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MX480 Universal Routing Platform Hardware Guide

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MX480 Universal Routing Platform Hardware Guide
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About This Guide

Use this guide to install hardware and perform initial software configuration, routine maintenance, and troubleshooting for the MX480 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.

RELATED DOCUMENTATION

- MX480 Quick Start

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MX480 Router Description

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The MX480 5G Universal Routing Platform is an Ethernet-optimized edge router that provides both switching and carrier-class Ethernet routing. The MX480 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.

Benefits of the MX480 Router

- **System Capacity**—MX480 provides 9 Tbps of system capacity for a wide range of cloud, campus, enterprise, data center, service provider, cable, and mobile service core applications.
- **Always-on Infrastructure Base**—MX Series routers ensure network and service availability with a broad set of multilayered physical, logical, and protocol-level resiliency aspects. Junos OS Virtual Chassis technology on MX Series routers supports chassis-level redundancy and enables you to manage two routers as a single element. Multichassis link aggregation group (MC-LAG) implementation supports stateful chassis, card, and port redundancy.
- **Application-Aware Networking**—On MX Series routers you can use deep packet inspection to detect applications, and by using the user-defined policies, you can determine traffic treatment for each application. This feature enables highly customized and differentiated services at scale.
- **Programmable Chipset**—The chipset implemented in the MX Series routers has a programmable forwarding data structure that allows fast microcode changes in the hardware itself, and a programmable lookup engine that allows inline service processing. the chip's programmable QoS engine supports coarse and fine-grained queuing to address the requirements of core, edge, and aggregation use cases.
- **Junos Continuity and Unified In-Service Software Upgrade (Unified ISSU)**—With the Junos continuity plug-in package, you can perform a smooth upgrade when new hardware is installed in your MX Series router.

Unified in-service software upgrade (unified ISSU) enables software upgrades and changes without disrupting network traffic.

- **Junos Telemetry Interface**—Using the Junos telemetry interface data, you can stream component-level data to monitor, analyze, and enhance the performance of the network. Analytics derived from this streaming telemetry can identify current and trending congestion, resource utilization, traffic volume, and buffer occupancy.
- **Integrated Hardware-Based Timing**—You do not need to use external clocks because MX Series routers support highly scalable and reliable hardware-based timing, including Synchronous Ethernet for frequency, and the Precision Time Protocol (PTP) for frequency and phase synchronization. Synchronous Ethernet and PTP can be combined in a hybrid mode to achieve a high level of frequency (10 ppb) and phase (<1.5 uS) accuracy.

MX480 Hardware Overview

The MX480 chassis provides redundancy and resiliency. The hardware system is fully redundant, including power supplies, Routing Engines, and Switch Control Boards (SCBs).

The MX480 router is eight rack units (U) tall. Five routers can be stacked in a single floor-to-ceiling rack, for increased port density per unit of floor space. The router provides eight slots that can be populated with up to six Dense Port Concentrators (DPCs) or Modular Port Concentrators (MPCs), three Flexible PIC Concentrators (FPCs), and two SCBs. Each FPC holds up to two PICs and each MPC holds up to two Modular Interface Cards (MICs).

Fully populated, the MX480 router provides an aggregate switch fabric capacity of up to 5.76 Tbps and line-rate throughput for up to 240 10-Gigabit Ethernet ports, or 24 100-Gigabit Ethernet, or 72 40-Gigabit Ethernet ports.

Table 1 on page 3 lists the MX480 router capacity.

Table 1: MX480 Router Capacity

Description	Capacity
System capacity	5.76 Tbps half duplex
Switch fabric capacity per slot	480 Gbps
MPCs and DPCs per chassis	6

Table 1: MX480 Router Capacity *(Continued)*

Description	Capacity
Chassis per rack	6

Each DPC includes either two or four Packet Forwarding Engines. Each Packet Forwarding Engine enables a throughput of 10 Gbps. Many types of DPCs are available. For a list of the DPCs supported, see the *MX Series Interface Module Reference*.

The MX480 supports up to 3 FPCs containing up to 6 PICs or up to 6 MPCs containing up to 12 MICs. For a list of the supported line cards, see the *MX Series Interface Module Reference*.

Four SCBs are available for the MX480 routers—SCB, SCBE, SCBE2, and SCBE3.

Table 2 on page 4 compares the fabric bandwidth capacities of SCBs per MX-series router.

Table 2: 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

Table 2: Switch Control Board Capacities for MX Series 5G Universal Routing Platforms (Full-Duplex) ***(Continued)***

Description	Fabric Bandwidth Per Slot	MX240 Fabric Bandwidth	MX480 Fabric Bandwidth	MX960 Fabric Bandwidth
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 DPCs, FPCs, MPCs, and SCBs are organized in three groups:

- Switch fabric—Connects the interface cards and provides for packet transport between DPCs, FPCs, and MPCs.
- 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 for low-level status diagnostic support.

MX480 Chassis

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MX480 Chassis Description

The router chassis is a rigid sheet metal structure that houses all the other router components (see Figure 1 on page 7, Figure 2 on page 7, and Figure 3 on page 8). The chassis measures 14.0 in. (35.6 cm) high, 17.45 in. (44.3 cm) wide, and 24.5 in. (62.2 cm) deep (from the front to the rear of the chassis). The chassis installs in standard 800-mm (or larger) enclosed cabinets, 19-in. equipment

racks, or telco open-frame racks. Up to five routers can be installed in one standard 48-U rack if the rack can handle their combined weight, which can be greater than 818 lb (371.0 kg).

Figure 1: Front View of a Fully Configured Router Chassis

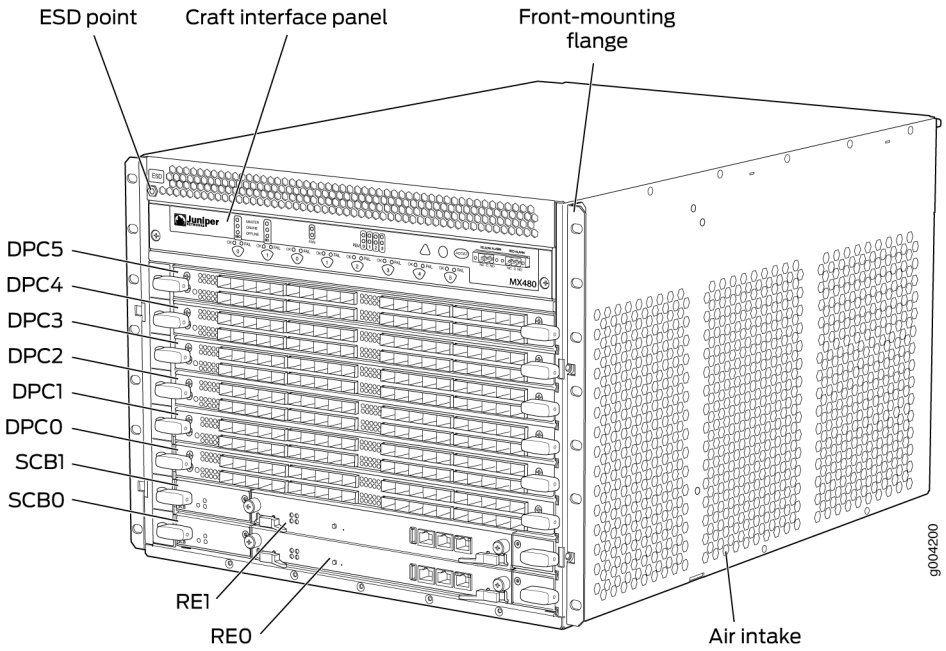


Figure 2: Rear View of a Fully Configured AC-Powered Router Chassis

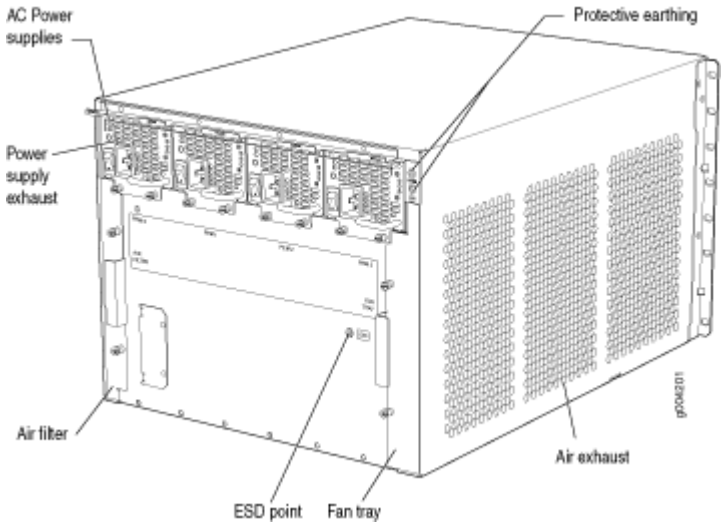
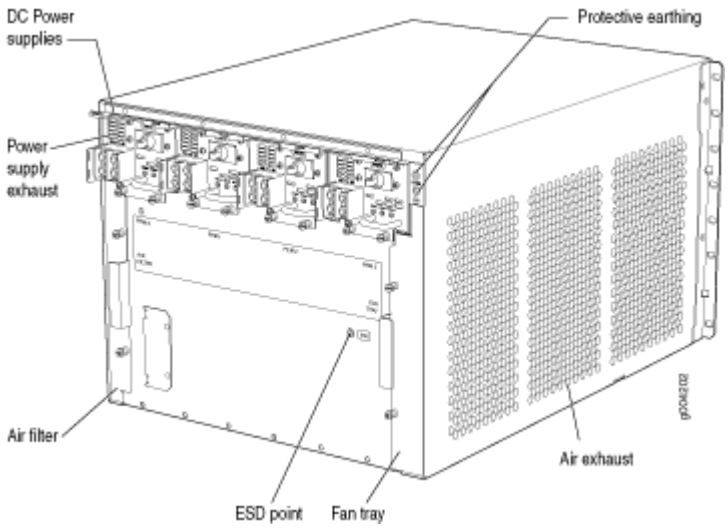


Figure 3: Rear View of a Fully Configured DC-Powered Router Chassis



SEE ALSO

MX480 Router Physical Specifications | 195

MX480 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 functioning together with 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.

  If the Routing Engines are configured for *graceful switchover*, the backup Routing Engine automatically synchronizes its configuration and state with the primary Routing Engine. Any update to the primary Routing Engine state is replicated on the backup Routing Engine. If the backup Routing Engine assumes primary role, packet forwarding continues through the router without interruption. For more information about graceful switchover, see the Junos OS Administration Library for Routing Devices.

- Power supplies—In the low-line (110 V) AC power configuration, the router contains three or four AC power supplies, located horizontally at the rear of the chassis in slots **PEM0** through **PEM3** (left to right). Each AC power supply provides power to all components in the router. When three power supplies are present, they share power almost equally within a fully populated system. Four AC power supplies provide full power redundancy. If one power supply fails or is removed, the remaining power supplies instantly assume the entire electrical load without interruption. Three power supplies provide the maximum configuration with full power for as long as the router is operational.

  In the high-line (220 V) AC power configuration, the router contains two or four AC power supplies located horizontally at the rear of the chassis in slots **PEM0** through **PEM3** (left to right). Each AC power supply provides power to all components in the router. When two or more power supplies are present, they share power almost equally within a fully populated system. Four AC power supplies provide full power redundancy. If one power supply fails or is removed, the remaining power supplies instantly assume the entire electrical load without interruption. Two power supplies provide the maximum configuration with full power for as long as the router is operational.

  In the DC configuration, 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 or is removed, the remaining power supplies instantly assume the entire electrical load without interruption. Two power supplies provide the maximum configuration with full power for as long as the router is operational.

- Cooling system—The cooling system has redundant components, which are controlled by the host subsystem. If one of the fans fails, the host subsystem increases the speed of the remaining fans to provide sufficient cooling for the router indefinitely.

MX480 Router Hardware and CLI Terminology Mapping

The MX480 router supports the components in Table 3 on page 9.

Table 3: MX480 Router Hardware Components and CLI Terminology

Component	Hardware Model Number	CLI Name	Description
Chassis	CHAS-BP-MX480	`MX480`	"MX480 Router Physical Specifications" on page 195 "MX480 Chassis Description" on page 6

Table 3: MX480 Router Hardware Components and CLI Terminology *(Continued)*

Component	Hardware Model Number	CLI Name	Description
Craft Interface Panel	CRAFT-MX480-S	`Front Panel Display`	"MX480 Craft Interface Description" on page 13
Cooling System			
Fan tray	FFANTRAY-MX480	`Left Fan tray`	"MX480 Cooling System Description" on page 21
High-capacity fan tray	FFANTRAY-MX480-HC	`Enhanced Left Fan Tray`	
Filter kit	FLTR-KIT-MX480	N/A	
Host Subsystem			"MX480 Host Subsystem Description" on page 47
Routing Engine	See "Supported Routing Engines by Router" on page 79.		"MX480 Routing Engine Description" on page 50
Switch Control Board	SCB-MX	`MX SCB`	*SCB-MX Description*
	SCBE-MX	`Enhanced MX SCBE`	*SCBE-MX Description*
	SCBE2-MX	`Enhanced MX SCB 2`	*SCBE2-MX Description*
	SCBE3-MX	`Enhanced MX SCB 3`	*SCBE3-MX Description*
Interface Modules			

Table 3: MX480 Router Hardware Components and CLI Terminology *(Continued)*

Component	Hardware Model Number	CLI Name	Description
DPC	See "DPCs Supported on MX240, MX480, and MX960 Routers" on page 111 in the *MX Series Interface Module Reference*.		"MX480 Dense Port Concentrator (DPC) Description" on page 104
FPC	MX-FPC2	`MX FPC Type 2`	"MX480 Flexible PIC Concentrator (FPC) Description" on page 116
	MX-FPC3	`MX FPC Type 3`	
MIC	See "MICs Supported by MX Series Routers" on page 143 in the *MX Series Interface Module Reference*.		"MX480 Modular Interface Card (MIC) Description" on page 138
MPC	See "MPCs Supported by MX Series Routers" on page 161 in the *MX Series Interface Module Reference*.		"MX480 Modular Port Concentrator (MPC) Description" on page 157
PIC	See "PICs Supported by MX240, MX480, and MX960 Routers" on page 124 in the *MX Series Interface Module Reference*.		"MX480 PIC Description" on page 120
Interface module blank panel	DPC-SCB-BLANK MIC-BLANK	N/A	
Transceiver	See *MX Series Interface Module Reference*	`Xcvr`	"Maintaining MX480 Switch Control Boards" on page 436
Power System			"MX480 Power System Description" on page 27
AC power supply	PWR-MX480-AC	`AC Power Entry Module`	"MX480 AC Power Supply Description" on page 28

Table 3: MX480 Router Hardware Components and CLI Terminology *(Continued)*

Component	Hardware Model Number	CLI Name	Description
	PWR-MX480-1200-AC	PS 1.2-1.7kW 100-240V AC in	
	PWR-MX480-2520-AC (high-capacity)	PS 1.4-2.52kW; 90-264V AC in	
DC power supply	PWR-MX480-DC	DC Power Entry Module	"MX480 DC Power Supply Description" on page 39
	PWR-MX480-1600-DC	DC Power Entry Module	
	PWR-MX480-2400-DC	DC 2.4kW Power Entry Module	
Power supply blank panel	PWR-BLANK-MX480	N/A	"MX480 Power System Description" on page 27

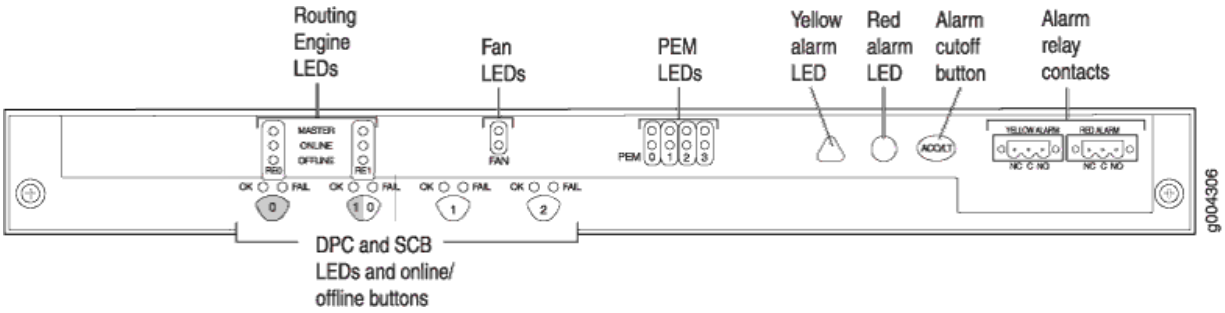
SEE ALSO

- MX480 DPC Port and Interface Numbering | **107**
- MX480 MIC Port and Interface Numbering | **139**
- MX480 PIC Port and Interface Numbering | **121**
- *MX Series Router Interface Names*

MX480 Craft Interface Description

The craft interface allows you to view status and troubleshooting information at a glance and to perform many system control functions. It is hot-insertable and hot-removable. The craft interface is located on the front of the router above the card cage and contains LEDs for the router components, the alarm relay contacts, and alarm cutoff button. See Figure 4 on page 13.

