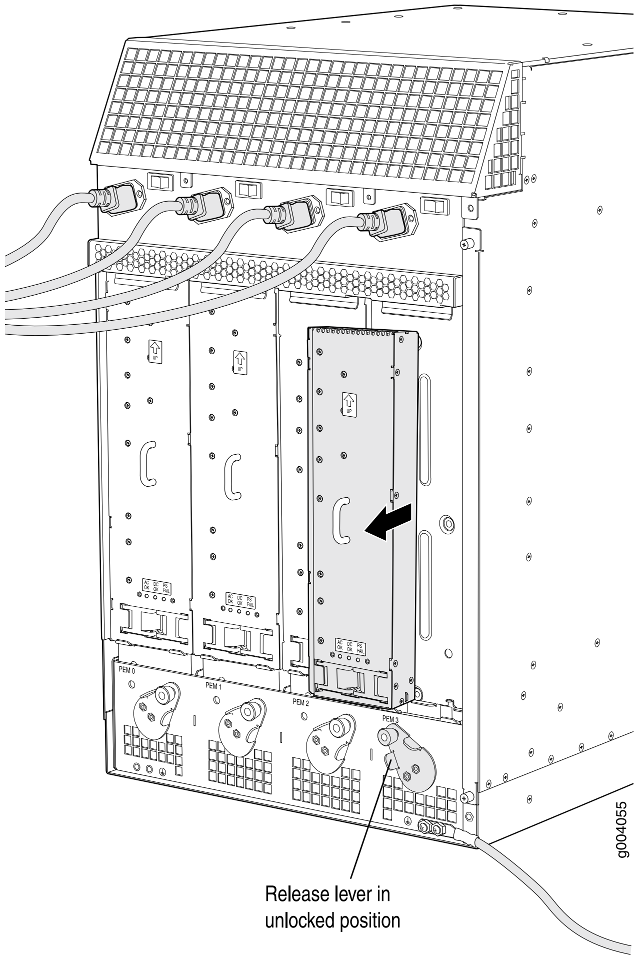
4. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.

5. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

6. Pull the power supply straight out of the chassis.

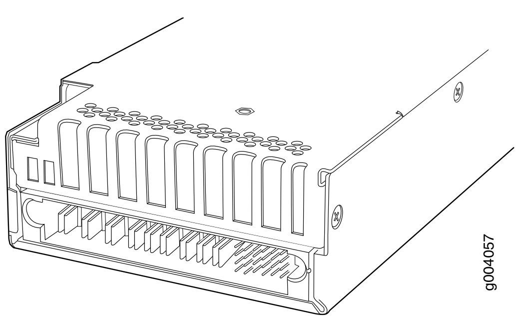
   WARNING: Do not touch the power connector on the top of the power supply (see Figure 227 on page 559). It can contain dangerous voltages.

Figure 226: Removing a AC Power Supply



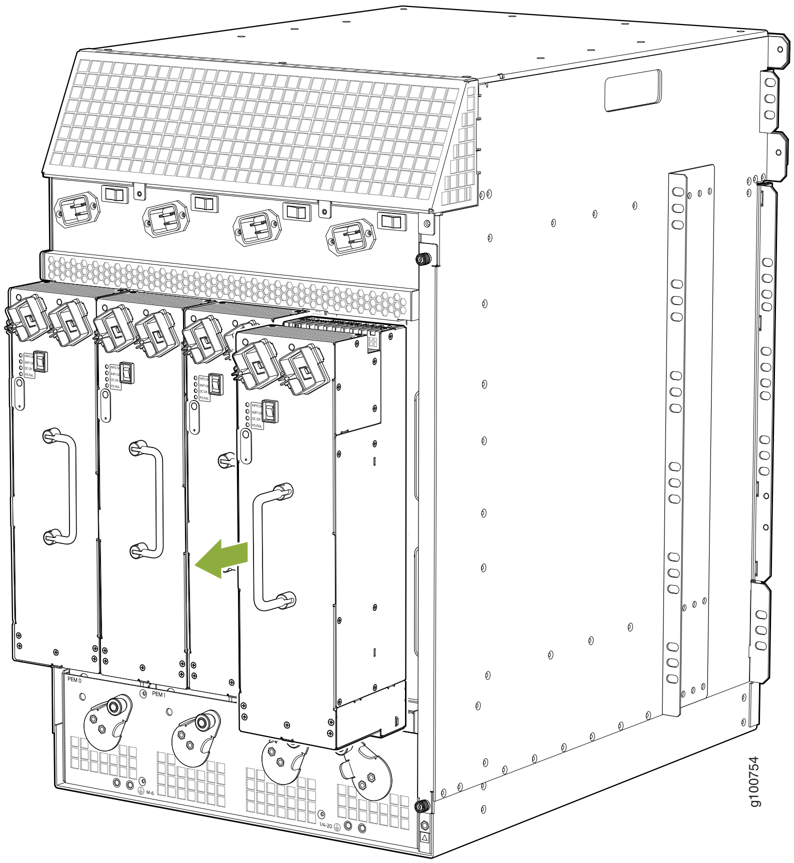
NOTE: The chassis is shown without the extended cable manager.

Figure 227: Top of the PowerSupply Showing Midplane Connector



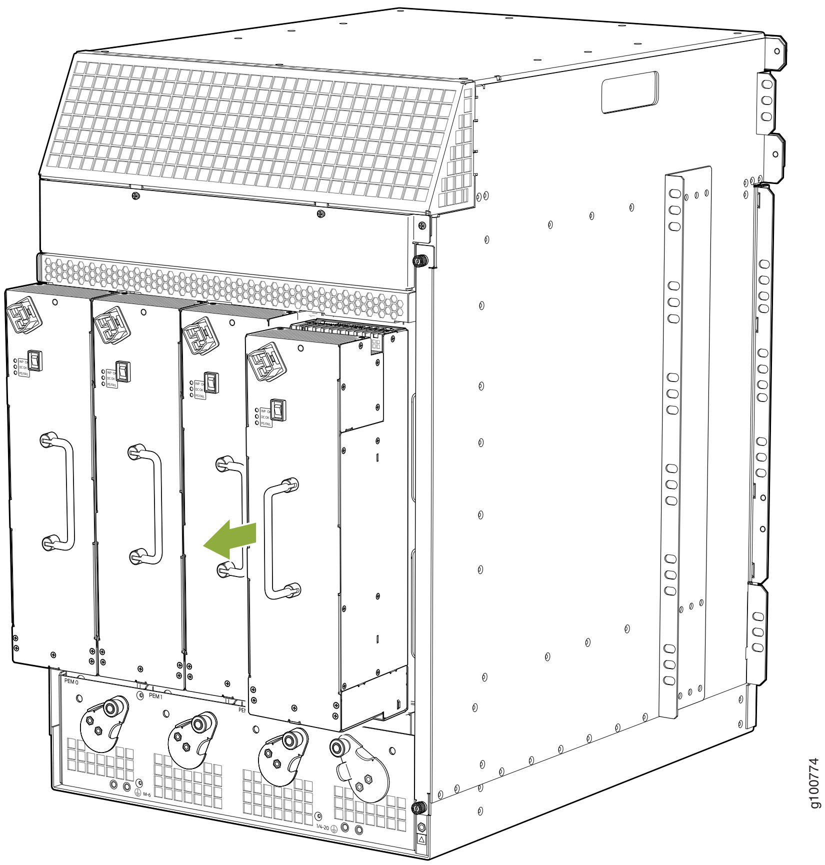
Connector end of AC or DC power supply

Figure 228: Removing a High-Capacity Second-Generation AC Power Supply



> **NOTE:** The chassis is shown without the extended cable manager.

Figure 229: Removing a High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply



NOTE: The chassis is shown without the extended cable manager.

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Connecting an MX960 AC Power Supply Cord | **378**

Disconnecting an MX960 AC Power Supply Cord | **575**

Installing a MX960 AC Power Supply or High-Voltage Second-Generation Universal (HVAC or HVDC) | **433**

MX960 AC Power Electrical Safety Guidelines and Warnings

MX960 AC Power Supply Description | **127**

Installing a MX960 AC Power Supply or High-Voltage Second-Generation Universal (HVAC or HVDC)

To install an AC or universal (HVAC/HVDC) power supply (see Figure 113 on page 339):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

2. Move the AC input switch in the chassis above the empty power supply slot to the off (**O**) position.

   NOTE: When upgrading to enhanced power supplies, always upgrade power supplies in adjacent slots.

3. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 113 on page 339).

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

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 faceplates.

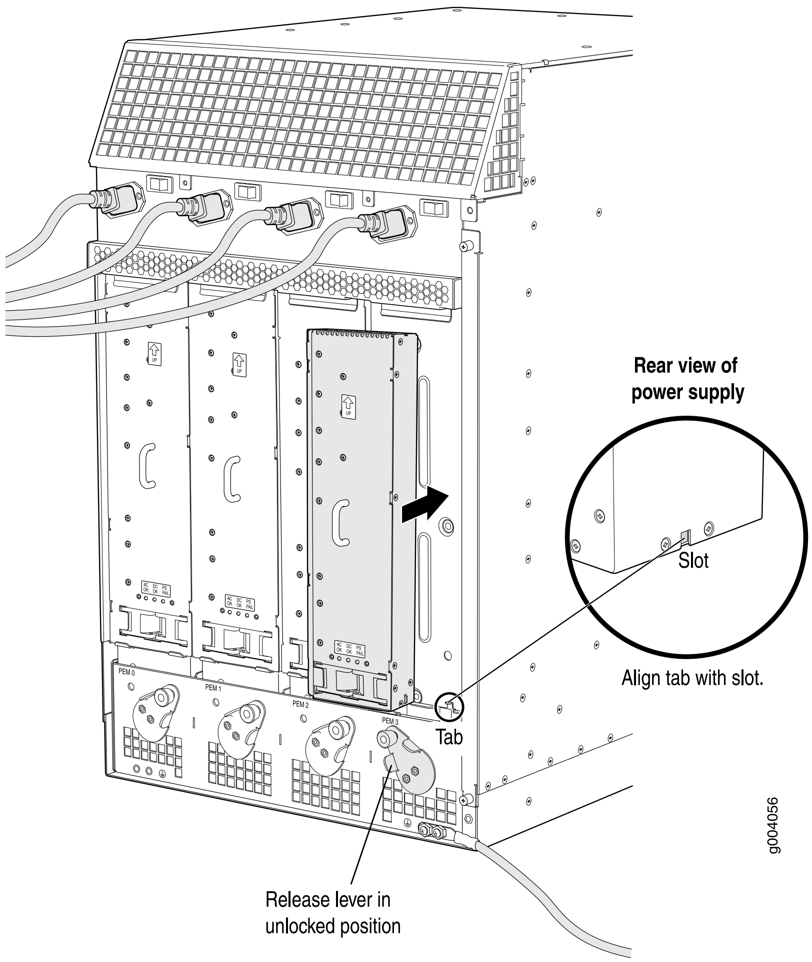
   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 113 on page 339). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

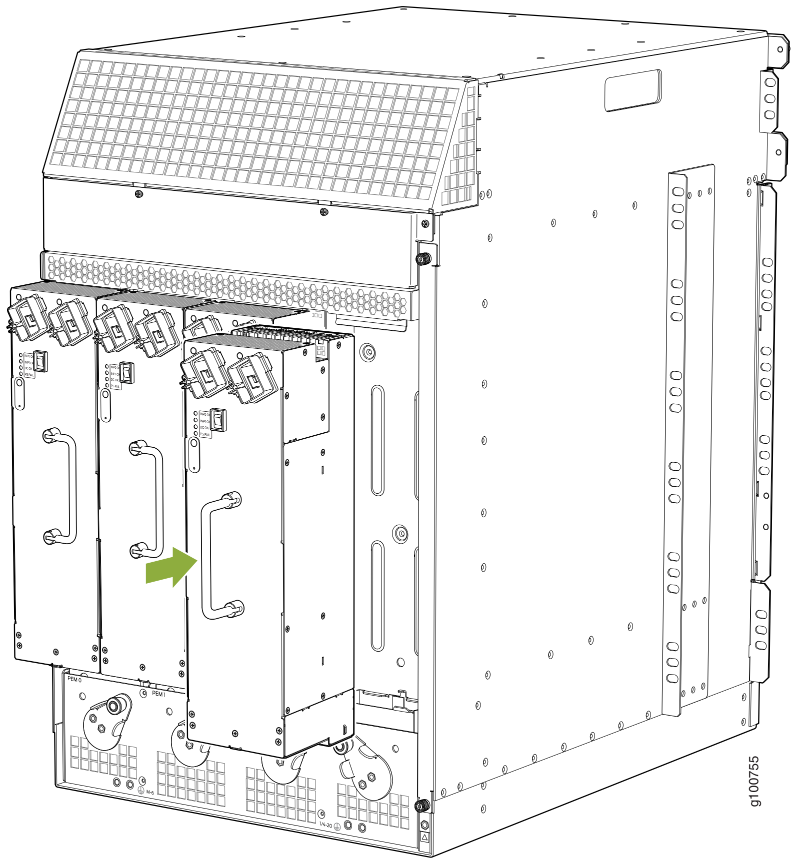
7. Move the AC input switch in the chassis above the power supply to the on (**—**) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

Figure 230: Installing an AC Power Supply



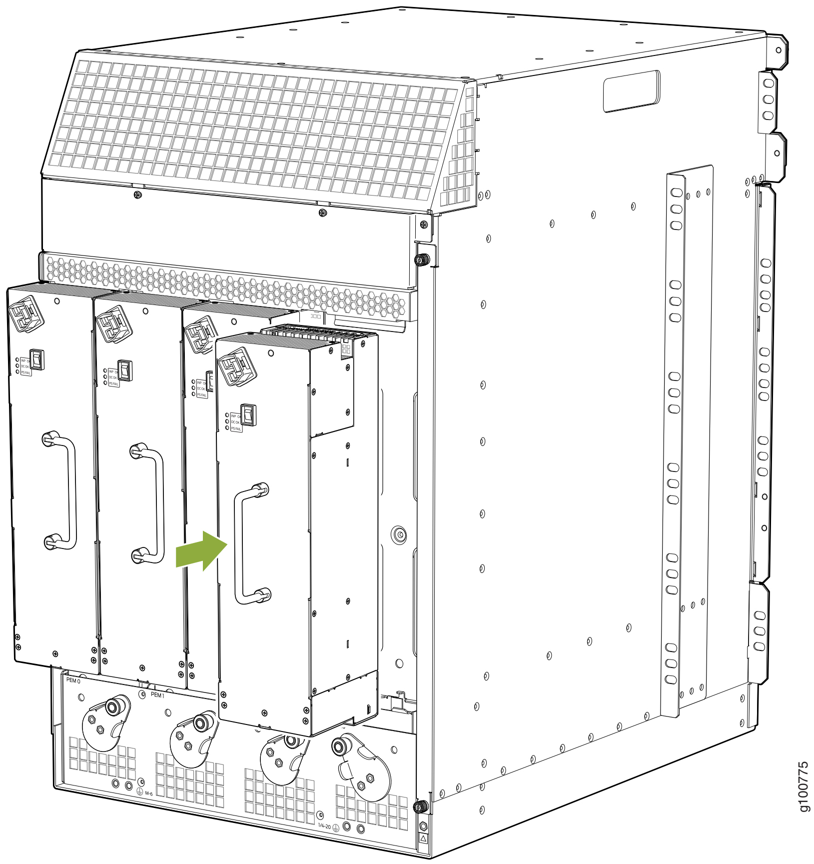
NOTE: The chassis is shown without the extended cable manager.

Figure 231: Installing a High-Capacity Second-Generation AC Power Supply



NOTE: The chassis is shown without the extended cable manager.

Figure 232: Installing a High-Voltage Second-Generation Universal (HVAC or HVDC) Power Supply



NOTE: The chassis is shown without the extended cable manager.

NOTE: If you are replacing the MX960-PSM-5K-AC or MX960-PSM-HV power supplies on an existing chassis, make sure to replace the agency label on the chassis with the new label. See "MX960 Chassis Serial Number and Agency Label" on page 696.

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 AC Power Supply Description | **127**

MX960 AC Power Electrical Safety Guidelines and Warnings

RELATED DOCUMENTATION

Replacing an MX960 DC Power Supply

Removing an MX960 DC Power Supply

Before you remove a power supply, be aware of the following:

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

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

CAUTION: 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.

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 233 on page 569):

1. Switch off the dedicated customer site 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. Verify that the **INPUT OK** LEDs on the power supply to be removed are not lit.

4. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

5. Move the DC circuit breaker on the power supply faceplate to the off (**O**) position.

6. Remove the clear plastic cover protecting the terminal studs on the faceplate.

7. Remove the nut and washer from each of the terminal studs. (Use a 7/16-in. [11 mm] nut driver or socket wrench.)

8. Remove the cable lugs from the terminal studs.

9. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

10. Carefully move the power cables out of the way.

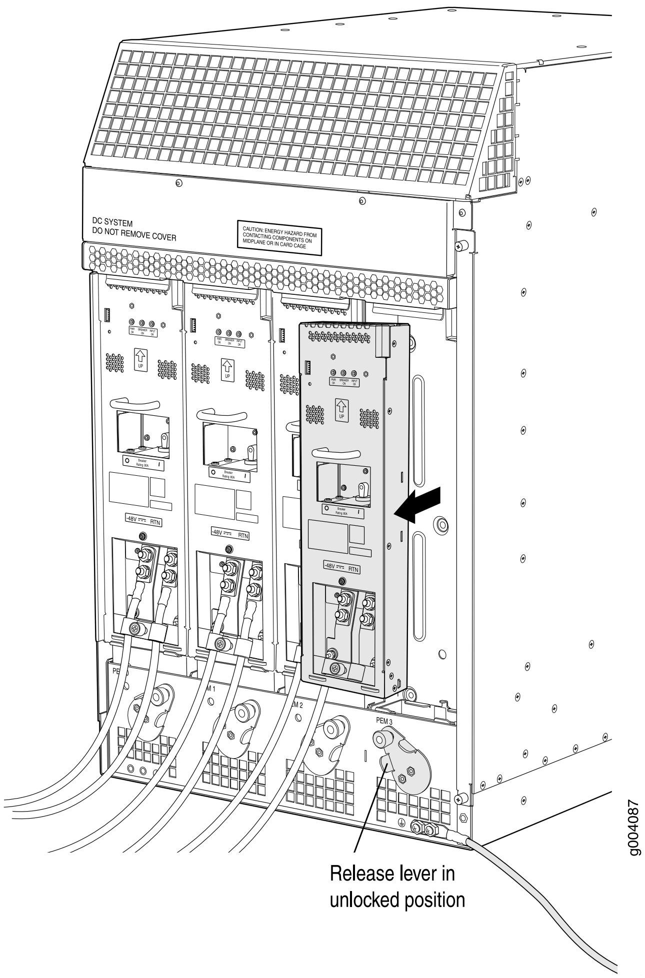
11. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.

12. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

13. Pull the power supply straight out of the chassis.

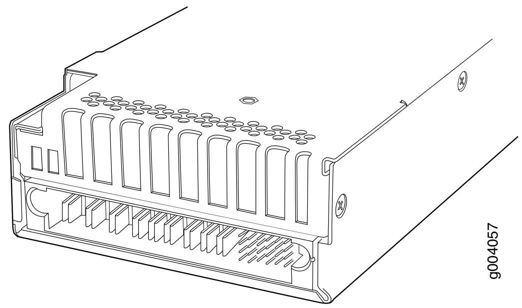
> **WARNING:** Do not touch the power connector on the top of the power supply (see Figure 234 on page 570). It can contain dangerous voltages.

Figure 233: Removing a DC Power Supply from the MX960 Router



NOTE: The chassis is shown without the extended cable manager.

Figure 234: Top of the Power Supply Showing Midplane Connector



Connector end of AC or DC power supply

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
MX960 DC Power Supply | **138**
MX960 DC Power Electrical Safety Guidelines
Installing an MX960 DC Power Supply | **437**
Connecting an MX960 DC Power Supply Cable | **379**
Disconnecting an MX960 DC Power Supply Cable | **577**

Installing an MX960 DC Power Supply

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

To install a DC power supply (see Figure 168 on page 440):

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 ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Move the DC circuit breaker on the power supply faceplate to the off (**O**) position.

4. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 168 on page 440).

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

5. 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 faceplates.

   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 168 on page 440). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

6. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

7. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

8. Remove the clear plastic cover protecting the terminal studs on the faceplate.

9. Remove the nut and washer from each of the terminal studs.

10. Secure each power cable lug to the terminal studs, first with the split 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 169 on page 441). Do not overtighten the nut. (Use a 7/16-in. (11 mm) torque-controlled driver or socket wrench.)

    a. Attach the positive (+) DC source power cable lug to the **RTN** (return) terminal.

    b. Attach the negative (–) DC source power cable lug to the **–48V** (input) terminal.

    > **CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.

CAUTION: The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

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: The DC power supplies in slots **PEM0** and **PEM1** must be powered by dedicated power feeds derived from feed **A**, and the DC power supplies in **PEM2** and **PEM3** must be powered by dedicated power feeds derived from feed **B**. This configuration provides the commonly deployed **A/B** feed redundancy for the system. For information about connecting to DC power sources, see *Electrical Specifications for the MX960 DC Power Supply*.

11. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

12. Route the positive and negative DC power cables through the left and right sides of the cable restraint.

13. Tighten the cable restraint captive screw to hold the power cables in place.

WARNING: Once the DC power supply is connected, the cable will be blocking the PEM slot label. Make sure and note or mark the PEM slot once the power supply is connected.

14. Replace the clear plastic cover over the terminal studs on the faceplate.

15. Verify that the power cabling is correct, that the cables are not touching, and that they do not block access to router components or drape where people could trip on them.

16. Switch on the dedicated customer site circuit breaker.

17. Verify that the **INPUT OK** LED on the power supply is lit steadily.

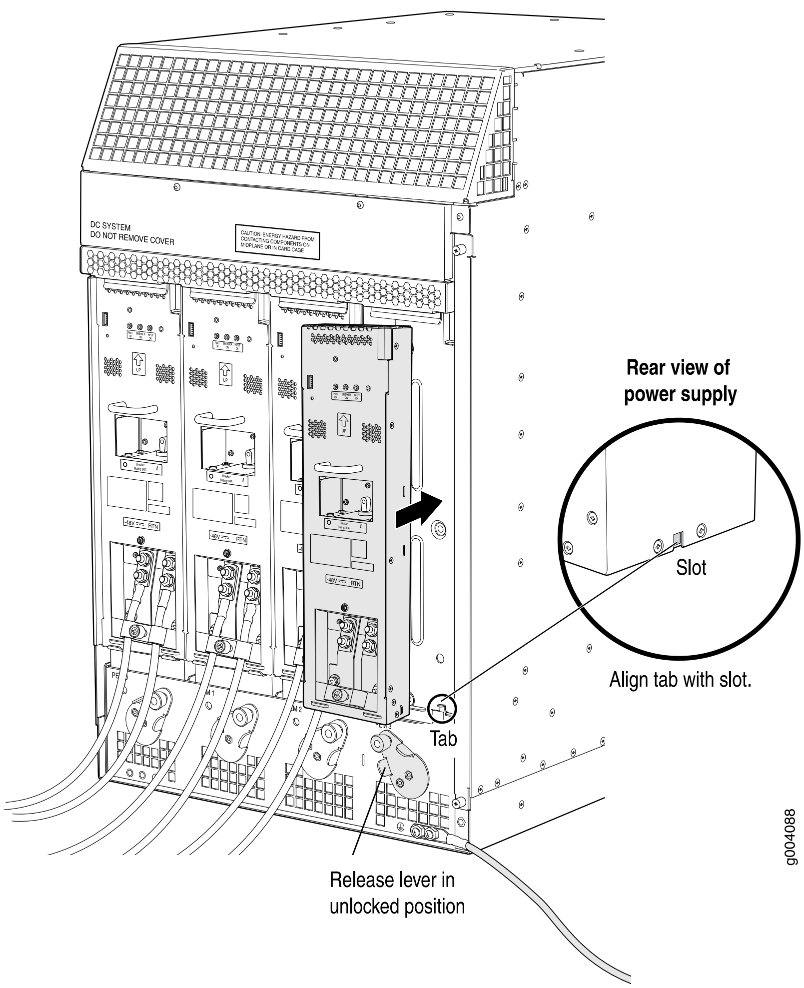
18. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (**|**) position.

> **NOTE:** The circuit breaker may bounce back to the off (**O**) position if you move the breaker too quickly.

19. Verify that the **BREAKER ON** LED is lit steadily.

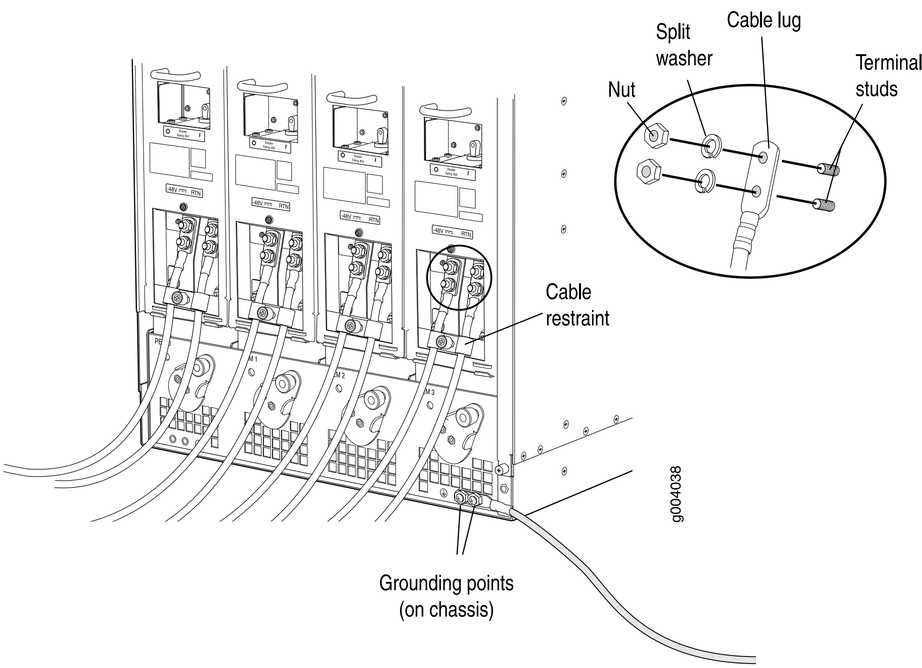
20. Verify that the **PWR OK** LED is lit steadily.

Figure 235: Installing a DC Power Supply



NOTE: The chassis is shown without the extended cable manager.

Figure 236: Connecting DC Power to the MX960 Router



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

MX960 DC Power Supply | 138

MX960 DC Power Electrical Safety Guidelines

Removing an MX960 DC Power Supply | 566

Connecting an MX960 DC Power Supply Cable | 379

Disconnecting an MX960 DC Power Supply Cable | 577

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

Electrical Specifications for the MX960 DC Power Supply

MX960 DC Power Supply | 138

MX960 DC Power Electrical Safety Guidelines
Connecting an MX960 DC Power Supply Cable | **379**
Disconnecting an MX960 DC Power Supply Cable | **577**

Replacing an MX960 AC Power Supply Cord

Disconnecting an MX960 AC Power Supply Cord

To disconnect the AC power cord:

1. Move the AC input switch, which is to the right of the appliance inlet on the chassis, to the off (**O**) position.

2. Unplug the power cord from the power source receptacle.

3. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

4. Unplug the power cord from the appliance inlet on the power supply.

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
AC Power Cord Specifications for the MX960 Router | **217**
MX960 AC Power Supply Description | **127**
MX960 AC Power Electrical Safety Guidelines and Warnings
Connecting an MX960 AC Power Supply Cord | **378**
Replacing an MX960 AC or High-Voltage Second-Generation Universal (HVAC/HVDC) Power Supply | **557**

Connecting an MX960 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 for the MX960 Router" on page 217 and "High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router" on page 260).

2. Plug the replacement power cord into the corresponding appliance inlet located in the chassis directly above the power supply.

   For enhanced power supplies, also plug the replacement power cord into the corresponding power supply inlet.

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 customer site circuit breaker. We recommend that you use a 15 A (250 VAC) minimum, or as required by local code.

   > **NOTE:** For the high-capacity second-generation AC power supply, use a screwdriver to tighten the screw on the AC receptacle retainer to prevent the AC power cord from getting lose.

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. Move the AC input switch in the chassis above 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.

SEE ALSO

MX960 AC Power Supply Description | **127**

Disconnecting an MX960 AC Power Supply Cord | **575**

MX960 AC Power Electrical Safety Guidelines and Warnings

RELATED DOCUMENTATION

Replacing an MX960 DC Power Supply Cable

Disconnecting an MX960 DC Power Supply Cable

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

To disconnect a power cable for a DC power supply:

1. Switch off the dedicated customer site 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. Verify that the **INPUT OK** LED on the power supply is not lit.

4. Remove the power cable from the external DC power source.

5. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

6. Move the DC circuit breaker on the power supply faceplate to the off (**O**) position.

7. Remove the clear plastic cover protecting the terminal studs on the faceplate.

8. Remove the nut and washer from each of the terminal studs. (Use a 7/16-in. [11 mm] nut driver or socket wrench.)

9. Remove the cable lug from the terminal studs.

10. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

11. Carefully move the power cable out of the way.

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
DC Power Cable Specifications for the MX960 Router | **241**
Connecting an MX960 DC Power Supply Cable | **379**
MX960 DC Power Supply | **138**
MX960 DC Power Electrical Safety Guidelines

Connecting an MX960 DC Power Supply Cable

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

To connect a power cable for a DC power supply:

1. Locate a replacement power cable that meets the specifications defined in *Electrical Specifications for the MX960 DC Power Supply*.

2. Verify that a licensed electrician has attached a cable lug to the replacement power cable.

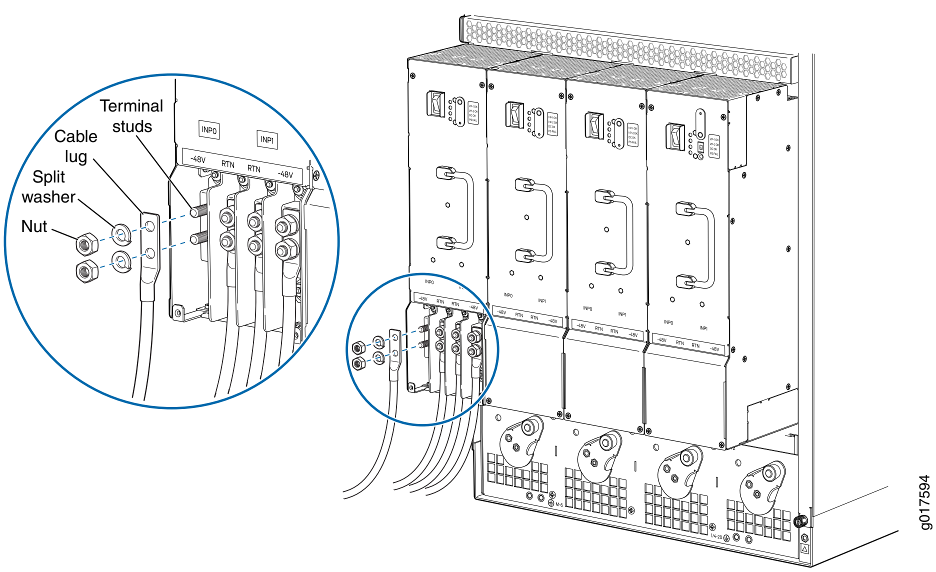
3. Verify that the **INPUT OK** LED is off.

4. Secure the power cable lug to the terminal studs, first with the split 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 136 on page 380). Do not overtighten the nut. (Use a 7/16-in. (11 mm) torque-controlled driver or socket wrench.)

> **CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.

> **CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

Figure 237: Connecting Power Cables to the DC Power Supply



5. Route the power cable through the cable restraint. Make sure that the cable does not touch or obstruct any router components.

6. Tighten the cable restraint captive screw to hold the power cables in place.

7. 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.

8. Replace the clear plastic cover over the terminal studs on the faceplate.

9. Attach the power cable to the DC power source.

10. Turn on the dedicated customer site circuit breaker to the power supply.

11. Verify that the **INPUT OK** LED on the power supply is lit steadily.

12. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (|) position.

    NOTE: The circuit breaker may bounce back to the off (**O**) position if you move the breaker too quickly.

    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.

SEE ALSO

DC Power Cable Specifications for the MX960 Router | 241
Disconnecting an MX960 DC Power Supply Cable | 577
MX960 DC Power Supply | 138
MX960 DC Power Electrical Safety Guidelines

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router
DC Power Cable Specifications for the MX960 Router | 241
MX960 DC Power Supply | 138
MX960 DC Power Electrical Safety Guidelines

CHAPTER 30

Replacing and Upgrading Switch Control Boards

IN THIS CHAPTER

Replacing an MX960 SCB

Before replacing an SCB, read the guidelines in *Operating and Positioning the MX960 SCB Ejectors*.