Figure 4: Front Panel of the Craft Interface



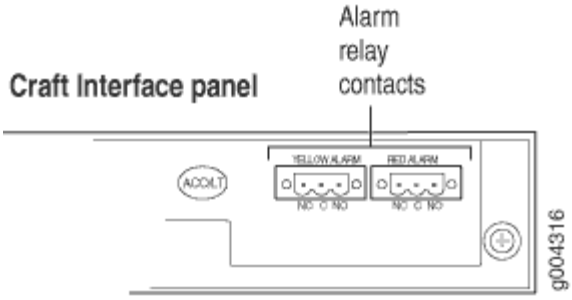
NOTE: At least one SCB must be installed in the router for the craft interface to obtain power.

Alarm Relay Contacts on the MX480 Craft Interface

The craft interface has two alarm relay contacts for connecting the router to external alarm devices (see Figure 5 on page 14). 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 5: Alarm Relay Contacts



Alarm LEDs and Alarm Cutoff/Lamp Test Button on the MX480 Craft Interface

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 4 on page 14 describes the alarm LEDs and alarm cutoff button in more detail.

Table 4: 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.

Table 4: Alarm LEDs and Alarm Cutoff/Lamp Test Button *(Continued)*

Shape	Color	State	Description
	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.

MX480 Component LEDs on the Craft Interface

IN THIS SECTION

- Host Subsystem LEDs on the MX480 Craft Interface | **15**
- Power Supply LEDs on the MX480 Craft Interface | **16**
- DPC and MPC LEDs on the MX480 Craft Interface | **16**
- FPC LEDs on the MX480 Craft Interface | **17**
- SCB LEDs on the MX480 Craft Interface | **17**
- Fan LEDs on the MX480 Craft Interface | **18**

Host Subsystem LEDs on the MX480 Craft Interface

Each host subsystem has three LEDs, located on the upper left of the craft interface, that indicate its status. The LEDs labeled **RE0** show the status of the Routing Engine in slot **0** and the SCB in slot **0**. The LEDs labeled **RE1** show the status of the Routing Engine and SCB in slot **1**. Table 5 on page 16 describes the functions of the host subsystem LEDs on the craft interface.

Table 5: 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.

Power Supply LEDs on the MX480 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 6 on page 16 describes the functions of the power supply LEDs on the craft interface.

Table 6: Power Supply LEDs on the Craft Interface

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

DPC and MPC LEDs on the MX480 Craft Interface

Each DPC or MPC has LEDs on the craft interface that indicate its status. The LEDs, labeled **0** through **5**, are located along the bottom of the craft interface. Table 7 on page 17 describes the functions of the LEDs.

Table 7: 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.

FPC LEDs on the MX480 Craft Interface

An FPC takes up two DPC slots when installed in an MX Series router. The LEDs, labeled **0** through **5**, are located along the bottom of the craft interface. The LED corresponds to the lowest DPC slot number in which the FPC is installed. Table 8 on page 17 describes the functions of the FPC LEDs.

Table 8: 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.

SCB LEDs on the MX480 Craft Interface

Each SCB has two LEDs on the craft interface that indicates its status. The SCB LEDs, labeled **0** and **1**, are located along the bottom of the craft interface. Table 9 on page 18 describes the functions of the SCB LEDs.

Table 9: 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.

Fan LEDs on the MX480 Craft Interface

The fan LEDs are located on the top left of the craft interface. Table 10 on page 18 describes the functions of the fan LEDs.

Table 10: Fan LEDs on the Craft Interface

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

MX480 Cable Management Brackets

The cable management brackets (see Figure 6 on page 19 and Figure 7 on page 20) consist of plastic dividers located on the left and right sides of each DPC, FPC, or MPC slot, and SCB slot. The cable

management brackets allow you to route the cables outside the router and away from the DPCs, MPCs, MICs, PICs, and SCBs.

Figure 6: Cable Management Brackets

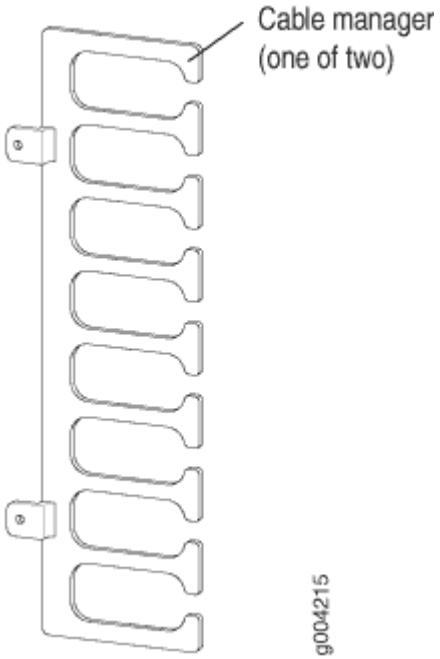
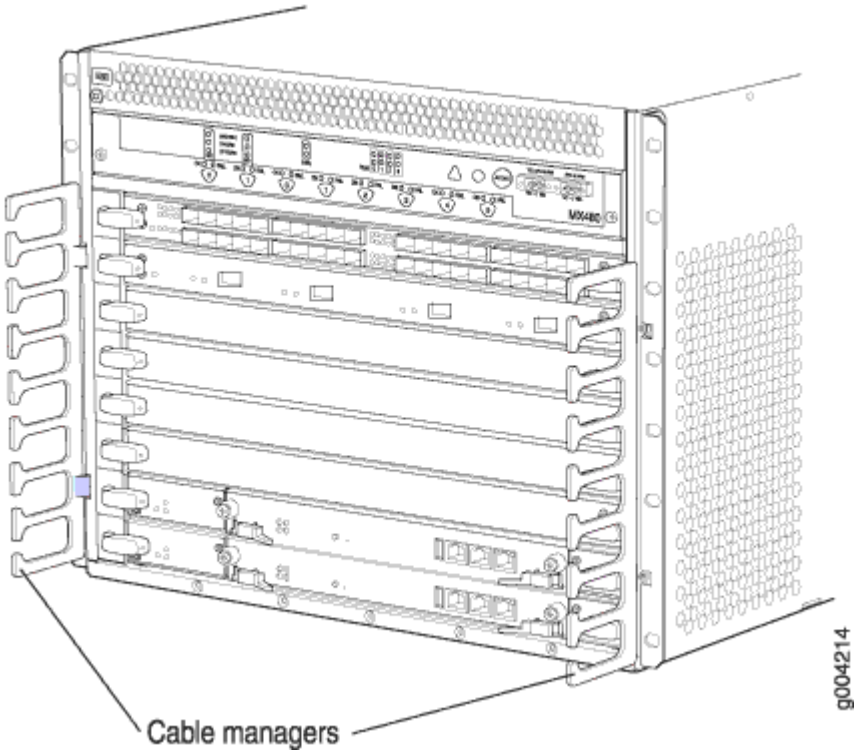


Figure 7: Cable Management Brackets Installed on the Router



SEE ALSO

Maintaining Cables That Connect to MX480 DPCs, MPCs, MICs, or PICs | **412**

Replacing the MX480 Cable Management Brackets | **306**

MX480 Cooling System

IN THIS SECTION

- MX480 Cooling System Description | **21**
- MX480 Fan LED | **23**

MX480 Cooling System Description

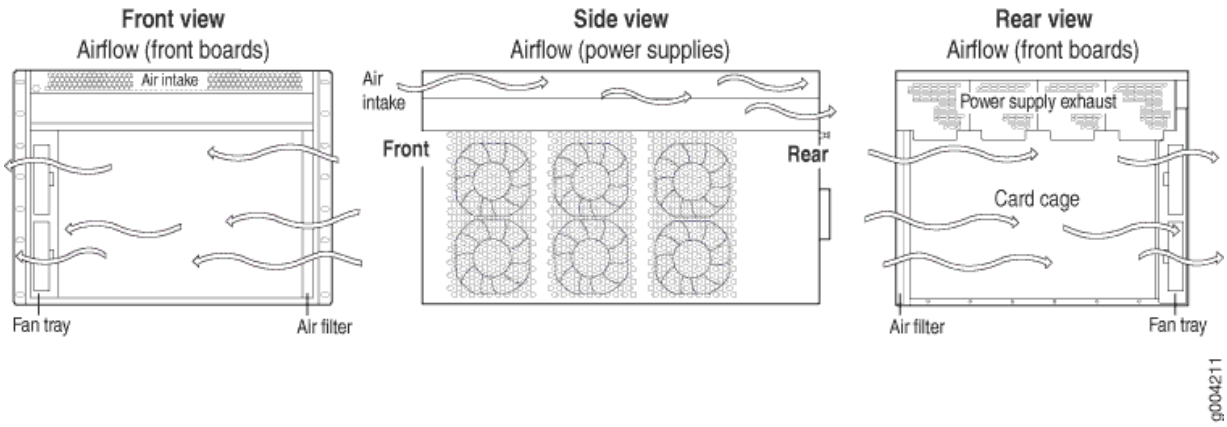
The cooling system consists of the following components:

- Fan tray
- Air filter

The cooling system components work together to keep all router components within the acceptable temperature range (see Figure 8 on page 21, Figure 9 on page 22, and Figure 10 on page 23). The router has one fan tray and one air filter that install vertically in the rear of the router. The fan tray contains six fans. The MX Series high-capacity fan trays satisfy cooling requirements for high-density DPCs and MPCs, and must be upgraded for proper cooling.

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

Figure 8: 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 power supply.

Figure 9: Fan Tray

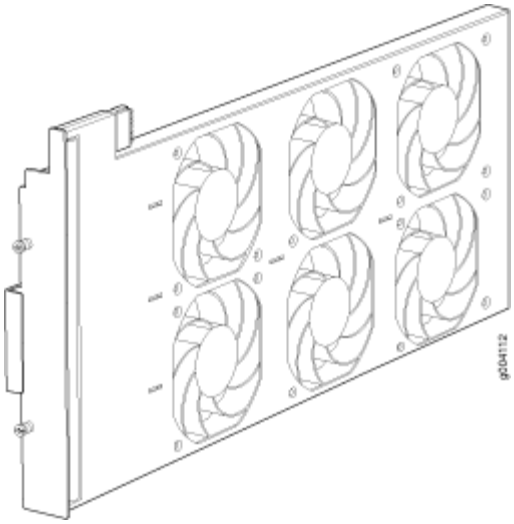
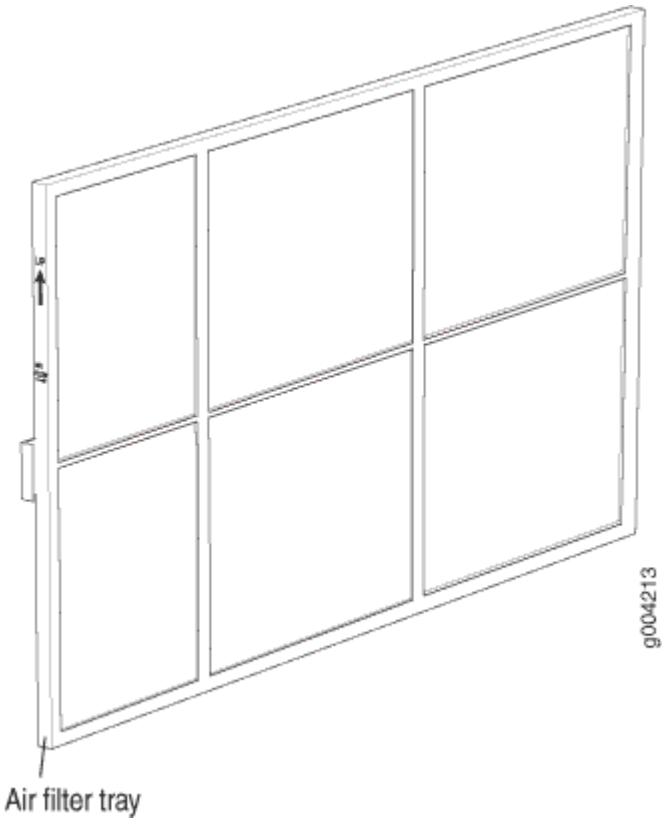


Figure 10: Air Filter



MX480 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 "Fan LED on the MX480 Craft Interface" on page 15.

SEE ALSO

Maintaining the MX480 Fan Tray | **312**

Troubleshooting the MX480 Cooling System | **463**

MX480 Air Deflector Kits

Optional air deflector kits are available that let you install the MX480 routers in a hot aisle/cold aisle ventilation environment. These kits convert the MX480 router from side-to-side ventilation into front-to-back ventilation. The air deflectors contain no additional fans, so they require no additional electrical power.

The air deflector kits consist of four main components: two intake/exhaust boxes and two side plenums. The two intake/exhaust boxes are identical to each other, as are the side plenums.

The intake/exhaust boxes are installed above and below the device to direct intake air from the air space in front of the device into the side plenum mounted on the intake side of the device. The intake air plenum directs air into the device, and the exhaust air plenum collects the exhaust air on the opposite side of the device. The exhaust plenum directs the exhausted air into the intake/exhaust boxes above and below the unit, where it is expelled into the air space behind the router.

The air deflector kit requires additional space around the device, increasing its overall height and width as described in Table 11 on page 24.

Table 11: MX480 Router and Air Deflector Dimensions

Specification	MX480 Router
Router height	8 U (14 in. or 35.6 cm)
Additional height required for air deflector kit	6 U (10.5 in. or 26.7 cm)
Total height of services gateway and air deflector kit	14 U (24.5 in. or 62.2 cm)
Router width	17.5 in. (44.5 cm)
Additional width required for air deflector kit	5.6 in. (14.2 cm) per side 11.2 in. (28.4 cm) total
Total width of router and air deflector kit	28.7 in. (72.9 cm)

See Figure 11 on page 25 and Table 12 on page 25 for the list of components that comprise the air deflector kit.