Removing an MX960 SCB

To remove an SCB (see Figure 238 on page 583):

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

> **CAUTION:** Before removing an SCB, ensure that you know how to operate the ejector handles properly to avoid damage to the equipment.

> **NOTE:** You do not need to offline the host subsystem in the following scenarios:
>
> - You are replacing an SCB installed in slot **2/6**.
> - You are replacing an SCB that functions as a third SCB and no Routing Engine is installed.

1. Take the host subsystem offline.

   > **NOTE:** If there is only one host subsystem, taking the host subsystem offline shuts down the router and you are not required to offline the SCB.

2. Take the SCB offline by issuing the following CLI command:

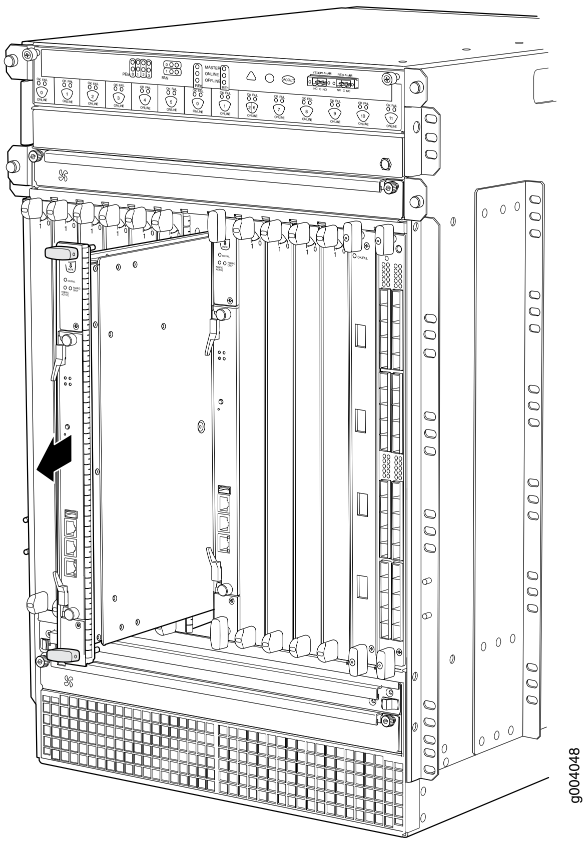
   ```
   user@host>request chassis cb slot slot-number offline
   ```

3. Place an electrostatic bag or antistatic mat on a flat, stable surface.
4. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
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 238: Removing a MX960 SCB



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router
Operating and Positioning the MX960 SCB Ejectors
Effect of Taking the MX960 Host Subsystem Offline
Taking an MX960 Host Subsystem Offline
Installing an MX960 Switch Control Board | 409

Installing an MX960 Switch Control Board

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

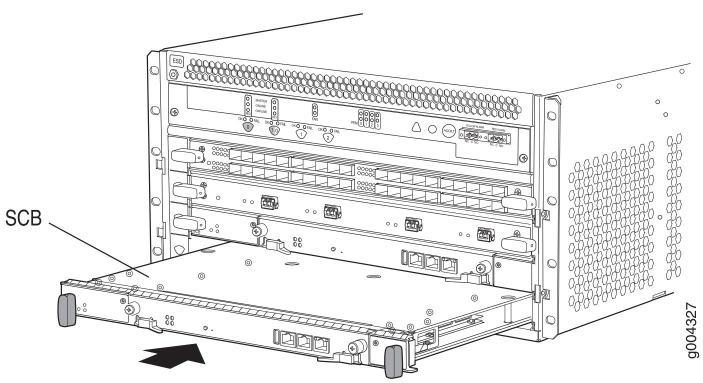
2. Carefully align the sides of the Switch Control Board with the guides inside the chassis.

3. Slide the Switch Control Board 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 Switch Control Board is fully seated.

5. Place the ejector handles in the proper position, horizontally and toward the center of the board.

Figure 239: Installing a Switch Control Board in the MX480



6. Check the LEDs on the Switch Control Board faceplate to verify that it is functioning normally.
   - The green **OK/FAIL** LED should light steadily a few minutes after the Switch Control Board is installed.
   - If the **OK/FAIL** LED is red, remove and install the Switch Control Board again. If the **OK/FAIL** LED still lights steadily, the Switch Control Board is not functioning properly. Contact your customer support representative.

7. Check the status of the Switch Control Board using the **show chassis environment cb** 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
```

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX960 Router

Operating and Positioning the MX960 SCB Ejectors

Upgrading an MX960 to Use the SCBE-MX

This topic describes how to upgrade your MX960, MX480, or MX240 router to use the SCBE-MX without taking the router offline. This “in-service” upgrade only works for MX routers with DPC, MS-DPC, MPC1, MPC2, or MPC3 line cards. If your MX router has another type of line card, you’ll need to take the router offline before you do the upgrade.

> **NOTE:** Junos OS does not support in-service upgrades to the SCBE-MX on routers with an MX-MPC3E-3D or MX-MPC3-3D MPC. If your MX router has these MPCs, you’ll need to shutdown the system before you do the upgrade. An in-service upgrade can result in service disruption.

Before you do the upgrade, open a telnet session to the primary Routing Engine CLI operational mode and issue the **configure exclusive** command. This command locks the configuration to prevent accidental changes during the upgrade process.

> **TIP:** To prevent traffic loss during the upgrade process, we recommend that you operate the line cards at 50% line rate. This 50% limit must be maintained per PFE on each line card.

Prepare for the Upgrade

Prior to upgrading to the SCBE-MX:

1. Verify that the system runs Junos OS Release 11.4 or later by issuing the **show version** command on the primary router. Here's an example for the MX960:

   user@host> **show version**

   ```
   Model: mx960
   Junos Base OS Software Suite [11.4-20110530];
   ```

   NOTE: The SCBE-MX is supported only in Junos OS Release 11.4 or later.

   The latest software ensures a healthy system—that is, Routing Engines, control boards, and FPCs—before the upgrade.

2. Verify that SCB-MX boards are installed:

   user@host> **show chassis hardware**

   ```
   Item  Version  Part Number Serial Number Description
   CB0  REV 07 710-021523 ABBC8281  MX SCB
   CB1  REV 07 710-021523 ABBC8323  MX SCB
   CB2  REV 07 710-021523 ABBD1410  MX SCB
   ```

   SCB-MX details are displayed as above, along with other hardware components.

3. Establish console connections to both Routing Engines. You can use a telnet session to connect to the router console by issuing the **<router name>-con** command. For example, if the router name is juniper, you can connect to RE0 and RE1 consoles by issuing the **telnet juniper-con** and **telnet juniper1-con** commands.

4. Ensure that graceful switchover (GRES), commit synchronize (required for nonstop routing), and nonstop routing (NSR) are enabled or configured by running the **set chassis redundancy graceful-switchover, set system commit synchronize, set routing-options nonstop-routing** commands.

   NOTE: These commands are mandatory for this upgrade and may be removed, if desired, after the upgrade.

5. Set the upgrade flag on and start the SCB-MX upgrade by issuing the **set chassis state cb-upgrade on** command.

user@host# **configure**

user@host# **set chassis state cb-upgrade on**

user@host# **commit**

6. Determine the order to replace the existing SCB-MXs with upgraded ones. SCB 0, SCB 1, and SCB 2 are available for the MX960. SCB 0 is associated with RE0, SCB 1 is associated with RE1, and SCB 2 is the spare SCB. The SCB upgrade order for the MX960 is:
   - Upgrade the SCB in the Spare Slot 2 (SCB 2)
   - Upgrade the SCB in the Backup Routing Engine Slot 1 (SCB 1)
   - Upgrade the SCB in the Primary Routing Engine Slot 0 (SCB 0)

> **NOTE:** Do not add or remove any router hardware during the upgrade procedure.

Upgrade the SCB-MX in the Spare Slot 2 (SCB 2)

1. Take the fabric plane offline by issuing the **request chassis fabric plane 4 offline** command.

2. Verify that fabric plane 4 is offline by issuing the **show chassis fabric summary** command.

   user@host> **show chassis fabric summary**

```
Plane  State  Uptime
  4  Offline
  5  Online  1 hour, 15 minutes, 35 seconds
```

3. Take the next fabric plane offline by issuing the **request chassis fabric plane 5 offline** command, and then verify that the fabric plane is offline by issuing the command given in Step 2.

4. Take the SCB-MX in slot 2 offline by issuing the **request chassis cb offline slot 2** command.

5. Verify that the control board is offline by issuing the **show chassis environment cb 2** command:

   user@host> **show chassis environment cb 2**

```
CB 2 status:
State  Offline
Power 1  Disabled
Power 2  Disabled
```

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.

7. Remove and replace the SCB-MX in slot 2 on the router (SCB 2) with the SCBE. Use the procedure described in "Replacing an MX960 SCB" on page 581.

8. Verify that the installation is successful and the SCBE is online:

   user@host> **show chassis environment cb 2**

```
CB 2 status
State  Online
Temperature 30 degrees C / 86 degrees F
```

9. Verify that the fabric planes come online correctly by issuing the **show chassis fabric summary** command:

   user@host> **show chassis fabric summary**

```
Plane  State Uptime
4 Online 2 minutes, 25 seconds
5 Online 2 minutes, 15 seconds
```

10. Verify the alarms:

   user@host> **show chassis alarms**

```
Alarm Time   Class Description
2011-06-01 13:26:56 EDT Major CB fabrics are of mixed types
2011-06-01 12:10:41 EDT Major Require a fan tray upgrade
```

   Because only one SCB-MX has been upgraded, the alarm indicates that the SCBs are of mixed type. This alarm is cleared after all the control boards are upgraded.

Upgrade the SCB-MX in the Backup Routing Engine Slot 1 (SCB 1)

1. Power down the backup Routing Engine from the primary Routing Engine by issuing the **request system power-off other-routing-engine** command.

2. Ensure that the Routing Engine is powered down by issuing the **show chassis routing-engine 1** command. The slot of the Routing Engine may be 0 or 1, and is shown as 1 in this example:

   user@host> **show chassis routing-engine 1**

```
Routing Engine Status:
Slot 1:
Current State  Present
```

Verify that the Current State is Present, which indicates that the Routing Engine is offline.

3. Take the first fabric plane of the backup Routing Engine offline by issuing the **request chassis fabric plane 3 offline** command.

4. Verify that the fabric plane is offline by issuing the **show chassis fabric summary** command.

   `user@host>` **show chassis fabric summary**

```
Plane State Uptime
2  Online 3 minutes, 45 seconds
3 Offline
```

   Check if the state of plane 4 is Offline.

5. Take the next fabric plane offline by issuing the **request chassis fabric plane 2 offline** command and verify that the fabric plane is offline by issuing the command in Step 4.

6. Take the SCB-MX in slot 1 offline by issuing the **request chassis cb offline slot 1** command.

7. Verify that the SCB-MX is offline by issuing the **show chassis environment cb 1** command:

   `user@host>` **show chassis environment cb 1**

```
CB 1 status:
State  Offline
Power 1  Disabled
Power 2  Disabled
```

8. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

9. Remove and replace the offline SCB-MX on the router with the SCBE.

10. Verify that the installation is successful and the SCB is online by issuing the **show chassis environment cb 1** command:

   `user@host>` **show chassis environment cb 1**

```
CB 1 status
State  Online
Temperature 30 degrees C / 86 degrees F
```

Other details, such as power, are also displayed along with the state.

11. Verify that the fabric planes 2 and 3 come online correctly by issuing the **show chassis fabric summary** command:

    `user@host>` **show chassis fabric summary**

    ```
    Plane State Uptime
    2 Online 2 minutes, 5 seconds
    3 Online 1 minutes, 55 seconds
    ```

12. Verify that the backup routing engine is back online by issuing the **show chassis routing-engine 1** command:

    `user@host>` **show chassis routing-engine 1**

    ```
    Routing Engine Status:
    Slot 1:
    Current State  Backup
    ```

Upgrade the SCB-MX in the Primary Routing Engine Slot 0 (SCB 0)

To upgrade the SCB-MX in the primary Routing Engine slot:

1. Ensure a Graceful RE Switchover (GRES) to gracefully switch between the primary and backup Routing Engines, so that the backup RE becomes the primary RE, by issuing the **request chassis routing-engine master switch** command.

2. Log in to the new primary Routing Engine after the switchover.

3. Switch the configuration mode to ensure that you are still in configure exclusive mode by issuing the **exit** command and then the **configure exclusive** command, from the old primary Routing Engine.

4. Log in to the current primary Routing Engine again and issue the **configure exclusive** command.

5. Power down the backup Routing Engine from the primary Routing Engine by issuing the **request system power-off other-routing-engine** command.

6. Ensure that the Routing Engine is powered down by issuing the **show chassis routing-engine 0** command. The slot of the Routing Engine may be 0 or 1, and is shown as 1 in this example:

   `user@host>` **show chassis routing-engine 1**

   ```
   Routing Engine Status:
   Slot 0:
   Current State  Present
   ```

   Verify that the Current State is Present, which indicates that the Routing Engine is offline or powered down.

7. Take the first fabric plane of the backup Routing Engine offline by issuing the **request chassis fabric plane offline 1** command.

8. Verify that the fabric plane is offline by issuing the **show chassis fabric summary** command.

   `user@host>` **show chassis fabric summary**

   ```
   Plane State Uptime
   1 Offline
   2 Online  3 minutes, 25 seconds
   ```

   Verify that the state of plane 1 is Offline.

9. Take the next fabric plane offline by issuing the **request chassis fabric plane offline 0** command and verify that the fabric plane is offline by issuing the command given in Step 2.

10. Take the SCB-MX in slot 0 offline by issuing the **request chassis cb offline slot 0** command.

11. Verify that the control board is offline by issuing the **show chassis environment cb 0** command:

   `user@host>` **show chassis environment cb 0**

   ```
   CB 0 status:
   State  Offline
   Power 1  Disabled
   Power 2  Disabled
   ```

12. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

13. Remove and replace the offline SCB-MX on the router with the SCBE. Use the procedure described in "Replacing an MX960 SCB" on page 581.

14. Verify that the installation is successful and the SCBE is online by issuing the **show chassis environment cb 0** command:

    user@host> **show chassis environment cb 0**

```
CB 0 status
State  Online
Temperature 30 degrees C / 86 degrees F
```

15. Verify that the fabric planes 0 and 1 come online correctly by issuing the **show chassis fabric summary** command:

    user@host> **show chassis fabric summary**

```
Plane State Uptime
0 Online 2 minutes, 9 seconds
1 Online 2 minutes, 2 seconds
```

16. Verify that the backup Routing Engine is back online by issuing the **show chassis routing-engine 0** command:

    user@host> **show chassis routing-engine 0**

```
Routing Engine Status:
Slot 0:
Current State  Backup
```

17. Verify the alarms by issuing the **show chassis alarms** command:

    user@host> **show chassis alarms**

```
Alarm Time   Class Description
2011-06-01 13:26:56 EDT Major CB fabric links require upgrade/training
2011-06-01 12:10:41 EDT Major Require a fan tray upgrade
```

    The major alarm has changed from **CB fabrics are of mixed types** to **CB fabric links require upgrade/training**, as a SCB-MX requires training to change the link speed from 3G to 6G for the SCBE-MX. This alarm is displayed until the 3G to 6G link transition is completed.

Complete the SCBE-MX Upgrade

1. Verify if there are any MPCs running at 3G instead of 6G:

   `user@host>` **request chassis fabric upgrade-bandwidth info**

   ```
   Slot State
   0 Upgrade not supported
   1 Upgraded
   2 Empty
   3 Empty
   4 Empty
   5 Empty
   6 Empty
   7 Empty
   ```

   In this example, the results indicate that slot 0 does not support the upgrade and slot 1 needs upgrade.

   NOTE: The SCBE line card supports only DPC, MS-DPC, MPC1, MPC2, and MPC3 line cards for the **upgrade-bandwidth.** If line cards that do not support the command option are present in the chassis during the SCB-MX to SCBE-MX upgrade, the **request chassis fabric upgrade-bandwidth** commands will return **Upgrade not supported** for the slot(s) that contain the unsupported line card(s).

2. Upgrade the bandwidth of all MPCs by issuing the **request chassis fabric upgrade-bandwidth fpc all** command. If you want to control the MPC line card upgrade, go to Step 3.

   CAUTION: Use this command only if you are not concerned with the slot upgrade order or if only one old MPC is present in the chassis. Running this command may result in a loss of traffic across that MPC. Using this method may increase that loss, as it does not consider any redundancy or graceful switchover strategies that you may have configured on the system.

3. Issue the **request chassis fabric upgrade-bandwidth fpc slot 1** command to upgrade the MPC in slot 1.

4. Verify that the MPC is upgraded:

   `user@host>` **request chassis fabric upgrade-bandwidth info**

```
Slot State
0 Upgrade not supported
1 Upgraded
2 Empty
```

5. Verify the fabric plane state for all MPCs:

   `user@host>` **show chassis fabric summary**

```
Plane State Uptime
0 Spare 21 seconds
1 Spare 12 seconds
2 Online   12 minutes
3 Online   12 minutes
4 Online   30 minutes
5 Online   30 minutes
```

6. Verify the state of MPCs:

   `user@host>` **show chassis fabric fpcs**

```
FPC 1
PFE #0
 Plane 0: Links ok
 Plane 1: Links ok
 Plane 2: Plane enabled
 Plane 3: Plane enabled
 Plane 4: Plane enabled
 Plane 5: Plane enabled
PFE #1
 Plane 0: Links ok
 Plane 1: Links ok
 Plane 2: Plane enabled
 Plane 3: Plane enabled
 Plane 4: Plane enabled
 Plane 5: Plane enabled
PFE #2
 Plane 0: Links ok
 Plane 1: Links ok
 Plane 2: Plane enabled
 Plane 3: Plane enabled
 Plane 4: Plane enabled
 Plane 5: Plane enabled
PFE #3
```

```
Plane 0: Links ok
Plane 1: Links ok
Plane 2: Plane enabled
Plane 3: Plane enabled
Plane 4: Plane enabled
Plane 5: Plane enabled
```

Fabric plane details of all MPCs are similarly displayed.

7. Verify if the **show chassis fabric summary** command output shows fabric planes in the 'check' state. This indicates that the fabric plane has an error. You can try to recover the fabric plane to normal operation by issuing the **request chassis fabric plane <#> offline** command, followed by the **request chassis fabric plane <#> online** command, where <#> equals the fabric plane in error.

   NOTE: After you issue the **request chassis fabric plane <#> offline** and **request chassis fabric plane <#> online** commands, issue the **show chassis fabric summary** command to verify that the fabric plane errors are rectified and to verify the current state of the fabric planes.

8. Verify if there are any major alarms:

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

```
Alarm Time   Class Description
2011-06-01 13:37:43 EDT Minor Require a fan tray upgrade
2011-06-01 13:37:26 EDT Minor Backup RE Active
```

   In this example, the major alarms are no longer displayed, and the upgrade is successfully completed.

9. Disable the upgrade configuration by issuing the **set chassis state cb-upgrade off** command and then the **commit** command.

10. Disable the upgrade configuration by issuing the **set chassis state cb-upgrade off** command.

11. You can delete the upgrade configuration by issuing the **delete chassis state cb-upgrade** command and then the **commit** command.

> **WARNING:** Deleting the **chassis state cb-upgrade on** configuration before disabling the SCB-MX upgrade using the **set chassis state cb-upgrade off** command can cause unexpected errors in the fabric.

12. Verify the SCBE-MXs are installed by issuing the **show chassis hardware** command:

    `user@host>` **show chassis hardware**

```
Item  Version  Part Number Serial Number Description
CB0  REV 02 750-031391 YE8505  Enhanced MX SCB
CB1  REV 07 710-031391 YL6769  Enhanced MX SCB
CB2  REV 07 710-031391 YE8492  Enhanced MX SCB
```

    As shown in the example, the MX960 now has MX SCBEs.

SEE ALSO

SCBE-MX Description | 164

Upgrading an MX960 to Use the SCBE2-MX

Consider the following scenarios when upgrading an MX960 SCB-MX or SCBE-MX to use the SCBE2-MX:

Scenario 1: SCBE2-MX; Routing Engine with Junos OS Release 13.3R1 or later installed.

- Replace the SCBs. Ensure you replace the Routing Engines at the same time.
- Ensure that Enhanced IP or Enhanced Ethernet Network Services mode is configured before you power on the router.

Scenario 2: SCB-MX or SCBE-MX; existing Routing Engine with a Junos OS Release 13.3R1 or earlier installed.

- Upgrade the Routing Engine (**RE0** and **RE1**) software to Junos OS Release 13.3 or later.
- Configure Enhanced IP or Enhanced Ethernet Network Services mode.
- Replace the SCBs. Ensure that you replace the SCBs at the same time.

Scenario 3: Failed SCB-MX or SCBE-MX; Routing Engine with a Junos OS Release 13.3R1 or earlier installed.

- Upgrade the software on the Routing Engine hosting the failed SCB-MX or SCBE-MX with Junos OS Release 13.3R1 or later.
- Replace the SCBs. Ensure that you replace the SCBs at the same time.
- Upgrade the software on the Routing Engine hosting the SCBE2-MX with Junos OS Release 13.3R1 or later.
- Configure Enhanced IP or Enhanced Ethernet Network Services mode.

To upgrade the SCB-MX or SCBE-MX to SCBE2, perform the following steps:

> **NOTE:** You cannot upgrade to SCBE2-MX without powering off the MX960 router.

Prepare the MX960 Router for SCBE2-MX Upgrade

1. Verify that the system runs Junos OS Release 13.3 or later by issuing the **show version** command on the primary router.

   `user@host>` **show version**

   ```
   Model: mx960
   Junos Base OS Software Suite [13.3-yyyymmdd];
   ...
   ```

   > **NOTE:** The SCBE2-MX is supported only on:
   >
   > - Junos OS Release 13.3 or later
   > - Network Services Mode: Enhanced-IP

   The latest software ensures a healthy system—that is, a system that comprises Routing Engines, control boards, and FPCs—before the upgrade.

   For information about how to verify and upgrade the Junos OS, see the *Junos OS Installation and Upgrade Guide*.

Power Off the MX960 Router

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

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 that their state information is preserved. (If the router contains only one Routing Engine, issue the **request system halt** command.)

   `user@host>` **request system halt both-routing-engines**

2. Wait until a message appears on the console confirming that the operating system has halted.

3. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

4. Move the AC input switch on the chassis above the AC power supply or the DC circuit breaker on each DC power supply faceplate to the off **(O)** position.

Remove the MX960 Routing Engine

1. Remove the cables connected to the Routing Engine.

2. Place an electrostatic bag or antistatic mat on a flat, stable surface.

3. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

4. Loosen the captive screws on the top and bottom of the Routing Engine.

5. Flip the ejector handles outward to unseat the Routing Engine.

6. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.

7. Place one hand underneath the Routing Engine to support it, and slide it completely out of the chassis.

8. Place the Routing Engine on the antistatic mat.

Install the MX960 Routing Engine into the SCBE2-MX

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.

3. Place one hand underneath the Routing Engine to support it.

4. Carefully align the sides of the Routing Engine with the guides inside the opening on the SCBE2-MX.

5. Slide the Routing Engine into the SCBE2-MX until you feel resistance and then press the faceplate of the Routing Engine until it engages the connectors.

6. Press both of the ejector handles inward to seat the Routing Engine.

7. Tighten the captive screws on the top and bottom of the Routing Engine.

8. Connect the management device cables to the Routing Engine.

Power On the MX960 Router

1. Verify that the power supplies are fully inserted in the chassis.

2. Verify that each AC power cord is securely inserted into its appliance inlet.

3. Verify that an external management device is connected to one of the Routing Engine ports (**AUX**, **CONSOLE**, or **ETHERNET**).

4. Turn on the power to the external management device.

5. Switch on the dedicated customer-site circuit breakers. Follow the ESD and safety instructions for your site.

6. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

7. Move the AC input switch on the chassis above the AC power supply or the DC circuit breaker on each DC power-supply faceplate to the off **(—)** position.

8. Check that the AC or the DC power supply is correctly installed and functioning normally. Verify that the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

   > **NOTE:** 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.

   If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures.

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

NOTE: 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. Normally, the router boots from the Junos OS on the CompactFlash card.

After turning on a power supply, wait at least 60 seconds before turning it off.

Complete the SCBE2-MX Upgrade

1. Verify that the installation is successful and the SCBE2-MX is online by issuing the **show chassis environment cb** command:

   `user@host>` **show chassis environment cb 0**

   ```
   CB 0 status
   State  Online
   Temperature 30 degrees C / 86 degrees F
   ...
   ```

   `user@host>` **show chassis environment cb 1**

   ```
   CB 1 status
   State  Online
   Temperature 30 degrees C / 86 degrees F
   ...
   ```

   Other details, such as, temperature, power, etc are also displayed along with the state.

2. Verify that the fabric planes come online correctly by issuing the **show chassis fabric summary** command:

   `user@host>` **show chassis fabric summary**

   ```
   Plane   State    Uptime
    0      Online   2 days, 19 hours, 10 minutes, 9 seconds
    1      Online   2 days, 19 hours, 10 minutes, 9 seconds
   ...
   ```

3. Verify that the backup Routing Engine is back online by issuing the **show chassis routing-engine 1** command:

   `user@host>` **show chassis routing-engine 1**

```
Routing Engine Status:
Slot 1:
Current State  Backup
...
```

4. Verify the SCBE2-MXs before you finish by issuing the **show chassis hardware** command:

   `user@host>` **show chassis hardware**

```
Hardware inventory:
Item              Version  Part number  Serial number     Description
CB 0              REV 08   750-048307   CABC9829          Enhanced MX SCB 2
CB 1              REV 08   750-048307   CABC9828          Enhanced MX SCB 2
...
```

   As shown in the example, the MX960 now has SCBE2-MXs.

RELATED DOCUMENTATION

SCBE2-MX Description | 157
Removing an MX960 SCB | 582
Installing an MX960 Switch Control Board | 409

Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX

Upgrade the Routing Engine

If you are upgrading to the SCBE3-MX from an SCBE2-MX or older SCB, the Routing Engine must be upgraded to the first supported Junos release for the SCBE3-MX (18.4R1) before you install it in the SCBE3-MX. Also, we recommend that you update the recovery snapshot with the 18.4R1 or later image before you begin the upgrade. If the Routing Engine fails to boot from the primary image, it will attempt to boot from the recovery image. Since the older recovery image does not support the SCBE3-MX, the Routing Engine will crash if it attempts to boot from the old recovery image.

> **CAUTION:** If you plug the Routing Engine into the SCBE3-MX without first upgrading Junos to 18.4R1 or later, Junos might crash and go to a **db** prompt. Should this occur, you'll need to recover the router by copying the Junos software image for the 18.4R1 or later release and then booting from the USB drive to install 18.4R1 Junos on the SCBE3-MX. The USB install will wipe out the router configuration and all user files on the Routing Engine.

To upgrade the Routing Engine while it's plugged into an SCBE2-MX or older SCB:

1. Download the software related to your MX Series Routing Engine.

2. If you have not already done so, connect to the console port on the switch from your management device, and log in to the Junos OS CLI.

3. (Optional) Back up the current software configuration to a second storage option. See the *Junos OS Installation and Upgrade Guide* for instructions on performing this task.

4. Install the new software.

5. Reboot the Routing Engine and wait for it to boot with the new Routing Engine image.

6. Install the SCBE3-MX into the Router Chassis. See:

   Installing an MX240 Switch Control Board

   Installing an MX480 Switch Control Board

   Installing an MX960 Switch Control Board on page 409

Install the Routing Engine into the SCBE3-MX

Refer to the Routing Engine installation procedure for your MX model:

Installing an MX240 Routing Engine

Installing an MX480 Routing Engine

"Installing an MX960 Routing Engine" on page 407

Install the SCBE3-MX into the Router Chassis

Refer to the Switch Control Board installation procedure for your MX model:

Installing an MX240 Switch Control Board

Installing an MX480 Switch Control Board

“Installing an MX960 Switch Control Board” on page 409

Complete the SCBE3-MX Upgrade

1. Verify that the installation is successful and the SCBE3-MX is online:

   user@host> **show chassis environment cb 0**

   ```
   CB 0 status
   State   Online
   Temperature 30 degrees C / 86 degrees F
   ...
   ```

   user@host> **show chassis environment cb 1**

   ```
   CB 1 status
   State   Online
   Temperature 30 degrees C / 86 degrees F
   ...
   ```

   Other details, such as, temperature, power, etc are also displayed along with the state.

2. Verify that the fabric planes come online correctly:

   user@host> **show chassis fabric summary**

   ```
   Plane   State    Uptime
    0      Online   2 days, 19 hours, 10 minutes, 9 seconds
    1      Online   2 days, 19 hours, 10 minutes, 9 seconds
   ...
   ```

3. Verify that the backup Routing Engine is back online:

   user@host> **show chassis routing-engine 1**

   ```
   Routing Engine Status:
   Slot 1:
   ```

```
Current State   Backup
...
```

4. Verify the SCBE3-MXs are installed:

   `user@host>` **show chassis hardware**

```
Hardware inventory:
Item                Version  Part number  Serial number     Description
CB 0                REV 29   750-070866   CAKP0543          Enhanced MX SCB 3
CB 1                REV 29   750-070866   CAKP0541          Enhanced MX SCB 3
...
```

RELATED DOCUMENTATION

SCBE3-MX Description | 149

5

PART

Maintaining the Chassis and Components

CHAPTER 31

Routine Maintenance Procedures

IN THIS CHAPTER

Routine Maintenance Procedures for the MX960 Router

Purpose

For optimum router performance, perform preventive maintenance procedures.

Action

- 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.

RELATED DOCUMENTATION

Tools and Parts Required to Maintain the MX960 Router | 609

Maintaining the MX960 Air Filter | 610

Maintaining the MX960 Fan Trays | 610

CHAPTER 32

Maintaining Components

IN THIS CHAPTER

Tools and Parts Required to Maintain the MX960 Router

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

RELATED DOCUMENTATION

Maintaining the MX960 Air Filter

Purpose

For optimum cooling, verify the condition of the air filters.

Action

- Regularly inspect the air filter. A dirty air filter restricts airflow in the unit, producing a negative effect on the ventilation of the device. The filter degrades over time. You must replace the filter every 6 months.

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

- The shelf life of polyurethane filter varies from two years to five years depending on the storage conditions. Store in a cool, dry, and dark environment. Wrap the media in plastic and store in an environment with relative humidity between 40%- 80% and temperature between 40° F (4° C) to 90° F (32° C). Note that if the material flakes, or becomes brittle when rubbed or deformed, it is no longer usable.

RELATED DOCUMENTATION

Maintaining the MX960 Fan Trays

Purpose

For optimum cooling, verify the condition of the fans.

Action

- Monitor the status of the fans. A 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         40 degrees C / 104 degrees F
      PEM 1                          Absent
      PEM 2                          Absent
      PEM 3                          OK         40 degrees C / 104 degrees F
      Routing Engine 0               OK         39 degrees C / 102 degrees F
      Routing Engine 1               OK         42 degrees C / 107 degrees F
      CB 0 Intake                    OK         26 degrees C / 78 degrees F
      CB 0 Exhaust A                 OK         27 degrees C / 80 degrees F
      CB 0 Exhaust B                 OK         27 degrees C / 80 degrees F
      CB 0 ACBC                      OK         26 degrees C / 78 degrees F
      CB 0 SF A                      OK         37 degrees C / 98 degrees F
      CB 0 SF B                      OK         35 degrees C / 95 degrees F
      CB 1 Intake                    OK         27 degrees C / 80 degrees F
      CB 1 Exhaust A                 OK         30 degrees C / 86 degrees F
      CB 1 Exhaust B                 OK         28 degrees C / 82 degrees F
      CB 1 ACBC                      OK         27 degrees C / 80 degrees F
      CB 1 SF A                      OK         36 degrees C / 96 degrees F
      CB 1 SF B                      OK         36 degrees C / 96 degrees F
      CB 2 Intake                    Absent
      CB 2 Exhaust A                 Absent
      CB 2 Exhaust B                 Absent
      CB 2 ACBC                      Absent
      CB 2 SF A                      Absent
      CB 2 SF B                      Absent
      FPC 2 Intake                   OK         22 degrees C / 71 degrees F
      FPC 2 Exhaust A                OK         27 degrees C / 80 degrees F
      FPC 2 Exhaust B                OK         33 degrees C / 91 degrees F
      FPC 2 I3 0 TSensor             OK         33 degrees C / 91 degrees F
      FPC 2 I3 0 Chip                OK         35 degrees C / 95 degrees F
      FPC 2 I3 1 TSensor             OK         33 degrees C / 91 degrees F
      FPC 2 I3 1 Chip                OK         33 degrees C / 91 degrees F
      FPC 2 I3 2 TSensor             OK         33 degrees C / 91 degrees F
```

```
         FPC 2 I3 2 Chip                OK          30 degrees C / 86 degrees F
         FPC 2 I3 3 TSensor             OK          30 degrees C / 86 degrees F
         FPC 2 I3 3 Chip                OK          30 degrees C / 86 degrees F
         FPC 2 IA 0 TSensor             OK          33 degrees C / 91 degrees F
         FPC 2 IA 0 Chip                OK          36 degrees C / 96 degrees F
         FPC 2 IA 1 TSensor             OK          30 degrees C / 86 degrees F
         FPC 2 IA 1 Chip                OK          35 degrees C / 95 degrees F
         FPC 4 Intake                   OK          22 degrees C / 71 degrees F
         FPC 4 Exhaust A                OK          28 degrees C / 82 degrees F
         FPC 4 Exhaust B                OK          31 degrees C / 87 degrees F
         FPC 4 I3 0 TSensor             OK          31 degrees C / 87 degrees F
         FPC 4 I3 0 Chip                OK          34 degrees C / 93 degrees F
         FPC 4 I3 1 TSensor             OK          31 degrees C / 87 degrees F
         FPC 4 I3 1 Chip                OK          33 degrees C / 91 degrees F
         FPC 4 I3 2 TSensor             OK          31 degrees C / 87 degrees F
         FPC 4 I3 2 Chip                OK          29 degrees C / 84 degrees F
         FPC 4 I3 3 TSensor             OK          29 degrees C / 84 degrees F
         FPC 4 I3 3 Chip                OK          29 degrees C / 84 degrees F
         FPC 4 IA 0 TSensor             OK          35 degrees C / 95 degrees F
         FPC 4 IA 0 Chip                OK          37 degrees C / 98 degrees F
         FPC 4 IA 1 TSensor             OK          31 degrees C / 87 degrees F
         FPC 4 IA 1 Chip                OK          35 degrees C / 95 degrees F
         FPC 7 Intake                   OK          20 degrees C / 68 degrees F
         FPC 7 Exhaust A                OK          21 degrees C / 69 degrees F
         FPC 7 Exhaust B                OK          21 degrees C / 69 degrees F
         FPC 7 I3 0 TSensor             OK          31 degrees C / 87 degrees F
         FPC 7 I3 0 Chip                OK          36 degrees C / 96 degrees F
         FPC 7 I3 1 TSensor             OK          32 degrees C / 89 degrees F
         FPC 7 I3 1 Chip                OK          35 degrees C / 95 degrees F
         FPC 7 I3 2 TSensor             OK          32 degrees C / 89 degrees F
         FPC 7 I3 2 Chip                OK          30 degrees C / 86 degrees F
         FPC 7 I3 3 TSensor             OK          30 degrees C / 86 degrees F
         FPC 7 I3 3 Chip                OK          31 degrees C / 87 degrees F
         FPC 7 IA 0 TSensor             OK          34 degrees C / 93 degrees F
         FPC 7 IA 0 Chip                OK          37 degrees C / 98 degrees F
         FPC 7 IA 1 TSensor             OK          31 degrees C / 87 degrees F
         FPC 7 IA 1 Chip                OK          35 degrees C / 95 degrees F
Fans     Top Fan Tray Temp              OK          27 degrees C / 80 degrees F
         Top Tray Fan 1                 OK          Spinning at high speed
         Top Tray Fan 2                 OK          Spinning at high speed
         Top Tray Fan 3                 OK          Spinning at high speed
         Top Tray Fan 4                 OK          Spinning at high speed
         Top Tray Fan 5                 OK          Spinning at high speed
         Top Tray Fan 6                 OK          Spinning at high speed
```

```
Bottom Fan Tray Temp             OK          28 degrees C / 82 degrees F
Bottom Tray Fan 1                OK          Spinning at high speed
Bottom Tray Fan 2                OK          Spinning at high speed
Bottom Tray Fan 3                OK          Spinning at high speed
Bottom Tray Fan 4                OK          Spinning at high speed
Bottom Tray Fan 5                OK          Spinning at high speed
Bottom Tray Fan 6                OK          Spinning at high speed
```

NOTE: The fan numbers are stamped into the fan tray sheet metal next to each fan.