Figure 11: Components of the Air Deflector Kit

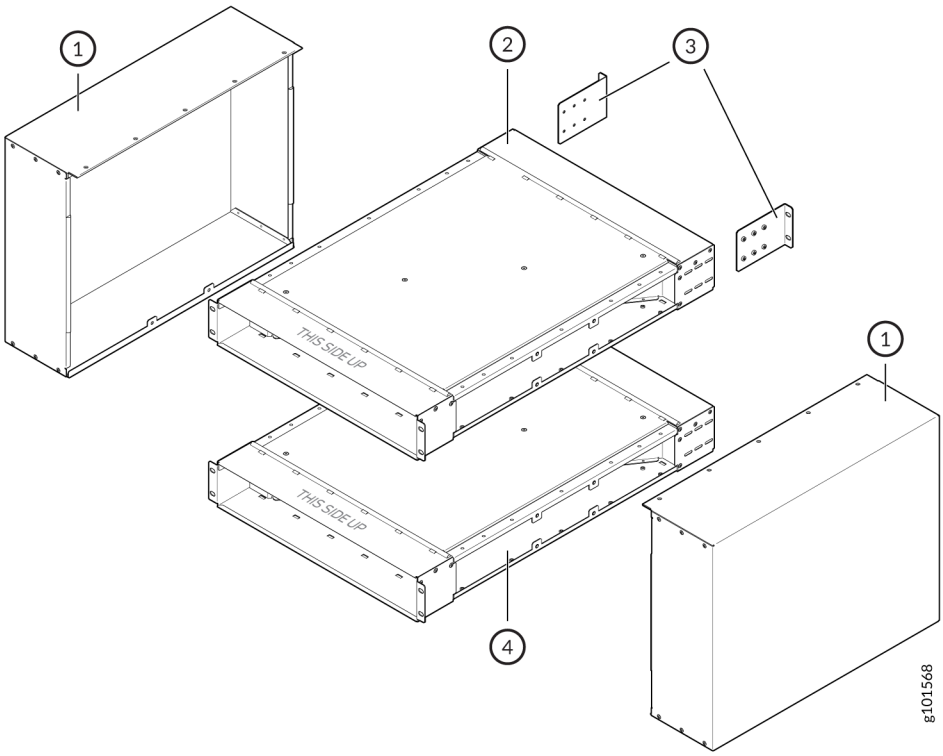
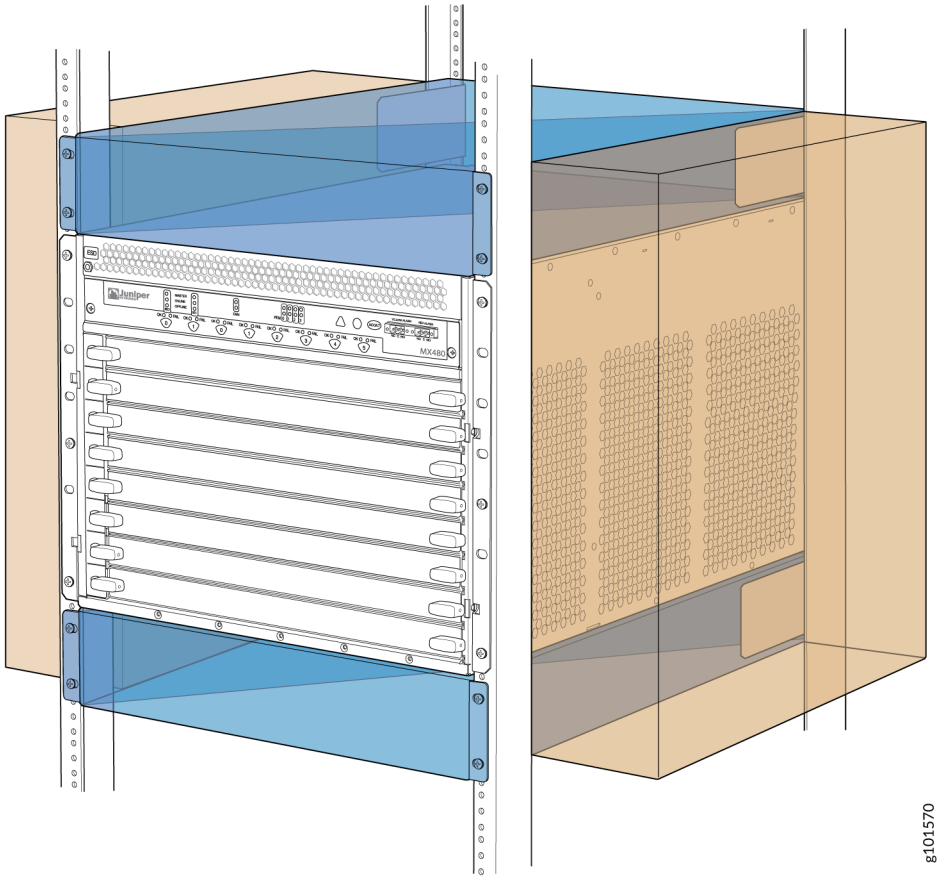


Table 12: Air Deflector Kit Components

Number	Component
1	Two side plenums (one for right and one for left)
2 and 4	Top plenum and bottom plenum
3	Rear mounting brackets

Figure 12 on page 26 shows the MX480 router installed in typical four-post mounting racks with the air deflector kit parts in place.

Figure 12: MX480 Router Air Deflector Kit



RELATED DOCUMENTATION

MX480 Chassis | 5

MX480 Power System Description

The MX480 router uses either AC or DC power supplies. The MX480 router is configurable with two, three, or four AC power supplies or two or four DC power supplies. The power supplies connect to the midplane, which distributes the different output voltages produced by the power supplies to the router components, depending on their voltage requirements. Each power supply is cooled by its own internal cooling system.

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

Redundant power supplies are hot-removable and hot-insertable, as described in "MX480 Field-Replaceable Units (FRUs)" on page 299.

CAUTION: When you remove a power supply from a router that uses a nonredundant power supply configuration, the router might shut down depending on your configuration.

NOTE:
Enhanced AC and DC power supplies are an upgrade for the MX480 router, and satisfy power requirements for higher-density DPCs. When upgrading to enhanced power supplies, always upgrade power supplies in adjacent slots.

NOTE: Routers configured with DC power supplies are shipped with a blank panel installed over the power distribution modules. Routers configured with AC power supplies have no blank panel.

RELATED DOCUMENTATION

- Connecting Power to an AC-Powered MX480 Router with Normal-Capacity Power Supplies | 273
- Connecting Power to a DC-Powered MX480 Router with Normal Capacity Power Supplies | 276
- Replacing an MX480 AC Power Supply | 420
- MX480 Chassis Grounding Specifications | 198
- MX480 Router Grounding Cable Lug Specifications

MX480 AC Power System

IN THIS SECTION

- MX480 AC Power Supply Description | 28
- MX480 AC Power Supply LEDs | 30
- AC Electrical Specifications for the MX480 Router | 31
- AC Power Circuit Breaker Requirements for the MX480 Router | 33
- AC Power Cord Specifications for the MX480 Router | 33
- Outstanding Issues with the MX480 Router | 36
- Errata with the MX480 Router Documentation | 37

MX480 AC Power Supply Description

IN THIS SECTION

- AC Power Supply Configurations | 30

Each AC power supply weighs approximately 5.0 lb (2.3 kg) and consists of one AC appliance inlet, an AC input switch, a fan, and LEDs to monitor the status of the power supply. Figure 13 on page 29 shows the power supply. For existing power supplies, each inlet requires a dedicated AC power feed and a dedicated 15 A (250 VAC) circuit breaker.

For high-capacity power supplies, each inlet requires a dedicated AC power feed and a dedicated 16.0 A @ 100 VAC or 16.0 A @ 200 VAC circuit breaker, or as required by local code.

The maximum inrush current for a high-capacity AC power supply is 49A at 264VAC.

Figure 13: AC Power Supply

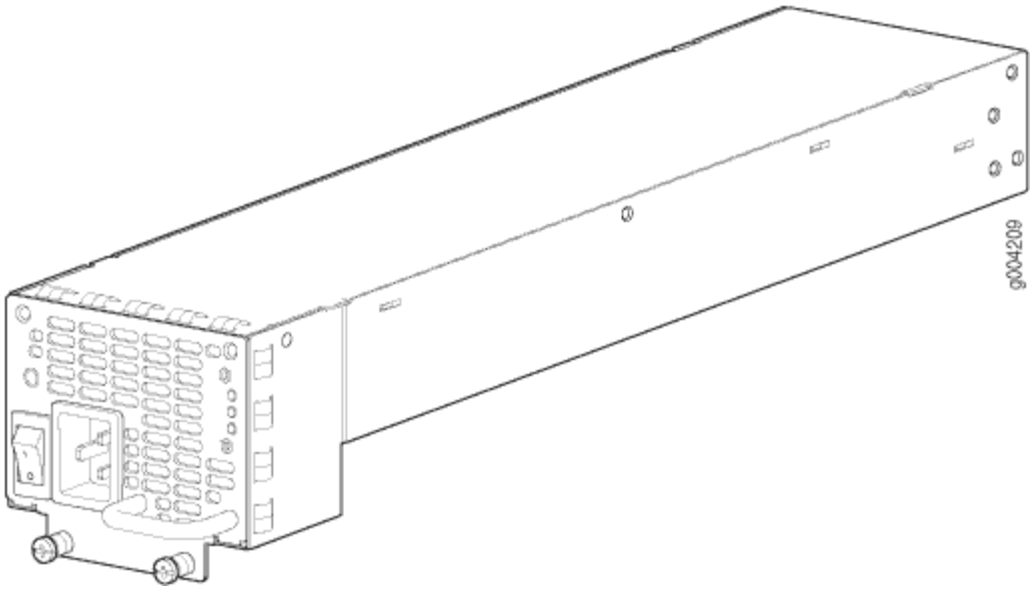
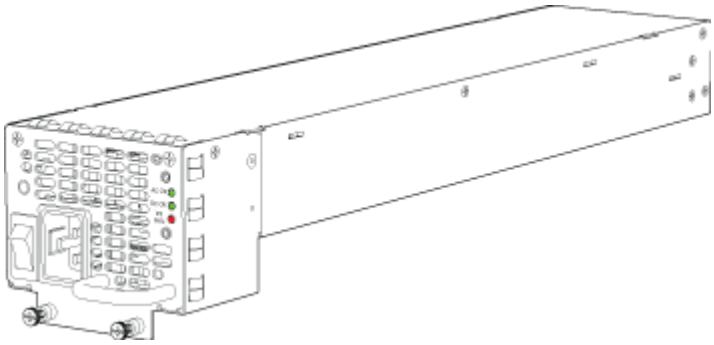


Figure 14: High-Capacity AC Power Supply



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

NOTE: You can mix the MX480 high-capacity and normal-capacity power supplies only during the PEM upgrade process. We do not recommend using this configuration in any other cases.

AC Power Supply Configurations

The MX480 high-capacity and normal-capacity power supplies each support either of the following AC power configurations:

- In the low-line (110 V) AC power configuration, the MX480 router contains three or four AC power supplies (see Figure 13 on page 29), located horizontally at the rear of the chassis in slots **PEM0** through **PEM3** (left to right). Each AC power supply provides power to all components in the router. When three power supplies are present, they share power almost equally within a fully populated system. Four AC power supplies provide full power redundancy. If one power supply fails or is removed, the remaining power supplies assume the entire electrical load without interruption. Three power supplies provide the maximum configuration with full power for as long as the router is operational. The low-line configuration requires three power supplies and the fourth power supply provides redundancy. With high-capacity power supplies, you must have a minimum of three power supplies installed in the router.

- In the high-line (220 V) AC power configuration, the MX480 router contains two or four AC power supplies (see Figure 13 on page 29), located horizontally at the rear of the chassis in slots **PEM0** through **PEM3** (left to right). In a high-line AC power configuration, each AC power supply provides power to all components in the router. When two or more power supplies are present, they share power almost equally within a fully populated system. Four AC power supplies provide full power redundancy. If one power supply fails or is removed, the remaining power supplies assume the entire electrical load without interruption. Two power supplies provide the maximum configuration with full power for as long as the router is operational. In the two-PEM high-line configuration, slots **PEM0** and **PEM1** or **PEM2** and **PEM3** are used. The high-line configuration requires two power supplies, with the third and fourth providing redundancy. With high-capacity power supplies, you must have a minimum of two power supplies installed in the router.

MX480 AC Power Supply LEDs

Each AC power supply faceplate contains three LEDs that indicate the status of the power supply (see Table 13 on page 31). 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 13: AC Power Supply LEDs

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

AC Electrical Specifications for the MX480 Router

Table 14 on page 31 lists the AC power supply electrical specifications; Table 15 on page 32 lists the AC power system specifications.

Table 14: AC Power Supply Electrical Specifications

Item	Specification
Normal-Capacity Power Supplies	
Maximum output power	1027 W (low line) 1590 W (high line)
AC input voltage	Operating range: 100 – 240 VAC (nominal)

Table 14: AC Power Supply Electrical Specifications *(Continued)*

Item	Specification
AC input line frequency	50 to 60 Hz (nominal)
AC input current rating	11.0 A @ 200 VAC or 14.5 A @ 110 VAC maximum
Efficiency **NOTE**: This value is at full load and nominal voltage.	85% (low line and high line)
High-Capacity Power Supplies	
Maximum output power	1167 W (low line) 2050 W (high line)
AC input voltage	Operating range: 100 – 240 VAC (nominal)
AC input line frequency	50 to 60 Hz (nominal)
AC input current rating	16 A @ 110 VAC maximum 15.1 A @ 200 VAC maximum
Efficiency **NOTE**: This value is at full load and nominal voltage.	84% (low line) 89% (high line)

Table 15: AC Power System Specifications

Item	Normal Capacity–Low Line	Normal-Capacity–High Line	High-Capacity–Low Line	High-Capacity–High Line
Redundancy	3+1	2+2	3+1	2+2

Table 15: AC Power System Specifications *(Continued)*

Item	Normal Capacity–Low Line	Normal-Capacity–High Line	High-Capacity–Low Line	High-Capacity–High Line
Output power (maximum) per power supply	1027 W	3200 W	1167 W	2050 W
Output power (maximum) per system	3081 W	3200 W	3501 W	4100 W

SEE ALSO

Calculating Power Requirements for MX480 Routers | **219**

AC Power Circuit Breaker Requirements for the MX480 Router

Each AC power supply has a single AC appliance inlet located on the power supply that requires a dedicated AC power feed. We recommend that you use a customer site circuit breaker rated for 15 A (250 VAC) minimum for each AC power supply, or as required by local code. Doing so enables you to operate the router in any configuration without upgrading the power infrastructure.

AC Power Cord Specifications for the MX480 Router

Each AC power supply has a single AC appliance inlet located on the power supply that requires a dedicated AC power feed. Most sites distribute power through a main conduit that leads to frame-mounted power distribution panels, one of which can be located at the top of the rack that houses the router. An AC power cord connects each power supply to the power distribution panel.

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.

Table 16 on page 34 provides specifications and Figure 15 on page 35 depicts the plug on the AC power cord provided for each country or region.

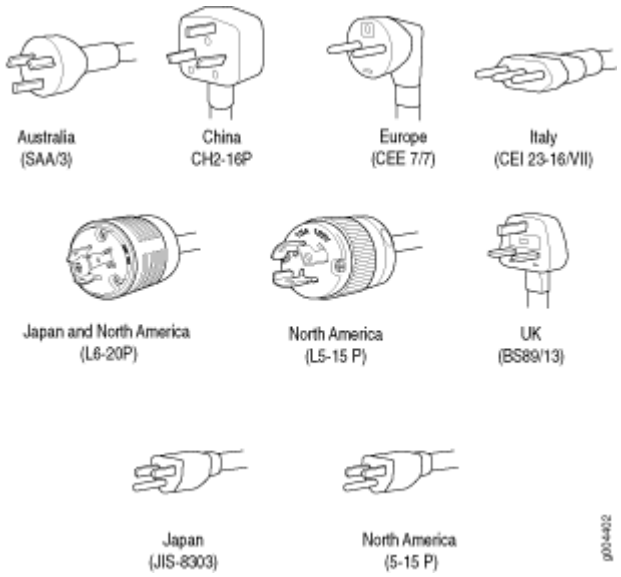
Table 16: AC Power Cord Specifications

Country	Model Number	Electrical Specification	Plug Type
Australia	CBL-M-PWR-RA-AU	240 VAC, 50 Hz AC	SAA/3/15
China	CBL-M-PWR-RA-CH	220 VAC, 50 Hz AC	CH2-16P
Europe (except Denmark, Italy, Switzerland, and United Kingdom)	CBL-M-PWR-RA-EU	220 or 230 VAC, 50 Hz AC	CEE 7/7
Italy	CBL-M-PWR-RA-IT	230 VAC, 50 Hz AC	CEI 23-16/VII
Japan	CBL-PWR-RA-JP15	125 VAC, 50 or 60 Hz AC	JIS 8303
	CBL-M-PWR-RA-JP	220 VAC, 50 or 60 Hz AC	NEMA L6-20P
North America	CBL-PWR-RA-US15	125 VAC, 60 Hz AC	NEMA 5-15P
	CBL-PWR-RA-TWLK-US15	125 VAC, 60 Hz AC	NEMA L5-15P
	CBL-M-PWR-RA-US	250 VAC, 60 Hz AC	NEMA 6-20
	CBL-M-PWR-RA-TWLK-US	250 VAC, 60 Hz AC	NEMA L6-20P

Table 16: AC Power Cord Specifications *(Continued)*

Country	Model Number	Electrical Specification	Plug Type
United Kingdom	CBL-M-PWR-RA-UK	240 VAC, 50 Hz AC	BS89/13

Figure 15: AC Plug Types



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

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。

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



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

SEE ALSO

Connecting Power to an AC-Powered MX480 Router with Normal-Capacity Power Supplies | 273

Replacing an MX480 AC Power Supply Cord | 423

Calculating Power Requirements for MX480 Routers | 219

Outstanding Issues with the MX480 Router

This topic lists outstanding hardware issues with the MX480 router. For information about software issues, see the Junos OS Release Notes.