RELATED DOCUMENTATION

Tools and Parts Required to Maintain the MX960 Router | 609
Replacing an MX960 Fan Tray | 478

Maintaining the MX960 Host Subsystem

Purpose

For optimum router performance, verify the condition of the host subsystem. The host subsystem includes an SCB and a Routing Engine installed into a slot in the SCB.

Action

On a regular basis:

- Check the LEDs on the craft interface to view information about the status of the Routing Engines.
- Check the LEDs on the SCB faceplate (see Table 9 in "SCB-MX Description" on page 169).
- Check the LEDs on the Routing Engine faceplate (see Table 10 in "MX960 Routing Engine Description" on page 28).
- 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                 39 degrees C / 102 degrees F
    CPU temperature             47 degrees C / 116 degrees F
    DRAM                      3584 MB
    Memory utilization          10 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     6 percent
      Interrupt                  0 percent
      Idle                      94 percent
    Model                          RE-S-2000
    Serial ID                      1000639065
    Start time                     2006-11-07 11:42:58 PST
    Uptime                         53 minutes, 35 seconds
    Load averages:                 1 minute   5 minute  15 minute
                                       0.06       0.07       0.02
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 42 degrees C / 107 degrees F
    CPU temperature             50 degrees C / 122 degrees F
    DRAM                      3584 MB
    Memory utilization           9 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                     100 percent
    Model                          RE-S-2000
    Serial ID                      1000664335
    Start time                     2006-11-02 18:35:01 PST
    Uptime                         4 days, 18 hours, 1 minute, 28 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                 26 degrees C / 78 degrees F
  Power 1
    1.2 V                      1202 mV
    1.5 V                      1508 mV
    1.8 V                      1830 mV
    2.5 V                      5053 mV
    3.3 V                      6593 mV
    5.0 V                      5111 mV
    12.0 V                    12181 mV
    1.25 V                     1263 mV
    3.3 V SM3                  6593 mV
    5 V RE                     5078 mV
    12 V RE                   12007 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                 27 degrees C / 80 degrees F
  Power 1
    1.2 V                      1214 mV
    1.5 V                      1517 mV
    1.8 V                      1814 mV
    2.5 V                      2507 mV
    3.3 V                      3312 mV
    5.0 V                      5136 mV
    12.0 V                    12142 mV
    1.25 V                     1256 mV
    3.3 V SM3                  3306 mV
    5 V RE                     5085 mV
    12 V RE                   11949 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
```

To check the status of a specific SCB, issue the **show chassis environment cb** command and include the slot number of the SCB—for example, **show chassis environment cb 0**.

For more information about using the CLI, see the Junos OS manuals.

RELATED DOCUMENTATION

MX960 Craft Interface Overview | 15

MX960 Host Subsystem Description | 27

Taking an MX960 Host Subsystem Offline

Effect of Taking the MX960 Host Subsystem Offline

Maintaining MX960 DPCs

Purpose

The router can have up to 12 Dense Port Concentrators (DPCs) mounted vertically in the DPC card cage at the front of the chassis. For optimum router performance, verify the condition of the DPCs.

Action

On a regular basis:

- 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.
- Check the **OK/FAIL** LED on the DPC. For more information, see *MX Series Interface Module Reference*. If the DPC detects a failure, the DPC sends an alarm message to the Routing Engine.
- Check the status of installed DPCs by issuing 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**

```
              Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
```

```
 1  Empty
 2  Online            22     40          0       1024       15          57
 3  Empty
 4  Online            22     24          0       1024       15          57
 5  Empty
 6  Empty
 7  Offline         ---Offlined by cli command---
 8  Empty
 9  Empty
10  Empty
11  Empty
```

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 2 information:
  State                                Online
  Temperature                       22 degrees C / 71 degrees F
  Total CPU DRAM                  1024 MB
  Total SRAM                       256 MB
  Total SDRAM                        0 MB
  Start time                           2006-11-03 07:35:40 PST
  Uptime                               2 hours, 27 minutes, 1 second
Slot 4 information:
  State                                Online
  Temperature                       22 degrees C / 71 degrees F
  Total CPU DRAM                  1024 MB
  Total SRAM                       256 MB
  Total SDRAM                        0 MB
  Start time                           2006-11-03 07:35:48 PST
  Uptime                               2 hours, 26 minutes, 53 seconds
Slot 7 information:
  State                                Online
  Temperature                       24 degrees C / 75 degrees F
  Total CPU DRAM                  1024 MB
  Total SRAM                       256 MB
  Total SDRAM                        0 MB
  Start time                           2006-11-03 07:35:53 PST
  Uptime                               2 hours, 26 minutes, 48 seconds
```

- Issue the CLI **show chassis fpc pic-status** command. The DPC slots are numbered from **0** through **5**, **2/6**, **7** through **11**, left to right:

user@host> **show chassis fpc pic-status**

```
Slot 2   Online       MX960 40GE DPC
  PIC 0  Online       10x 1GE
  PIC 1  Online       10x 1GE
  PIC 2  Online       10x 1GE
  PIC 3  Online       10x 1GE
Slot 4   Online       MX960 4 XGE DPC
  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 7   Offline      MX960 4 XGE DPC
```

For further description of the output from the command, see the CLI Explorer.

RELATED DOCUMENTATION

MX960 Chassis Description | 5
MX960 Dense Port Concentrator Description | 58
MX960 DPC and MPC LEDs on the Craft Interface | 18
Troubleshooting the MX960 DPCs | 675
Replacing an MX960 DPC | 507

Holding an MX960 DPC

When carrying a DPC, you can hold it either vertically or horizontally.

> **NOTE:** A DPC weighs 14.5 lb (6.6 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.

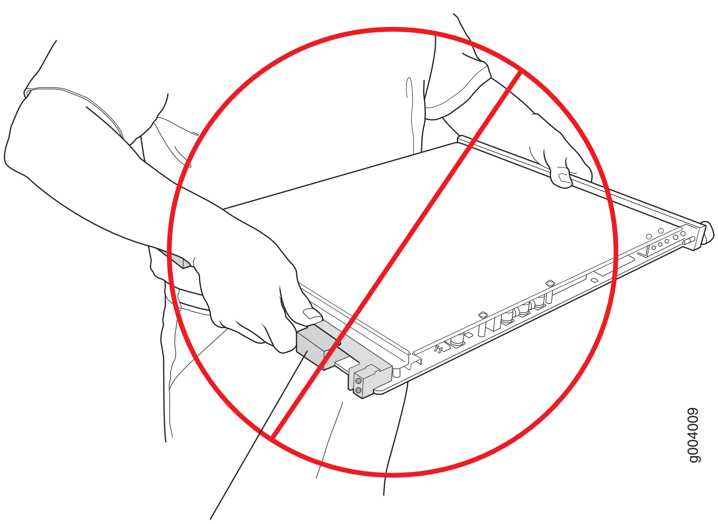
2. Grasp the top edge with your left hand and the bottom edge with your right hand.

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 240 on page 619.

Figure 240: Do Not Grasp the Connector Edge

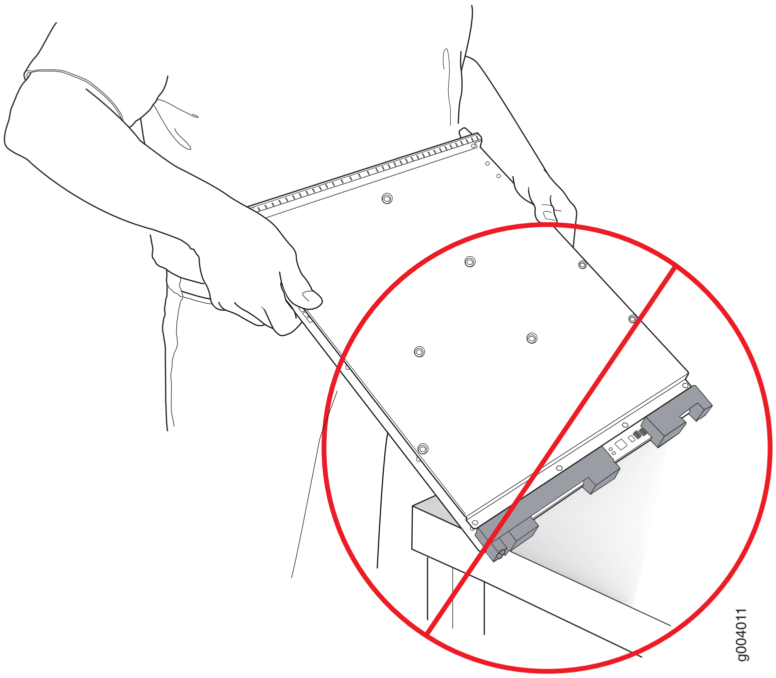


Never carry the DPC by the faceplate with only one hand.

Do not rest any edge of a DPC directly against a hard surface (see Figure 241 on page 620).

Do not stack DPCs.

Figure 241: 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.

RELATED DOCUMENTATION

MX960 DPC Terminology

Storing an MX960 DPC | 620

Troubleshooting the MX960 DPCs | 675

Replacing an MX960 DPC | 507

Storing an MX960 DPC

You must store a DPC as follows:

- In the router
- 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.

RELATED DOCUMENTATION

MX960 DPC Terminology
Holding an MX960 DPC | **618**
Maintaining MX960 DPCs | **616**
Replacing an MX960 DPC | **507**
Troubleshooting the MX960 DPCs | **675**

Maintaining MX960 FPCs

Purpose

The router can have one Flexible PIC Concentrator (FPC) installed vertically in two DPC slots at the front of the chassis. For optimum router performance, verify the condition of the FPC.

Action

On a regular basis:

- Check the LEDs on the craft interface directly above the FPC. The green LED labeled **OK** lights steadily when an FPC is functioning normally.
- Check the **OK/FAIL** LED on the FPC. If the FPC detects a failure, the FPC sends an alarm message to the Routing Engine.
- Issue the CLI **show chassis fpc** command to check the status of the installed FPC. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the FPC is functioning normally:

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

```
              Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State     (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online    24      3          0       1024        13         21
  1  Empty
  2  Online    41      9          0       1024        15         57
  3  Online    43      5          0       1024        16         57
  4  Online    43     11          0       1024        16         57
  5  Online    41      9          0       1024        15         57
  6  Online    43      5          0       1024        16         57
  7  Empty
  8  Empty
  9  Empty
  10 Online    24      3          0       1024        13         21
  11 Empty
```

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 0 information:
  State                                  Online
  Temperature                         24 degrees C / 75 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       128 MB
  Total DDR DRAM                    2048 MB
  Start time:                            2008-12-11 16:53:24 PST
  Uptime:                                15 hours, 2 minutes, 47 seconds
Slot 2 information:
  State                                  Online
  Temperature                         29 degrees C / 84 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       256 MB
  Total DDR DRAM                    4096 MB
  Start time:                            2008-12-11 16:53:18 PST
  Uptime:                                15 hours, 2 minutes, 53 seconds
Slot 3 information:
  State                                  Online
  Temperature                         29 degrees C / 84 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       256 MB
  Total DDR DRAM                    4096 MB
  Start time:                            2008-12-11 16:53:18 PST
```

```
  Uptime:                             15 hours, 2 minutes, 53 seconds
Slot 4 information:
  State                               Online
  Temperature                      29 degrees C / 84 degrees F
  Total CPU DRAM                 1024 MB
  Total RLDRAM                    256 MB
  Total DDR DRAM                 4096 MB
  Start time:                         2008-12-11 16:53:18 PST
  Uptime:                             15 hours, 2 minutes, 53 seconds
Slot 5 information:
  State                               Online
  Temperature                      29 degrees C / 84 degrees F
  Total CPU DRAM                 1024 MB
  Total RLDRAM                    256 MB
  Total DDR DRAM                 4096 MB
  Start time:                         2008-12-11 16:53:22 PST
  Uptime:                             15 hours, 2 minutes, 49 seconds
Slot 6 information:
  State                               Online
  Temperature                      29 degrees C / 84 degrees F
  Total CPU DRAM                 1024 MB
  Total RLDRAM                    256 MB
  Total DDR DRAM                 4096 MB
  Start time:                         2008-12-11 16:53:18 PST
  Uptime:                             15 hours, 2 minutes, 53 seconds
Slot 10 information:
  State                               Online
  Temperature                      24 degrees C / 75 degrees F
  Total CPU DRAM                 1024 MB
  Total RLDRAM                    128 MB
  Total DDR DRAM                 2048 MB
  Start time:                         2008-12-11 16:53:24 PST
  Uptime:                             15 hours, 2 minutes, 47 seconds
```

- Issue the CLI **show chassis fpc pic-status** command. The following example shows an FPC installed in DPC slots **1** and **2**:

  `user@host>` **show chassis fpc pic-status**

```
  Slot 0   Online       DPC 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 1   Online        MX FPC Type 3
  PIC 0  Online        1x OC-192 SONET
  PIC 1  Online        1x OC-192 SONET
```

NOTE: An FPC takes up two DPC slots when installed on an MX Series router. The slot number corresponds to the lowest numbered DPC slot.

For further description of the output from the command, see the CLI Explorer.

RELATED DOCUMENTATION

MX960 Flexible PIC Concentrator (FPC) LEDs | 71
Troubleshooting the MX960 FPCs | 677
Replacing an MX960 FPC | 514
Holding an MX960 FPC | 624
Storing an MX960 FPC | 629

Holding an MX960 FPC

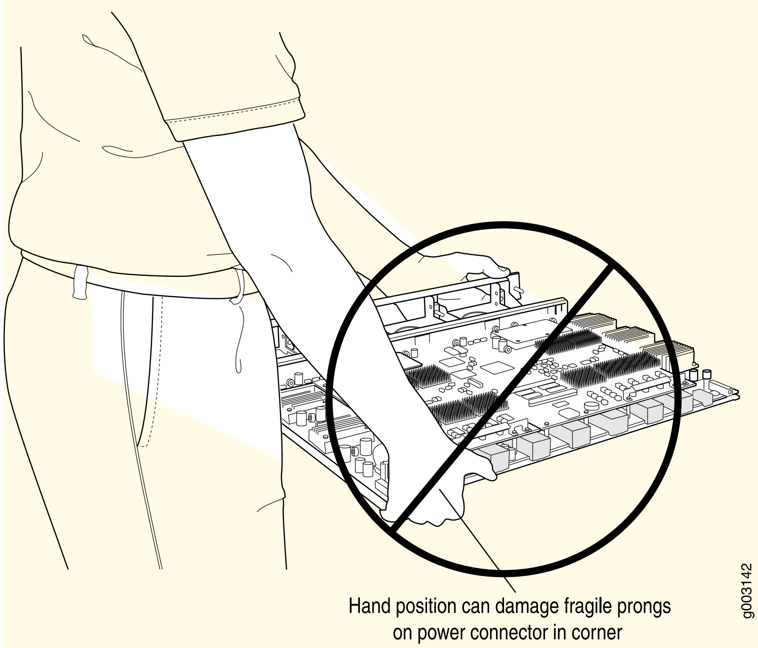
CAUTION: Many components on the FPC are fragile. Failure to handle FPCs as specified in this document can cause irreparable damage.

NOTE: An FPC configured with PICs installed can weigh as much as 18 lb (8.2 kg). Be prepared to accept the full weight of the FPC as you lift it.

CAUTION: To prevent damage when handling or carrying FPCs:

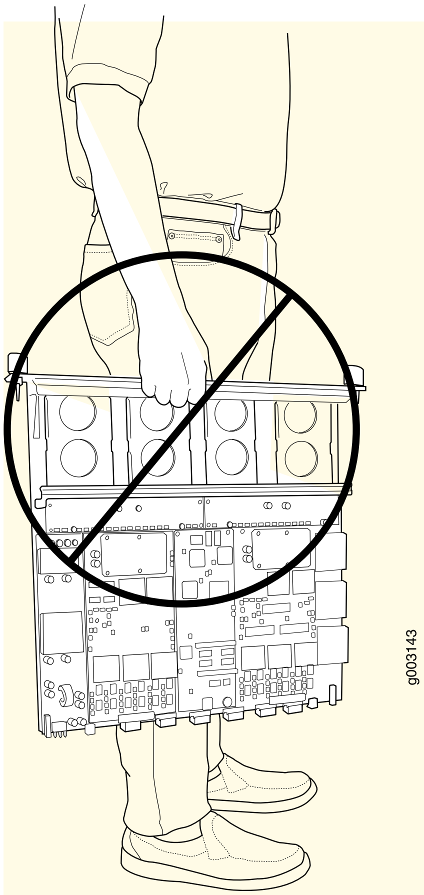
- As you carry the FPC, do not bump it against anything. FPC components are fragile.
- Do not grasp the FPC anywhere except places that this document indicates. In particular, never grasp the connector edge, especially at the power connector in the corner where the connector and bottom edges meet (see Figure 242 on page 626).

Figure 242: Do Not Grasp the Connector Edge



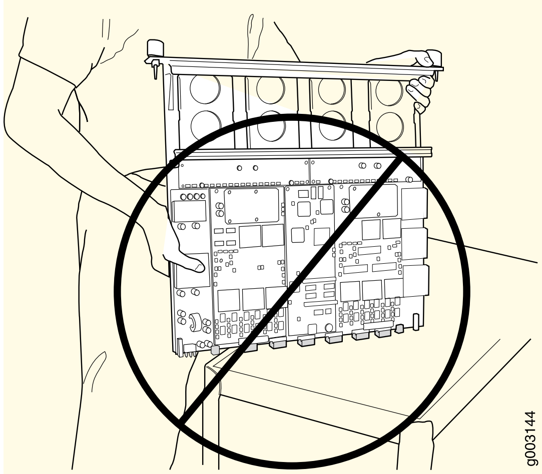
- Do not carry the FPC by the faceplate with only one hand (see Figure 243 on page 626).

Figure 243: Do Not Carry an FPC with Only One Hand



- Do not rest any edge of an FPC directly against a hard surface (see Figure 244 on page 627). If you must rest the FPC temporarily on an edge while changing its orientation between vertical and horizontal, use your hand as a cushion between the edge and the surface.

Figure 244: Do Not Rest the FPC on an Edge



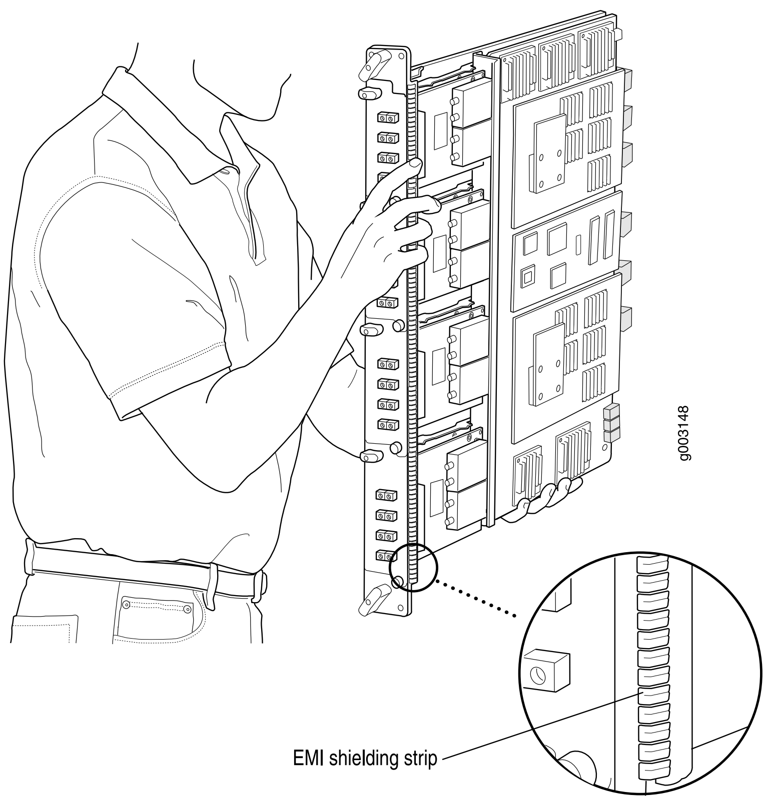
You hold an FPC vertically when installing it into the chassis or an equipment rack. To hold an FPC vertically (see Figure 245 on page 628):

1. Orient the FPC so that the faceplate faces you.

2. Place one hand around the FPC faceplate about a quarter of the way down from the top edge. To avoid deforming the electromagnetic interference (EMI) shielding strip, do not press hard on it.

3. Place your other hand at the bottom edge of the FPC. If the FPC has heat sinks about midway between the faceplate and connector edge, place your other hand against the heat sinks.

Figure 245: Holding an FPC Vertically



RELATED DOCUMENTATION

MX960 Flexible PIC Concentrator Description | 68

MX960 FPC Terminology

Storing an MX960 FPC | 629

Storing an MX960 FPC

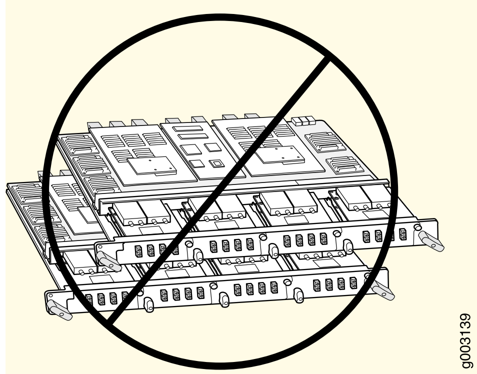
When not installed in the routing platforms, FPCs must be either stored in the container in which a spare FPC is shipped or stored horizontally with the component-side up on a flat, stable surface. When you store an FPC on a horizontal surface or in the shipping container, always place it inside an antistatic bag. Because the FPC is heavy and because antistatic bags are fragile, inserting the FPC into the bag is easier with two people. The storage guidelines are as follows:

- When storing an FPC with two people, one person holds the FPC in the horizontal position with the faceplate facing their body, the other person slides the opening of the bag over the FPC connector edge.
- When storing an FPC with one person, you must insert the FPC into a bag by yourself. First lay the FPC horizontally on a flat, stable surface, component-side up. Orient the FPC with the faceplate facing you. Carefully insert the FPC connector edge into the opening of the bag, and pull the bag toward you to cover the FPC.

CAUTION: To prevent damage when storing FPCs:

- Never lay an FPC component-side down.

Figure 246: Do Not Stack FPCs



- Never stack an FPC under or on top of any other component (see Figure 246 on page 629).

RELATED DOCUMENTATION

Maintaining MX960 MICs

Purpose

For optimum router performance, verify the condition of the Modular Interface Cards (MICs).

Action

On a regular basis:

- Check the LEDs on MIC faceplates. The meaning of the LED states differs for various MICs. For more information, see the *MX Series Interface Module Reference*. If the MPC that houses the MIC detects a MIC failure, the MPC generates an alarm message to be sent to the Routing Engine.
- Issue the CLI **show chassis fpc pic-status** command. The MIC slots in an MPC are numbered **PIC 0/1** and **PIC 2/3**, top to bottom:

user@host> **show chassis fpc pic-status**

```
Slot 0    Online       DPCE 4x 10GE R EQ
  PIC 0   Online       1x 10GE(LAN/WAN) EQ
  PIC 1   Online       1x 10GE(LAN/WAN) EQ
  PIC 2   Online       1x 10GE(LAN/WAN) EQ
  PIC 3   Online       1x 10GE(LAN/WAN) EQ
Slot 1    Online       DPCE 40x 1GE R EQ
  PIC 0   Online       10x 1GE(LAN) EQ
  PIC 1   Online       10x 1GE(LAN) EQ
  PIC 2   Online       10x 1GE(LAN) EQ
  PIC 3   Online       10x 1GE(LAN) EQ
Slot 2    Online       MS-DPC
  PIC 0   Online       MS-DPC PIC
  PIC 1   Online       MS-DPC PIC
Slot 3    Online       MPC Type 2 3D EQ
  PIC 0   Online       1x 10GE XFP
  PIC 1   Online       1x 10GE XFP
Slot 4    Online       MPC 3D 16x 10GE
  PIC 0   Online       4x 10GE(LAN) SFP+
  PIC 1   Online       4x 10GE(LAN) SFP+
  PIC 2   Online       4x 10GE(LAN) SFP+
  PIC 3   Online       4x 10GE(LAN) SFP+
Slot 6    Online       MX960 40GE DPC
  PIC 0   Online       10x 1GE
  PIC 1   Online       10x 1GE
  PIC 2   Online       10x 1GE
  PIC 3   Online       10x 1GE
Slot 10   Online       MPC 3D 16x 10GE
  PIC 0   Online       4x 10GE(LAN) SFP+
```

```
PIC 1   Online        4x 10GE(LAN) SFP+
PIC 2   Online        4x 10GE(LAN) SFP+
PIC 3   Online        4x 10GE(LAN) SFP+
```

For further description of the output from the command, see the CLI Explorer.

RELATED DOCUMENTATION

MX960 Modular Interface Card Description | 93

MX960 Modular Interface Card (MIC) LEDs | 94

Troubleshooting the MX960 MICs | 680

Replacing an MX960 MIC | 521

Maintaining MX960 MPCs

Purpose

The router can have up to 12 Modular Port Concentrators (MPCs) mounted vertically in the card cage at the front of the chassis. For optimum router performance, verify the condition of the MPCs.

Action

On a regular basis:

- Check the LEDs on the craft interface directly above each MPC slot. The green LED labeled **OK** lights steadily when an MPC is functioning normally.
- Check the **OK/FAIL** LED on the MPC. If the MPC detects a failure, the MPC sends an alarm message to the Routing Engine.
- Issue the CLI **show chassis fpc** command to check the status of installed MPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the MPC is functioning normally:

  user@host> **show chassis fpc**

```
                    Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State           (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online           36      3          0       2048       14         13
  1  Online           40      5          0       2048       26         13
  2  Online           41      6          0       1024        7         43
  3  Online           43      5          0       1024       16         57
  4  Online           24      3          0       1024       13         21
```

```
  5  Empty
  6  Online          43      5          0       1024       16          57
  7  Empty
  8  Empty
  9  Empty
  10 Online          24      3          0       1024       13          21
  11 Empty
```

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 0 information:
  State                                  Online
  Temperature                         33 degrees C / 91 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       256 MB
  Total DDR DRAM                    4096 MB
  Start time:                            2009-12-22 12:26:54 PST
  Uptime:                                6 days, 3 hours, 8 minutes, 51 seconds
  Max Power Consumption              330 Watts
Slot 1 information:
  State                                  Online
  Temperature                         32 degrees C / 89 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       256 MB
  Total DDR DRAM                    4096 MB
  Start time:                            2009-12-22 12:26:54 PST
  Uptime:                                6 days, 3 hours, 8 minutes, 51 seconds
  Max Power Consumption              365 Watts
Slot 2 information:
  State                                  Online
  Temperature                         41 degrees C / 105 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       128 MB
  Total DDR DRAM                    2048 MB
  Start time:                            2009-12-22 12:26:46 PST
  Uptime:                                6 days, 3 hours, 8 minutes, 59 seconds
  Max Power Consumption              265 Watts
Slot 3 information:
  State                                  Online
  Temperature                         36 degrees C / 96 degrees F
  Total CPU DRAM                    2048 MB
```

```
  Total RLDRAM                     806 MB
  Total DDR DRAM                  2632 MB
  Start time:                          2009-12-22 12:27:04 PST
  Uptime:                              6 days, 3 hours, 8 minutes, 41 seconds
  Max Power Consumption            450 Watts
Slot 4 information:
  State                                Online
  Temperature                      40 degrees C / 104 degrees F
  Total CPU DRAM                  2048 MB
  Total RLDRAM                    1324 MB
  Total DDR DRAM                  5120 MB
  Start time:                          2009-12-22 12:27:02 PST
  Uptime:                              6 days, 3 hours, 8 minutes, 43 seconds
  Max Power Consumption            440 Watts
Slot 6 information:
  State                                Online
  Temperature                      29 degrees C / 84 degrees F
  Total CPU DRAM                  1024 MB
  Total RLDRAM                     256 MB
  Total DDR DRAM                  4096 MB
  Start time:                          2008-12-11 16:53:18 PST
  Uptime:                              15 hours, 2 minutes, 53 seconds
  Max Power Consumption            365 Watts
Slot 10 information:
  State                                Online
  Temperature                      24 degrees C / 75 degrees F
  Total CPU DRAM                  1024 MB
  Total RLDRAM                     128 MB
  Total DDR DRAM                  2048 MB
  Start time:                          2008-12-11 16:53:24 PST
  Uptime:                              15 hours, 2 minutes, 47 seconds
  Max Power Consumption            440 Watts
```

- Issue the CLI **show chassis fpc pic-status** command. The MPC slots are numbered **0** through **5**, bottom to top:

`user@host>` **show chassis fpc pic-status**

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

```
  PIC 0  Online        10x 1GE(LAN) EQ
  PIC 1  Online        10x 1GE(LAN) EQ
  PIC 2  Online        10x 1GE(LAN) EQ
  PIC 3  Online        10x 1GE(LAN) EQ
Slot 2   Online        MS-DPC
  PIC 0  Online        MS-DPC PIC
  PIC 1  Online        MS-DPC PIC
Slot 3   Online        MPC Type 2 3D EQ
  PIC 0  Online        1x 10GE XFP
  PIC 1  Online        1x 10GE XFP
Slot 4   Online        MPC 3D 16x 10GE
  PIC 0  Online        4x 10GE(LAN) SFP+
  PIC 1  Online        4x 10GE(LAN) SFP+
  PIC 2  Online        4x 10GE(LAN) SFP+
  PIC 3  Online        4x 10GE(LAN) SFP+
Slot 6   Online        MX960 40GE DPC
  PIC 0  Online        10x 1GE
  PIC 1  Online        10x 1GE
  PIC 2  Online        10x 1GE
  PIC 3  Online        10x 1GE
Slot 10  Online        MPC 3D 16x 10GE
  PIC 0  Online        4x 10GE(LAN) SFP+
  PIC 1  Online        4x 10GE(LAN) SFP+
  PIC 2  Online        4x 10GE(LAN) SFP+
  PIC 3  Online        4x 10GE(LAN) SFP+
```

For further description of the output from the command, see the CLI Explorer.