- In Junos OS Release 10.0R2, if a third AC supply is inserted in an empty slot (even though the power supply is turned off and the AC cord is not plugged in), the operational power supplies' output voltage reading in the Junos OS can show an inaccurate number (60-61V instead of 57V) under some conditions, such as when the load is nearly 100% and the operating temperature exceeds 40C.
- There is an input mode switch on each MX480 DC high capacity power supply, covered by a small plate. The input mode switch tells the system what capacity feed is connected (60A or 70A), which in turn is used for power inventory management When the input mode switch is set to '0' (zero): expect 60A feeds, with a voltage range of -39V to -72VDC. When the input mode switch is set to '1' (one), expect 70A feeds or 60A feed with minimum voltage range 42V and up. The default setting is 1

In Junos OS Releases 10.0R3, 10.1R2, and 10.2R1, the MX480 DC high capacity power supply input mode switch is not operating as expected, though this has no effect on the power supply operations, it will generate alarms incorrectly. [PR532230]

> **NOTE**:
>
> - All supplies should have the same feed setting.
> - Correct usage of the feed setting is required for all supplies in order to get the desired power inventory management.

- Juniper Networks strongly recommends that you install Junos OS Release 8.4R2 or later before deploying the MX480 router into service.
- The XFP cages and optics on the MX480 router 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. [PR/98055]
- Do not mix AC and DC power supplies on an MX480 router. Mixing of AC supplies and DC supplies may damage your chassis. [PR/233340]

Errata with the MX480 Router Documentation

This topic lists outstanding documentation issues:

- The shut-down voltage and start-up voltages as stated in the following note in the MX480 hardware guides and MX480 Quick Start are not correct under all circumstances: [PR/273771]

  > **NOTE**: If the input voltage from the DC power source drops below –36.5 to –38.5 VDC, the router automatically shuts down. During automatic shutdown, the circuit remains active. When the input voltage returns to –40.0 to –41.0 VDC, the router automatically starts up again and the system returns to normal operation within 30 minutes. No operator intervention is required.

- For the cooling system to function properly, the airflow around the chassis must be unrestricted. Allow at least 8 in. (20.3 cm) of clearance between side-cooled routers. Allow 5.5 in. (14 cm) between the side of the chassis and any non-heat-producing surface such as a wall. [PR/258887]

- When installing the router without a mechanical lift, remove and reinstall components from the chassis, first from the rear and then from the front. Components should be removed and reinstalled in the following order: power supplies, fan tray, SCBs, and DPCs.[PR/265034]
- Replace the air filter, located at the left rear of the router, every 6 months for optimum cooling system performance.
- Two threaded inserts (PEM nuts) are provided on the upper rear of the chassis for connecting the router to earth ground. The grounding points fit UNC 1/4–20 screws (American).
- The mounting shelf should be installed on the back of the rail as described in the MX480 Universal Routing Platform Hardware Guide.
- After installing a DC power cable or AC power cord, route the power cable or power cord along the cable restraint towards the left or right corner of the chassis. If needed, thread plastic cable ties, which you must provide, through the openings on the cable restraint to hold the power cord or cables in place.
- Table 17 on page 38 describes the functions of the host subsystem **OFFLINE** LED.

Table 17: Host Subsystem OFFLINE LED

Label	Color	State	Description
OFFLINE	Red	On steadily	Host is installed but the Routing Engine is offline.
		Off	Host is not installed.

MX480 DC Power System

IN THIS SECTION

- MX480 DC Power Supply Description | **39**
- MX480 DC Power Supply LEDs | **41**
- DC Power Supply Electrical Specifications for MX240 and MX480 | **42**
- DC Power Circuit Breaker Requirements for the MX480 Router | **44**

- DC Power Source Cabling for the MX480 Router | **45**
- DC Power Cable Specifications for the MX480 Router | **46**

MX480 DC Power Supply Description

IN THIS SECTION

- DC Power Supply Configurations | **40**

Each DC power supply weighs approximately 3.8 lb (1.7 kg) and consists of one DC input (–48 VDC and return), one 40 A (–48 VDC) circuit breaker, a fan, and LEDs to monitor the status of the power supply. Figure 16 on page 40 shows the power supply. Each DC power supply has a single DC input (–48 VDC and return) that requires a dedicated circuit breaker.

For high capacity power supplies, we recommend that you provision 60 A or 70 A per feed, depending on the selected DIP switch setting.

Figure 16: DC Power Supply

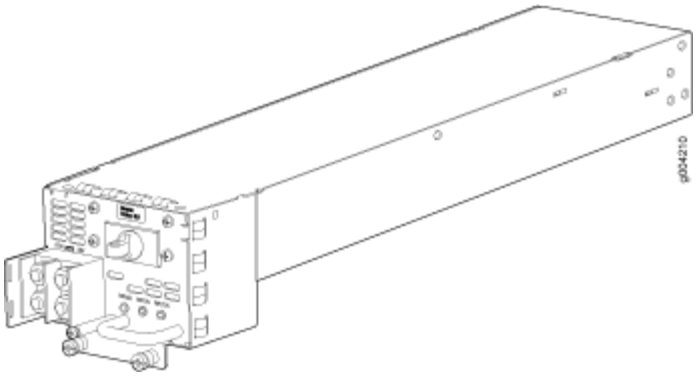
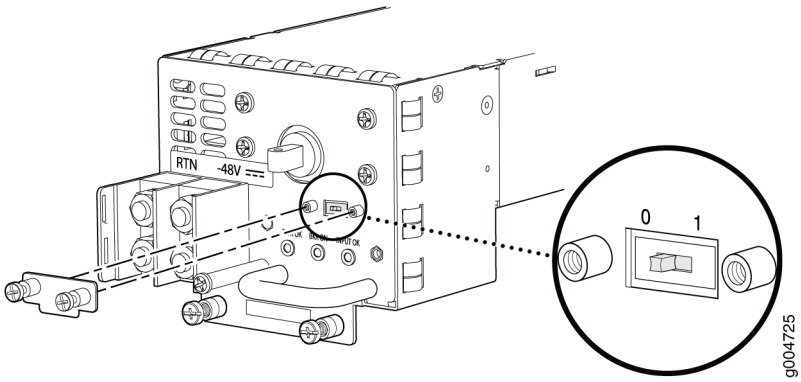


Figure 17: High-Capacity DC Power Supply



NOTE: You can mix the MX480 high-capacity and normal-capacity power supplies only during the PEM upgrade process. We do not recommend using this configuration in any other cases.

DC Power Supply Configurations

In the DC power configuration, the MX480 router contains either two or four DC power supplies (see Figure 16 on page 40) located at the 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.

Four power supplies provide full redundancy. If a DC power supply in a redundant configuration is removed or fails, its redundant power supply takes over without interruption. The DC power supply in

PEM2 serves as redundant to the DC power supply in slot **PEM0**, and the DC power supply in **PEM3** serves as redundant to the DC power supply in slot **PEM1**. If only two DC power supplies are installed, they must be installed in slots **PEM0** and **PEM1** or in slots **PEM2** and **PEM3**.

Table 18 on page 41 shows the components that are powered by each DC power supply slot. It applies to existing and high-capacity power supplies.

Table 18: Power Supply Redundancy and Power Distribution

DC Power Supply Slot	Power Supply Provides Power to the Following Components
PEM0	Fan tray, DPC slots **0** and **1**, and SCB slots **0** and **1**
PEM1	Fan tray and DPC slots **2** through **5**
PEM2	Fan tray, DPC slots **0** and **1**, and SCB slots **0** and **1**
PEM3	Fan tray and DPC slots **2** through **5**

MX480 DC Power Supply LEDs

Each DC power supply faceplate contains three LEDs that indicate the status of the power supply (see Table 19 on page 41). 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.

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

Table 19: 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.

Table 19: DC Power Supply LEDs *(Continued)*

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

DC Power Supply Electrical Specifications for MX240 and MX480

Table 20 on page 42 lists the DC power supply electrical specifications. Table 21 on page 44 lists the DC power system specifications.

Table 20: Power Supply Electrical Specifications

Item	Specification
Normal-Capacity Power Supplies	
Maximum output power	1600 W
DC input current rating	33.3 A @ –48 V nominal operating voltage

Table 20: Power Supply Electrical Specifications *(Continued)*

Item	Specification	
Maximum Input Current	40 A	
DC input voltage	Operating Range: –40.5 VDC to –72 VDC Nominal: –48 VDC	
Efficiency **NOTE**: This value is at full load and nominal voltage.	~98%	
Internal Circuit Breaker	40 A	
High-Capacity Power Supplies		
Maximum Input Current	60 A (DIP=0)	70 A (DIP=1)
Maximum output power	2240 W	2440 W
DC input current rating	50 A @ -48 VDC normal operating voltage	54.2 A @ -48 VDC normal operating voltage
DC input voltage	Operating Range: –40.5 VDC to –72 VDC Nominal: –48 VDC	
Efficiency **NOTE**: This value is at full load and nominal voltage.	~98%	

Table 21: Power System Specifications

Item	Normal-Capacity	High-Capacity	
Redundancy	2+2	1+1	
Output power (maximum) per supply	1600 W	60 A (DIP=0)	70 A (DIP=1)
		2240 W	2440 W
Output power (maximum) per system	3200 W	2240 W	2240 W

SEE ALSO

Calculating Power Requirements for MX480 Routers | 219

DC Power Circuit Breaker Requirements for the MX480 Router

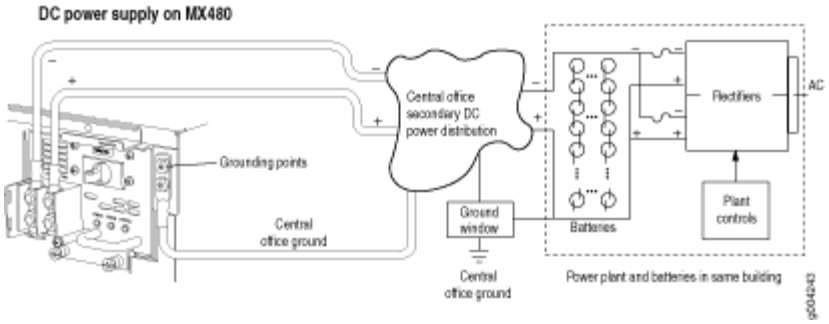
Each DC power supply has a single DC input (–48 VDC and return) that requires a dedicated circuit breaker. If you plan to operate a maximally configured DC-powered router with normal-capacity power supplies, we recommend that you use a dedicated customer site circuit breaker rated for 40 A (–48 VDC) minimum, or as required by local code. If you plan to operate a maximally configured DC-powered router with high-capacity power supplies, we recommend that you use a circuit breaker rated for 70 A (–48 VDC), or as required by local code.

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.

DC Power Source Cabling for the MX480 Router

Figure 18 on page 45 shows a typical DC source cabling arrangement.

Figure 18: Typical DC Source Cabling to the Router



The DC power supplies in **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.

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.

SEE ALSO

In Case of an Electrical Accident

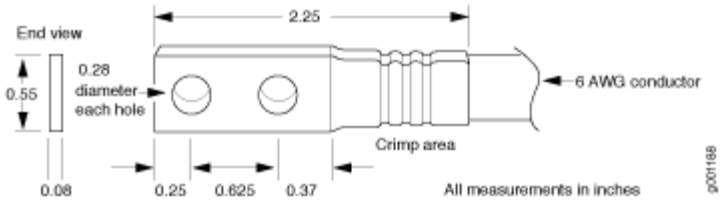
Connecting Power to a DC-Powered MX480 Router with Normal Capacity Power Supplies | **276**

Replacing an MX480 DC Power Supply Cable | **430**

DC Power Cable Specifications for the MX480 Router

DC Power Cable Lug Specifications—The accessory box shipped with the router includes the cable lugs that attach to the terminal studs of each power supply (see Figure 19 on page 46).

Figure 19: DC Power Cable Lug



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

NOTE: The same cable lug is used for the grounding cable.

DC Power Cable Specifications—Table 22 on page 46 summarizes the specifications for the power cables, which you must supply.

Table 22: DC Power Cable Specifications

Cable Type	Quantity and Specification
Power	Eight 6-AWG (13.3 mm^2), minimum 60°C wire, or as required by the local code

MX480 Host Subsystem

IN THIS SECTION

- MX480 Host Subsystem Description | 47
- MX480 Host Subsystem LEDs | 48
- MX480 Midplane Description | 48
- MX480 Routing Engine Description | 50
- MX480 Routing Engine LEDs | 53
- RE-S-1800 Routing Engine Description | 56
- RE-S-1800 Routing Engine LEDs | 59
- RE-S-X6-64G Routing Engine Description | 60
- RE-S-X6-64G Routing Engine LEDs | 62
- RE-S-X6-128G Routing Engine Description | 63
- RE-S-X6-128G-K Routing Engine Description | 67
- Routing Engine Specifications | 70
- Supported Routing Engines by Router | 79

MX480 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.

SEE ALSO

Maintaining the MX480 Host Subsystem | 318

Taking an MX480 Host Subsystem Offline

MX480 Host Subsystem LEDs

Each host subsystem has three LEDs that display its status. The host subsystem LEDs are located on the upper left of the craft interface. For more information, see "Host Subsystem LEDs on the MX480 Craft Interface" on page 15.

MX480 Midplane Description

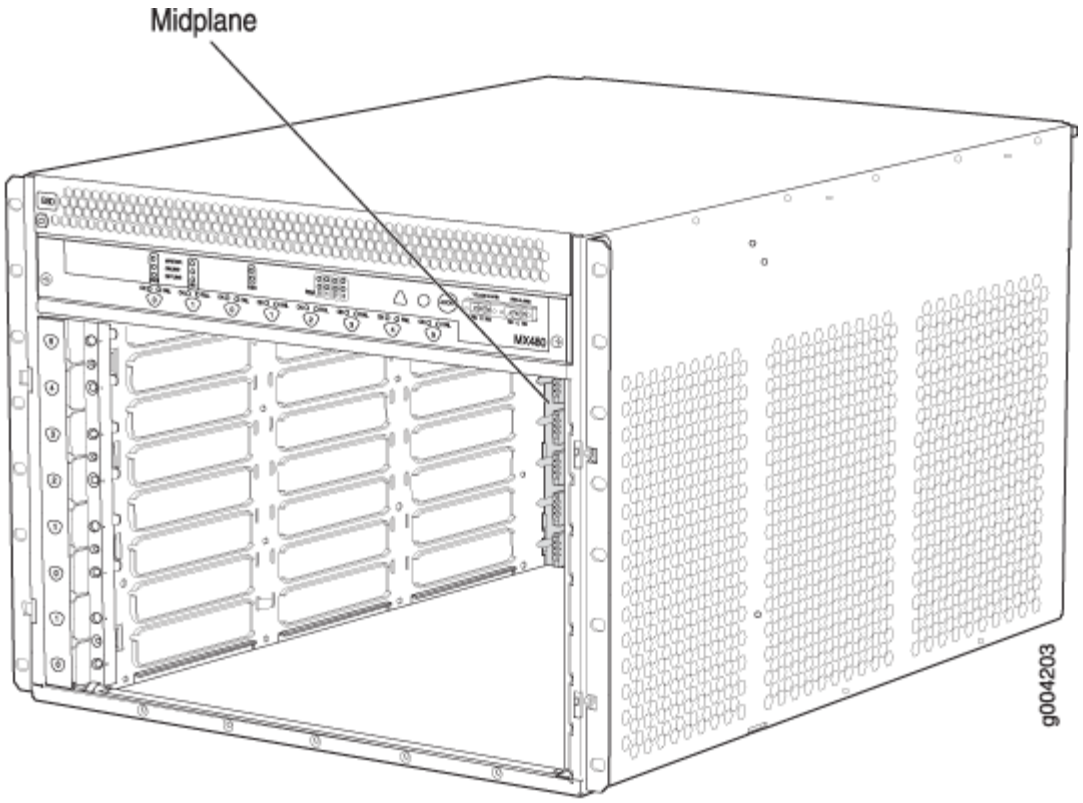
The midplane is located toward the rear of the chassis and forms the rear of the card cage (see Figure 20 on page 49). The line cards and SCBs install into the midplane from the front of the chassis, and the power supplies install into the midplane from the rear of the chassis. The cooling system components 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 20: Midplane



SEE ALSO

MX480 Router Description | 2

MX480 Chassis Description | 6

MX480 Dense Port Concentrator (DPC) Description | 104

MX480 Modular Port Concentrator (MPC) Description | 157

MX-Series Switch Control Board (SCB) Description | 187

MX480 Flexible PIC Concentrator (FPC) Description | 116

MX480 Power System Description | 27

MX480 Routing Engine Description

IN THIS SECTION

- Routing Engine Components | 52
- Routing Engine Interface Ports | 52
- Routing Engine Boot Sequence | 52

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

You can install one or two Routing Engines in the router. The Routing Engines install into the front of the chassis in horizontal slots in 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.