RELATED DOCUMENTATION

MX960 Modular Port Concentrator Description | 108

MX960 Modular Port Concentrator LEDs | 111

Troubleshooting the MX960 MPCs | 682

Replacing an MX960 MPC | 532

Maintaining MX960 PICs

Purpose

For optimum router performance, verify the condition of the PICs.

Action

On a regular basis:

- Check the LEDs on PIC faceplates. The meaning of the LED states differs for various PICs. For more information, see the *MX Series Interface Module Reference*. If the FPC that houses the PIC detects a PIC failure, the FPC generates an alarm message to be sent to the Routing Engine.
- Issue the CLI **show chassis fpc pic-status** command. The PIC slots in an FPC are numbered from **0** through **1**, top to bottom:

  `user@host>` **show chassis fpc pic-status**

```
Slot 0   Online        DPC 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 1   Online        MX FPC Type 3
  PIC 0  Online        1x OC-192 SONET
  PIC 1  Online        1x OC-192 SONET
```

  For further description of the output from the command, see the CLI Explorer.

RELATED DOCUMENTATION

Maintaining Cables That Connect to MX960 DPCs, MPCs, MICs, or PICs

Purpose

For optimum router performance, verify the condition of the cables that connect to the DPCs, MPCs, MICs, or PICs.

Action

On a regular basis:

- Use a standard cable manager or extended cable manager (shown in Figure 247 on page 636 and Figure 248 on page 636) to support cables and prevent cables from dislodging or developing stress points.

Figure 247: Standard Cable Manager

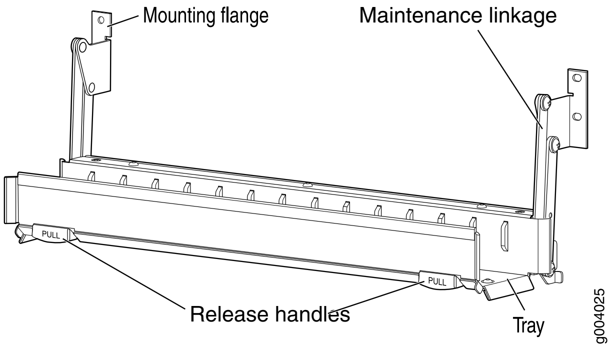
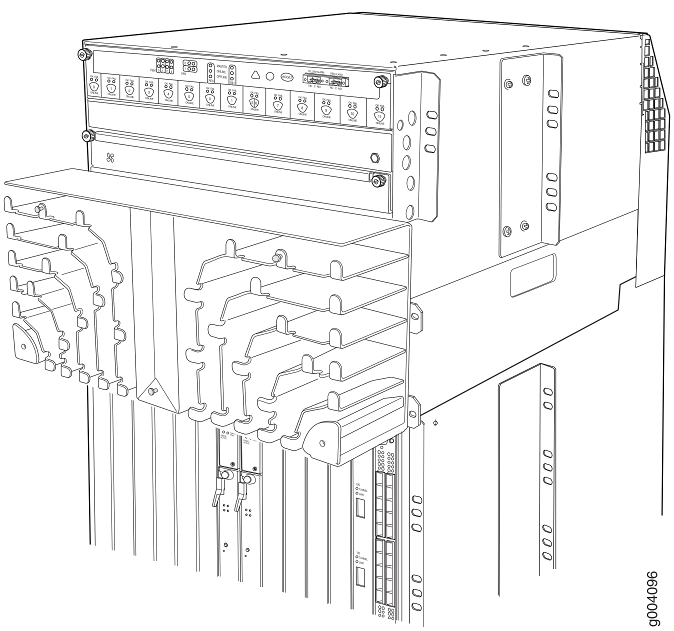


Figure 248: Extended Cable Manager



- Place excess cable out of the way in the standard or extended cable manager. Do not allow fastened loops of cable to dangle from the connector or cable manager 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 the cables to identify them.

The following guidelines apply specifically to fiber-optic cables:

- When you unplug a fiber-optic cable, always place a rubber safety plug over the transceiver on the faceplate and on the end of the cable.
- Anchor fiber-optic cables to avoid stress on the connectors. Be sure to secure fiber-optic cables so that they do not support their own weight as they hang 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 clean an optical transceiver, 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.

RELATED DOCUMENTATION

Maintaining MX960 DPCs | 616
Maintaining MX960 MPCs | 631
Maintaining MX960 MICs | 630
Maintaining MX960 PICs | 634

Maintaining MX-SPC3 Services Card

IN THIS SECTION

Maintaining MX-SPC3 Services Card

Purpose

For optimum router performance, verify the condition of the MX-SPC3 Services Card. To maintain MX-SPC3s cards, perform the following procedures regularly.

Action

On a regular basis:

- Check the LEDs on the craft interface corresponding to the slot for each MX-SPC3. The green LED labeled **OK** lights steadily when a MX-SPC3 is functioning normally.
- Check the **OK/FAIL** LED on the MX-SPC3. If the MX-SPC3 detects a failure, the MX-SPC3 sends an alarm message to the Routing Engine.
- Issue the CLI **show chassis fpc** command to check the status of installed MX-SPC3s.

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

  For more detailed output, add the **detail** option.

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

- Issue the CLI **show chassis fpc pic-status** command.

  `user@host>` **show chassis fpc pic-status**

  For further description of the output from the command, see the CLI Explorer.

Replacing an MX-SPC3

IN THIS SECTION

Removing an MX-SPC3

The MX-SPC3 installs horizontally in the front of the MX240 & MX480 routers and vertically in the MX960 router. The MX-SPC3s are hot-insertable and hot-removable and the router continues to function when you remove an MX-SPC3.

A fully configured MX-SPC3 can weigh up to 18.35 lb (8.3 kg). Be prepared to accept its full weight.

To remove an MX-SPC3:

1. Have ready a replacement MX-SPC3 or a blank panel and an antistatic mat for the MX-SPC3. Also have ready rubber safety caps for transceivers.

2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

3. Label the cables connected to each port on the MX-SPC3 so that you can later reconnect the cables to the correct ports.

4. Use one of the following methods to take the MX-SPC3 offline:

   - Press and hold the corresponding online button on the craft interface. The green **OK/FAIL** 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 CLI Explorer.

5. Disconnect the cables from the MX-SPC3. If the MX-SPC3 uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.

   WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables 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 a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

CAUTION: Avoid bending a 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. Arrange the disconnected cables in the cable manager to prevent the cables from developing stress points.

7. Simultaneously turn both the ejector handles counterclockwise to unseat the MX-SPC3.

8. Grasp the handles, and slide the MX-SPC3 straight out of the card cage halfway.

9. Place one hand around the front of the MX-SPC3 and the other hand under it to support it. Slide the MX-SPC3 completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.

CAUTION: The weight of the MX-SPC3 is concentrated in the back end. Be prepared to accept the full weight—up to 18.35 lb (8.3 kg)—as you slide the MX-SPC3 out of the chassis.

When the MX-SPC3 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 MX-SPC3s on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

10. If you are not reinstalling an MX-SPC3 into the emptied line card slots within a short time, install a blank panel over each slot to maintain proper airflow in the card cage.

CAUTION: After removing an MX-SPC3 from the chassis:

- Check the back panel connectors of the MX-SPC3 for damages. A damaged connector on the MX-SPC3 card can damage the chassis back plane.
- Wait for at least 30 seconds before reinserting the MX-SPC3 into the same slot or inserting it into a different slot.

Installing an MX-SPC3

The MX-SPC3 installs horizontally in the front of the MX240 & MX480 routers and vertically in the MX960 router.

A fully configured MX-SPC3 can weigh up to 18.35 lb (8.3 kg). Be prepared to accept its full weight.

CAUTION: Before installing an MX-SPC3 into the chassis:

- Check the back panel connectors of the MX-SPC3 for damages. A damaged connector on the MX-SPC3 card can damage the chassis back plane.
- Wait for at least 30 seconds, before reinserting the MX-SPC3 into the same slot or inserting it into a different slot.

To install an MX-SPC3:

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Place the MX-SPC3 on an antistatic mat.
3. Locate the slot in the card cage in which you plan to install the MX-SPC3.
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 MX-SPC3 so that the faceplate faces you.
6. Lift the MX-SPC3 into place, and carefully align first the bottom and then the top of the card with the guides inside the card cage.

   CAUTION: When the MX-SPC3 is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

7. Slide the MX-SPC3 all the way into the card cage until you feel resistance.
8. Grasp both ejector handles, and rotate them clockwise simultaneously until the MX-SPC3 is fully seated.
9. If the MX-SPC3 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 cables connected to a transceiver emit laser light that can damage your eyes.

10. Insert the appropriate cables into the cable connector ports on MX-SPC3. 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 cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

    CAUTION: Avoid bending a 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 MX-SPC3 online:

    - Press and hold the corresponding MX-SPC3 online button on the craft interface until the green **OK/FAIL** 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 CLI Explorer.

    CAUTION: After the **OK/FAIL** LED lights steadily, wait at least 30 seconds before removing the MX-SPC3 again, removing an MX-SPC3 from a different slot, or inserting an MX-SPC3 in a different slot.

Maintaining the MX960 Power Supplies

Purpose

For optimum router performance, verify the condition of the power supplies.

Action

On a regular basis:

- Check the status of the power supplies by issuing 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 1 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 if the power supplies are functioning normally.
- 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**

- 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.

RELATED DOCUMENTATION

MX960 Power Supply LEDs on the Craft Interface | 18
MX960 AC Power Supply Description | 127
MX960 DC Power Supply | 138
Troubleshooting Resources for MX960 Routers | 671
MX960 Site Preparation Checklist | 180

Verifying the Version of the MX960 Cable Manager

Purpose

To verify the version of the cable manager—standard or extended.

Action

Issue the **show chassis hardware** command. In the following output, *Extended Cable Manager* in the **Description** field indicates that the MX960 router has an extended cable manager installed.

`user@host>` **show chassis hardware**

```
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN10BA496AFA      MX960
Midplane         REV 03   710-013698   TR0193            MX960 Backplane
Fan Extender     REV 02   710-018051   JY5226            Extended Cable
Manager
FPM Board        REV 03   710-014974   JZ6867            MX960 Front
Panel Display
PDM              Rev 03   740-013110   QCS11035022       Power
Distribution Module
PEM 0            Rev 03   740-013683   QCS1104706T       DC Power Entry
Module
PEM 1            Rev 03   740-013683   QCS11047071       DC Power Entry
Module
PEM 2            Rev 03   740-013683   QCS1110700A       DC Power Entry
Module
PEM 3            Rev 03   740-013683   QCS11107006       DC Power Entry
Module
Routing Engine 0 REV 06   740-013063   1000690747        RE-S-2000
Routing Engine 1 REV 06   740-013063   1000690717        RE-S-2000
CB 0             REV 07   710-013385   KA3976            MX SCB
CB 1             REV 07   710-013385   KA2127            MX SCB
CB 2             REV 07   710-013385   KA2122            MX SCB
FPC 0            REV 06   710-013699   JZ8103            DPCE 40x 1GE X
   CPU             REV 06   710-013713   JZ7349            DPC PMB
   PIC 0                    BUILTIN      BUILTIN           10x 1GE(LAN)
     Xcvr 0        REV 01   740-011783   PB93302           SFP-LX
     Xcvr 1        REV 01   740-011613   AM0703S02F5       SFP-SX
     Xcvr 2        REV 01   740-011613   AM0703S02EV       SFP-SX
     Xcvr 3        REV 01   740-011613   AM0703S02EN       SFP-SX
     Xcvr 4        REV 01   740-011613   AM0703S02FD       SFP-SX
     Xcvr 5        REV 01   740-011783   PB93RLK           SFP-LX
     Xcvr 6        REV 01   740-011783   PB9292T           SFP-LX
```

```
      Xcvr 7         REV 01    740-011613    AM0703S02EC       SFP-SX
      Xcvr 8         REV 01    740-011783    PB9296B           SFP-LX
      Xcvr 9         REV 01    740-011783    PB9294X           SFP-LX
    PIC 1                      BUILTIN       BUILTIN           10x 1GE(LAN)
      Xcvr 0         REV 01    740-011783    PB9330R           SFP-LX
      Xcvr 1         REV 01    740-011613    PB349PQ           SFP-SX
      Xcvr 2         REV 01    740-011613    AM0703S02F1       SFP-SX
      Xcvr 3         REV 01    740-011613    PB3494J           SFP-SX
      Xcvr 4         REV 01    740-011613    AM0703S02EY       SFP-SX
      Xcvr 5         REV 01    740-011613    AM0703S02F3       SFP-SX
      Xcvr 6         REV 01    740-011613    AM0703S02EX       SFP-SX
      Xcvr 7         REV 01    740-011613    AM0703S02EZ       SFP-SX
      Xcvr 8         REV 01    740-011613    AM0703S02ET       SFP-SX
      Xcvr 9         REV 01    740-011613    AM0703S02G8       SFP-SX
    PIC 2                      BUILTIN       BUILTIN           10x 1GE(LAN)
      Xcvr 0         REV 01    740-011783    PB92938           SFP-LX
      Xcvr 1         REV 01    740-011613    AM0703S02E0       SFP-SX
      Xcvr 2         REV 01    740-011613    AM0703S02F6       SFP-SX
      Xcvr 3         REV 01    740-011613    AM0703S02FB       SFP-SX
      Xcvr 4         REV 01    740-011613    AM0703S02FA       SFP-SX
      Xcvr 5         REV 01    740-011613    AM0703S02ED       SFP-SX
      Xcvr 6         REV 01    740-011783    PB9338R           SFP-LX
      Xcvr 7         REV 01    740-011613    AM0703S02E1       SFP-SX
      Xcvr 8         REV 01    740-011783    PB929AU           SFP-LX
      Xcvr 9         REV 01    740-011783    PB929AV           SFP-LX
    PIC 3                      BUILTIN       BUILTIN           10x 1GE(LAN)
      Xcvr 0         REV 01    740-011783    PB9330Q           SFP-LX
      Xcvr 1         REV 01    740-011613    AM0703S02E8       SFP-SX
      Xcvr 2         REV 01    740-011613    PB34FPU           SFP-SX
      Xcvr 3         REV 01    740-011613    PB34FZ4           SFP-SX
      Xcvr 4         REV 01    740-011613    PB34N3Q           SFP-SX
      Xcvr 5         REV 01    740-011613    AM0703S02EL       SFP-SX
      Xcvr 6         REV 01    740-011613    AM0703S02EG       SFP-SX
      Xcvr 7         REV 01    740-011613    AM0703S02EJ       SFP-SX
      Xcvr 8         REV 01    740-011783    PB9292Y           SFP-LX
      Xcvr 9         REV 01    740-011783    PB9296A           SFP-LX
FPC 3              REV 08    710-014219    KA1048            DPCE 4x 10GE X
    CPU              REV 06    710-013713    JZ7177            DPC PMB
    PIC 0                      BUILTIN       BUILTIN           1x
10GE(LAN/WAN)
      Xcvr 0         REV 01    740-014279    6Z3019A00247      XFP-10G-LR
    PIC 1                      BUILTIN       BUILTIN           1x
10GE(LAN/WAN)
      Xcvr 0         REV 01    740-014279    723019A00434      XFP-10G-LR
```

```
   PIC 2                   BUILTIN      BUILTIN           1x
10GE(LAN/WAN)
     Xcvr 0       REV 01    740-014289   C712XU00S         XFP-10G-SR
   PIC 3                   BUILTIN      BUILTIN           1x
10GE(LAN/WAN)
     Xcvr 0       REV 01    740-014279   6Z3019A00216      XFP-10G-LR
Fan Tray 0       REV 03    740-014971   TP0730            Fan Tray
Fan Tray 1       REV 03    740-014971   TP0451            Fan Tray
```

RELATED DOCUMENTATION

MX960 Cable Manager Description | 20

Replacing the MX960 Cable Manager | 459

CHAPTER 33

Converting to a Different Type of Power Supply

IN THIS CHAPTER

Converting from AC to DC Power Supplies on an MX960 Router

The conversion of an MX960 router from AC to DC or DC to AC should be performed with the system completely powered off. A system cannot operate with a mix of AC and DC power supplies. This procedure assumes conversion from normal-capacity power supplies to high-capacity power supplies.

Remove MX960 normal-capacity AC power supplies for power supplies in slots 0, 1, 2, 3 where present. All power supplies should be removed before proceeding with the installation of the DC power supplies. To convert from AC to DC, use the following procedures.

Use the following procedures to install the MX960 high capacity DC power supplies or install the high-voltage second-generation universal (HVAC/HVDC) power supplies for power supply in slots 0, 1, 2, 3 where present.

To remove a normal-capacity AC power supply (see Figure 226 on page 559):

1. Move the AC input switch in the chassis above the power supply in slot 0 to the off (**O**) position.

2. Remove the power cord from the AC power source. Follow the ESD and disconnection instructions for your site.

3. Remove the power cord from the power supply.

4. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.

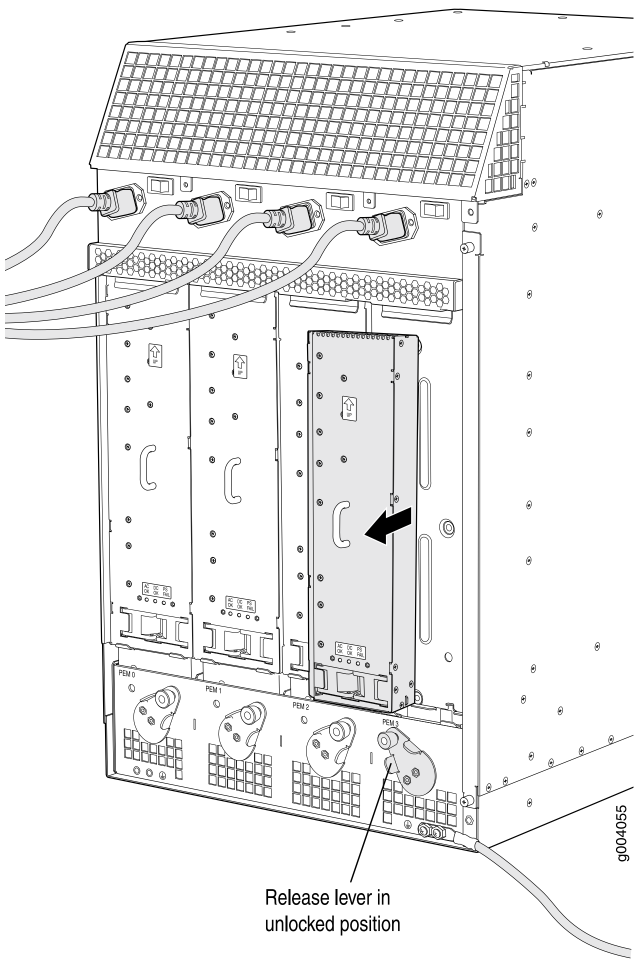
5. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

6. Pull the power supply straight out of the chassis as shown in Figure 226 on page 559.

> **WARNING:** Do not touch the power connector on the top of the power supply. It can contain dangerous voltages.

7. Repeat steps 1-6 for power supplies in slot 1, 2, 3 where present.

Figure 249: Removing an MX960 AC Power Supply



> **NOTE:** The chassis is shown without the extended cable manager.

Use the following procedures to install the MX960 high-capacity DC power supplies for power supply in slots 0, 1, 2, and 3, where present.

To install an MX960 high-capacity DC power supply:

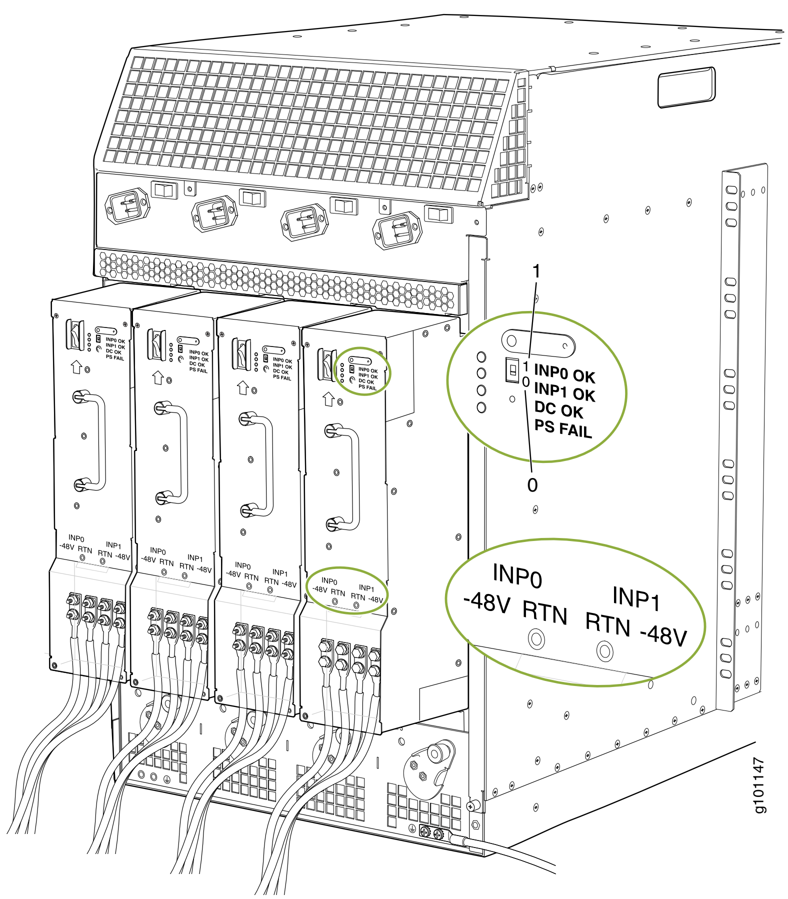
1. Verify that the power switch on the power supply is in the off (**O**) position.

2. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

3. Move the input mode switch to position 0 for one feed or position 1 for two feeds (see Figure 250 on page 649).

> **NOTE:** For a fully redundant configuration in two-feed mode, eight feeds are required. For a nonredundant configuration, four feeds are required.

Figure 250: MX960 with High-Capacity DC Power Supplies Installed



NOTE: The chassis is shown without the extended cable manager.

CAUTION: Do not use a pencil, because fragments can break off and cause damage to the power supply.

4. 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.

5. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position.

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

6. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot.

   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply. This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

7. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

8. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

9. Remove the cover protecting the terminal studs on the faceplate.

10. Remove the nut and washer from each of the terminal studs.

11. Secure each power cable lug to the terminal studs, first with the split 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. Do not overtighten the nut. (Use a 7/16-in. [11-mm] torque-controlled driver or socket wrench.)

    a. On **INPUT 0**, attach the positive (+) DC source power cable lug to the **RTN** (return) terminal as shown in Figure 250 on page 649. Repeat this step for **INPUT 1** if using two feeds.

b. On **INPUT 0** attach the negative (–) DC source power cable lug to the **-48V** (input) terminal. Repeat this step for **INPUT 1** if using two feeds.if using two feeds.

> **CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.

> **CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 36 lb-in. (4.0 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

> **NOTE:** **INPUT 0** for all four power supplies must be powered by dedicated power feeds derived from feed **A**, and **INPUT 1** for all four power supplies must be powered by dedicated power feeds derived from feed **B**. This configuration provides the commonly deployed **A/B** feed redundancy for the system. For information about connecting to DC power sources, see *Electrical Specifications for the MX960 DC Power Supply*.

12. Verify that the power cabling is correct, that the cables are not touching, and that they do not block access to router components or drape where people could trip on them.

13. Replace the clear plastic cover over the terminal studs on the faceplate.

14. Switch on the dedicated customer site circuit breaker.

15. Verify that the **INPUT 0 OK** or **INPUT 1 OK** LEDs on the power supply are lit green steadily. If using two feeds, verify that both **INPUT 0 OK** and **INPUT 1 OK** LEDs on the power supply are lit steadily. The **INPUT OK** will be lit amber if that input's voltage is in reverse polarity. Check the polarity of the power cables to fix the condition (see Figure 132 on page 371 and Table 131 on page 371.

16. Move the switch to the on (**|**) position.

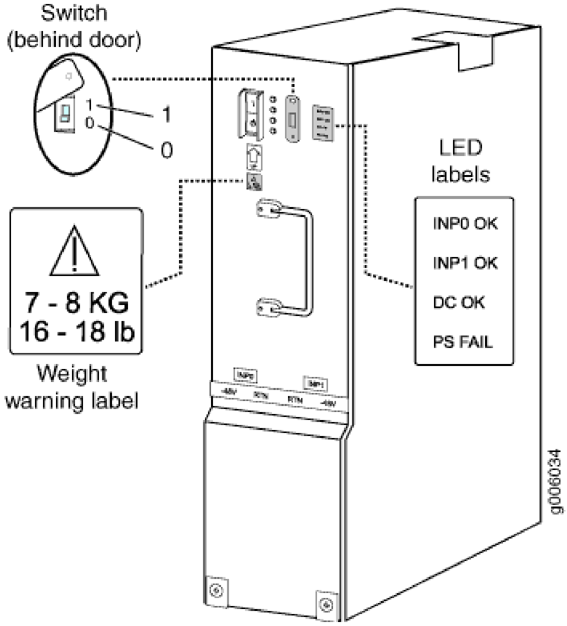
17. Verify that the **DC OK** LED is lit green steadily. See Table 131 on page 371 for information on MX960 high-capacity DC LEDs.

Table 133: MX960 High-Capacity DC Power Supply LEDs

Connected Inputs	DIP Switch Position	LEDs			
		INP-0 OK	**INP-1 OK**	**DC OK**	**PS FAIL**
INP0 connected, INP1 disconnected	0 (1 input)	Green	Off	Green	Off
INP0 disconnected, INP1 connected		Off	Green	Green	Off
INP0 connected, INP1 connected		Green	Green	Green	Off
INP0 connected, INP1 disconnected	1 (2 inputs)	Green	Off	Off	Red
INP0 disconnected, INP1 connected		Off	Green	Off	Red
INP0 connected, INP1 connected		Green	Green	Green	Off

18. Repeat steps 1-17 for installing power supplies in slots 1, 2, and 3, where present.

Figure 251: MX960 DC High-Capacity Power Supply Front View



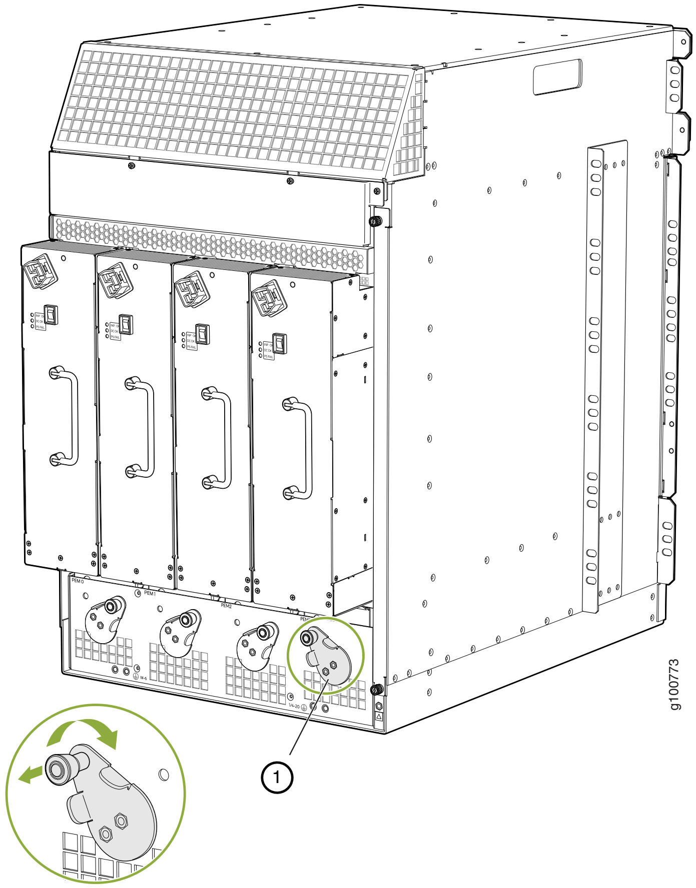
19. Install a blank panel over the power distribution modules, if available.

To install and power on an MX960 universal (HVAC or HVDC) power supply, use the following procedure (see Figure 252 on page 654).

1. Verify that the power switch on the power supply is in the off (**O**) position.

2. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 252 on page 654).

Figure 252: MX960 with High-Voltage Second Generation Power Supplies Installed



> **NOTE:** The chassis is shown without the extended cable manager.

If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

3. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

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 protrudes beyond the chassis.

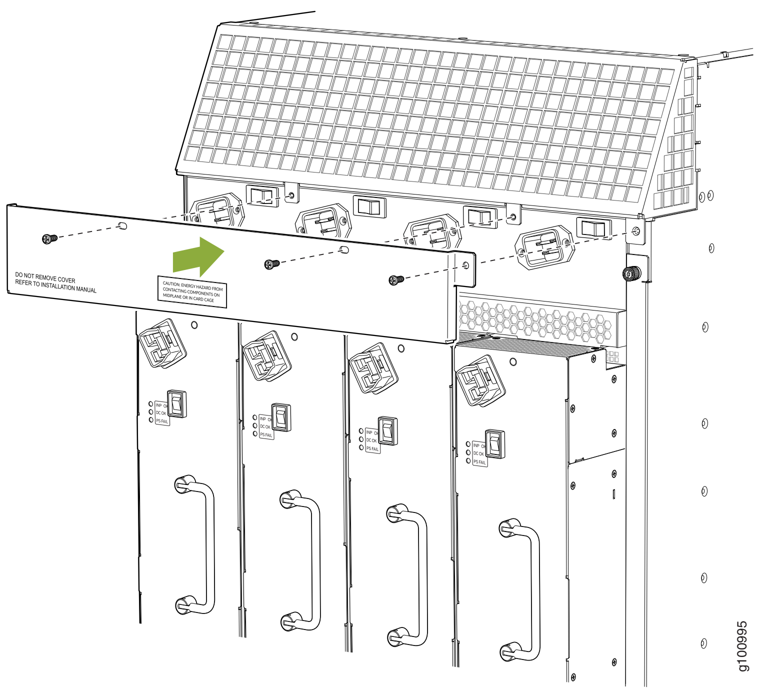
   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 252 on page 654). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

7. Make sure the cover is installed on the power distribution unit of the chassis, see Figure 253 on page 655.

Figure 253: Installing the Cover on the Chassis



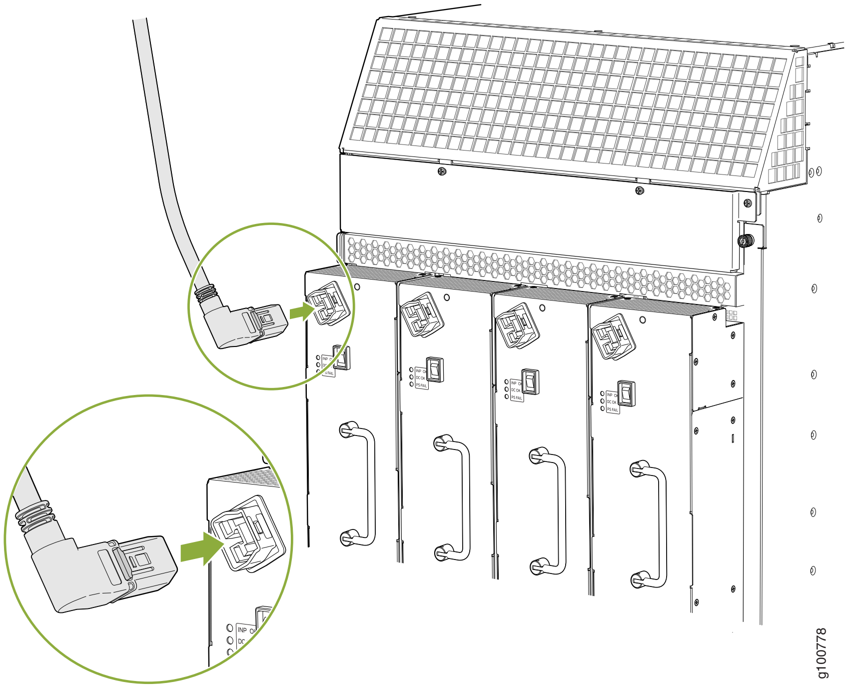
8. Make sure the grounding cable is attached, see "Grounding the MX960 Router" on page 350.

9. Locate a power cord with the type of plug appropriate for your geographical location (see "High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router" on page 260).

10. Plug the power cord into the corresponding appliance inlet located in the chassis directly on the power supply.

> **NOTE:** Each power supply must be connected to a dedicated power feed and a dedicated customer site circuit breaker.

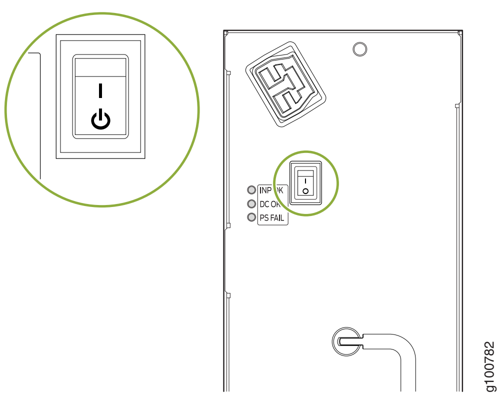
Figure 254: MX960 with a High-Voltage Second-Generation (HVAC or HVDC) Power Feed Connected



11. Dress the power cords appropriately. Verify that the power cord does not block the air exhaust and access to router components, and that they do not drape where people could trip on them.

12. Move the input switch above the power supply to the on (—) position.

Figure 255: MX960 Power Input Mode Switch



13. If the power supply is correctly installed and functioning normally, the **INP OK**, **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

14. Repeat steps 1-12 for installing power supplies in slots 1, 2, and 3, where required.

15. Install a blank panel over the power distribution modules, if available.

RELATED DOCUMENTATION

MX960 Power System Overview | 125
Troubleshooting the MX960 Power System | 685

Converting from DC to AC Power Supplies on an MX960 Router

The conversion of an MX960 router from AC to DC or DC to AC should be performed with the system completely powered off. A system cannot operate with a mix of AC and DC power supplies. This procedure assumes conversion from normal-capacity power supplies to high-capacity power supplies.

Remove MX960 normal-capacity DC power supplies for power supply in slots 0, 1, 2, 3 where present. All power supplies should be removed proceeding with the installation of the AC power supplies. To convert from DC to AC, use the following procedures.

To remove a normal-capacity DC power supply (see Figure 233 on page 569):

1. Switch off the dedicated customer site circuit breaker for the power supply being removed. Follow your site's procedures for electrostatic discharge (ESD).

2. Move the DC circuit breaker on the power supply faceplate to the off (**O**) position.

3. Verify that the **INPUT OK** LEDs on the power supply to be removed are not lit. Also verify that the **BREAKER ON** LED is not lit.

4. 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.

5. Remove the clear plastic cover protecting the terminal studs on the faceplate from the power supply in slot 0.

6. Remove the nut and washer from each of the terminal studs. (Use a 7/16-in. [11-mm] nut driver or socket wrench.)

7. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

8. Remove the cable lugs from the terminal studs.

9. Carefully move the power cables out of the way.

10. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.

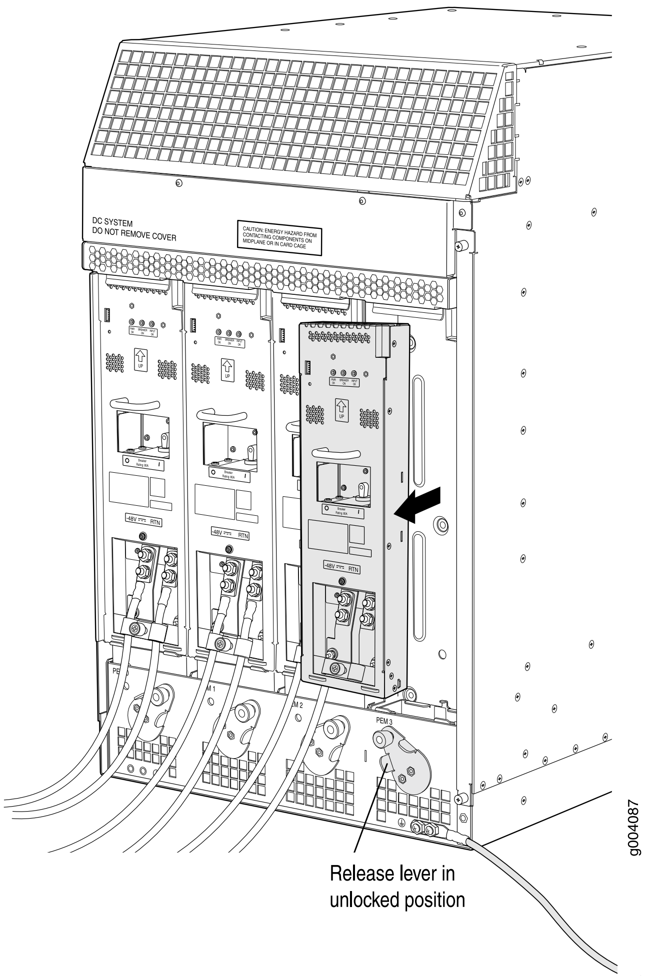
11. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

12. Pull the power supply straight out of the chassis (see Figure 233 on page 569).

    WARNING: Do not touch the power connector on the top of the power supply. It can contain dangerous voltages.

13. Repeat steps 1-12 for power supplies in slot 1, 2, and 3, where present.

Figure 256: Removing a DC Power Supply from the MX960 Router



NOTE: The chassis is shown without the extended cable manager.

Use the following procedures to install the MX960 high-capacity AC power suppliess, the high-capacity second-generation AC power supplies, or the high-voltage second-generation universal power supplies in slots 0, 1, 2, and 3, where present.

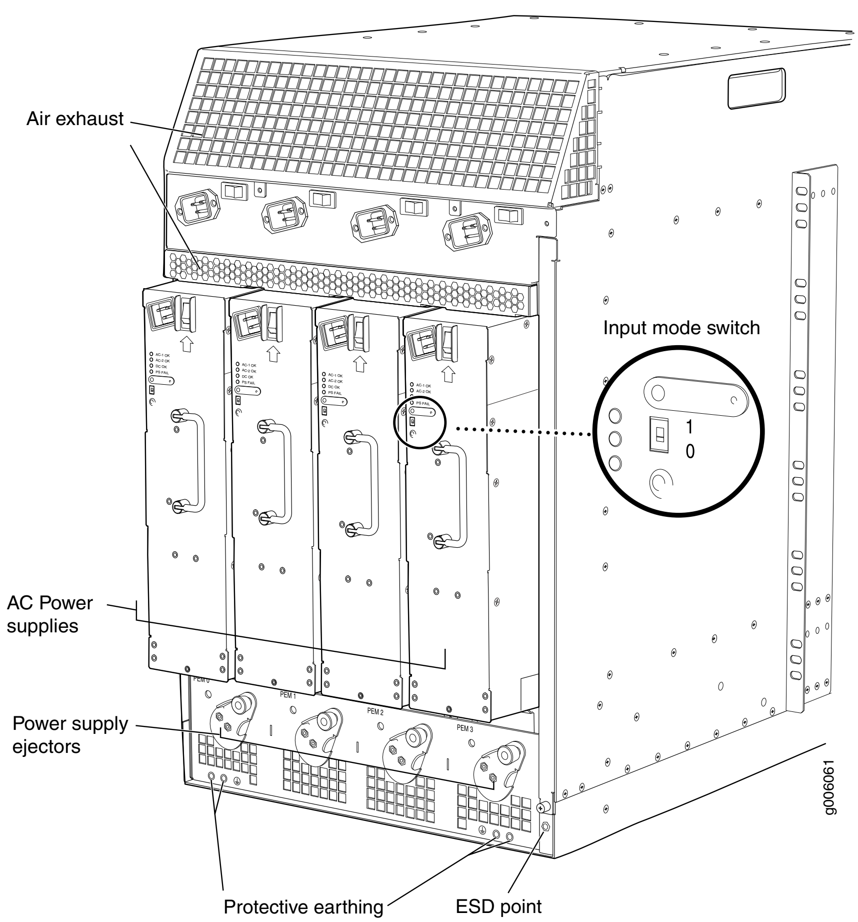
NOTE: During the upgrade process, you can simultaneously run normal-capacity and high-capacity power supplies. However, it is recommended to upgrade all power supplies to high-capacity power supplies.

To install an MX960 high-capacity AC or high-capacity second-generation power supply, use the following procedure (see Figure 257 on page 660).

1. Verify that the power switch on the power supply is in the off (**O**) position.

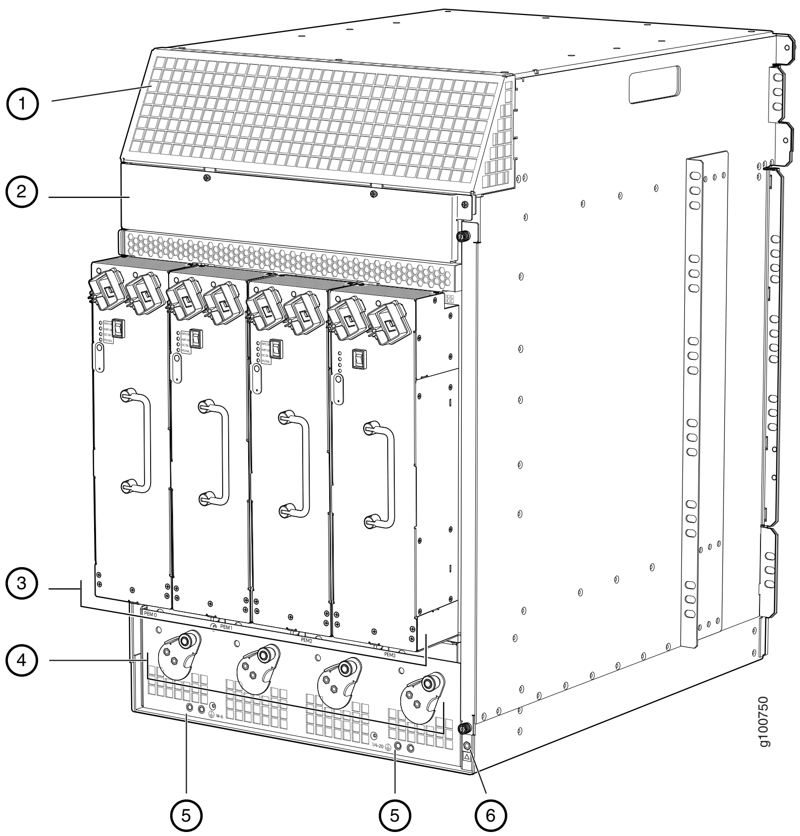
2. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 257 on page 660).

Figure 257: MX960 with High-Capacity AC Power Supplies Installed



NOTE: The chassis is shown without the extended cable manager.

Figure 258: Rear View of a Fully Configured AC-powered High-Capacity Second-Generation Powered MX960 Router Chassis



1–Air exhaust	4–Power supply ejectors
2–Power distribution unit cover	5–Grounding points
3–High-capacity second-generation AC power supplies	6–ESD point

> **NOTE:** The chassis is shown without the extended cable manager.

If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

3. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

4. Move the input mode switch to position 0 for one feed or position 1 for two feeds (see Figure 124 on page 355).

Figure 259: MX960 AC Power Input Mode Switch

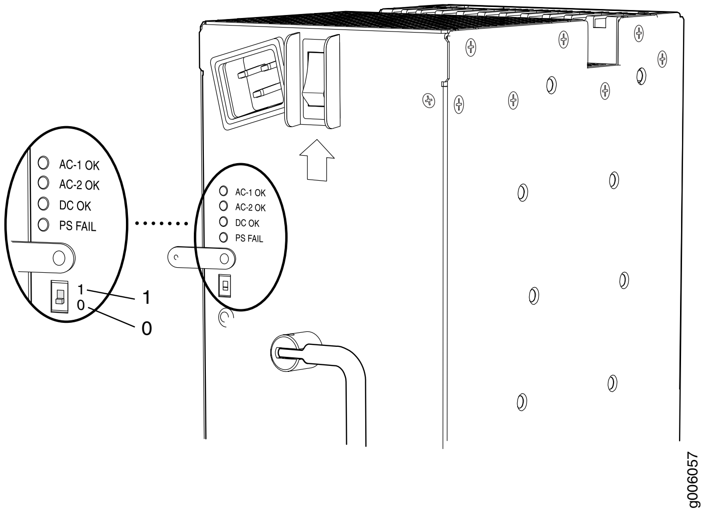
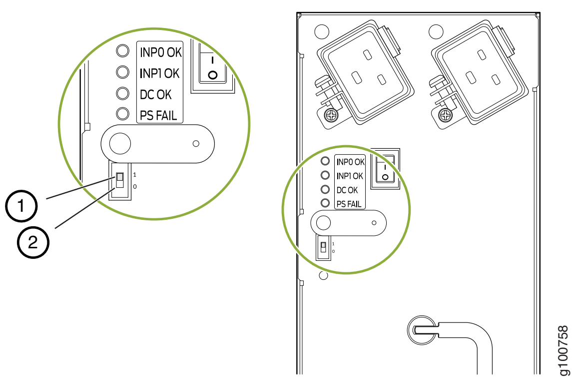


Figure 260: Setting the Input Mode Switch (DIP Switch) on High-Capacity Second-Generation AC PSM



1–Position **1** setting	2–Position **0** setting

CAUTION: Do not use a pencil, because fragments can break off and cause damage to the power supply.

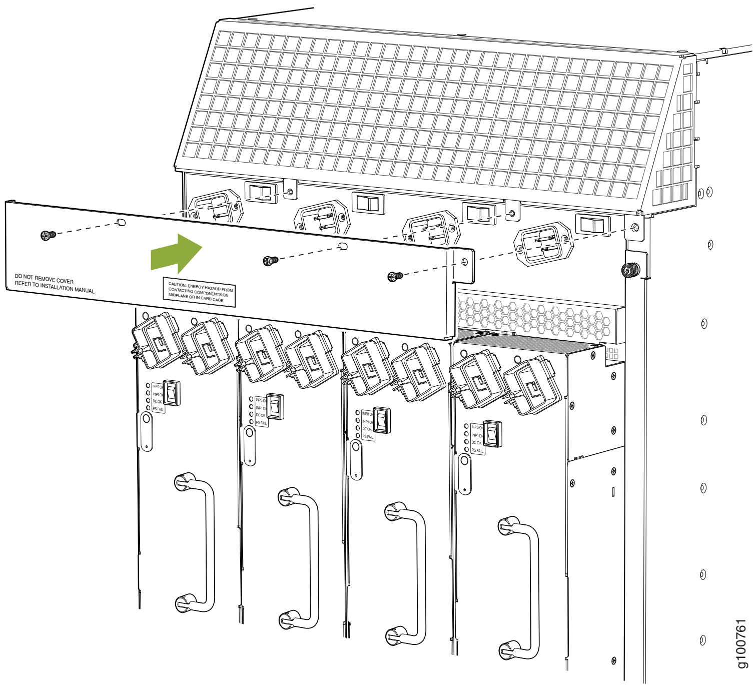
5. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate will protrude beyond the chassis.

   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 124 on page 355). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

6. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

7. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

8. Attach the cover on the power distribution unit on the chassis for the high-capacity second-generation AC power supply.

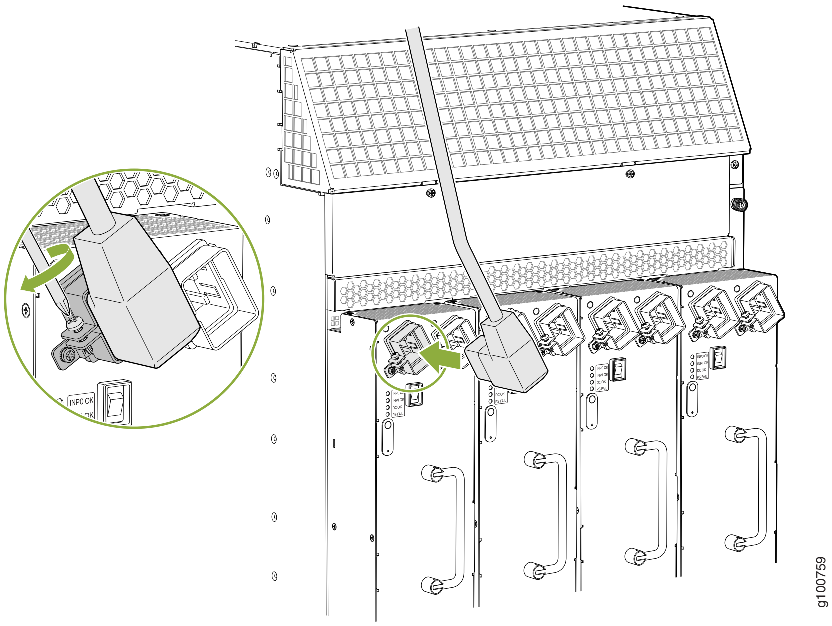


9. Make sure the grounding cable is attached, see “Grounding the MX960 Router” on page 350.

10. Locate a power cord with the type of plug appropriate for your geographical location (see “AC Power Cord Specifications for the MX960 Router” on page 217).

11. Plug the power cord into the corresponding appliance inlet located in the chassis directly above the power supply. This is the recommend receptacle when using the power supply in one feed mode. If using the power supply in two-feed mode, plug the second power cord into the receptacle on the power supply. For the high-capacity second-generation PSM, use a screwdriver to tighten the screw on the retainer to prevent the AC cord from getting lose. See Figure 127 on page 361

Figure 261: MX960 with One High-Capacity Second-Generation AC Power Feed Connected



NOTE: Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker.

12. Dress the power cord appropriately. Verify that the power cord does not block the air exhaust and access to router components, and that they do not drape where people could trip on them.

13. Move the AC input switch above the power supply to the on (—) position. This is the only switch you have to turn on if you are using the power supply in one feed mode. If using the power supply in two-feed mode, move the power switch on the power supply to the on position. Remember to turn on both switches when operating the power supply in two-feed mode.

14. If the power supply is correctly installed and functioning normally, the **AC1 OK**, **AC2 OK** (two-feed mode only), and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit. See Table 130 on page 362.

15. Repeat steps 1-12 for installing power supplies in slots 1, 2, and 3, where present.

Table 134: MX960 or High-Capacity Second-Generation AC Power Supply LEDs

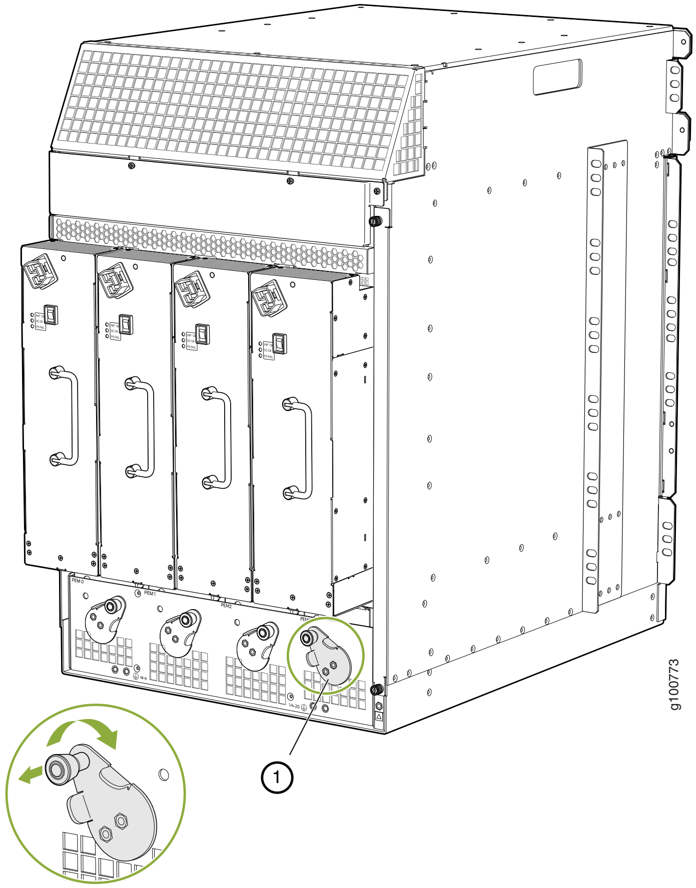
Connected Inputs	DIP Switch Position	LEDs			
		INP0 OK	**INP1 OK**	**DC OK**	**PS FAIL**
INP0 connected, INP1 disconnected	0 (1 input)	Green	Off	Green	Off
INP0 disconnected, INP1 connected	0 (1 input)	Off	Green	Green	Off
INP0 connected, INP1 connected	0 (1 input)	Green	Green	Green	Off
INP0 connected, INP1 disconnected	1 (2 inputs)	Green	Off	Off	Red
INP0 disconnected, INP1 connected	1 (2 inputs)	Off	Green	Off	Red
INP0 connected, INP1 connected	1 (2 inputs)	Green	Green	Green	Off

To install and power on an MX960 universal (HVAC or HVDC) power supply, use the following procedure (see Figure 252 on page 654).

1. Verify that the power switch on the power supply is in the off (**O**) position.

2. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see Figure 252 on page 654).

Figure 262: MX960 with High-Voltage Second Generation Power Supplies Installed



> **NOTE:** The chassis is shown without the extended cable manager.

If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

3. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

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 protrudes beyond the chassis.

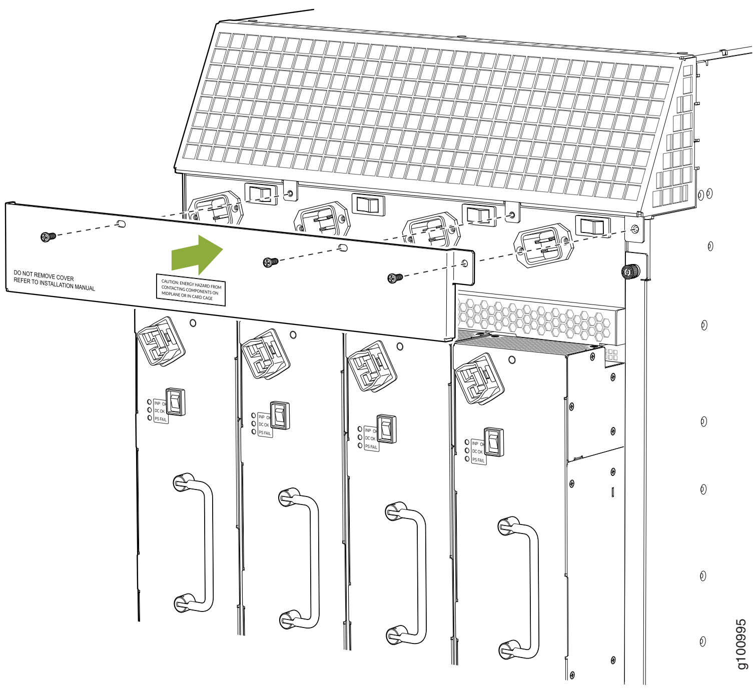
   The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see Figure 252 on page 654). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

7. Make sure the cover is installed on the power distribution unit of the chassis, see Figure 253 on page 655.

Figure 263: Installing the Cover on the Chassis



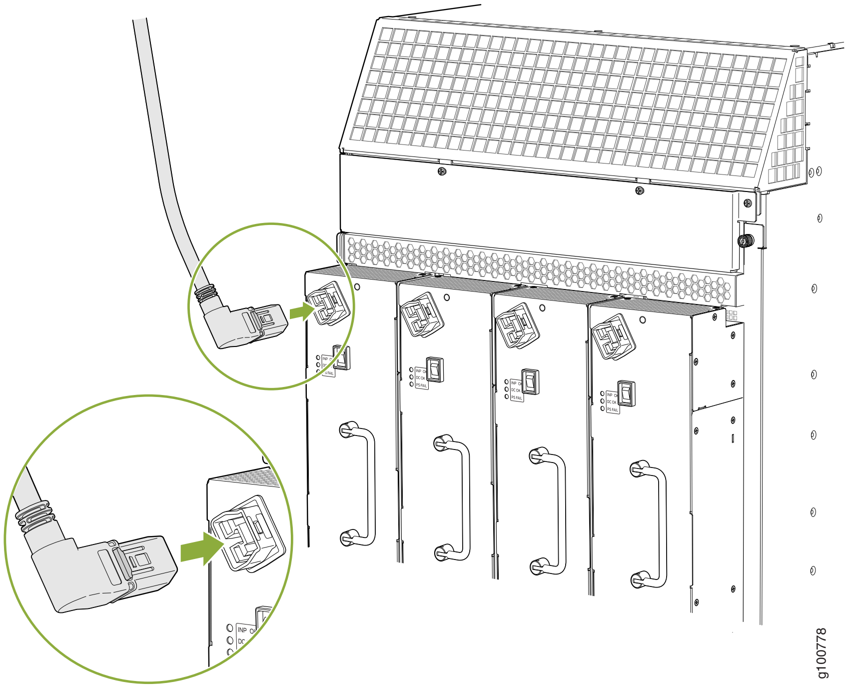
8. Make sure the grounding cable is attached, see "Grounding the MX960 Router" on page 350.

9. Locate a power cord with the type of plug appropriate for your geographical location (see "High-Voltage Second-Generation Universal (MX960-PSM-HV) Power Cord Specifications for the MX960 Router" on page 260).

10. Plug the power cord into the corresponding appliance inlet located in the chassis directly on the power supply.

> **NOTE:** Each power supply must be connected to a dedicated power feed and a dedicated customer site circuit breaker.

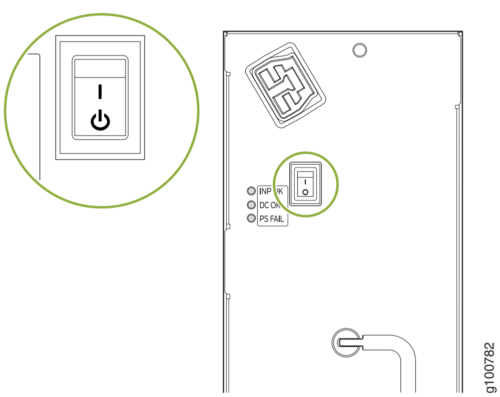
Figure 264: MX960 with a High-Voltage Second-Generation (HVAC or HVDC) Power Feed Connected



11. Dress the power cords appropriately. Verify that the power cord does not block the air exhaust and access to router components, and that they do not drape where people could trip on them.

12. Move the input switch above the power supply to the on (—) position.

Figure 265: MX960 Power Input Mode Switch



13. If the power supply is correctly installed and functioning normally, the **INP OK**, **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

14. Repeat steps 1-12 for installing power supplies in slots 1, 2, and 3, where required.

15. Install a blank panel over the power distribution modules, if available.

RELATED DOCUMENTATION

MX960 Power System Overview | 125

Troubleshooting the MX960 Power System | 685

6

PART

Troubleshooting Hardware

CHAPTER 34

Troubleshooting Components

IN THIS CHAPTER

Troubleshooting Resources for MX960 Routers

IN THIS SECTION

Command-Line Interface

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

You enter CLI commands on one or more external management devices connected to ports on the Routing Engine.

For information about using the CLI to troubleshoot the Junos OS, see the appropriate Junos OS 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. 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.

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.

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 primary. 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**.
- Power supply LEDs—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**.
- Line card LEDs—Two LEDs, **OK** and **FAIL**, indicate the status of each DPC, FPC, or MPC. Green indicates OK and red indicates a failure. The line card LEDs are located along the bottom of the craft interface.
- 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.
- Fan LEDs—Two LEDs indicate the status of the fans. Green indicates the fans are functioning normally and red indicates a fan has failed. The fan LEDs are located on the upper left of the craft interface.

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 the *MX Series Interface Module Reference*.
- FPC LED—One LED labeled **OK/FAIL** on each FPC faceplate indicates the FPC's status.
- MPC LED—One LED labeled **OK/FAIL** on each FPC faceplate indicates the FPC's status.
- MIC LED—One LED labeled **OK/FAIL** on each MIC faceplate indicates the MIC's status. For more information, see the *MX Series Interface Module Reference*.
- PIC LED—One LED labeled **OK/FAIL** on each PIC faceplate indicates the PIC's status. For more information, see the *MX Series Interface Module Reference*.
- 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 primary RE might still be booting or the SCB is not receiving power.

- Routing Engine 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.
- Power supply LEDs—Two LEDs on each power supply faceplate indicate the status of that power supply.

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.

RELATED DOCUMENTATION

Troubleshooting the MX960 Cooling System

Problem

Description: The fans in a fan tray are not functioning normally.

Solution

Follow these guidelines to troubleshoot the fans:

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

  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.
- 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.

- If a fan tray is removed, a yellow alarm and a red alarm occur.
- The following conditions automatically cause the fans to run at full speed and also trigger the indicated alarm:
  - A fan fails (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).

RELATED DOCUMENTATION

MX960 Alarm LEDs and Alarm Cutoff/Lamp Test Button | **16**

Replacing an MX960 Fan Tray | **478**

Maintaining the MX960 Air Filter | **610**

Maintaining the MX960 Fan Trays | **610**

Troubleshooting the MX960 DPCs

Problem

Description: The DPCs are not functioning normally.

Solution

- Monitor the green LED labeled **OK** above the DPC on the craft interface as soon as a DPC is seated in an operating router.

  The Routing Engine downloads the DPC software to it under two conditions: the DPC is present when the Routing Engine boots Junos OS, and the DPC is installed and requested online through the CLI or push button on the front panel. The DPC then runs diagnostics, during which the **OK** LED blinks. When the DPC is online and functioning normally, the **OK** LED lights green steadily.
- Make sure the DPC is properly seated in the midplane. Check that each ejector handle has been turned clockwise and is tight.
- 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
  ```

```
                Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot 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
```

NOTE: The **show chassis fpc** command displays the status of the DPCs.

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 2 information:
  State                               Online
  Temperature                      22 degrees C / 71 degrees F
  Total CPU DRAM                 1024 MB
  Total SRAM                      256 MB
  Total SDRAM                       0 MB
  Start time                          2006-11-03 07:35:40 PST
  Uptime                              2 hours, 27 minutes, 1 second
Slot 4 information:
  State                               Online
  Temperature                      22 degrees C / 71 degrees F
  Total CPU DRAM                 1024 MB
  Total SRAM                      256 MB
  Total SDRAM                       0 MB
  Start time                          2006-11-03 07:35:48 PST
  Uptime                              2 hours, 26 minutes, 53 seconds
Slot 7 information:
  State                               Online
  Temperature                      24 degrees C / 75 degrees F
  Total CPU DRAM                 1024 MB
  Total SRAM                      256 MB
  Total SDRAM                       0 MB
  Start time                          2006-11-03 07:35:53 PST
  Uptime                              2 hours, 26 minutes, 48 seconds
```

For further description of the output from the commands, see the *Junos OS Administration Library*.

RELATED DOCUMENTATION

MX960 Dense Port Concentrator Description | 58
Installing an MX960 DPC | 412
Maintaining MX960 DPCs | 616

Troubleshooting the MX960 FPCs

Problem

Description: The FPCs are not functioning normally.

Solution

- Monitor the green LED labeled **OK** above the FPC on the craft interface as soon as an FPC is seated in an operating router.

  The Routing Engine downloads the FPC software to it under two conditions: the FPC is present when the Routing Engine boots Junos OS, and the FPC is installed and requested online through the CLI or push button on the front panel. The FPC then runs diagnostics, during which the **OK** LED blinks. When the FPC is online and functioning normally, the **OK** LED lights green steadily.

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

- Check the **OK/FAIL** LED on the FPC and **OK** and **FAIL** FPC LEDs on the craft interface. When the FPC is online and functioning normally, the **OK** LED lights green steadily.

- Issue the **show chassis fpc** command to check the status of installed FPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the FPC is functioning normally:

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

```
                Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State      (C)  Total  Interrupt      DRAM (MB) Heap      Buffer
  0  Online     24      3           0      1024        13          21
  1  Empty
  2  Online     41      9           0      1024        15          57
  3  Online     43      5           0      1024        16          57
  4  Online     43     11           0      1024        16          57
  5  Online     41      9           0      1024        15          57
  6  Online     43      5           0      1024        16          57
```

```
  7  Empty
  8  Empty
  9  Empty
  10 Online   24      3          0       1024       13          21
  11 Empty
```

NOTE: The **show chassis fpc** command displays the status of the FPCs.