The Routing Engines are hot-pluggable. Each Routing Engine must be installed directly into an SCB. A USB port on the Routing Engine accepts a USB memory card that allows you to load Junos OS. Figure

21 on page 51 shows RE-S-1800 Routing Engine and Figure 22 on page 51 shows the RE-S-X6-64G Routing Engine.

Figure 21: RE-S-1800 Routing Engine

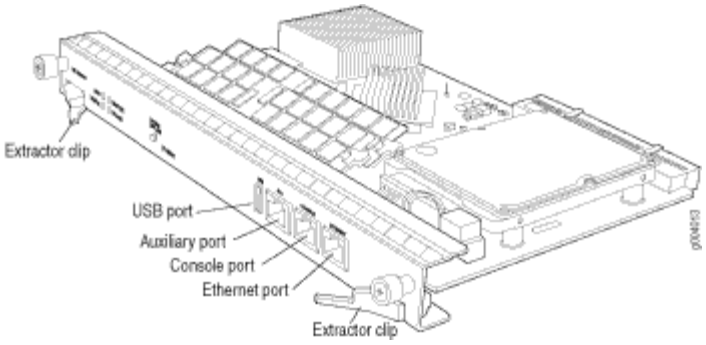
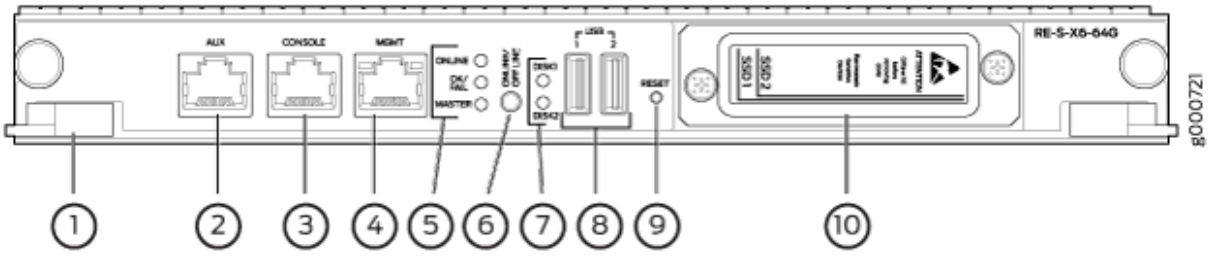
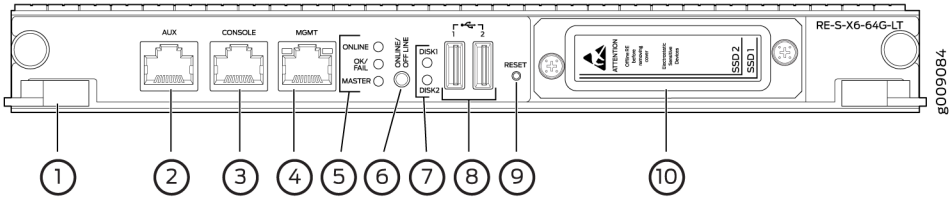


Figure 22: RE-S-X6-64G Routing Engine Front View



1– Extractor clips	6– **ONLINE/OFFLINE** Button
2– Auxiliary port (**AUX**)	7– SSD LEDs—**DISK1** and **DISK2**
3– Console port (**Con**)	8– Ports—**USB1** and **USB2**
4– Management port (**MGMT**)	9– **RESET** Button
5– LEDs—**ONLINE, OK/FAIL,** and **MASTER**	10– SSD card slot cover

Figure 23: RE-S-X6-64G-LT Routing Engine Front View



1– Extractor clips	6– **ONLINE/OFFLINE** Button
2– Auxiliary port (**AUX**)	7– SSD LEDs—**DISK1** and **DISK2**
3– Console port (**Con**)	8– Ports—**USB1** and **USB2**
4– Management port (**MGMT**)	9– **RESET** Button
5– LEDs—**ONLINE, OK/FAIL,** and **MASTER**	10– SSD card slot cover

Routing Engine Components

NOTE: For specific information about Routing Engine components (for example, the amount of DRAM), issue the `show vmhost hardware` command.

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 on the left indicates speed—green for 1000-Mbps, yellow for 100-Mbps and when the LED is dark, it indicates 10-Mbps speed. The LED on the right indicates activity—flashing green when packets are passing through the port.

Routing Engine Boot Sequence

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

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

Booting in a RE-S-X6-64G Routing Engine follows this sequence—the USB device, SSD1, SSD2, and LAN. SSD1 is the primary boot device. Boot sequence is tried twice for SSD1 and SSD2.

If the Routing Engines are configured for *graceful switchover*, the backup Routing Engine automatically synchronizes its configuration and state with the primary Routing Engine. Any update to the primary Routing Engine state is replicated on the backup Routing Engine. If the backup Routing Engine assumes primary role, packet forwarding continues through the router without interruption. For more information about graceful switchover, see the Junos OS Administration Library for Routing Devices.

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

SEE ALSO

MX480 Router Description | 2

MX480 Routing Engine LEDs | 53

MX480 Host Subsystem Description | 47

MX-Series Switch Control Board (SCB) Description

MX480 Routing Engine LEDs

IN THIS SECTION

- Routing Engine LEDs (RE-S-X6-64G) | 55

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 23 on page 54 and Table 24 on page 55 describe the functions of the Routing Engine LEDs.

Figure 24: RE-S-1800 Routing Engine

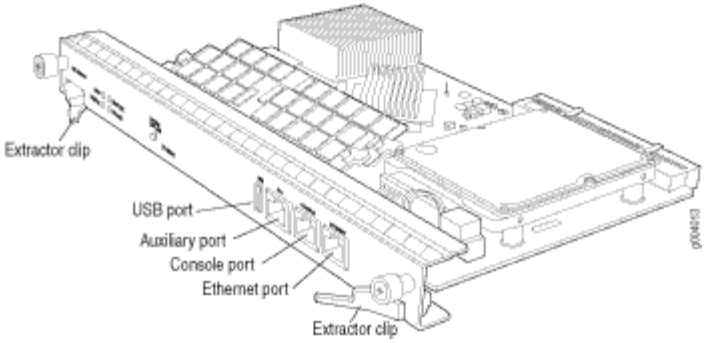
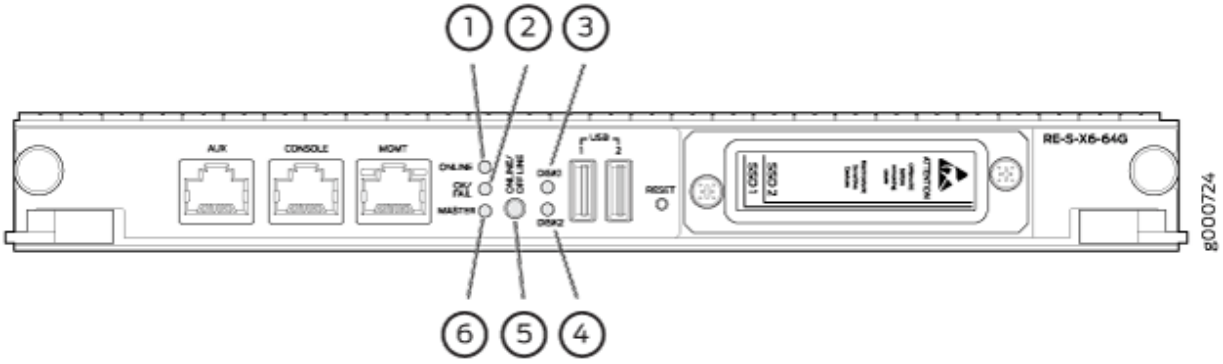


Table 23: RE-S-1800 Routing Engine LEDs

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.

Routing Engine LEDs (RE-S-X6-64G)

Figure 25: RE-S-X6-64G Routing Engine LEDs



1– **ONLINE** LED	4– **DISK2** LED
2– **OK/FAIL** LED	5– **ONLINE/OFFLINE** Button
3– **DISK1** LED	6– **MASTER** LED

Table 24: Routing Engine LEDs (RE-S-X6-64G)

Label	Color	State	Description
ONLINE	Green	Blinking slowly	Routing Engine is in the process of booting BIOS, and the host OS.
		Blinking rapidly	Routing Engine is in the process of booting Junos OS.
	-	Off	Routing Engine is not online or not functioning normally
DISK1	Green	Blinking	Indicates presence of the disk activity.
	-	Off	There is no disk activity.
DISK2	Green	Blinking	Indicates presence of the disk activity.
	-	Off	There is no disk activity.

Table 24: Routing Engine LEDs (RE-S-X6-64G) *(Continued)*

Label	Color	State	Description
OK/FAIL	Green	On steadily	Routing Engine is powering up.
	Yellow	On steadily	Routing Engine is not powering up indicating failure.
MASTER	Blue	On steadily	This Routing Engine is the Primary Routing Engine.

SEE ALSO

Replacing an MX480 Routing Engine | 322

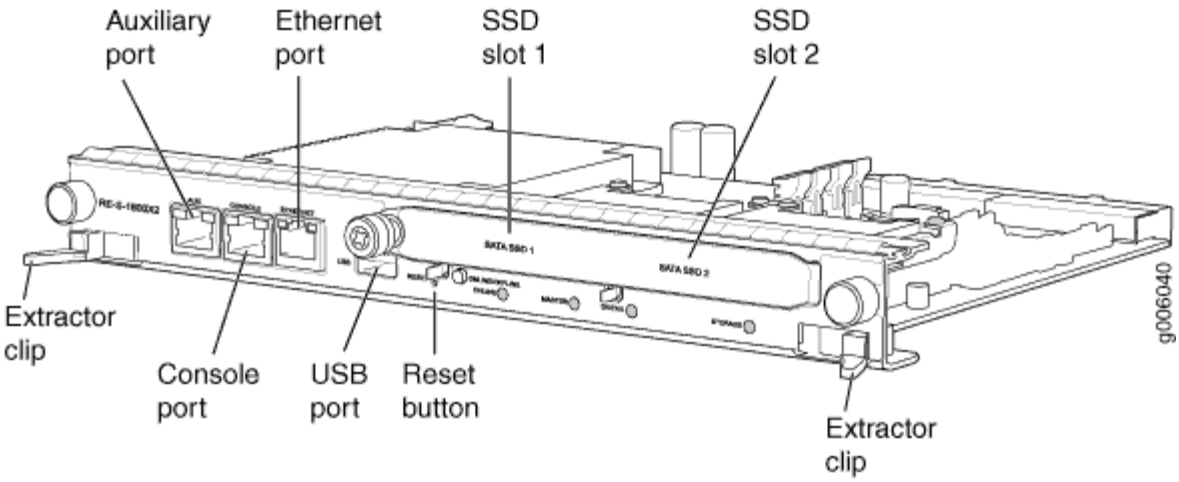
RE-S-1800 Routing Engine Description

IN THIS SECTION

- RE-S-1800 Routing Engine Components | 57
- RE-S-1800 Routing Engine LEDs | 58
- RE-S-1800 Routing Engine Boot Sequence | 58

Figure 26 on page 57 shows RE-S-1800 routing engine.

Figure 26: RE-S-1800 Front View



RE-S-1800 Routing Engine Components

Each Routing Engine consists of the following components:

- CPU—Runs Junos OS to maintain the router's routing tables and routing protocols..
- DRAM—Provides storage for the routing and forwarding tables and for other Routing Engine processes.
- USB port—Provides a removable media interface through which you can install Junos OS manually. Junos OS supports USB version 1.0.
- CompactFlash card—Provides primary storage for software images, configuration files, and microcode. The CompactFlash card is fixed and is inaccessible from outside the router.
- Solid-state Drive (SSD)—Provides secondary storage for log files, memory dumps, and rebooting the system if the CompactFlash card fails.
- Interface ports—The **AUX**, **CONSOLE**, and **ETHERNET** provide access to management devices. Each Routing Engine has one 10/100/1000-Mbps Ethernet port for connecting to a management network, and two asynchronous serial ports—one for connecting to a console and one for connecting to a modem or other auxiliary device.
- EEPROM—Stores the serial number of the Routing Engine.
- **RESET** button—Reboots the Routing Engine when pressed.

- **ONLINE/OFFLINE** button—Takes the Routing Engine online or offline when pressed.
- Extractor clips—Used for inserting and extracting the Routing Engine.
- Captive screws—Secure the Routing Engine in place.

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

RE-S-1800 Routing Engine LEDs

Each Routing Engine has four LEDs that indicate its status. The LEDs, labeled **MASTER**, **STORAGE**, **ONLINE**, and **OK/FAIL**, are located directly on the faceplate of the Routing Engine. Table 25 on page 58 describes the functions of the Routing Engine LEDs.

Table 25: Routing Engine LEDs

Label	Color	State	Description
MASTER	Blue	On steadily	Routing Engine is the Primary.
STORAGE	Green	Blinking	Indicates activity on the SSD or Compact Flash.
ONLINE	Green	Blinking	Routing Engine is transitioning online.
		On steadily	Routing Engine is functioning normally.
OK/FAIL	Red	On steadily	Routing Engine has failed.

RE-S-1800 Routing Engine Boot Sequence

The router is shipped with Junos OS preinstalled on the Routing Engine. There are three copies of software:

- One copy on the CompactFlash card in the Routing Engine.
- One copy on the hard disk in the Routing Engine.
- One copy on a USB flash drive that can be inserted into the slot on the Routing Engine faceplate.

The Routing Engine boots from the storage media in this order: the USB device (if present), then the CompactFlash card, then the Solid State Disk (SSD), then the LAN. Normally, the router boots from the copy of the software on the CompactFlash card.

SEE ALSO

- *RJ-45 Connector Pinouts for MX Series Routing Engine AUX and CONSOLE Ports*
- *RJ-45 Connector Pinouts for an MX Series Routing Engine ETHERNET Port*
- *Replacing an MX960 Routing Engine*
- *Supported Routing Engines by Router*

RE-S-1800 Routing Engine LEDs

Each Routing Engine has four LEDs that indicate its status. The LEDs, labeled **MASTER**, **STORAGE**, **ONLINE**, and **OK/FAIL**, are located directly on the faceplate of the Routing Engine. Table 26 on page 59 describes the functions of the Routing Engine LEDs.

Table 26: Routing Engine LEDs

Label	Color	State	Description
MASTER	Blue	On steadily	Routing Engine is the Primary.
STORAGE	Green	Blinking	Indicates activity on the SSD or Compact Flash.
ONLINE	Green	Blinking	Routing Engine is transitioning online.
		On steadily	Routing Engine is functioning normally.
OK/FAIL	Red	On steadily	Routing Engine has failed.

SEE ALSO

- *MX240 Routing Engine Description*

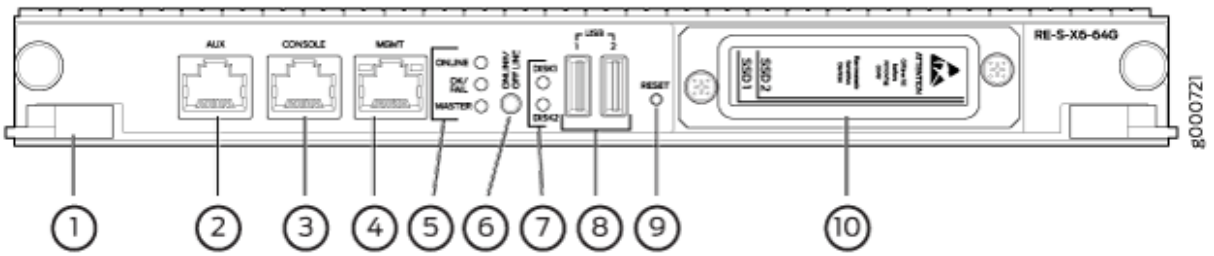
RE-S-X6-64G Routing Engine Description

IN THIS SECTION

- RE-S-X6-64G Routing Engine Components | 60
- RE-S-X6-64G Routing Engine Boot Sequence | 61

Figure 27 on page 60 shows the Routing Engine.