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 0 information:
  State                                 Online
  Temperature                        24 degrees C / 75 degrees F
  Total CPU DRAM                   1024 MB
  Total RLDRAM                      128 MB
  Total DDR DRAM                   2048 MB
  Start time:                           2008-12-11 16:53:24 PST
  Uptime:                               15 hours, 2 minutes, 47 seconds
Slot 2 information:
  State                                 Online
  Temperature                        29 degrees C / 84 degrees F
  Total CPU DRAM                   1024 MB
  Total RLDRAM                      256 MB
  Total DDR DRAM                   4096 MB
  Start time:                           2008-12-11 16:53:18 PST
  Uptime:                               15 hours, 2 minutes, 53 seconds
Slot 3 information:
  State                                 Online
  Temperature                        29 degrees C / 84 degrees F
  Total CPU DRAM                   1024 MB
  Total RLDRAM                      256 MB
  Total DDR DRAM                   4096 MB
  Start time:                           2008-12-11 16:53:18 PST
  Uptime:                               15 hours, 2 minutes, 53 seconds
Slot 4 information:
  State                                 Online
  Temperature                        29 degrees C / 84 degrees F
  Total CPU DRAM                   1024 MB
```

```
  Total RLDRAM                   256 MB
  Total DDR DRAM                4096 MB
  Start time:                        2008-12-11 16:53:18 PST
  Uptime:                            15 hours, 2 minutes, 53 seconds
Slot 5 information:
  State                              Online
  Temperature                     29 degrees C / 84 degrees F
  Total CPU DRAM                1024 MB
  Total RLDRAM                   256 MB
  Total DDR DRAM                4096 MB
  Start time:                        2008-12-11 16:53:22 PST
  Uptime:                            15 hours, 2 minutes, 49 seconds
Slot 6 information:
  State                              Online
  Temperature                     29 degrees C / 84 degrees F
  Total CPU DRAM                1024 MB
  Total RLDRAM                   256 MB
  Total DDR DRAM                4096 MB
  Start time:                        2008-12-11 16:53:18 PST
  Uptime:                            15 hours, 2 minutes, 53 seconds
Slot 10 information:
  State                              Online
  Temperature                     24 degrees C / 75 degrees F
  Total CPU DRAM                1024 MB
  Total RLDRAM                   128 MB
  Total DDR DRAM                2048 MB
  Start time:                        2008-12-11 16:53:24 PST
  Uptime:                            15 hours, 2 minutes, 47 seconds
```

For further description of the output from the commands, see the *Junos OS Administration Library*.

RELATED DOCUMENTATION

Maintaining MX960 FPCs | 621

Replacing an MX960 FPC | 514

MX960 Flexible PIC Concentrator (FPC) LEDs | 71

Holding an MX960 FPC | 624

Storing an MX960 FPC | 629

Troubleshooting the MX960 PICs

Problem

Description: The PICs are not functioning normally.

Solution

- Check the status of each port on a PIC by looking at the LED located on the PIC faceplate. For information about the meaning of LED states on different PICs, see the *MX Series Interface Module Reference*.
- Check the status of a PIC by issuing the **show chassis fpc pic-status** CLI command. The PIC slots in the FPC are numbered from **0** through **1**, top to bottom:

  `user@host>` **show chassis fpc pic-status**

```
Slot 0   Online       DPC 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 1   Online       MX FPC Type 3
  PIC 0  Online       1x OC-192 SONET
  PIC 1  Online       1x OC-192 SONET
```

  For further description of the output from the command, see the CLI Explorer.

RELATED DOCUMENTATION

MX960 PIC Description | 72
Replacing an MX960 PIC | 538
Maintaining MX960 PICs | 634
MX960 PIC Serial Number Label | 706

Troubleshooting the MX960 MICs

Problem

Description: The MICs are not functioning normally.

Solution

- Check the status of each port on a MIC by looking at the LED located on the MIC faceplate. For information about the meaning of LED states on different MICs, see the *MX Series Ethernet Services Routers Line Card Guide*.
- Check the status of a MIC by issuing the **show chassis fpc pic-status** CLI command. The MIC slots in the MPC are labeled **PIC 0/1** and **PIC 2/3**, top to bottom:

`user@host>` **show chassis fpc pic-status**

```
Slot 0   Online        DPCE 4x 10GE R EQ
  PIC 0  Online        1x 10GE(LAN/WAN) EQ
  PIC 1  Online        1x 10GE(LAN/WAN) EQ
  PIC 2  Online        1x 10GE(LAN/WAN) EQ
  PIC 3  Online        1x 10GE(LAN/WAN) EQ
Slot 1   Online        DPCE 40x 1GE R EQ
  PIC 0  Online        10x 1GE(LAN) EQ
  PIC 1  Online        10x 1GE(LAN) EQ
  PIC 2  Online        10x 1GE(LAN) EQ
  PIC 3  Online        10x 1GE(LAN) EQ
Slot 2   Online        MS-DPC
  PIC 0  Online        MS-DPC PIC
  PIC 1  Online        MS-DPC PIC
Slot 3   Online        MPC Type 2 3D EQ
  PIC 0  Online        1x 10GE XFP
  PIC 1  Online        1x 10GE XFP
Slot 4   Online        MPC 3D 16x 10GE
  PIC 0  Online        4x 10GE(LAN) SFP+
  PIC 1  Online        4x 10GE(LAN) SFP+
  PIC 2  Online        4x 10GE(LAN) SFP+
  PIC 3  Online        4x 10GE(LAN) SFP+
Slot 6   Online        MX960 40GE DPC
  PIC 0  Online        10x 1GE
  PIC 1  Online        10x 1GE
  PIC 2  Online        10x 1GE
  PIC 3  Online        10x 1GE
Slot 10  Online        MPC 3D 16x 10GE
  PIC 0  Online        4x 10GE(LAN) SFP+
  PIC 1  Online        4x 10GE(LAN) SFP+
  PIC 2  Online        4x 10GE(LAN) SFP+
  PIC 3  Online        4x 10GE(LAN) SFP+
```

For further description of the output from the command, see the CLI Explorer.

RELATED DOCUMENTATION

Troubleshooting the MX960 MPCs

Problem

Description: The MPCs are not functioning normally.

Solution

- Monitor the green LED labeled **OK** above the MPC on the craft interface as soon as an MPC is seated in an operating router.

  The Routing Engine downloads the MPC software to it under two conditions: The MPC is present when the Routing Engine boots Junos OS, and the MPC is installed and requested online through the CLI or push button on the front panel. The MPC then runs diagnostics, during which the **OK** LED blinks. When the MPC is online and functioning normally, the **OK** LED lights green steadily.

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

- Check the **OK/FAIL** LED on the MPC and **OK** and **FAIL** line card LEDs on the craft interface. When the MPC is online and functioning normally, the **OK** LED lights green steadily.

- Issue the **show chassis fpc** command to check the status of installed MPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the MPC is functioning normally:

  user@host> **show chassis fpc**

```
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap      Buffer
  0  Online           36      3          0        2048       14          13
  1  Online           40      5          0        2048       26          13
  2  Online           41      6          0        1024        7          43
  3  Online           43      5          0        1024       16          57
  4  Online           24      3          0        1024       13          21
  5  Empty
  6  Online           43      5          0        1024       16          57
  7  Empty
  8  Empty
  9  Empty
```

```
10 Online          24       3          0        1024       13          21
11 Empty
```

NOTE: The **show chassis fpc** command displays the status of the MPCs.

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 0 information:
  State                                  Online
  Temperature                         33 degrees C / 91 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       256 MB
  Total DDR DRAM                    4096 MB
  Start time:                            2009-12-22 12:26:54 PST
  Uptime:                                6 days, 3 hours, 8 minutes, 51 seconds
  Max Power Consumption              330 Watts
Slot 1 information:
  State                                  Online
  Temperature                         32 degrees C / 89 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       256 MB
  Total DDR DRAM                    4096 MB
  Start time:                            2009-12-22 12:26:54 PST
  Uptime:                                6 days, 3 hours, 8 minutes, 51 seconds
  Max Power Consumption              365 Watts
Slot 2 information:
  State                                  Online
  Temperature                         41 degrees C / 105 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       128 MB
  Total DDR DRAM                    2048 MB
  Start time:                            2009-12-22 12:26:46 PST
  Uptime:                                6 days, 3 hours, 8 minutes, 59 seconds
  Max Power Consumption              265 Watts
Slot 3 information:
  State                                  Online
  Temperature                         36 degrees C / 96 degrees F
  Total CPU DRAM                    2048 MB
  Total RLDRAM                       806 MB
```

```
  Total DDR DRAM                    2632 MB
  Start time:                            2009-12-22 12:27:04 PST
  Uptime:                                6 days, 3 hours, 8 minutes, 41 seconds
  Max Power Consumption              450 Watts
Slot 4 information:
  State                                  Online
  Temperature                         40 degrees C / 104 degrees F
  Total CPU DRAM                    2048 MB
  Total RLDRAM                      1324 MB
  Total DDR DRAM                    5120 MB
  Start time:                            2009-12-22 12:27:02 PST
  Uptime:                                6 days, 3 hours, 8 minutes, 43 seconds
  Max Power Consumption              440 Watts
Slot 6 information:
  State                                  Online
  Temperature                         29 degrees C / 84 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       256 MB
  Total DDR DRAM                    4096 MB
  Start time:                            2008-12-11 16:53:18 PST
  Uptime:                                15 hours, 2 minutes, 53 seconds
  Max Power Consumption              365 Watts
Slot 10 information:
  State                                  Online
  Temperature                         24 degrees C / 75 degrees F
  Total CPU DRAM                    1024 MB
  Total RLDRAM                       128 MB
  Total DDR DRAM                    2048 MB
  Start time:                            2008-12-11 16:53:24 PST
  Uptime:                                15 hours, 2 minutes, 47 seconds
  Max Power Consumption              440 Watts
```

For further description of the output from the commands, see the *Junos OS Administration Library*.

RELATED DOCUMENTATION

MX960 Modular Port Concentrator Description | 108

Maintaining MX960 MPCs | 631

Replacing an MX960 MPC | 532

Troubleshooting the MX960 Power System

Problem

Description: The power system is not functioning normally.

Solution

- 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** LED's light steadily, and the **PS FAIL** LED is not lit.
  - If a DC power supply is correctly installed and functioning normally, the **PWR_OK**, **INPUT OK**, and **BREAKER ON** LED's light steadily.
- Issue the CLI **show chassis environment pem** command to check the status of installed power supply modules. As shown in the sample output, the value **Online** in the rows labeled **State** indicates that each power supply is functioning normally:

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

  ```
  PEM 0 status:
    State                          Online
    Temperature                    OK
    DC output                      OK
  PEM 1 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.
- Check that the AC input switch (—) or DC circuit breaker (|) is in the on position and that the power supply 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 operating normally, the power supply is the source of the problem. Replace the power supply with a spare.
- 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 OS shuts down all power supplies so that no status is displayed.
>
> The Junos OS also can shut down one of the power supplies for other reasons. In this case, the remaining power supplies provide power to the router, and you can still view the system status through the CLI or display.

To restart a high-capacity AC power supply after a shut down due to an over-temperature situation:

1. Move the power switch on the power supply to the off (o) position.
2. Turn off power to where the AC line goes into the power distribution module (PDM) area.
3. Wait for the power supply LEDs to fade out and for the fans inside the power supply to shutdown. This can take up to 10 seconds.

   > **CAUTION:** Do not attempt to power-on the power supply if the LED is still lit and the fan is still running. If you do, the router will not reboot.

4. Turn on power to where the AC line goes into the power distribution module (PDM) area.
5. Move the power switch on the power supply to the on (|) position.
6. Verify that the LEDs on the power supply faceplate are properly lit.
7. Issue the CLI **show chassis environment pem** command and verify the State is **ONLINE** and the Temperature is **OK**.

To restart a high-capacity DC power supply after a shut down due to an over-temperature situation:

1. Switch off the circuit breaker(s) on the DC distribution panel to remove power to the chassis and power supplies.

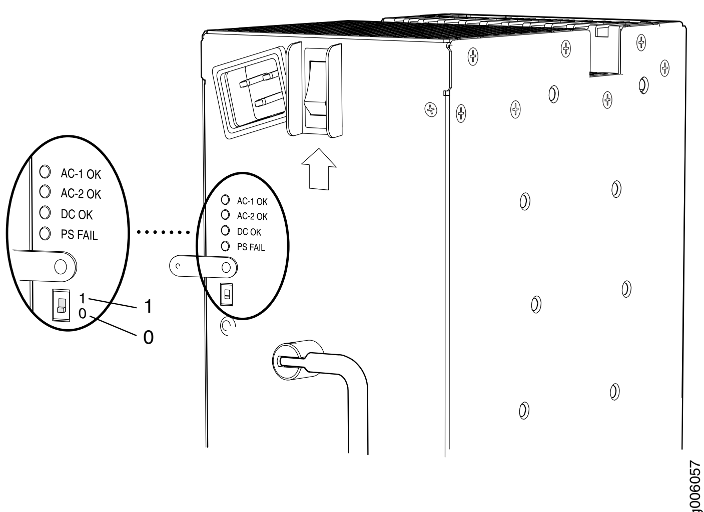
2. Switch on the circuit breaker(s) on the distribution panel to power up the chassis and power supplies.

 > **NOTE:** The power switch on the power supplies is not part of the outer or inner DC circuits and therefore does not need to be switched off when restarting the chassis.

> **NOTE:** If output power is not load-balancing correctly in the same zone on an MX960 with a high-capacity AC or DC power supply module, connect two feeds and change the DIP switch to **1** to boost the voltage on the power supply module.

Each High Capacity AC or DC power supply accepts two AC or DC feeds in two unique AC or DC receptacles. It is possible to operate with one feed, but there is a reduction in the power supply output. The DIP switch must be set according to the number of AC or DC feeds that are present for the power supply.

Figure 266: MX960 AC Power Input Mode Switch



- Position – **0** indicates that only one AC or DC feed is provided.
- Position – **1** indicates that two AC or DC feeds are provided.

To check the DIP switch position:

1. Issue the **show chassis power** command and check to see how many feeds are connected. The following example shows there are two AC input feeds connected for PEM 0 and one AC input feed connected for PEM 1. This indicates that the DIP switch for PEM 0 is in position 1 and the DIP switch for PEM 1 is in position 0. These are the proper settings.

 # run show chassis power

```
PEM 0:
State: Online
AC input: OK (2 feed expected, 2 feed connected)
Capacity: 4100 W (maximum 4100 W)
DC output: 855 W (zone 0, 15 A at 57 V, 20% of capacity)

PEM 1:
State: Online
AC input: OK (1 feed expected, 1 feed connected)
Capacity: 1700 W (maximum 4100 W)
DC output: 969 W (zone 1, 17 A at 57 V, 57% of capacity)
```

2. Issue the **show chassis alarms** command to see if there are any active alarms on the DIP switch:

> show chassis alarms

```
4 alarms currently active
Alarm time Class Description 2013-01-11 14:48:26 UTC Minor PEM 0 Dipswitch 0
Feed Connection 2
```

3. If the **show chassis alarms** output shows an alarm on **Dipswitch**, issue the **show chassis power** command to check the DIP switch position.

 # run show chassis power

```
PEM 0:
State: Online
AC input: OK (1 feed expected, 2 feed connected)
Capacity: 4100 W (maximum 4100 W)
DC output: 855 W (zone 0, 15 A at 57 V, 20% of capacity)
```

In this example, the DIP switch is in the wrong position since there is one AC feed expected but two AC feeds are connected. Change the DIP switch to position 1. This should clear the alarm.

> **NOTE:** Changing the DIP switch position does not impact traffic. However, it is always recommended to do so in a maintenance window.

RELATED DOCUMENTATION

7

PART

Contacting Customer Support and Returning the Chassis or Components

CHAPTER 35

Contacting Customer Support

IN THIS CHAPTER

Contact Customer Support

You can contact Juniper Networks Technical Assistance Center (JTAC) 24 hours a day, 7 days a week in one of the following ways:

- On the Web, using the Service Request Manager link at:

  https://support.juniper.net/support/

- By telephone:
  - From the US and Canada: 1-888-314-JTAC
  - From all other locations: 1-408-745-9500

> **NOTE:** If contacting JTAC by telephone, enter your 12-digit service request number followed by the pound (#) key if this is an existing case, or press the star (*) key to be routed to the next available support engineer.

When requesting support from JTAC by telephone, be prepared to provide the following information:

- Your existing service request number, if you have one
- Details of the failure or problem
- Type of activity being performed on the device when the problem occurred
- Configuration data displayed by one or more **show** commands
- Your name, organization name, telephone number, fax number, and shipping address

The support representative validates your request and issues an RMA number for return of the component.

CHAPTER 36

Locating Component Serial Numbers

IN THIS CHAPTER

Displaying MX960 Router Components and 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 display 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                                 JN107FC5DAFA      MX960
Midplane          REV 02   710-013698   CC6220            MX960 Midplane
FPM Board         REV 01   710-014974   JS4208            MX960 Front Panel Displ
ay
```

```
PIM              Rev 02   740-013110   QCS10375009      Power Inlet Module
PEM 0            Rev 01   740-013682   QCS10374009      PS 1.7kW; 200-240VAC in
PEM 1            Rev 01   740-013682   QCS10374029      PS 1.7kW; 200-240VAC in
Routing Engine 0 REV 02   740-013063   1000639065       RE-S-2000
Routing Engine 1 REV 04   740-013063   1000664335       RE-S-2000
CB 0             REV 02.6 710-013385   JM7908           MX960 SCB
CB 1             REV 03   710-013385   JS9412           MX960 SCB
FPC 2            REV 03   710-013699   JS4284           MX960 40GE DPC
  CPU            REV 04   710-013713   JS9401           MX960 DPC PMB
  PIC 0                   BUILTIN      BUILTIN          10x 1GE
    Xcvr 0       REV 01   740-011613   P9F1ANQ          SFP-SX
    Xcvr 1       REV 01   740-011613   P9F1ANB          SFP-SX
    Xcvr 2       REV 01   740-011613   P9F18GT          SFP-SX
    Xcvr 3       REV 01   740-011613   P9F1AP1          SFP-SX
    Xcvr 4       REV 01   740-011613   P9F1ANF          SFP-SX
    Xcvr 5       REV 01   740-011613   P9F1ANK          SFP-SX
    Xcvr 6       REV 01   740-011613   P9F1AP2          SFP-SX
    Xcvr 7       REV 01   740-011613   P9F1ALL          SFP-SX
    Xcvr 8       REV 01   740-011613   P9F1ANM          SFP-SX
    Xcvr 9       REV 01   740-011613   P9F1ANU          SFP-SX
  PIC 1                   BUILTIN      BUILTIN          10x 1GE
    Xcvr 0       REV 01   740-011613   P9F18HA          SFP-SX
    Xcvr 1       REV 01   740-011613   P9F18GY          SFP-SX
    Xcvr 2       REV 01   740-011613   P9F18GL          SFP-SX
    Xcvr 3       REV 01   740-011613   P9F18H3          SFP-SX
    Xcvr 4       REV 01   740-011613   P9F18GQ          SFP-SX
    Xcvr 5       REV 01   740-011613   P9F18GX          SFP-SX
    Xcvr 6       REV 01   740-011613   P9F18GK          SFP-SX
    Xcvr 7       REV 01   740-011613   P9F18H7          SFP-SX
    Xcvr 8       REV 01   740-011613   P9F13JV          SFP-SX
    Xcvr 9       REV 01   740-011613   P9F18GF          SFP-SX
  PIC 2                   BUILTIN      BUILTIN          10x 1GE
    Xcvr 0                NON-JNPR     P5A08SR          SFP-T
    Xcvr 1       REV 01   740-007327   435040B00332     SFP-LX
    Xcvr 2       REV 01   740-011782   P8J1SZ4          SFP-SX
    Xcvr 3       REV 01   740-011782   P8J1SYH          SFP-SX
    Xcvr 4       REV 01   740-011613   P9F18HB          SFP-SX
    Xcvr 5       REV 01   740-011613   P9F1AN9          SFP-SX
  PIC 3                   BUILTIN      BUILTIN          10x 1GE
    Xcvr 0       REV 01   740-011613   P9F18GE          SFP-SX
    Xcvr 1       REV 01   740-011613   P9F18GW          SFP-SX
    Xcvr 2       REV 01   740-011613   P9F18H0          SFP-SX
    Xcvr 3       REV 01   740-011613   P9F18GG          SFP-SX
    Xcvr 4       REV 01   740-011613   P9F18GD          SFP-SX
```

```
    Xcvr 5       REV 01   740-013111   60882058          SFP-T
    Xcvr 6       REV 01   740-011613   P9F18GN           SFP-SX
    Xcvr 8       REV 01   740-011613   P9F18GV           SFP-SX
    Xcvr 9       REV 01   740-011613   P9F18H5           SFP-SX
FPC 4            REV 04   710-014219   JS4980            MX960 4 XGE DPC
  CPU            REV 03   710-013713   JS4164            MX960 DPC PMB
  PIC 0                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
    Xcvr 0                NON-JNPR     K9J02RS           XFP-10G-LR
  PIC 1                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
    Xcvr 0                NON-JNPR     K9J03CY           XFP-10G-LR
  PIC 2                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
    Xcvr 0       REV 01   740-014279   62E204N00004      XFP-10G-LR
  PIC 3                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
FPC 7            REV 04   710-014219   JW7120            MX960 4 XGE DPC
  CPU            REV 04   710-013713   JS4236            MX960 DPC PMB
  PIC 0                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
    Xcvr 0                NON-JNPR     K9J02T3           XFP-10G-LR
  PIC 1                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
    Xcvr 0                NON-JNPR     K9J03BQ           XFP-10G-LR
  PIC 2                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
    Xcvr 0                NON-JNPR     K9J03DA           XFP-10G-LR
  PIC 3                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
    Xcvr 0                NON-JNPR     K9J02Q0           XFP-10G-LR
Fan Tray 0       REV 01   740-014971   FT0655            MX960 Fan Tray
Fan Tray 1       REV 01   740-014971   FT0653            MX960 Fan Tray
```

Most components also have a small rectangular serial number ID label (see Figure 267 on page 694) attached to the component body.

Figure 267: Serial Number ID Label

RELATED DOCUMENTATION

MX960 Chassis Serial Number and Agency Label | 696
MX960 Craft Interface Serial Number Label | 699
MX960 DPC Serial Number Label | 707
MX960 FPC Serial Number Label | 706
MX960 PIC Serial Number Label | 706

MX960 Routing Engine Serial Number Label

The serial number label is located on the left side of the top of the Routing Engine (see Figure 268 on page 695 and Figure 269 on page 696).

Figure 268: Routing Engine Serial Number Label

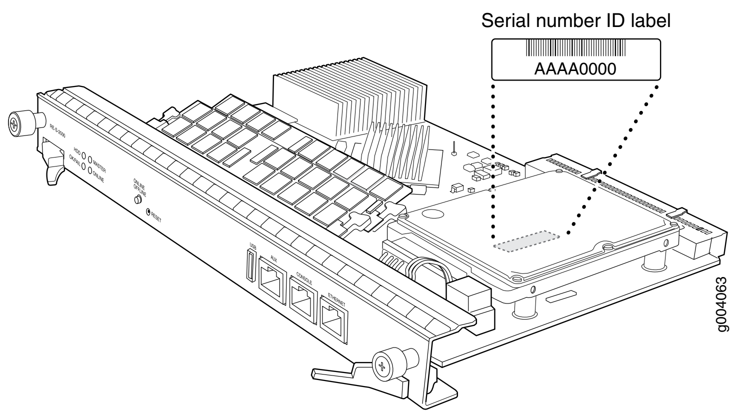
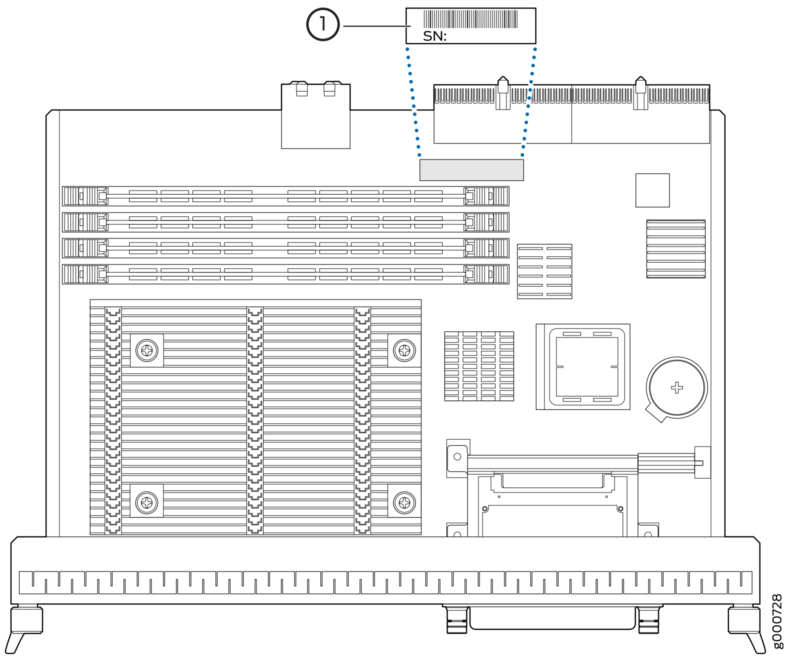


Figure 269: RE-S-X6-64G Routing Engine Serial Number Label



RELATED DOCUMENTATION

MX960 Chassis Serial Number and Agency Label

The chassis serial number label and agency label are located on the side of the chassis. See Figure 270 on page 697 for older legacy routers, and see Figure 271 on page 698 for routers shipping with the new power supplies (MX960-PSM-5K-AC or MX960-PSM-HV).

NOTE: If you are installing the new power supplies (MX960-PSM-5K-AC or MX960-PSM-HV) in your existing chassis, you need to replace the old agency label with the new supplied agency label. The new agency label does not show the power rating, see the front of the power supply for the power rating.

Figure 270: MX960 Chassis Agency and Serial Number Label (Routers with Legacy Power Supplies)

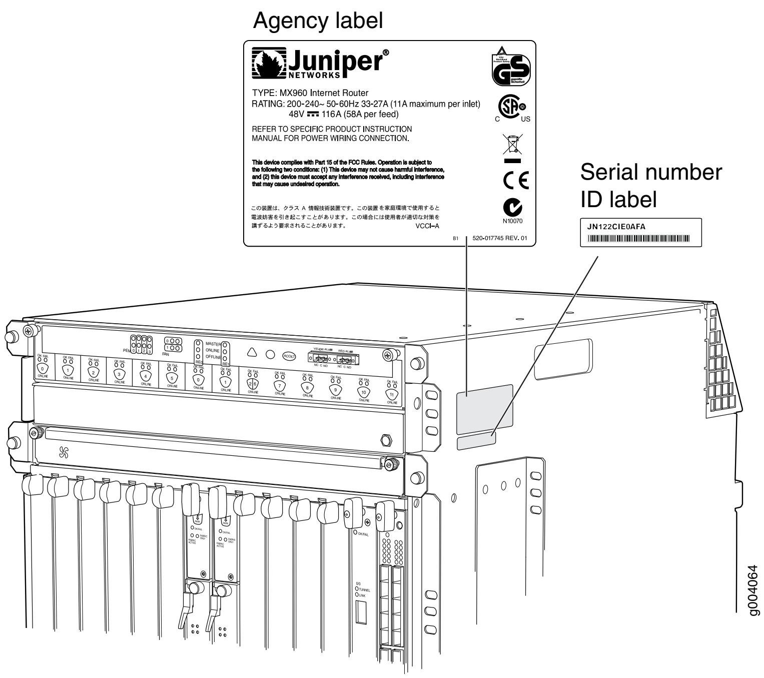
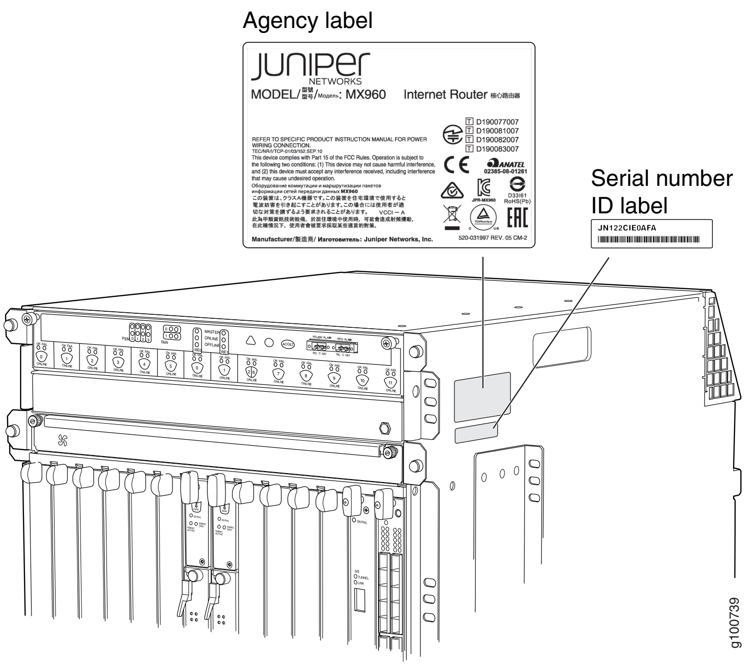


Figure 271: MX960 Chassis Agency and Serial Number Label (Routers Shipped with MX960-PSM-5K-AC or MX960-PSM-HV Power Supplies)

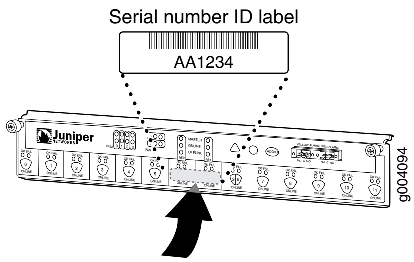


RELATED DOCUMENTATION

MX960 Craft Interface Serial Number Label

The serial number is located on the back of the craft interface panel (see Figure 272 on page 699).

Figure 272: Craft Interface Serial Number Label

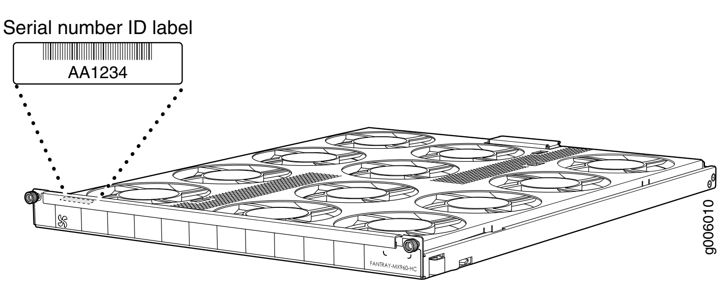


RELATED DOCUMENTATION

MX960 Fan Tray Serial Number Label

The serial number is located on the top left-hand corner of the fan tray, near the captive thumbscrew (see Figure 273 on page 699).

Figure 273: MX960 Fan Tray Serial Number Label



RELATED DOCUMENTATION

MX960 Power Supply Serial Number Labels

The serial number label is located on the AC power supply faceplate under the on/off switch (see Figure 274 on page 700 and Figure 275 on page 701).

The serial number label is located on the universal (HVAC/HVDC) power supply faceplate under the on/off switch (Figure 276 on page 702).

The serial number label is located on the DC power supply faceplate under the circuit breaker switch (see Figure 277 on page 702).