Figure 27: RE-S-X6-64G Routing Engine Front View



1– Extractor clips	6– **ONLINE/OFFLINE** button
2– Auxiliary port (**AUX**)	7– SSD LEDs—**DISK1** and **DISK2**
3– Console port (**CONSOLE**)	8– Ports—**USB1** and **USB2**
4– Management port (**MGMT**)	9– **RESET** button
5– LEDs—**ONLINE, OK/FAIL,** and **MASTER**	10– SSD card slot cover

RE-S-X6-64G Routing Engine Components

In routers with dual Routing Engines, both Routing Engines must be RE-S-X6-64G Routing Engines.

Each RE-S-X6-64G Routing Engine (shown in Figure 27 on page 60) consists of the following components:

- CPU—Runs Junos OS to maintain the routing tables and routing protocols.
- EEPROM—Stores the serial number of the Routing Engine.
- DRAM—Provides storage for the routing and forwarding tables and for other Routing Engine processes.
- One 10-Gigabit Ethernet interface between the Routing Engine and Switch Control Board.
- Two 50-GB slim solid-state drives—**SSD1** (primary) and **SSD2** (secondary)—Provide storage for software images, configuration files, microcode, log files, and memory dumps. The Routing Engine reboots from SSD2 when boot from primary SSD fails.
- Two USB ports (**USB1** and **USB2**)—Provide a removable media interface through which you can install Junos OS manually. The Junos OS supports USB versions 3.0, 2.0, and 1.1.
- Interface ports—The **AUX**, **CONSOLE**, and **MGMT** provide access to management devices. Each Routing Engine has one 10/100/1000-Mbps Ethernet port for connecting to a management network, and two asynchronous serial ports—one for connecting to a console and one for connecting to a modem or other auxiliary device.
- **RESET** button—Reboots the Routing Engine when pressed.
- **ONLINE/OFFLINE** button—Brings the Routing Engine online or takes it offline when pressed.

  NOTE: The **ONLINE/OFFLINE** button must be pressed for a minimum of 4 seconds for the power off or power on to occur.

- Extractor clips—Control the locking system that secures the Routing Engine.
- LEDs—*RE-S-X6-64G Routing Engine LEDs* describes the functions of these LEDs.

NOTE: For specific information about Routing Engine components (for example, the amount of DRAM), issue the `show vmhost hardware` command.

RE-S-X6-64G Routing Engine Boot Sequence

Booting in a RE-S-X6-64G Routing Engine follows this sequence—the USB device, SSD1, SSD2, LAN. SSD1 is the primary boot device. The boot sequence is tried twice for SSD1 and SSD2.

SEE ALSO

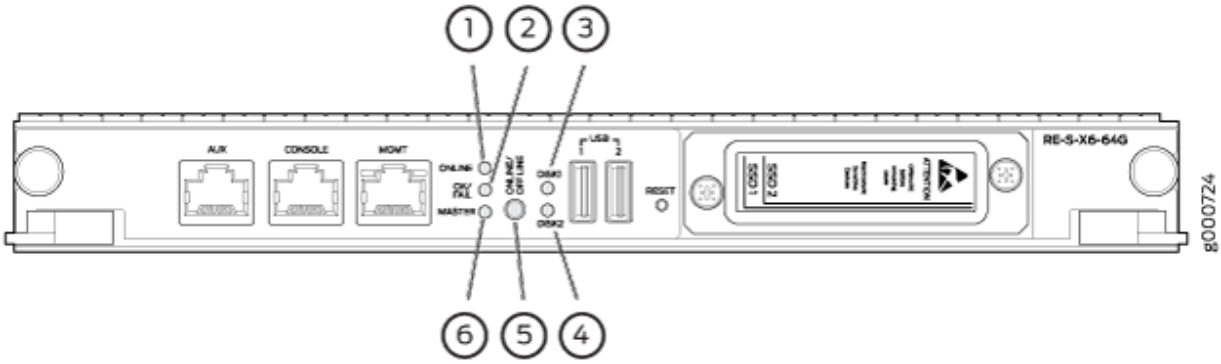
Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem

Upgrading to the RE-S-X6-64G Routing Engine in a Nonredundant Host Subsystem

RE-S-X6-64G Routing Engine LEDs

Each Routing Engine has five LEDs that indicate its status. The LEDs—labeled **MASTER**, **DISK1**, **DISK2**, **ONLINE**, and **OK/FAIL**—are located on the faceplate of the Routing Engine. Table 27 on page 62 describes the functions of the Routing Engine LEDs.

Figure 28: RE-S-X6-64G Routing Engine LEDs



1– **ONLINE** LED	4– **DISK2** LED
2– **OK/FAIL** LED	5– **ONLINE/OFFLINE** button
3– **DISK1** LED	6– **MASTER** LED

Table 27: RE-S-X6-64G Routing Engine LEDs

Label	Color	State	Description
ONLINE	Green	Blinking slowly	Routing Engine is in the process of booting BIOS, and the host OS.
		Blinking rapidly	Routing Engine is in the process of booting Junos OS.
	-	Off	Routing Engine is not online or not functioning normally.

Table 27: RE-S-X6-64G Routing Engine LEDs *(Continued)*

Label	Color	State	Description
	Green	On steadily	Routing Engine has booted both JunOS and host OS.
DISK1	Green	Blinking	Indicates presence of disk activity.
	-	Off	There is no disk activity.
DISK2	Green	Blinking	Indicates presence of disk activity.
	-	Off	There is no disk activity.
OK/FAIL	Yellow	On steadily	Routing Engine is not powering up, which indicates failure.
MASTER	Blue	On steadily	This Routing Engine is the Primary Routing Engine.
	-	Off	This Routing Engine is the backup Routing Engine, if the **ONLINE** LED is solid green.

SEE ALSO

MX240 Routing Engine Description

MX960 Routing Engine Description

RE-S-X6-128G Routing Engine Description

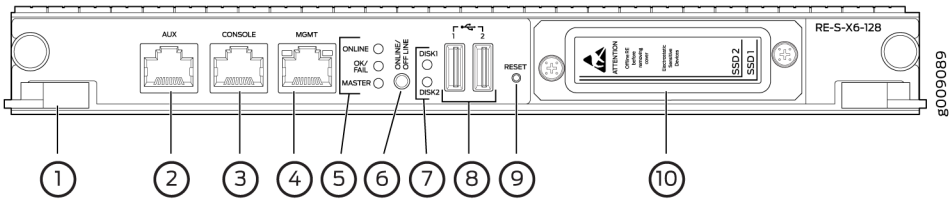
IN THIS SECTION

RE-S-X6-128G Routing Engine Components | 64

RE-S-X6-128G Routing Engine LEDs | 65
RE-S-X6-128G Routing Engine Boot Sequence | 66

Figure 29 on page 64 shows the Routing Engine.

Figure 29: RE-S-X6-128G Routing Engine Front View



1– Extractor clips	6– **ONLINE/OFFLINE** button
2– Auxiliary port (**AUX**)	7– SSD LEDs—**DISK1** and **DISK2**
3– Console port (**CONSOLE**)	8– Ports—**USB1** and **USB2**
4– Management port (**MGMT**)	9– **RESET** button
5– LEDs—**ONLINE, OK/FAIL,** and **MASTER**	10– SSD card slot cover

RE-S-X6-128G Routing Engine Components

In routers with dual Routing Engines, both Routing Engines must be RE-S-X6-128G Routing Engines.

Each RE-S-X6-128G Routing Engine (shown in Figure 29 on page 64) consists of the following components:

- CPU—Runs Junos OS to maintain the routing tables and routing protocols.
- EEPROM—Stores the serial number of the Routing Engine.
- DRAM—Provides storage for the routing and forwarding tables and for other Routing Engine processes.
- One 10-Gigabit Ethernet interface between the Routing Engine and Switch Control Board.
- Two 200-GB slim solid-state drives—**SSD1** (primary) and **SSD2** (secondary)—Provide storage for software images, configuration files, microcode, log files, and memory dumps. The Routing Engine reboots from SSD2 when boot from primary SSD fails.

- Two USB ports (**USB1** and **USB2**)—Provide a removable media interface through which you can install Junos OS manually. The Junos OS supports USB versions 3.0, 2.0, and 1.1.
- Interface ports—The **AUX**, **CONSOLE**, and **MGMT** provide access to management devices. Each Routing Engine has one 10/100/1000-Mbps Ethernet port for connecting to a management network, and two asynchronous serial ports—one for connecting to a console and one for connecting to a modem or other auxiliary device.
- **RESET** button—Reboots the Routing Engine when pressed.
- **ONLINE/OFFLINE** button—Brings the Routing Engine online or takes it offline when pressed.

  NOTE: The **ONLINE/OFFLINE** button must be pressed for a minimum of 4 seconds for the power off or power on to occur.

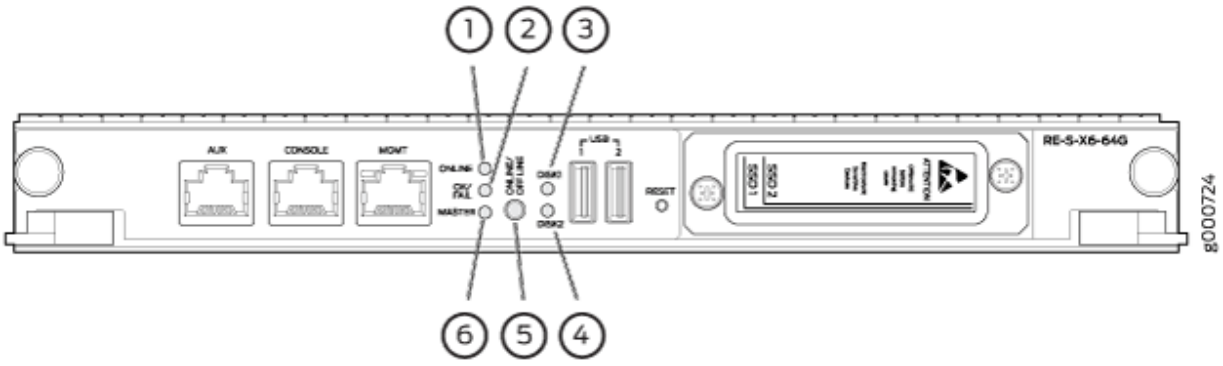
- Extractor clips—Control the locking system that secures the Routing Engine.
- LEDs—Table 28 on page 66 describes the functions of these LEDs.

NOTE: For specific information about Routing Engine components (for example, the amount of DRAM), issue the `show vmhost hardware` command.

RE-S-X6-128G Routing Engine LEDs

Each Routing Engine has five LEDs that indicate its status. The LEDs—labeled **MASTER**, **DISK1**, **DISK2**, **ONLINE**, and **OK/FAIL**—are located on the faceplate of the Routing Engine. Table 28 on page 66 describes the functions of the Routing Engine LEDs.

Figure 30: RE-S-X6-128G Routing Engine LEDs



1– **ONLINE** LED	4– **DISK2** LED
2– **OK/FAIL** LED	5– **ONLINE/OFFLINE** button
3– **DISK1** LED	6– **MASTER** LED

Table 28: RE-S-X6-128G Routing Engine LEDs

Label	Color	State	Description
ONLINE	Green	Blinking slowly	Routing Engine is in the process of booting BIOS, and the host OS.
		Blinking rapidly	Routing Engine is in the process of booting Junos OS.
	-	Off	Routing Engine is not online or not functioning normally.
DISK1	Green	Blinking	Indicates presence of disk activity.
	-	Off	There is no disk activity.
DISK2	Green	Blinking	Indicates presence of disk activity.
	-	Off	There is no disk activity.
OK/FAIL	Green	On steadily	Routing Engine is powering up.
	Yellow	On steadily	Routing Engine is not powering up, which indicates failure.
MASTER	Blue	On steadily	This Routing Engine is the Primary Routing Engine.

RE-S-X6-128G Routing Engine Boot Sequence

Booting in a RE-S-X6-128G Routing Engine follows this sequence—the USB device, SSD1, SSD2, LAN. SSD1 is the primary boot device. The boot sequence is tried twice for SSD1 and SSD2.

SEE ALSO

Supported Routing Engines by Router

Routing Engine Specifications

RE-S-X6-128G-K Routing Engine Description

IN THIS SECTION

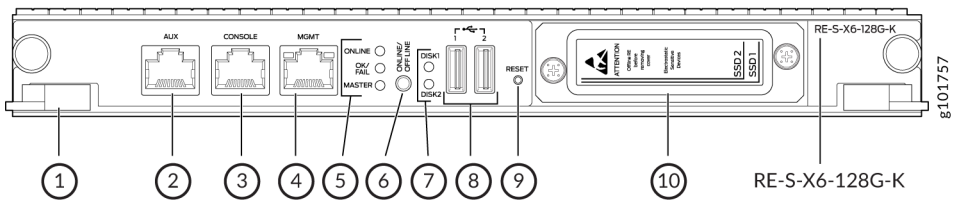
- RE-S-X6-128G-K Routing Engine Components | 68
- RE-S-X6-128G-K Routing Engine LEDs | 69
- RE-S-X6-128G-K Routing Engine Boot Sequence | 70

The RE-S-X6-128G-K is a Routing Engine integrated with Trusted Platform Module 2.0 (TPM 2.0). This Routing Engine is an upgrade to the RE-S-X6-128G-S. The key features of the RE-S-X6-128G-K include:

- Digital cryptographic identity (also called device ID or DevID) embedded in the TPM2.0. The DevID helps the device provide its authenticity to the phone-home, bootstrap, or redirect server.
- RFC 8572-based secure zero-touch provisioning (secure ZTP)

Figure 31 on page 67 shows the Routing Engine.

Figure 31: RE-S-X6-128G-K Routing Engine Front View



1– Extractor clips	6– **ONLINE/OFFLINE** button
2– Auxiliary port (**AUX**)	7– Solid-state drive (SSD) LEDs—**DISK1** and **DISK2**
3– Console port (**CONSOLE**)	8– USB Ports—**1** and **2**
4– Management port (**MGMT**)	9– **RESET** button

5– LEDs—**ONLINE, OK/FAIL,** and **MASTER**	10– SSD slot cover

RE-S-X6-128G-K Routing Engine Components

In routers with dual Routing Engines, you must install the RE-S-X6-128G-K in both Routing Engine slots.

> **NOTE**: The RE-S-X6-128G-K Routing Engine must be used with either SCBE2-MX or SCBE3-MX.

Each RE-S-X6-128G-K Routing Engine consists of the following components:

- CPU—Runs Junos OS to maintain the routing tables and routing protocols.
- EEPROM—Stores the serial number of the Routing Engine.
- DRAM (128 GB)—Provides storage for the routing and forwarding tables and for other Routing Engine processes.
- One 10-Gigabit Ethernet (10GbE) interface between the Routing Engine and Switch Control Board (SCB).
- Two 200-GB slim SSDs—The **SSD1** (primary) and **SSD2** (secondary) solid-state drives provide storage for software images, configuration files, microcode, log files, and memory dumps. The Routing Engine reboots from SSD2 when boot from the primary SSD (SSD1) fails.
- Two USB ports (**1** and **2**)—Provide a removable media interface through which you can install Junos OS manually. Junos OS supports USB versions 3.0, 2.0, and 1.1.
- Interface ports—The **AUX**, **CONSOLE**, and **MGMT** ports provide access to management devices. Each Routing Engine has one 10/100/1000-Mbps Ethernet port for connecting to a management network. It also has two asynchronous serial ports—one for connecting to a console and another for connecting to a modem or other auxiliary device.
- **RESET** button—Reboots the Routing Engine when pressed.
- **ONLINE/OFFLINE** button—Brings the Routing Engine online or takes it offline when pressed.

  > **NOTE**: You must keep the **ONLINE/OFFLINE** button pressed for a minimum of 4 seconds for the device to power off or power on.

- Extractor clips—Control the locking system that secures the Routing Engine.

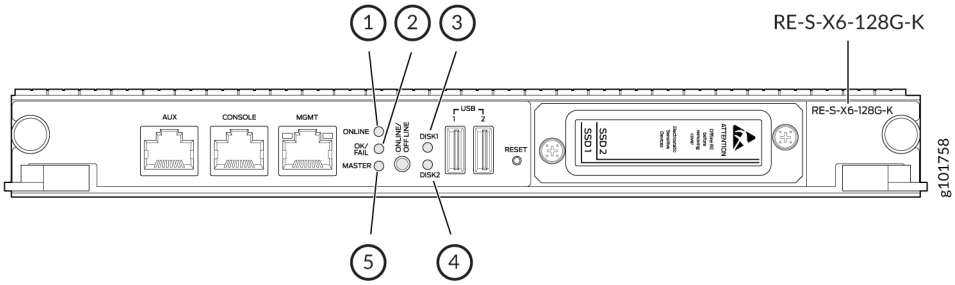
- LEDs—Table 29 on page 69 describes the functions of the LEDs on the RE-S-X6-128G-K Routing Engine.

NOTE: For specific information about Routing Engine components (for example, the amount of DRAM), issue the `show vmhost hardware` CLI command.

RE-S-X6-128G-K Routing Engine LEDs

Each Routing Engine has five LEDs that indicate its status. You'll see the LEDs—labeled **ONLINE**, **OK/FAIL**, **DISK1**, **DISK2**, and **MASTER**— on the faceplate of the Routing Engine. Table 29 on page 69 describes the functions of the Routing Engine LEDs.

Figure 32: RE-S-X6-128G-K Routing Engine LEDs



1– **ONLINE** LED	4– **DISK2** LED
2– **OK/FAIL** LED	5– **MASTER** LED
3– **DISK1** LED	

Table 29: RE-S-X6-128G-K Routing Engine LEDs

Label	Color	State	Description
ONLINE	Green	Blinking slowly	Routing Engine is in the process of booting BIOS and the host OS.
		Blinking rapidly	Routing Engine is in the process of booting Junos OS.
	–	Off	Routing Engine is not online or not functioning normally.
DISK1	Green	Blinking	Indicates presence of disk activity.

Table 29: RE-S-X6-128G-K Routing Engine LEDs *(Continued)*

Label	Color	State	Description
	–	Off	No disk activity.
DISK2	Green	Blinking	Indicates presence of disk activity.
	–	Off	No disk activity.
OK/FAIL	Green	On steadily	Routing Engine is powering on.
	Yellow	On steadily	Routing Engine is not powering on, which indicates failure.
MASTER	Blue	On steadily	This Routing Engine is the primary Routing Engine.

RE-S-X6-128G-K Routing Engine Boot Sequence

Booting in an RE-S-X6-128G-K Routing Engine follows this sequence—the USB device, SSD1, SSD2, LAN. SSD1 is the primary boot device. The Routing Engine tries the booting sequence twice for SSD1 and SSD2.

SEE ALSO

- *Supported Routing Engines by Router*
- *Routing Engine Specifications*

Routing Engine Specifications

Table 30 on page 71 lists the current specifications for Routing Engines supported on M Series, MX Series, and T Series routers. Table 31 on page 76 lists the hardware specifications of the Routing Engines with VMHost support. Table 32 on page 78 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*.

Table 30: 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
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.

Table 30: Routing Engine Specifications *(Continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
	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 30: 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	–

Table 30: Routing Engine Specifications *(Continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
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	–
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	-

Table 30: Routing Engine Specifications *(Continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-S-X6-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	18.1R1 (SCBE2) 18.4R1 (SCBE3)	SCBE2, SCBE3
RE-S-X6-128G-K	2.1 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	22.2R1S2	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	-
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 31 on page 76 lists the hardware specifications of the Routing Engines with VMHost support.

Table 31: 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 50-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 200-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 100-GB SSDs
RE-PTX-X8-64G	PTX5000	• 8-core Haswell CPU • Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 50-GB SSDs • New Control Board CB2-PTX
RCB-PTX-X6-32G	PTX3000	• Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 100-GB SSDs • Multi-core Haswell CPU RCB combines the functionality of a Routing Engine, Control Board, and Centralized Clock Generator (CCG)

Table 31: 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
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 32: 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
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

Table 32: End-of-Life Routing Engine Specifications *(Continued)*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	EOL Details
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 30 on page 71 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.

SEE ALSO

Supported Routing Engines by Router

Supported Routing Engines by Router

IN THIS SECTION

- M7i Routing Engines | **80**
- M10i Routing Engines | **81**
- M40e Routing Engines | **82**
- M120 Routing Engines | **82**
- M320 Routing Engines | **83**
- MX5, MX10, MX40, and MX80 Routing Engine | **84**
- MX104 Routing Engines | **84**
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- MX240 Routing Engines | **85**
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- MX2008 Routing Engines | **90**
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- T320 Routing Engines | **97**
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- T4000 Routing Engines | **101**
- TX Matrix Routing Engines | **101**
- TX Matrix Plus Routing Engines | **102**
- TX Matrix Plus (with 3D SIBs) Routing Engines | **103**

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 33 on page 81 lists the Routing Engines supported by the M7i router. The M7i router supports 32-bit Junos OS only.

Table 33: 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 34 on page 81 lists the Routing Engines supported by the M10i router. The M10i router supports 32-bit Junos OS only.

Table 34: M10i Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-400-768 (EOL details: TSB16445)	`RE-5.0`	9.0	fxp0	fxp1 fxp2
RE-850-1536 (EOL details: TSB15553)	`RE-850`	7.2	fxp0	fxp1 fxp2
RE-B-1800X1-4G	`RE-B-1800x1`	11.4R4 12.1R2	fxp0	em0

M40e Routing Engines

Table 35 on page 82 lists the Routing Engines supported by the M40e router.

Table 35: 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 36 on page 82 lists the Routing Engines supported by the M120 router.

Table 36: M120 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-1000-2048	`RE-A-1000`	8.0R2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	`RE-A-2000`	8.0R2	–	fxp0	em0 bcm0
RE-A-1800X2-8G	`RE-A-1800x2`	• 11.4R5 • 12.1R3	10.4	fxp0	fxp1 fxp2

Table 36: M120 Routing Engines *(Continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-1800X2-16G	RE-A-1800x2	• 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 37 on page 83 lists the Routing Engines supported by the M320 router.

Table 37: 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

Table 37: M320 Routing Engines *(Continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-A-1800X2-16G	`RE-A-1800x2`	• 11.4R5 • 12.1R3	10.4	fxp0	em0 bcm0
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 38 on page 84 lists the Routing Engines supported by the MX5, MX10, MX40, and MX80 routers.

Table 38: 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 39 on page 85 lists the Routing Engines supported by MX104 routers.

Table 39: 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 40 on page 85 lists the Routing Engines supported by the MX204 router.

Table 40: 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 41 on page 85 lists the Routing Engines supported by MX240 routers.

Table 41: 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

Table 41: 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-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
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-2X00x6	–	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	RE-S-2X00x6-LT	–	17.2R1	fxp0	ixlv0, igb0 em0

Table 41: MX240 Supported Routing Engines *(Continued)*

RE-S-X6-128G	RE-S-2X00x6-128	–	18.1R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G-K	RE-S-X6-128G-K	-	22.2R1S2	fxp0	ixlv0, igb0, em0

MX480 Routing Engines

Table 42 on page 87 lists the Routing Engines supported by MX480 routers.

Table 42: 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
RE-S-1800X2-16G (EOL details: TSB16556	RE-S-1800x2	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1

Table 42: MX480 Supported Routing Engines *(Continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X4-8G	RE-S-1800X4	• 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-2X00x6	–	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	RE-S-2X00x6--LT	–	17.2R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	RE-S-2X00x6-128	–	18.1R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G-K	RE-S-X6-128G-K	-	22.2R1S2	fxp0	ixlv0, igb0, em0

MX960 Routing Engines

Table 43 on page 89 lists the Routing Engines supported by MX960 routers.

Table 43: 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-2X00x6	–	15.1F4 16.1R1	fxp0	ixlv0, igb0

Table 43: MX960 Supported Routing Engines *(Continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-X6-64G (For MX960-VC)	RE-S-2X00x6	–	17.2R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	RE-S-2X00x6-LT	–	17.2R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	RE-S-2X00x6-128	–	18.1R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G-K	RE-S-X6-128G-K	-	22.2R1S2	fxp0	ixlv0, igb0, em0

MX2008 Routing Engines

Table 44 on page 90 lists the Routing Engines supported by MX2008 routers.

Table 44: 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	REMX2008-X8-64G-LT	17.2R1	fxp0	ixlv0 ixlv1

Table 44: MX2008 Supported Routing Engines *(Continued)*

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

MX2010 Routing Engines

Table 45 on page 91 lists the Routing Engines supported by MX2010 routers.

Table 45: 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
REMX2K-X8-64G-LT	RE-S-2X00x8	17.2R1	fxp0	ixlv0 ixlv1 em0

Table 45: 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-X8-128G	RE-MX200X8-128G	18.1R1	fxp0	ixlv0 ixlv1

MX2020 Supported Routing Engines

Table 46 on page 92 lists the Routing Engines supported by MX2020 routers.

Table 46: 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 46: 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 47 on page 93 lists the Routing Engines supported by MX10003 routers.

Table 47: 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 48 on page 94 lists the Routing Engines supported on the MX10008 router.

Table 48: 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 49 on page 94 lists the Routing Engine supported on the PTX1000.

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

Table 49: 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 em2	bme0 em1

PTX3000 Routing Engines

Table 50 on page 95 lists the Routing Engines supported on the PTX3000.

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

Table 50: 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 51 on page 96 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 51: 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 52 on page 96 lists the Routing Engines supported on the PTX10008 and PTX10016 routers.

Table 52: 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

Table 52: PTX10008 and PTX10016 Routing Engines *(Continued)*

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

PTX10001 Routing Engine

Table 53 on page 97 lists the Routing Engine supported on the PTX10001 router (JNP10001-20C).

Table 53: PTX10001 Routing Engine

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
Built-in Routing Engine	RE-PTX10001-20C	18.4R1	em0, em2	em1 bme0

PTX10002-60 Routing Engine

Table 54 on page 97 lists the Routing Engine supported on the PTX10002-60 router.

Table 54: PTX10002-60 Routing Engine

Model Number	Name in CLI Output	First Supported Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
Built-in Routing Engine	RE-PTX10002-60C	18.2R1	em0, em2	em1 bme0

T320 Routing Engines

Table 55 on page 98 lists the Routing Engines supported by the T320 router.

Table 55: 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 56 on page 98 lists the Routing Engines supported by the T640 router.

Table 56: 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

Table 56: T640 Routing Engines *(Continued)*

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-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 57 on page 100 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 57: 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 58 on page 101 lists the Routing Engines supported by the T4000 router.

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

Table 58: 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 59 on page 101 lists the Routing Engines supported by the TX Matrix router.

Table 59: 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

Table 59: 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-1600-2048 (EOL details: TSB14374	RE-4.0 (RE-1600)	7.0	–	fxp0	fxp1 fxp2
RE-A-2000-4096	RE-A-2000	8.5	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	RE-DUO-1800	11.4R9	11.4R9	em0	bcm0 em1
RE-DUO-C1800-16G	RE-DUO-1800	11.4R9	11.4R9	em0	bcm0 em1

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 60 on page 102 lists the Routing Engines supported by the TX Matrix Plus router.

Table 60: 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 61 on page 103 lists the Routing Engines supported by the TX Matrix Plus router with 3D SIBs.

Table 61: 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

SEE ALSO

Understanding Internal Ethernet Interfaces

MX480 Interface Modules—DPCs

IN THIS SECTION

- MX480 Dense Port Concentrator (DPC) Description | **104**
- MX480 DPC Port and Interface Numbering | **107**
- MX480 Dense Port Concentrator (DPC) LEDs | **111**
- DPCs Supported on MX240, MX480, and MX960 Routers | **111**

MX480 Dense Port Concentrator (DPC) Description

IN THIS SECTION

- DPC Components | **106**

A Dense Port Concentrator (DPC) is optimized for Ethernet density (see Figure 33 on page 105). 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 (SCBs).

The DPC slots are located in the front of the router (see Figure 33 on page 105). The router has six dedicated DPC slots that are numbered **0** through **5**. A DPC can be installed in any DPC slot on the router. 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, as described in "MX480 Field-Replaceable Units (FRUs)" on page 299. 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 33 on page 105 shows typical DPCs supported on the MX480 router. For more information about DPCs, see the *MX Series Interface Module Reference*.

Figure 33: Typical DPCs Supported on the Router

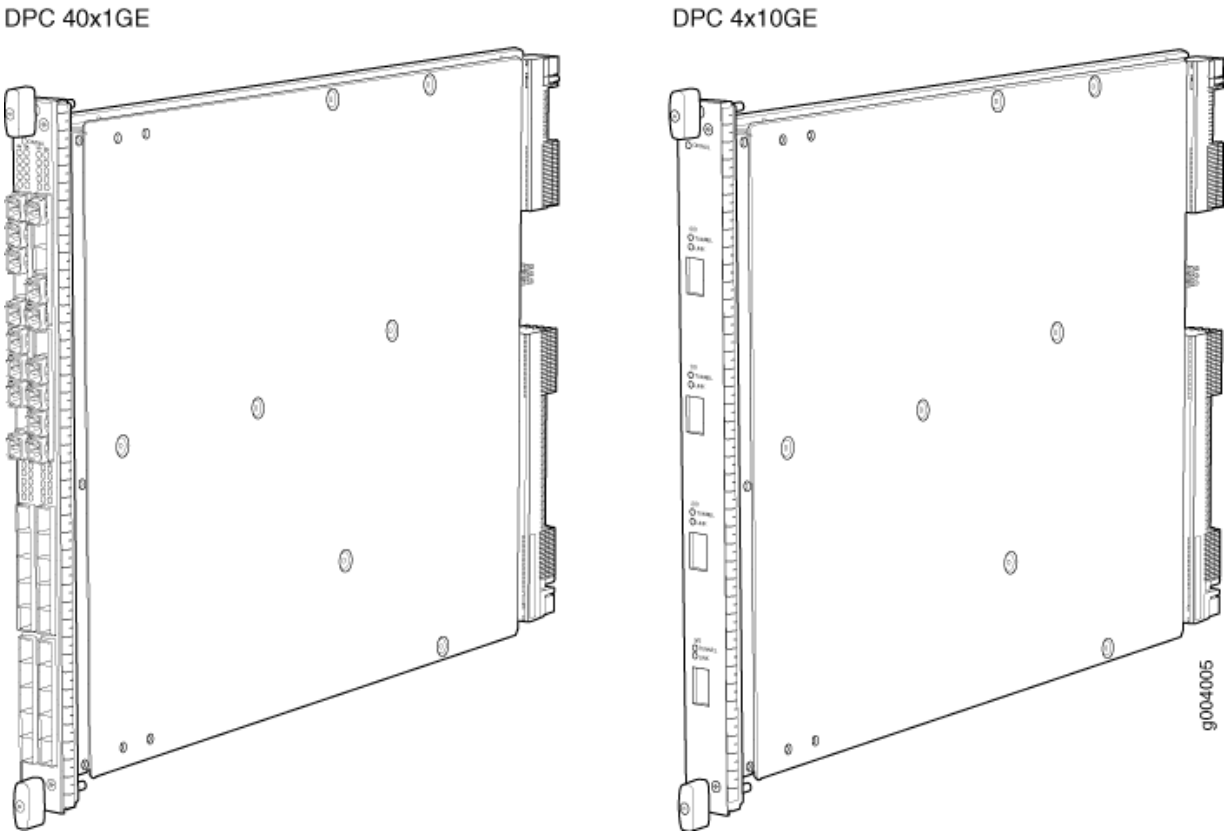
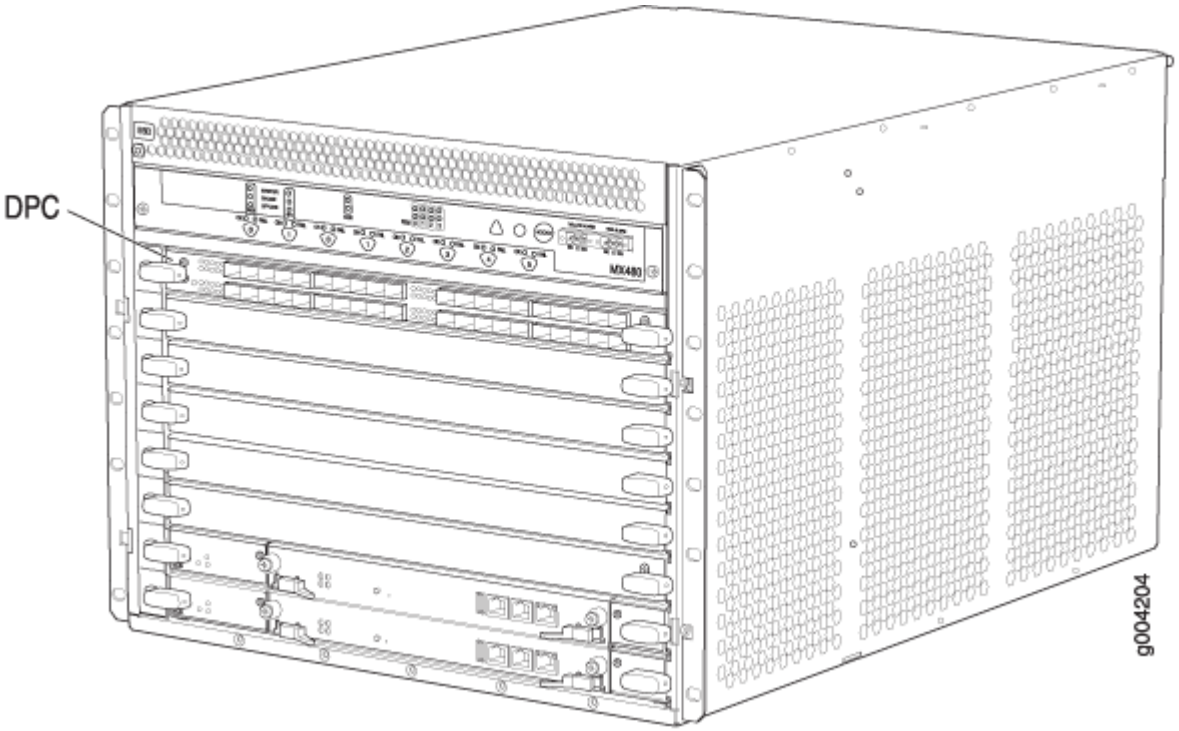


Figure 34: DPC Installed Horizontally in the Router



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**.