Figure 274: AC Power Supply Serial Number Label

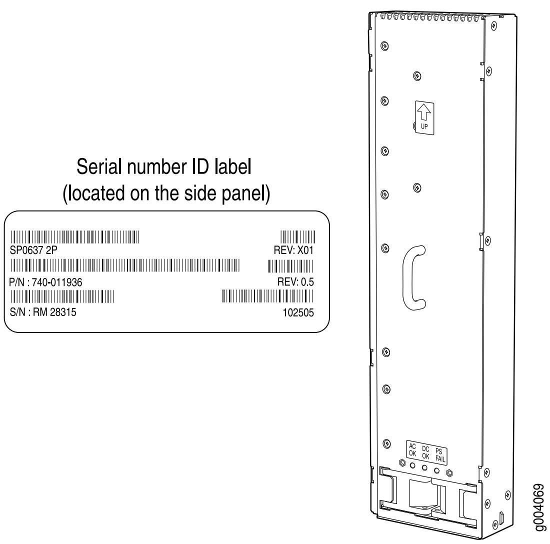


Figure 275: High-Capacity Second-Generation AC Power Supply Serial Number Label

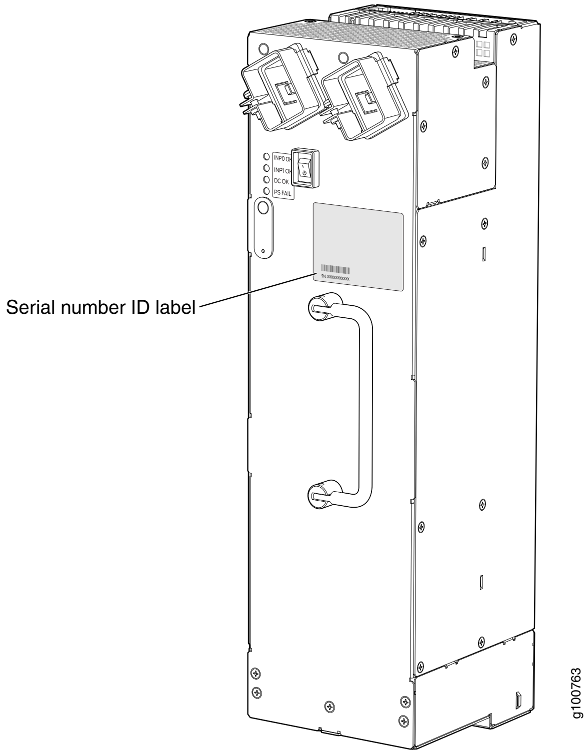


Figure 276: High-Voltage Second-Generation Universal Power Supply Serial Number Label

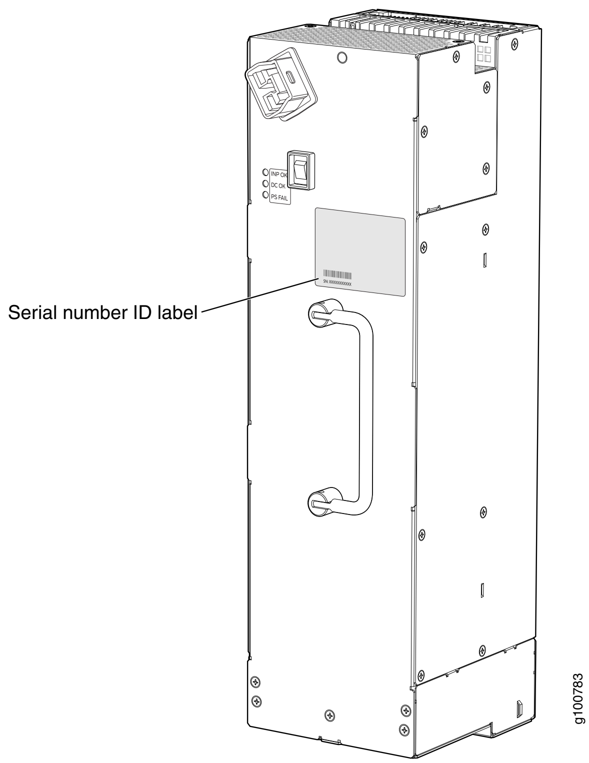
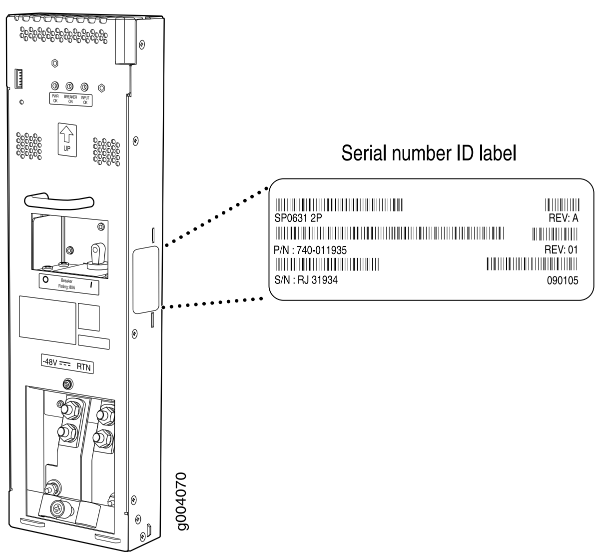


Figure 277: DC Power Supply Serial Number Label



RELATED DOCUMENTATION

MX960 MIC Serial Number Label

The serial number label location varies per MIC (see Figure 279 on page 703 and Figure 280 on page 704). The exact location may be slightly different on different MICs, depending on the placement of components on the MIC board (see Figure 278 on page 703, Figure 279 on page 703, Figure 280 on page 704, and Figure 281 on page 704).

Figure 278: 2-Port MIC Serial Number Label

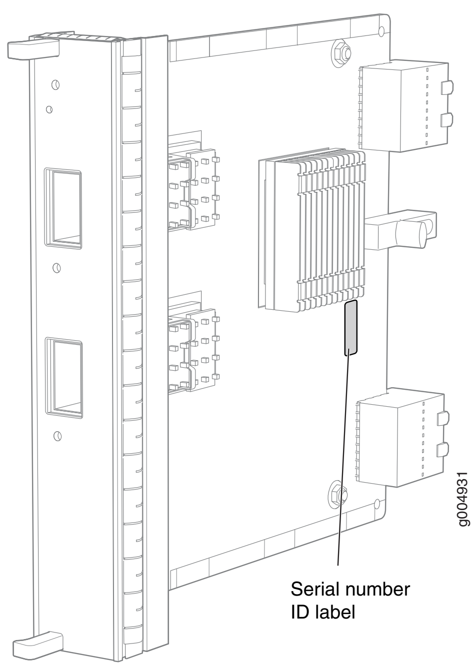


Figure 279: 4-Port MIC Serial Number Label

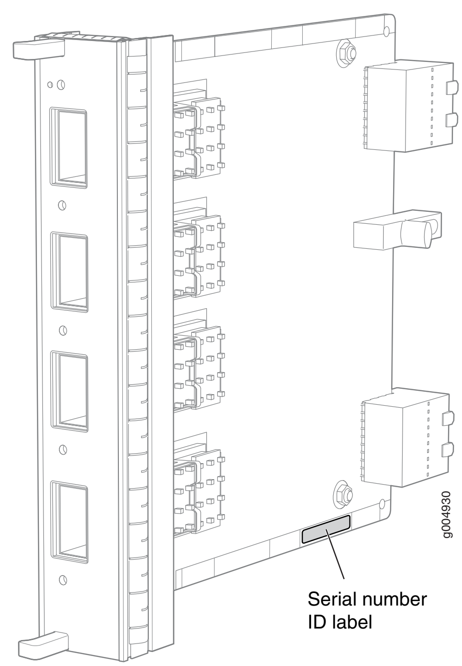


Figure 280: 20-Port MIC Serial Number Label

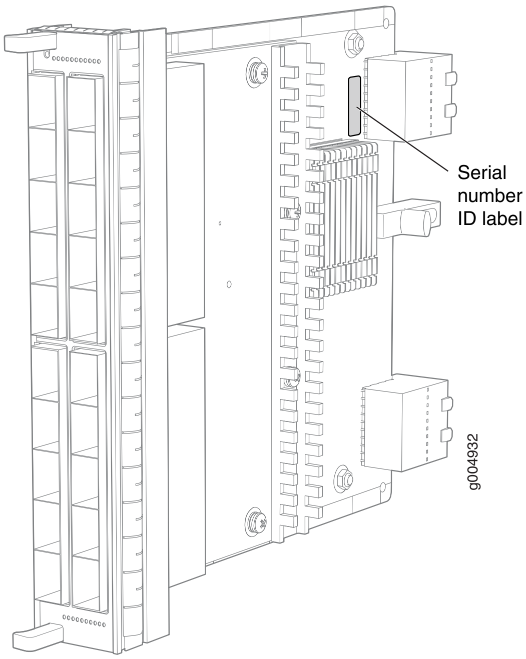
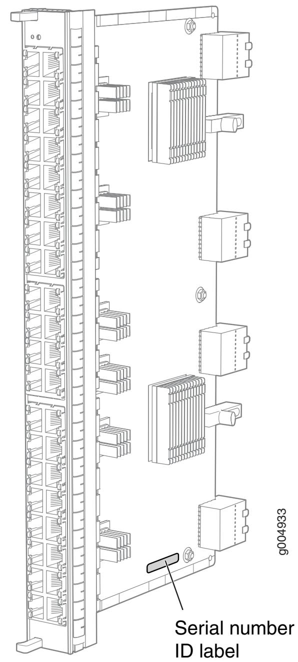


Figure 281: 40-Port MIC Serial Number Label



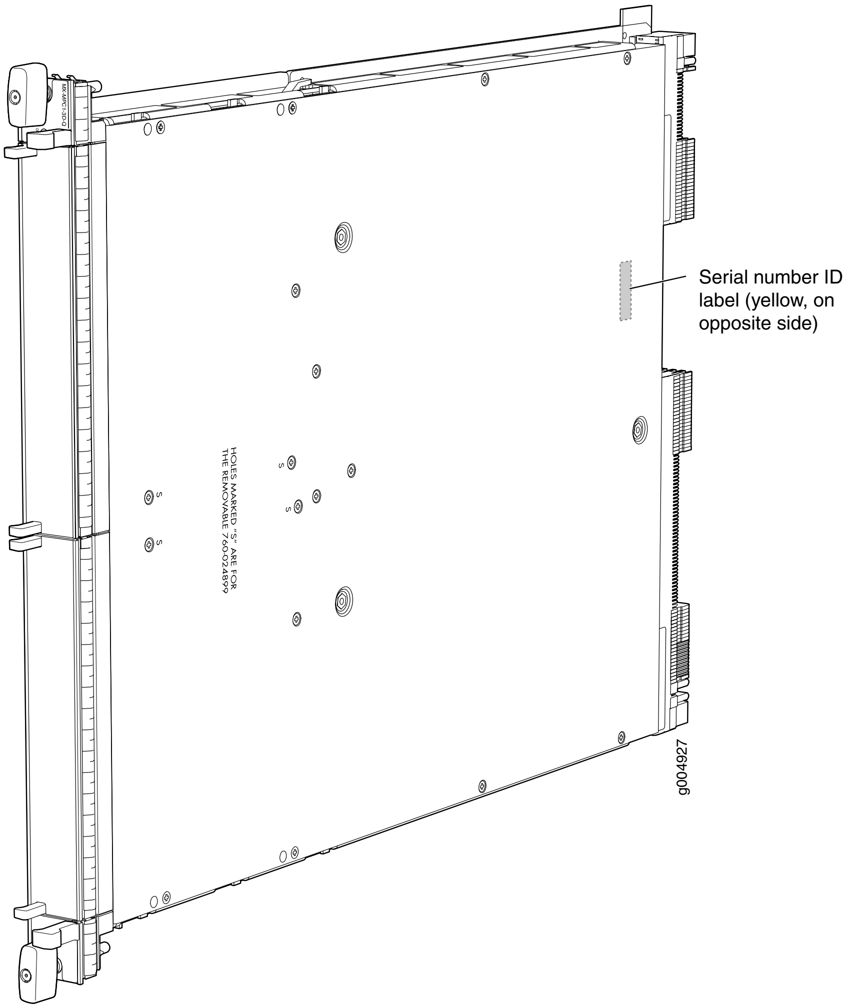
RELATED DOCUMENTATION

Replacing an MX960 MIC | 521
Displaying MX960 Router Components and Serial Numbers | 692
Contact Customer Support | 691
How to Return a Hardware Component to Juniper Networks, Inc. | 714
Guidelines for Packing Hardware Components for Shipment | 712

MX960 MPC Serial Number Label

The serial number label is near the connectors located on the left side of the MPC when it is oriented vertically (see Figure 282 on page 705).

Figure 282: MPC Serial Number Label



RELATED DOCUMENTATION

Replacing an MX960 MPC | 532

Displaying MX960 Router Components and Serial Numbers | 692

Contact Customer Support | 691

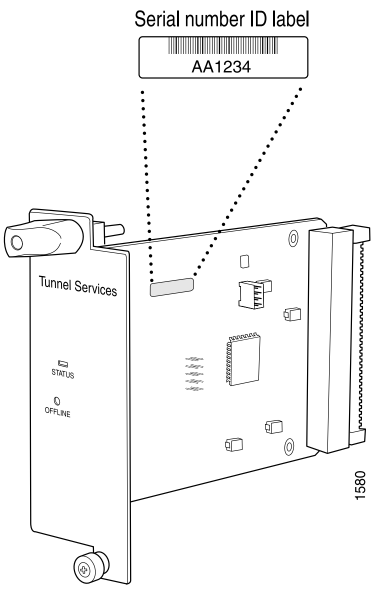
How to Return a Hardware Component to Juniper Networks, Inc. | 714

Guidelines for Packing Hardware Components for Shipment | 712

MX960 PIC Serial Number Label

The serial number label is located on the right side of the PIC (see Figure 283 on page 706), when the PIC is vertically oriented (as it would be installed in the router). The exact location may be slightly different on different PICs, depending on the placement of components on the PIC board.

Figure 283: PIC Serial Number Label

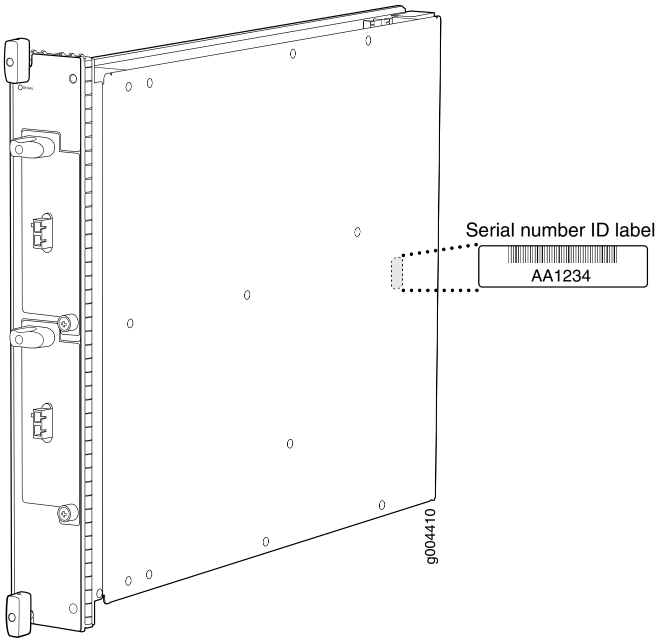


RELATED DOCUMENTATION

MX960 FPC Serial Number Label

The serial number label is located on the center of the right side of the FPC (see Figure 284 on page 707).

Figure 284: FPC Serial Number Label

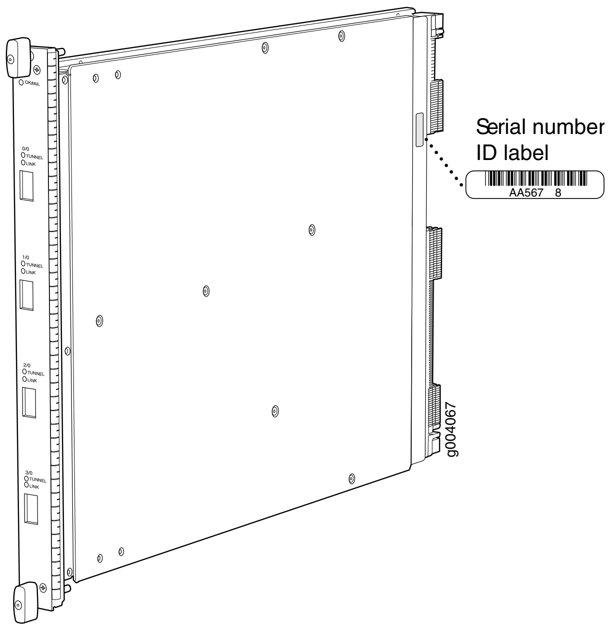


RELATED DOCUMENTATION

MX960 DPC Serial Number Label

The serial number label is located on the center of the right side of the DPC (see Figure 285 on page 708).

Figure 285: DPC Serial Number Label

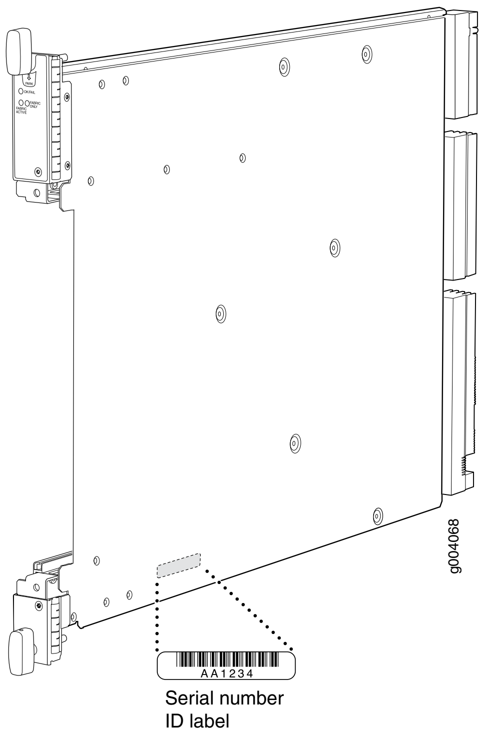


RELATED DOCUMENTATION

MX960 SCB Serial Number Label

The serial number is located on the right side of the top of the SCB (see Figure 286 on page 709).

Figure 286: SCB Serial Number Label



RELATED DOCUMENTATION

Replacing an MX960 SCB | 581
Displaying MX960 Router Components and Serial Numbers | 692
Contact Customer Support | 691
How to Return a Hardware Component to Juniper Networks, Inc. | 714
Guidelines for Packing Hardware Components for Shipment | 712

Contact Customer Support

You can contact Juniper Networks Technical Assistance Center (JTAC) 24 hours a day, 7 days a week in one of the following ways:

- On the Web, using the Service Request Manager link at:

  https://support.juniper.net/support/

- By telephone:

- From the US and Canada: 1-888-314-JTAC
- From all other locations: 1-408-745-9500

> **NOTE:** If contacting JTAC by telephone, enter your 12-digit service request number followed by the pound (#) key if this is an existing case, or press the star (*) key to be routed to the next available support engineer.

When requesting support from JTAC by telephone, be prepared to provide the following information:

- Your existing service request number, if you have one
- Details of the failure or problem
- Type of activity being performed on the device when the problem occurred
- Configuration data displayed by one or more **show** commands
- Your name, organization name, telephone number, fax number, and shipping address

The support representative validates your request and issues an RMA number for return of the component.

CHAPTER 37

Packing and Returning Components

IN THIS CHAPTER

Contact Customer Support to Obtain Return Material Authorization

If you are returning a device or hardware component to Juniper Networks for repair or replacement, obtain a Return Material Authorization (RMA) number from Juniper Networks Technical Assistance Center (JTAC).

After locating the serial number of the device or hardware component you want to return, open a service request with Juniper Networks Technical Assistance Center (JTAC) on the Web or by telephone.

Before you request an RMA number from JTAC, be prepared to provide the following information:

- Your existing service request number, if you have one
- Serial number of the component
- Your name, organization name, telephone number, fax number, and shipping address
- Details of the failure or problem
- Type of activity being performed on the device when the problem occurred
- Configuration data displayed by one or more **show** commands

You can contact JTAC 24 hours a day, seven days a week on the Web or by telephone:

- Service Request Manager: https://support.juniper.net/support
- Telephone: +1-888-314-JTAC (+1-888-314-5822), toll free in U.S., Canada, and Mexico

NOTE: For international or direct-dial options in countries without toll free numbers, see https://support.juniper.net/support

If you are contacting JTAC by telephone, enter your 12-digit service request number followed by the pound (#) key for an existing case, or press the star (*) key to be routed to the next available support engineer.

The support representative validates your request and issues an RMA number for return of the component.

Guidelines for Packing Hardware Components for Shipment

To pack and ship individual components:

- When you return components, make sure that 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 components in antistatic bags.
- Write the RMA number on the exterior of the box to ensure proper tracking.

CAUTION: Do not stack any of the hardware components.

Packing the MX960 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. On the console or other management device connected to the master Routing Engine, enter CLI operational mode and issue the following command to shut down the router software. (If two Routing Engines are installed, also issue the command on the backup Routing Engine.)

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

Wait until a message appears on the console confirming that the operating system has halted.

For more information about the command, see *request system halt*.

3. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.

4. Shut down power to the router by pressing the AC input switch or DC circuit breaker for all power supplies to the off (**O**) position.

5. Disconnect power from the router.

6. Remove the cables that connect to all external devices.

7. Remove all field replaceable units (FRUs) from the router.

8. Remove the router from the rack:

   - If you are using a mechanical lift, place the lift platform under the router, unscrew and remove the mounting screws from the rack, and move the router to the shipping crate.
   - If you are not using a mechanical lift and the router weight is fully supported by a shelf or another router, unscrew and remove the mounting screws from the rack. Three people can then lift the router and move it to the shipping crate.
   - If you are not using a mechanical lift and the router weight is not fully supported by a shelf or another router, three people should grasp the router while a fourth person unscrews and removes the mounting screws from the rack. The three lifters can then move the router to the shipping container.

9. Place the router in the shipping crate or onto the pallet. If on a pallet, bolt the router to the pallet.

10. Cover the router with an ESD bag and place the packing foam on top of and around the router.

11. Replace the accessory box on top of the packing foam.

12. Securely tape the box closed or place the crate cover over the router.

13. Write the RMA number on the exterior of the box to ensure proper tracking.

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX960 Router

How to Return a Hardware Component to Juniper Networks, Inc.

If a hardware component fails, please contact Juniper Networks, Inc. to obtain a Return Material Authorization (RMA) number. This number is used to track the returned material at the factory and to return repaired or new components to the customer as needed.

> **NOTE:** Do not return any component to Juniper Networks, Inc. unless you have first obtained an RMA number. Juniper Networks, Inc. reserves the right to refuse shipments that do not have an RMA. Refused shipments are returned to the customer by collect freight.

For more information about return and repair policies, see the customer support webpage at https://support.juniper.net/support/.

For product problems or technical support issues, contact the Juniper Networks Technical Assistance Center (JTAC) by using the Service Request Manager link at https://support.juniper.net/support/ or at 1-888-314-JTAC (within the United States) or 1-408-745-9500 (from outside the United States).

To return a defective hardware component:

1. Determine the part number and serial number of the defective component.

2. Obtain an RMA number from the Juniper Networks Technical Assistance Center (JTAC). You can send e-mail or telephone as described above.

3. Provide the following information in your e-mail message or during the telephone call:
   - Part number and serial number of component
   - Your name, organization name, telephone number, and fax number
   - Description of the failure

4. The support representative validates your request and issues an RMA number for return of the component.

5. Pack the component for shipment.

8

PART

Safety and Compliance Information

CHAPTER 38

General Safety Guidelines and Warnings

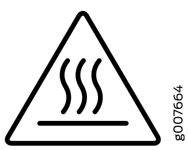
IN THIS CHAPTER

General Safety Guidelines and Warnings

The following guidelines help ensure your safety and protect the device from damage. The list of guidelines might not address all potentially hazardous situations in your working environment, so be alert and exercise good judgment at all times.

- Perform only the procedures explicitly described in the hardware documentation for this device. Make sure that only authorized service personnel perform other system services.
- Keep the area around the device clear and free from dust before, during, and after installation.
- Keep tools away from areas where people could trip over them while walking.
- Do not wear loose clothing or jewelry, such as rings, bracelets, or chains, which could become caught in the device.
- Wear safety glasses if you are working under any conditions that could be hazardous to your eyes.
- Do not perform any actions that create a potential hazard to people or make the equipment unsafe.
- Never attempt to lift an object that is too heavy for one person to handle.
- Never install or manipulate wiring during electrical storms.
- Never install electrical jacks in wet locations unless the jacks are specifically designed for wet environments.
- Operate the device only when it is properly grounded.
- Follow the instructions in this guide to properly ground the device to earth.

- Replace fuses only with fuses of the same type and rating.
- Do not open or remove chassis covers or sheet-metal parts unless instructions are provided in the hardware documentation for this device. Such an action could cause severe electrical shock.
- Do not push or force any objects through any opening in the chassis frame. Such an action could result in electrical shock or fire.
- Avoid spilling liquid onto the chassis or onto any device component. Such an action could cause electrical shock or damage the device.
- Avoid touching uninsulated electrical wires or terminals that have not been disconnected from their power source. Such an action could cause electrical shock.
- Some parts of the chassis, including AC and DC power supply surfaces, power supply unit handles, SFB card handles, and fan tray handles might become hot. The following label provides the warning of the hot surfaces on the chassis:



- Always ensure that all modules, power supplies, and cover panels are fully inserted and that the installation screws are fully tightened.

Definitions of Safety Warning Levels

The documentation uses the following levels of safety warnings (there are two *Warning* formats):

NOTE: You might find this information helpful in a particular situation, or you might overlook this important information if it was not highlighted in a Note.

CAUTION: You need to observe the specified guidelines to prevent minor injury or discomfort to you or severe damage to the device.

Attention Veillez à respecter les consignes indiquées pour éviter toute incommodité ou blessure légère, voire des dégâts graves pour l’appareil.

WARNING: This symbol alerts you to the risk of personal injury from a laser.

Avertissement Ce symbole signale un risque de blessure provoquée par rayon laser.

WARNING: This symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

Waarschuwing Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen.

Varoitus Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista.

Avertissement 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 vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker.

Aviso Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes.

¡Atención! Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes.

Varning! Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador.

Qualified Personnel Warning

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

Waarschuwing Installatie en reparaties mogen uitsluitend door getraind en bevoegd personeel uitgevoerd worden.

Varoitus Ainoastaan koulutettu ja pätevä henkilökunta saa asentaa tai vaihtaa tämän laitteen.

Avertissement Tout installation ou remplacement de l'appareil doit être réalisé par du personnel qualifié et compétent.

Warnung Gerät nur von geschultem, qualifiziertem Personal installieren oder auswechseln lassen.

Avvertenza Solo personale addestrato e qualificato deve essere autorizzato ad installare o sostituire questo apparecchio.

Advarsel Kun kvalifisert personell med riktig opplæring bør montere eller bytte ut dette utstyret.

Aviso Este equipamento deverá ser instalado ou substituído apenas por pessoal devidamente treinado e qualificado.

¡Atención! Estos equipos deben ser instalados y reemplazados exclusivamente por personal técnico adecuadamente preparado y capacitado.

Varning! Denna utrustning ska endast installeras och bytas ut av utbildad och kvalificerad personal.

Fire Safety Requirements

In the event of a fire emergency, the safety of people is the primary concern. You should establish procedures for protecting people in the event of a fire emergency, provide safety training, and properly provision fire-control equipment and fire extinguishers.

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

Fire Suppression

In the event of an electrical hazard or an electrical fire, you should first turn power off to the equipment at the source. Then use a Type C fire extinguisher, which uses noncorrosive fire retardants, to extinguish the fire.

Fire Suppression Equipment

Type C fire extinguishers, which use noncorrosive fire retardants such as carbon dioxide and Halotron™, are most effective for suppressing electrical fires. Type C fire extinguishers displace oxygen from the point of combustion to eliminate the fire. For extinguishing fire on or around equipment that draws air from the environment for cooling, you should use this type of inert oxygen displacement extinguisher instead of an extinguisher that leaves residues on equipment.

Do not use multipurpose Type ABC chemical fire extinguishers (dry chemical fire extinguishers). The primary ingredient in these fire extinguishers is monoammonium phosphate, which is very sticky and difficult to clean. In addition, in the presence of minute amounts of moisture, monoammonium phosphate can become highly corrosive and corrodes most metals.

Any equipment in a room in which a chemical fire extinguisher has been discharged is subject to premature failure and unreliable operation. The equipment is considered to be irreparably damaged.

> **NOTE:** To keep warranties effective, do not use a dry chemical fire extinguisher to control a fire at or near a Juniper Networks device. If a dry chemical fire extinguisher is used, the unit is no longer eligible for coverage under a service agreement.

We recommend that you dispose of any irreparably damaged equipment in an environmentally responsible manner.

Warning Statement for Norway and Sweden

WARNING: The equipment must be connected to an earthed mains socket-outlet.

Advarsel Apparatet skal kobles til en jordet stikkontakt.

Varning! Apparaten skall anslutas till jordat nätuttag.

CHAPTER 39

Installation and Maintenance Safety Guidelines and Warnings

IN THIS CHAPTER

Installation Instructions Warning

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

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

Varoitus Lue asennusohjeet ennen järjestelmän yhdistämistä virtalähteeseen.

Avertissement 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.

Chassis and Component Lifting Guidelines

- Before moving the device to a site, ensure that the site meets the power, environmental, and clearance requirements.
- Before lifting or moving the device, disconnect all external cables and wires.
- As when lifting any heavy object, ensure that most of the weight is borne by your legs rather than your back. Keep your knees bent and your back relatively straight. Do not twist your body as you lift. Balance the load evenly and be sure that your footing is firm.
- Use the following lifting guidelines to lift devices and components:

- Up to 39.7 lb (18 kg): One person.
- 39.7 lb (18 kg) to 70.5 lb (32 kg): Two or more people.
- 70.5 lb (32 kg) to 121.2 lb (55 kg): Three or more people.
- Above 121.2 lb (55 kg): Material handling systems (such as levers, slings, lifts and so on) must be used. When this is not practical, specially trained persons or systems must be used (riggers or movers).

Ramp Warning

WARNING: When installing the device, do not use a ramp inclined at more than 10 degrees.

Waarschuwing Gebruik een oprijplaat niet onder een hoek van meer dan 10 graden.

Varoitus Älä käytä sellaista kaltevaa pintaa, jonka kaltevuus ylittää 10 astetta.

Avertissement 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.

Rack-Mounting and Cabinet-Mounting Warnings

Ensure that the rack or cabinet in which the device is installed is evenly and securely supported. Uneven mechanical loading could lead to a hazardous condition.

WARNING: To prevent bodily injury when mounting or servicing the device in a rack, take the following precautions to ensure that the system remains stable. The following directives help maintain your safety:

- The device must be installed in a rack that is secured to the building structure.
- The device should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting the device on a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.
- If the rack is provided with stabilizing equipment, install the stabilizers before mounting or servicing the device in the rack.

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

- De Juniper Networks switch moet in een stellage worden geïnstalleerd die aan een 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 vältytään loukkaantumiselta. Noudata seuraavia turvallisuusohjeita:

- Juniper Networks switch on asennettava telineeseen, joka on kiinnitetty rakennukseen.
- Jos telineessä ei ole muita laitteita, aseta laite telineen alaosaan.
- Jos laite asetetaan osaksi täytettyyn telineeseen, aloita kuormittaminen sen alaosasta kaikkein raskaimmalla esineellä ja siirry sitten sen yläosaan.
- Jos telinettä varten on vakaimet, asenna ne ennen laitteen asettamista telineeseen tai sen huoltamista siinä.

Avertissement Pour éviter toute blessure corporelle pendant les opérations de montage ou de réparation de cette unité en casier, il convient de prendre des précautions spéciales afin de maintenir la stabilité du système. Les directives ci-dessous sont destinées à assurer la protection du personnel:

- Le rack sur lequel est monté le Juniper Networks switch doit être fixé à la structure du bâtiment.
- Si cette unité constitue la seule unité montée en casier, elle doit être placée dans le bas.
- Si cette unité est montée dans un casier partiellement rempli, charger le casier de bas en haut en plaçant l'élément le plus lourd dans le bas.
- Si le casier est équipé de dispositifs stabilisateurs, installer les stabilisateurs avant de monter ou de réparer l'unité en casier.

Warnung Zur Vermeidung von Körperverletzung beim Anbringen oder Warten dieser Einheit in einem Gestell müssen Sie besondere Vorkehrungen treffen, um sicherzustellen, daß das System stabil bleibt. Die folgenden Richtlinien sollen zur Gewährleistung Ihrer Sicherheit dienen:

- Der Juniper Networks switch muß in einem Gestell installiert werden, das in der Gebäudestruktur verankert ist.
- Wenn diese Einheit die einzige im Gestell ist, sollte sie unten im Gestell angebracht werden.
- Bei Anbringung dieser Einheit in einem zum Teil gefüllten Gestell ist das Gestell von unten nach oben zu laden, wobei das schwerste Bauteil unten im Gestell anzubringen ist.
- Wird das Gestell mit Stabilisierungszubehör geliefert, sind zuerst die Stabilisatoren zu installieren, bevor Sie die Einheit im Gestell anbringen oder sie warten.

Avvertenza Per evitare infortuni fisici durante il montaggio o la manutenzione di questa unità in un supporto, occorre osservare speciali precauzioni per garantire che il sistema rimanga stabile. Le seguenti direttive vengono fornite per garantire la sicurezza personale:

- Il Juniper Networks switch deve essere installato in un telaio, il quale deve essere fissato alla struttura dell'edificio.
- Questa unità deve venire montata sul fondo del supporto, se si tratta dell'unica unità da montare nel supporto.
- Quando questa unità viene montata in un supporto parzialmente pieno, caricare il supporto dal basso all'alto, con il componente più pesante sistemato sul fondo del supporto.
- Se il supporto è dotato di dispositivi stabilizzanti, installare tali dispositivi prima di montare o di procedere alla manutenzione dell'unità nel supporto.

Advarsel Unngå fysiske skader under montering eller reparasjonsarbeid på denne enheten når den befinner seg i et kabinett. Vær nøye med at systemet er stabilt. Følgende retningslinjer er gitt for å verne om sikkerheten:

- Juniper Networks switch må installeres i et stativ som er forankret til bygningsstrukturen.
- Denne enheten bør monteres nederst i kabinettet hvis dette er den eneste enheten i kabinettet.
- Ved montering av denne enheten i et kabinett som er delvis fylt, skal kabinettet lastes fra bunnen og opp med den tyngste komponenten nederst i kabinettet.
- Hvis kabinettet er utstyrt med stabiliseringsutstyr, skal stabilisatorene installeres før montering eller utføring av reparasjonsarbeid på enheten i kabinettet.

Aviso Para se prevenir contra danos corporais ao montar ou reparar esta unidade numa estante, deverá tomar precauções especiais para se certificar de que o sistema possui um suporte estável. As seguintes directrizes ajudá-lo-ão a efectuar o seu trabalho com segurança:

- O Juniper Networks switch deverá ser instalado numa prateleira fixa à estrutura do edificio.
- 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, oeriormente durante su mantenimiento, se debe poner mucho cuidado en que el sistema quede bien estable. Para garantizar su seguridad, proceda según las siguientes instrucciones:

- El Juniper Networks switch debe instalarse en un bastidor fijado a la estructura del edificio.
- Colocar el equipo en la parte inferior del bastidor, cuando sea la única unidad en el mismo.
- Cuando este equipo se vaya a instalar en un bastidor parcialmente ocupado, comenzar la instalación desde la parte inferior hacia la superior colocando el equipo más pesado en la parte inferior.
- Si el bastidor dispone de dispositivos estabilizadores, instalar éstos antes de montar o proceder al mantenimiento del equipo instalado en el bastidor.

Varning! För att undvika kroppsskada när du installerar eller utför underhållsarbete på denna enhet på en ställning måste du vidta särskilda försiktighetsåtgärder för att försäkra dig om att systemet står stadigt. Följande riktlinjer ges för att trygga din säkerhet:

- Juniper Networks switch måste installeras i en ställning som är förankrad i byggnadens struktur.
- Om denna enhet är den enda enheten på ställningen skall den installeras längst ned på ställningen.
- Om denna enhet installeras på en delvis fylld ställning skall ställningen fyllas nedifrån och upp, med de tyngsta enheterna längst ned på ställningen.
- Om ställningen är försedd med stabiliseringsdon skall dessa monteras fast innan enheten installeras eller underhålls på ställningen.

Grounded Equipment Warning

WARNING: This device must be properly grounded at all times. Follow the instructions in this guide to properly ground the device to earth.

Waarschuwing Dit apparaat moet altijd goed geaard zijn. Volg de instructies in deze gids om het apparaat goed te aarden.

Varoitus Laitteen on oltava pysyvästi maadoitettu. Maadoita laite asianmukaisesti noudattamalla tämän oppaan ohjeita.

Avertissement L'appareil doit être correctement mis à la terre à tout moment. Suivez les instructions de ce guide pour correctement mettre l'appareil à la terre.

Warnung Das Gerät muss immer ordnungsgemäß geerdet sein. Befolgen Sie die Anweisungen in dieser Anleitung, um das Gerät ordnungsgemäß zu erden.

Avvertenza Questo dispositivo deve sempre disporre di una connessione a massa. Seguire le istruzioni indicate in questa guida per connettere correttamente il dispositivo a massa.

Advarsel Denne enheten på jordes skikkelig hele tiden. Følg instruksjonene i denne veiledningen for å jorde enheten.

Aviso Este equipamento deverá estar ligado à terra. Siga las instrucciones en esta guía para conectar correctamente este dispositivo a tierra.

¡Atención! Este dispositivo debe estar correctamente conectado a tierra en todo momento. Siga las instrucciones en esta guía para conectar correctamente este dispositivo a tierra.

Varning! Den här enheten måste vara ordentligt jordad. Följ instruktionerna i den här guiden för att jorda enheten ordentligt.

CHAPTER 40

Radiation and Laser Warnings

IN THIS CHAPTER

Laser and LED Safety Guidelines and Warnings

IN THIS SECTION

Juniper Networks devices are equipped with laser transmitters, which are considered a Class 1 Laser Product by the U.S. Food and Drug Administration and are evaluated as a Class 1 Laser Product per EN 60825-1 requirements.

Observe the following guidelines and warnings:

General Laser Safety Guidelines

When working around ports that support optical transceivers, observe the following safety guidelines to prevent eye injury:

- Do not look into unterminated ports or at fibers that connect to unknown sources.
- Do not examine unterminated optical ports with optical instruments.
- Avoid direct exposure to the beam.

WARNING: Unterminated optical connectors can emit invisible laser radiation. The lens in the human eye focuses all the laser power on the retina, so focusing the eye directly on a laser source—even a low-power laser—could permanently damage the eye.

Avertissement Les connecteurs à fibre optique sans terminaison peuvent émettre un rayonnement laser invisible. Le cristallin de l’œil humain faisant converger toute la puissance du laser sur la rétine, toute focalisation directe de l’œil sur une source laser, —même de faible puissance—, peut entraîner des lésions oculaires irréversibles.

Class 1 Laser Product Warning

WARNING: Class 1 laser product.

Waarschuwing Klasse-1 laser produkt.

Varoitus Luokan 1 lasertuote.

Avertissement Produit laser de classe I.

Warnung Laserprodukt der Klasse 1.

Avvertenza Prodotto laser di Classe 1.

Advarsel Laserprodukt av klasse 1.

Aviso Produto laser de classe 1.

¡Atención! Producto láser Clase I.

Varning! Laserprodukt av klass 1.

Class 1 LED Product Warning

WARNING: Class 1 LED product.

Waarschuwing Klasse 1 LED-product.

Varoitus Luokan 1 valodiodituote.

Avertissement Alarme de produit LED Class I.

Warnung Class 1 LED-Produktwarnung.

Avvertenza Avvertenza prodotto LED di Classe 1.

Advarsel LED-produkt i klasse 1.

Aviso Produto de classe 1 com LED.

¡Atención! Aviso sobre producto LED de Clase 1.

Varning! Lysdiodprodukt av klass 1.

Laser Beam Warning

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

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

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

Avertissement 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.

Radiation from Open Port Apertures Warning

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.

Avertissement 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 emiteres 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 an 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.

CHAPTER 41

Maintenance and Operational Safety Guidelines and Warnings

IN THIS CHAPTER

Maintenance and Operational Safety Guidelines and Warnings

IN THIS SECTION

While performing the maintenance activities for devices, observe the following guidelines and warnings:

Battery Handling Warning

WARNING: Replacing a battery incorrectly might result in an explosion. Replace a battery only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

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

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

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

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

Advarsel Det kan være fare for eksplosjon hvis batteriet skiftes på feil måte. Skift kun med samme eller tilsvarende type som er anbefalt av produsenten. Kasser brukte batterier i henhold til produsentens instruksjoner.

Avvertenza Pericolo di esplosione se la batteria non è installata correttamente. Sostituire solo con una di tipo uguale o equivalente, consigliata dal produttore. Eliminare le batterie usate secondo le istruzioni del produttore.

Aviso Existe perigo de explosão se a bateria for substituída incorrectamente. Substitua a bateria por uma bateria igual ou de um tipo equivalente recomendado pelo fabricante. Destrua as baterias usadas conforme as instruções do fabricante.

¡Atención! Existe peligro de explosión si la batería se reemplaza de manera incorrecta. Reemplazar la baterían 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 can be welded to the terminals.

Waarschuwing Alvorens aan apparatuur te werken die met elektrische leidingen is verbonden, sieraden (inclusief ringen, kettingen en horloges) verwijderen. Metalen voorwerpen worden warm wanneer ze met stroom en aarde zijn verbonden, en kunnen ernstige brandwonden veroorzaken of het metalen voorwerp aan de aansluitklemmen lassen.

Varoitus Ennen kuin työskentelet voimavirtajohtoihin kytkettyjen laitteiden parissa, ota pois kaikki korut (sormukset, kaulakorut ja kellot mukaan lukien). Metalliesineet kuumenevat, kun ne ovat yhteydessä sähkövirran ja maan kanssa, ja ne voivat aiheuttaa vakavia palovammoja tai hitsata metalliesineet kiinni liitäntänapoihin.

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

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

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

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

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

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

Varning! Tag av alla smycken (inklusive ringar, halsband och armbandsur) innan du arbetar på utrustning som är kopplad till kraftledningar. Metallobjekt hettas upp när de kopplas ihop med ström och jord och kan förorsaka allvarliga brännskador; metallobjekt kan också sammansvetsas med kontakterna.

Lightning Activity Warning

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

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

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

Avertissement 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.

Operating Temperature Warning

WARNING: To prevent the device from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature. To prevent airflow restriction, allow at least 6 in. (15.2 cm) of clearance around the ventilation openings.

Waarschuwing Om te voorkomen dat welke switch van de Juniper Networks router dan ook oververhit raakt, dient u deze niet te bedienen op een plaats waar de maximale aanbevolen omgevingstemperatuur van 40° C wordt overschreden. Om te voorkomen dat de luchtstroom wordt beperkt, dient er minstens 15,2 cm speling rond de ventilatie-openingen te zijn.

Varoitus Ettei Juniper Networks switch-sarjan reititin ylikuumentuisi, sitä ei saa käyttää tilassa, jonka lämpötila ylittää korkeimman suositellun ympäristölämpötilan 40° C. Ettei ilmanvaihto estyisi, tuuletusaukkojen ympärille on jätettävä ainakin 15,2 cm tilaa.

Avertissement Pour éviter toute surchauffe des routeurs de la gamme Juniper Networks switch, ne l'utilisez pas dans une zone où la température ambiante est supérieure à 40° C. Pour permettre un flot d'air constant, dégagez un espace d'au moins 15,2 cm autour des ouvertures de ventilations.

Warnung Um einen Router der switch vor Überhitzung zu schützen, darf dieser nicht in einer Gegend betrieben werden, in der die Umgebungstemperatur das empfohlene Maximum von 40° C überschreitet. Um Lüftungsverschluß zu verhindern, achten Sie darauf, daß mindestens 15,2 cm lichter Raum um die Lüftungsöffnungen herum frei bleibt.

Avvertenza Per evitare il surriscaldamento dei switch, non adoperateli in un locale che ecceda la temperatura ambientale massima di 40° C. Per evitare che la circolazione dell'aria sia impedita, lasciate uno spazio di almeno 15.2 cm di fronte alle aperture delle ventole.

Advarsel Unngå overoppheting av eventuelle rutere i Juniper Networks switch Disse skal ikke brukes på steder der den anbefalte maksimale omgivelsestemperaturen overstiger 40° C (104° F). Sørg for at klaringen rundt lufteåpningene er minst 15,2 cm (6 tommer) for å forhindre nedsatt luftsirkulasjon.

Aviso Para evitar o sobreaquecimento do encaminhador Juniper Networks switch, não utilize este equipamento numa área que exceda a temperatura máxima recomendada de 40° C. Para evitar a restrição à circulação de ar, deixe pelo menos um espaço de 15,2 cm à volta das aberturas de ventilação.

¡Atención! Para impedir que un encaminador de la serie Juniper Networks switch se recaliente, no lo haga funcionar en un área en la que se supere la temperatura ambiente máxima recomendada de 40° C. Para impedir la restricción de la entrada de aire, deje un espacio mínimo de 15,2 cm alrededor de las aperturas para ventilación.

Varning! Förhindra att en Juniper Networks switch överhettas genom att inte använda den i ett område där den maximalt rekommenderade omgivningstemperaturen på 40° C överskrids. Förhindra att luftcirkulationen inskränks genom att se till att det finns fritt utrymme på minst 15,2 cm omkring ventilationsöppningarna.

Product Disposal Warning

WARNING: Disposal of this device must be handled according to all national laws and regulations.

Waarschuwing Dit produkt dient volgens alle landelijke wetten en voorschriften te worden afgedankt.

Varoitus Tämän tuotteen lopullisesta hävittämisestä tulee huolehtia kaikkia valtakunnallisia lakeja ja säännöksiä noudattaen.

Avertissement 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.

CHAPTER 42

Electrical Safety Guidelines and Warnings

IN THIS CHAPTER

General Electrical Safety Guidelines and Warnings

WARNING: Certain ports on the device are designed for use as intrabuilding (within-the-building) interfaces only (Type 2 or Type 4 ports as described in *GR-1089-CORE*) and require isolation from the exposed outside plant (OSP) cabling. To comply with NEBS requirements and protect against lightning surges and commercial power disturbances, the intrabuilding ports *must not* be metallically connected to interfaces that connect to the OSP or its wiring. The intrabuilding ports on the device are suitable for connection to intrabuilding or unexposed wiring or cabling only. The addition of primary protectors is not sufficient protection for connecting these interfaces metallically to OSP wiring.

Avertissement Certains ports de l'appareil sont destinés à un usage en intérieur uniquement (ports Type 2 ou Type 4 tels que décrits dans le document *GR-1089-CORE*) et doivent être isolés du câblage de l'installation extérieure exposée. Pour respecter les exigences NEBS et assurer une protection contre la foudre et les perturbations de tension secteur, les ports pour intérieur *ne doivent pas* être raccordés physiquement aux interfaces prévues pour la connexion à l'installation extérieure ou à son câblage. Les ports pour intérieur de l'appareil sont réservés au raccordement de câbles pour intérieur ou non exposés uniquement. L'ajout de protections ne constitue pas une précaution suffisante pour raccorder physiquement ces interfaces au câblage de l'installation extérieure.

CAUTION: Before removing or installing components of a device, connect an electrostatic discharge (ESD) grounding strap to an ESD point and wrap and fasten the other end of the strap around your bare wrist. Failure to use an ESD grounding strap could result in damage to the device.

Attention Avant de retirer ou d'installer des composants d'un appareil, raccordez un bracelet antistatique à un point de décharge électrostatique et fixez le bracelet à votre poignet nu. L'absence de port d'un bracelet antistatique pourrait provoquer des dégâts sur l'appareil.

- Install the device in compliance with the following local, national, and international electrical codes:
  - United States—National Fire Protection Association (NFPA 70), United States National Electrical Code.
  - Other countries—International Electromechanical Commission (IEC) 60364, Part 1 through Part 7.
  - Evaluated to the TN power system.

- Canada—Canadian Electrical Code, Part 1, CSA C22.1.
- Suitable for installation in Information Technology Rooms in accordance with Article 645 of the National Electrical Code and NFPA 75.

  Peut être installé dans des salles de matériel de traitement de l'information conformément à l'article 645 du National Electrical Code et à la NFPA 75.

- Locate the emergency power-off switch for the room in which you are working so that if an electrical accident occurs, you can quickly turn off the power.
- Make sure that grounding surfaces are cleaned and brought to a bright finish before grounding connections are made.
- Do not work alone if potentially hazardous conditions exist anywhere in your workspace.
- Never assume that power is disconnected from a circuit. Always check the circuit before starting to work.
- Carefully look for possible hazards in your work area, such as moist floors, ungrounded power extension cords, and missing safety grounds.
- Operate the device within marked electrical ratings and product usage instructions.
- To ensure that the device and peripheral equipment function safely and correctly, use the cables and connectors specified for the attached peripheral equipment, and make certain they are in good condition.

You can remove and replace many device components without powering off or disconnecting power to the device, as detailed elsewhere in the hardware documentation for this device. Never install equipment that appears to be damaged.

Prevention of Electrostatic Discharge Damage

Device components that are shipped in antistatic bags are sensitive to damage from static electricity. Some components can be impaired by voltages as low as 30 V. You can easily generate potentially damaging static voltages whenever you handle plastic or foam packing material or if you move components across plastic or carpets. Observe the following guidelines to minimize the potential for electrostatic discharge (ESD) damage, which can cause intermittent or complete component failures:

- Always use an ESD wrist strap when you are handling components that are subject to ESD damage, and make sure that it is in direct contact with your skin.

  If a grounding strap is not available, hold the component in its antistatic bag (see Figure 287 on page 749) in one hand and touch the exposed, bare metal of the device with the other hand immediately before inserting the component into the device.

  > **WARNING:** For safety, periodically check the resistance value of the ESD grounding strap. The measurement must be in the range 1 through 10 Mohms.
  >
  > **Avertissement** Par mesure de sécurité, vérifiez régulièrement la résistance du bracelet antistatique. Cette valeur doit être comprise entre 1 et 10 mégohms (Mohms).

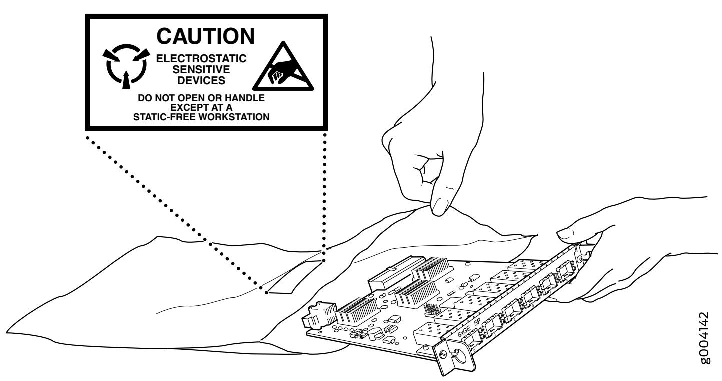
- When handling any component that is subject to ESD damage and that is removed from the device, make sure the equipment end of your ESD wrist strap is attached to the ESD point on the chassis.

  If no grounding strap is available, touch the exposed, bare metal of the device to ground yourself before handling the component.

- Avoid contact between the component that is subject to ESD damage and your clothing. ESD voltages emitted from clothing can damage components.

- When removing or installing a component that is subject to ESD damage, always place it component-side up on an antistatic surface, in an antistatic card rack, or in an antistatic bag (see Figure 287 on page 749). If you are returning a component, place it in an antistatic bag before packing it.

Figure 287: Placing a Component into an Antistatic Bag



CAUTION: ANSI/TIA/EIA-568 cables such as Category 5e and Category 6 can get electrostatically charged. To dissipate this charge, always ground the cables to a suitable and safe earth ground before connecting them to the system.

Attention Les câbles ANSI/TIA/EIA-568, par exemple Cat 5e et Cat 6, peuvent emmagasiner des charges électrostatiques. Pour évacuer ces charges, reliez toujours les câbles à une prise de terre adaptée avant de les raccorder au système.

AC Power Electrical Safety Guidelines

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

- Note the following warnings printed on the device:

  "**CAUTION:** THIS UNIT HAS MORE THAN ONE POWER SUPPLY CORD. DISCONNECT ALL POWER SUPPLY CORDS BEFORE SERVICING TO AVOID ELECTRIC SHOCK."

  "**ATTENTION:** CET APPAREIL COMPORTE PLUS D'UN CORDON D'ALIMENTATION. AFIN DE PRÉVENIR LES CHOCS ÉLECTRIQUES, DÉBRANCHER TOUT CORDON D'ALIMENTATION AVANT DE FAIRE LE DÉPANNAGE."

- AC-powered devices are shipped with a three-wire electrical cord with a grounding-type plug that fits only a grounding-type power outlet. Do not circumvent this safety feature. Equipment grounding must comply with local and national electrical codes.

- You must provide an external certified circuit breaker (2-pole circuit breaker or 4-pole circuit breaker based on your device) rated minimum 20 A in the building installation.

- The power cord serves as the main disconnecting device for the AC-powered device. The socket outlet must be near the AC-powered device and be easily accessible.
- For devices that have more than one power supply connection, you must ensure that all power connections are fully disconnected so that power to the device is completely removed to prevent electric shock. To disconnect power, unplug all power cords (one for each power supply).

Power Cable Warning (Japanese)

WARNING: The attached power cable is only for this product. Do not use the cable for another product.

注意

附属の電源コードセットはこの製品専用です。
他の電気機器には使用しないでください。

g017253

AC Power Disconnection Warning

WARNING: Before working on the device or near power supplies, unplug all the power cords from an AC-powered device.

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.

Varoitus Kytke irti vaihtovirtalaitteiden virtajohto, ennen kuin teet mitään asennuspohjalle tai työskentelet virtalähteiden läheisyydessä.

Avertissement Avant de travailler sur un châssis ou à proximité d'une alimentation électrique, débrancher le cordon d'alimentation des unités en courant alternatif.

Warnung Bevor Sie an einem Chassis oder in der Nähe von Netzgeräten arbeiten, ziehen Sie bei Wechselstromeinheiten das Netzkabel ab bzw.

Avvertenza Prima di lavorare su un telaio o intorno ad alimentatori, scollegare il cavo di alimentazione sulle unità CA.

Advarsel Før det utføres arbeid på kabinettet eller det arbeides i nærheten av strømforsyningsenheter, skal strømledningen trekkes ut på vekselstrømsenheter.

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.

¡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).

Varning! Innan du arbetar med ett chassi eller nära strömförsörjningsenheter skall du för växelströmsenheter dra ur nätsladden.

DC Power Copper Conductors Warning

WARNING: Use copper conductors only.

Waarschuwing Gebruik alleen koperen geleiders.

Varoitus Käytä vain kuparijohtimia.

Attention Utilisez uniquement des conducteurs en cuivre.

Warnung Verwenden Sie ausschließlich Kupferleiter.

Avvertenza Usate unicamente dei conduttori di rame.

Advarsel Bruk bare kobberledninger.

Aviso Utilize apenas fios condutores de cobre.

¡Atención! Emplee sólo conductores de cobre.

Varning! Använd endast ledare av koppar.

DC Power Disconnection Warning

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

Waarschuwing Voordat u een van de onderstaande procedures uitvoert, dient u te controleren of de stroom naar het gelijkstroom circuit uitgeschakeld is. Om u ervan te verzekeren dat alle stroom UIT is geschakeld, kiest u op het schakelbord de stroomverbreker die het gelijkstroom circuit bedient, draait de stroomverbreker naar de UIT positie en plakt de schakelaarhendel van de stroomverbreker met plakband in de UIT positie vast.

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

Avertissement 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.

DC Power Grounding Requirements and Warning

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

WARNING: When you install the device, the ground connection must always be made first and disconnected last.

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

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

Avertissement 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.

DC Power Wiring Sequence Warning

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

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

Varoitus Oikea yhdistettava kytkentajarjestys on maajohto maajohtoon, +RTN varten +RTN, –48 V varten – 48 V. Oikea irrotettava kytkentajarjestys on –48 V varten – 48 V, +RTN varten +RTN, maajohto maajohtoon.

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

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

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

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

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

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

Varning! Korrekt kopplingssekvens ar jord till jord, +RTN till +RTN, –48 V till –48 V. Korrekt kopplas kopplingssekvens ar –48 V till –48 V, +RTN till +RTN, jord till jord.

DC Power Wiring Terminations Warning

WARNING: When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations must be the appropriate size for the wires and must clamp both the insulation and conductor.

Waarschuwing Wanneer geslagen bedrading vereist is, dient u bedrading te gebruiken die voorzien is van goedgekeurde aansluitingspunten, zoals het gesloten-lus type of het grijperschop type waarbij de aansluitpunten omhoog wijzen. Deze aansluitpunten dienen de juiste maat voor de draden te hebben en dienen zowel de isolatie als de geleider vast te klemmen.

Varoitus Jos säikeellinen johdin on tarpeen, käytä hyväksyttyä johdinliitäntää, esimerkiksi suljettua silmukkaa tai kourumaista liitäntää, jossa on ylöspäin käännetyt kiinnityskorvat. Tällaisten liitäntöjen tulee olla kooltaan johtimiin sopivia ja niiden tulee puristaa yhteen sekä eristeen että johdinosan.

Avertissement Quand des fils torsadés sont nécessaires, utiliser des douilles terminales homologuées telles que celles à circuit fermé ou du type à plage ouverte avec cosses rebroussées. Ces douilles terminales doivent être de la taille qui convient aux fils et doivent être refermées sur la gaine isolante et sur le conducteur.

Warnung Wenn Litzenverdrahtung erforderlich ist, sind zugelassene Verdrahtungsabschlüsse, z.B. für einen geschlossenen Regelkreis oder gabelförmig, mit nach oben gerichteten Kabelschuhen zu verwenden. Diese Abschlüsse sollten die angemessene Größe für die Drähte haben und sowohl die Isolierung als auch den Leiter festklemmen.

Avvertenza Quando occorre usare trecce, usare connettori omologati, come quelli a occhiello o a 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 lederen.

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

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

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

Midplane Energy Hazard Warning

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

Multiple Power Supplies Disconnection Warning

WARNING: The network device has more than one power supply connection. All connections must be removed completely to remove power from the unit completely.

Waarschuwing Deze eenheid heeft meer dan één stroomtoevoerverbinding; alle verbindingen moeten volledig worden verwijderd om de stroom van deze eenheid volledig te verwijderen.

Varoitus Tässä laitteessa on useampia virtalähdekytkentöjä. Kaikki kytkennät on irrotettava kokonaan, jotta virta poistettaisiin täysin laitteesta.

Avertissement Cette unité est équipée de plusieurs raccordements d'alimentation. Pour supprimer tout courant électrique de l'unité, tous les cordons d'alimentation doivent être débranchés.

Warnung Diese Einheit verfügt über mehr als einen Stromanschluß; um Strom gänzlich von der Einheit fernzuhalten, müssen alle Stromzufuhren abgetrennt sein.

Avvertenza Questa unità ha più di una connessione per alimentatore elettrico; tutte le connessioni devono essere completamente rimosse per togliere l'elettricità dall'unità.

Advarsel Denne enheten har mer enn én strømtilkobling. Alle tilkoblinger må kobles helt fra for å eliminere strøm fra enheten.

Aviso Este dispositivo possui mais do que uma conexão de fonte de alimentação de energia; para poder remover a fonte de alimentação de energia, deverão ser desconectadas todas as conexões existentes.

¡Atención! Esta unidad tiene más de una conexión de suministros de alimentación; para eliminar la alimentación por completo, deben desconectarse completamente todas las conexiones.

Varning! Denna enhet har mer än en strömförsörjningsanslutning; alla anslutningar måste vara helt avlägsnade innan strömtillförseln till enheten är fullständigt bruten.

Action to Take After an 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 device.

3. If possible, send another person to get medical aid. Otherwise, assess the condition of the victim, then call for help.

CHAPTER 43

Agency Approvals and Compliance Statements

IN THIS CHAPTER

Agency Approvals for MX960 Routers

The routers comply with the following standards:

- Safety
  - EN 60825-1 Safety of Laser Products - Part 1: Equipment Classification, Requirements and User's Guide
  - CSA 60950-1 Safety of Information Technology Equipment
  - UL 60950-1 Safety of Information Technology Equipment
  - EN 60950-1 Safety of Information Technology Equipment
  - IEC 60950-1 Safety of Information Technology Equipment (with country deviations)
- EMC/EMI/ETSI
  - AS/NZS CISPR22 (Australia/New Zealand)
  - EN55022 Class A European Radiated Emissions
  - FCC Part 15 Class A USA Radiated Emissions
  - VCCI Class A Japanese Radiated Emissions
  - ETSI EN-300386 V1.3.3 Telecommunication Network Equipment. Electromagnetic Compatibility Requirements

- Immunity
  - EN 55024 +A1+A2 Information Technology Equipment Immunity Characteristics
  - EN-61000-3-2 Power Line Harmonics
  - EN-61000-3-3 +A1 +A2 +A3 Power Line Voltage Fluctuations and Flicker
  - EN-61000-4-2 +A1 +A2 Electrostatic Discharge
  - EN-61000-4-3 +A1+A2 Radiated Immunity
  - EN-61000-4-4 Electrical Fast Transients
  - EN-61000-4-5 Surge
  - EN-61000-4-6 Immunity to Conducted Disturbances
  - EN-61000-4-11 Voltage Dips and Sags
- NEBS
  - GR-1089-Core: EMC and Electrical Safety for Network Telecommunications Equipment
  - SR-3580 NEBS Criteria Levels (Level 3 Compliance)
  - GR-63-Core: NEBS, Physical Protection

RELATED DOCUMENTATION

Compliance Statements for NEBS for the MX960 Router | 767
Compliance Statements for EMC Requirements for the MX960 Router | 768
Compliance Statements for Environmental Requirements | 769
Compliance Statements for Acoustic Noise for the MX960 Router | 770

Compliance Statements for NEBS for the MX960 Router

- The equipment is suitable for installation as part of the Common Bonding Network (CBN).
- The equipment is suitable for installation in locations where the National Electrical Code (NEC) applies.
- The battery return connection is to be treated as an isolated DC return (that is, DC-I), as defined in GR-1089-CORE.
- You must provision a readily accessible device outside of the equipment to disconnect power. The device must also be rated based on local electrical code practice.

RELATED DOCUMENTATION

Compliance Statements for EMC Requirements for the MX960 Router

IN THIS SECTION

Canada

CAN ICES-3 (A)/NMB-3(A)

European Community

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

Israel

אזהרה

מוצר זה הוא מוצר Class A.
בסביבה ביתית,מוצר זה עלול לגרום הפרעות בתדר רדיו,ובמקרה זה ,המשתמש עשוי להידרש
לנקוט אמצעים מתאימים.

Translation from Hebrew—Warning: This product is Class A. In residential environments, the product might cause radio interference, and in such a situation, the user might be required to take adequate measures.

Japan

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

The preceding translates as follows:

This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this product is used near a radio or television receiver in a domestic environment, it might cause radio interference. Install and use the equipment according to the instruction manual. VCCI-A.

United States

The hardware equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

RELATED DOCUMENTATION

Grounded Equipment Warning | 732

Compliance Statements for Environmental Requirements

Batteries in this product are not based on mercury, lead, or cadmium substances. The batteries used in this product are in compliance with EU Directives 91/157/EEC, 93/86/EEC, and 98/101/EEC. The product documentation includes instructional information about the proper method of reclamation and recycling.

Compliance Statements for Acoustic Noise for the MX960 Router

The router complies with NEBS Level 3 requirements:

- GR-63-CORE: NEBS, Physical Protection
- GR-1089-CORE: EMC and Electrical Safety for Network Telecommunications Equipment

RELATED DOCUMENTATION

Agency Approvals for MX960 Routers | 766
Compliance Statements for NEBS for the MX960 Router | 767
Compliance Statements for EMC Requirements for the MX960 Router | 768
Compliance Statements for Environmental Requirements | 769

Statements of Volatility for Juniper Network Devices

A *statement of volatility (SoV)*—sometimes known as *letter of volatility (LoV)*—identifies the volatile and non-volatile storage components in Juniper Networks devices, and describes how to remove non-volatile storage components from the device.

> **NOTE:** Individual FRUs do not have separate SoV or LoV documents. They are covered in the SoV or LoV of the Juniper Networks device in which they are installed.

> **NOTE:** Statements of volatility are not available for all Juniper Networks devices.

CTP Series:

- CTP150
- CTP2000

EX Series:

- EX2200 and EX2200-C
- EX2300-24P, EX2300-24T, and EX2300-24T-DC

- EX2300-48P and EX2300-48T
- EX2300-C
- EX3300
- EX3400-24P, EX3400-24T, EX3400-24T-DC
- EX3400-48P, EX3400-48T, EX3400-48T-AFI
- EX4200
- EX4300
- EX4300-48MP
- EX4400:
  - EX4400–24T
  - EX4400–24P
  - EX4400–48T
  - EX4400–48P
  - EX4400–48F
- EX4500
- EX4550
- EX4600
- EX8200
- EX9251
- EX9253
- XRE200 External Routing Engine

LN Series:

- LN1000–CC

MX Series:

- M7i
- M7i Compact Forwarding Engine Board (CFEB)
- M40e and M10i
- M320
- MX5, MX10, MX40, and MX80
- MX104

- MX204
- MX240, MX480, and MX960
- MX10003
- RE-A-2000 Route Engine
- RE-S-X6-64G Routing Engine

QFX Series:

- QFX3008-I
- QFX3100
- QFX3500
- QFX3600
- QFX5100-24Q
- QFX5100-48S
- QFX5100-48T
- QFX5110-32Q
- QFX5110-48S
- QFX5200
- QFX5200-32C
- QFX10008 and QFX10016

SRX Series:

- SRX100
- SRX110
- SRX210B
- SRX210H-POE
- SRX210H-P-MGW
- SRX220
- SRX240H
- SRX240H-POE
- SRX300
- SRX320
- SRX340 and SRX345

- SRX550
- SRX650
- SRX1400
- SRX1500
- SRX3400 and SRX3600
- SRX4200
- SRX4600
- SRX5400, SRX5600, and SRX5800
- SRX-MP-1SERIAL
- SSG-520M

T Series:

- RE-A-2000 Route Engine