SEE ALSO

MX480 Component LEDs on the Craft Interface | **15**

Replacing an MX480 DPC | **351**

MX480 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 MX480 router, the DPCs are represented in the CLI as `FPC 0` through `FPC 5`.
- *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.

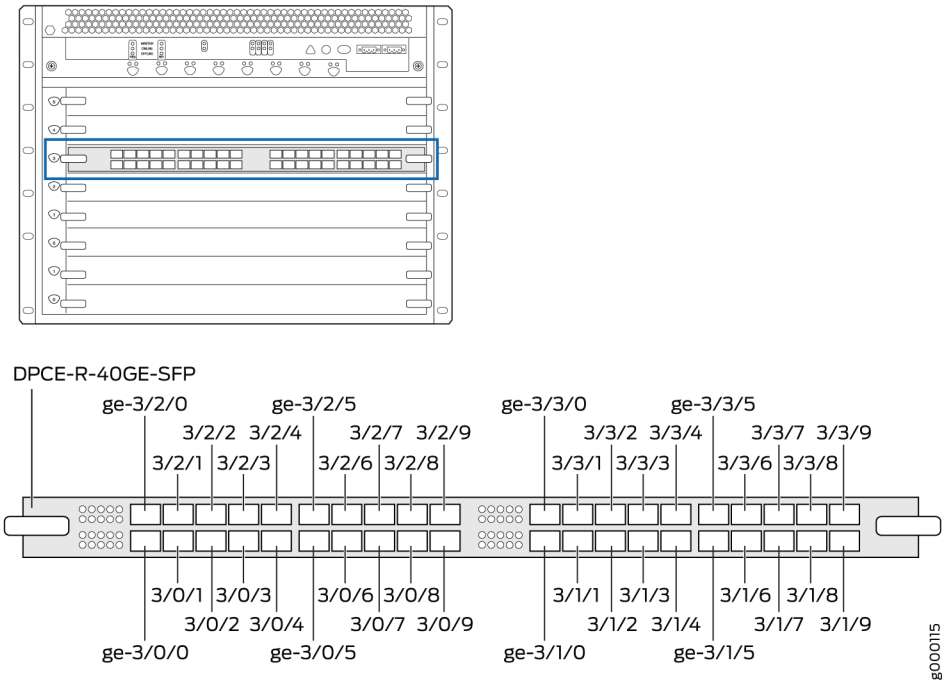
  For more information on specific DPCs, see "DPCs Supported on MX240, MX480, and MX960 Routers" on page 111 in the *MX Series Interface Module Reference*.

- *port*—Port number.

The MX480 router supports up to six DPCs that install horizontally and are numbered 0 through 5 from bottom to top.

Figure 35 on page 108 shows a 40-port Gigabit Ethernet DPC with SFP installed in slot **3** on the MX480 router.

Figure 35: MX480 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 (`DPCE 40x 1GE R`) is shown as `FPC 3` in the CLI. 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
```

SEE ALSO

MX480 Router Hardware and CLI Terminology Mapping | 9

MX480 Dense Port Concentrator (DPC) 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 "DPC and MPC LEDs on the MX480 Craft Interface" on page 15.

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*.

SEE ALSO

Maintaining MX480 DPCs | 345

Replacing an MX480 DPC | 351

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 62 on page 112 lists the DPCs supported by the MX240, MX480, and MX960 routers.

Table 62: 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
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

Table 62: 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-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

Table 62: DPCs Supported in MX240, MX480, and MX960 Routers *(Continued)*

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
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
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				

Table 62: DPCs Supported in MX240, MX480, and MX960 Routers *(Continued)*

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
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

SEE ALSO

- *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)*

MX480 Interface Modules—FPCs and PICs

IN THIS SECTION

- MX480 Flexible PIC Concentrator (FPC) Description | **116**
- MX480 Flexible PIC Concentrator (FPC) LEDs | **119**
- FPCs Supported by MX240, MX480, and MX960 Routers | **120**
- MX480 PIC Description | **120**
- MX480 PIC Port and Interface Numbering | **121**
- MX480 PIC LEDs | **123**
- PICs Supported by MX240, MX480, and MX960 Routers | **124**

MX480 Flexible PIC Concentrator (FPC) Description

IN THIS SECTION

- FPC Components | **119**

A Flexible PIC Concentrator (FPC) occupies two DPC slots on an MX Series router. The router has six dedicated DPC slots that are numbered **0** through **5**, bottom to top. Up to three FPCs can be installed

horizontally on the front of the router (see Figure 36 on page 117). The interface corresponds to the lowest numbered DPC slot for which the FPC is installed.

Figure 36: FPC Installed in the MX480 Router Chassis

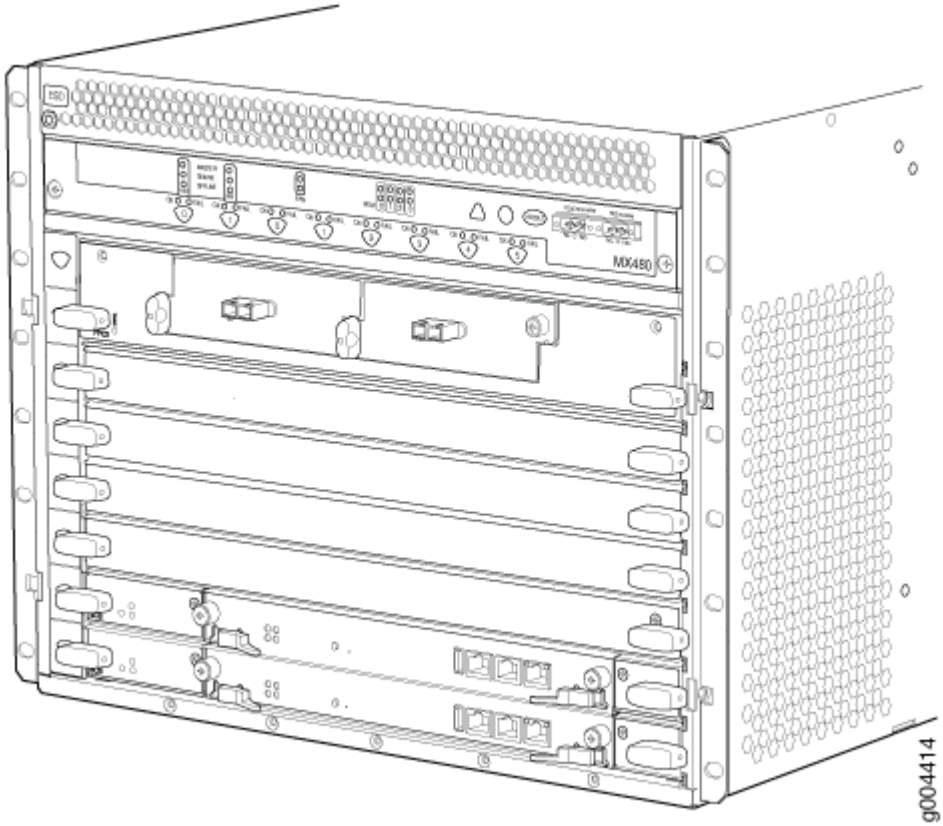
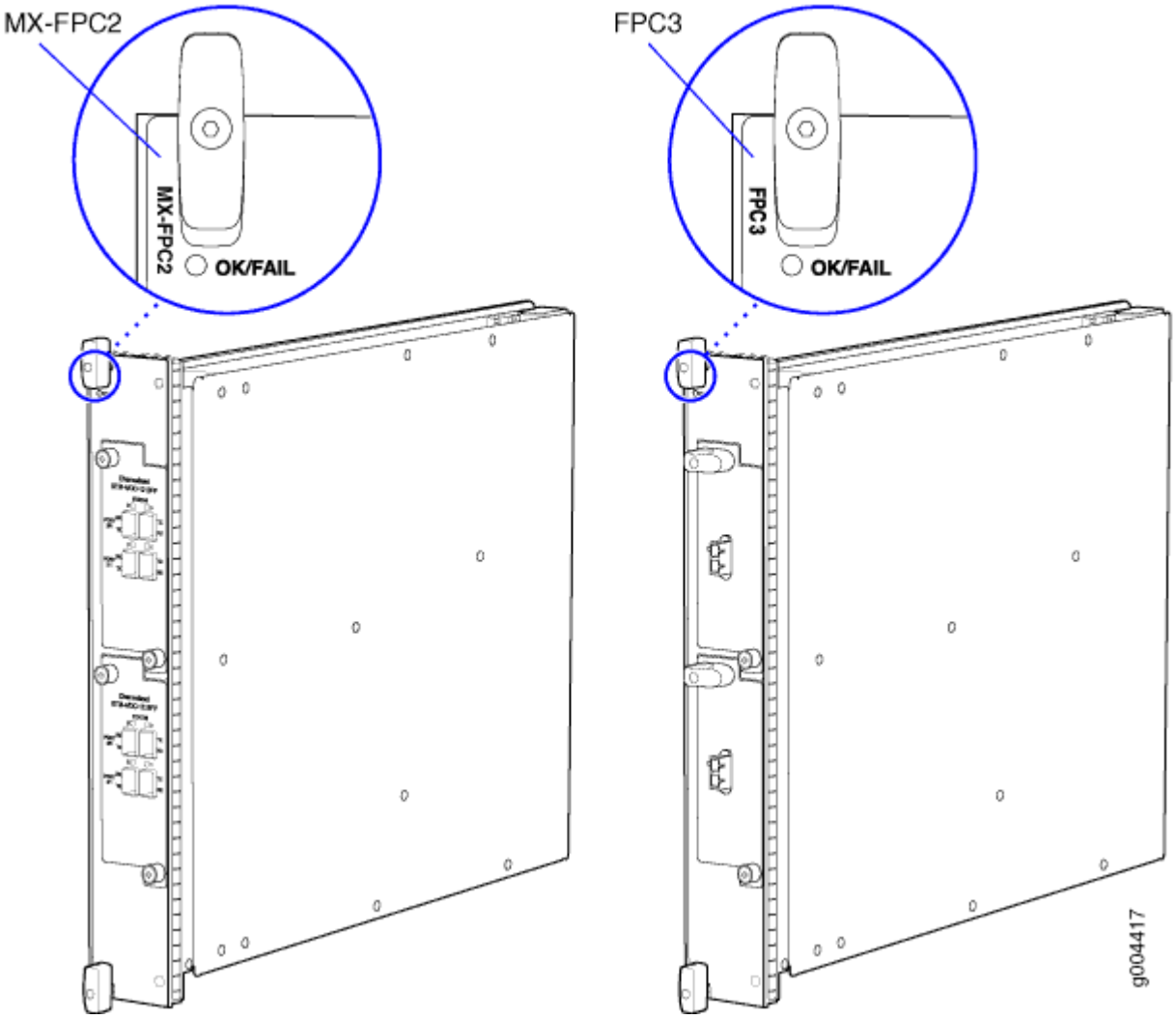


Figure 37 on page 118 shows the typical FPCs supported on the MX480 router.

Figure 37: Typical FPCs Supported on the MX480 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 forwards 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 "MX480 Component Redundancy" on page 8. 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

SEE ALSO

Maintaining MX480 FPCs | **360**

MX480 FPC Terminology

Troubleshooting the MX480 FPCs | **466**

Replacing an MX480 FPC | **367**

MX480 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 "MX480 Component LEDs on the Craft Interface" on page 15.

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 63 on page 120 lists FPCs supported by MX240, MX480, and MX960 routers.

Table 63: 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

SEE ALSO

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

MX480 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 three FPCs can be installed in an MX480 router. PICs used in a Type 2 FPC 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.

SEE ALSO

PICs Supported by MX240, MX480, and MX960 Routers | **124**

Replacing an MX480 PIC | **393**

MX480 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* 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

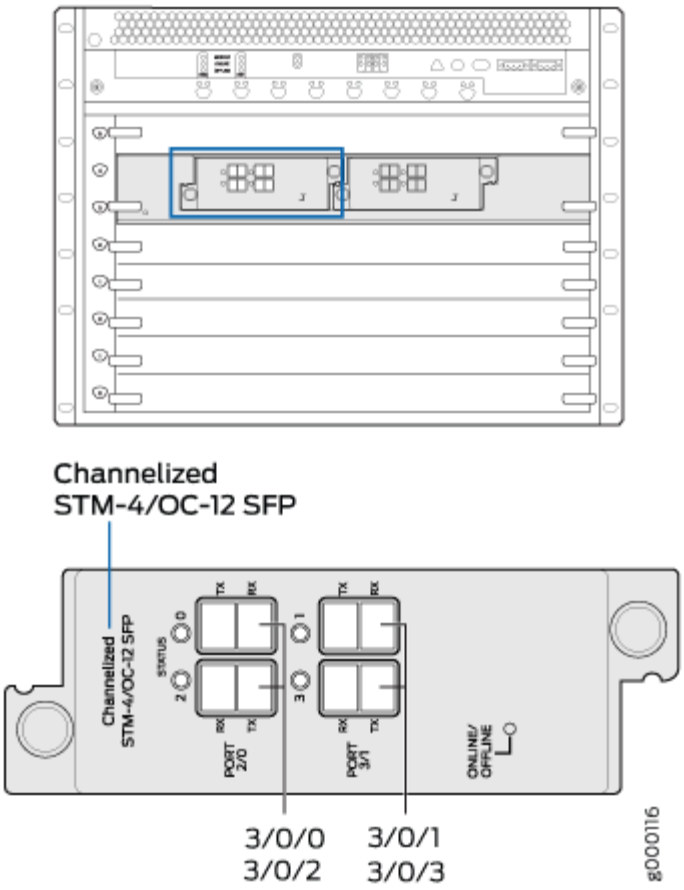
  For a complete list of media types, see *Interface Naming Overview*.
- *fpc*—Lowest slot number in which the FPC is installed. On the MX480 router, FPCs occupy two line card slots and are represented in the CLI as `FPC 0` through `FPC 4`.
- *pic*—PIC number, 0 or 1 depending on the *FPC* slot.

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

The MX480 supports up to three FPCs that install horizontally and are numbered from bottom to top.

Figure 38 on page 122 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 38: MX480 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 `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

...
coc12-3/0/0             up    up
lc-3/0/0                up    up
lc-3/0/0.32769          up    up   vpls
pfe-3/0/0               up    up
pfe-3/0/0.16383         up    up   inet
                                   inet6
pfh-3/0/0               up    up
pfh-3/0/0.16383         up    up   inet
coc12-3/0/1             up    up
coc12-3/0/2             up    up
coc12-3/0/3             up    up
...
```

SEE ALSO

MX480 Router Hardware and CLI Terminology Mapping | 9

MX480 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*.

SEE ALSO

Replacing an MX480 PIC | 393

Maintaining MX480 PICs | 392

PICs Supported by MX240, MX480, and MX960 Routers

Table 64 on page 124 lists the PICs supported by MX240, MX480, and MX960 routers.

Table 64: 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				
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

Table 64: PICs Supported by MX240, MX480, and MX960 Routers *(Continued)*

PIC Name	PIC Model Number	Ports	Type	First Junos OS Release
SONET/SDH OC192c/STM64 PIC with XFP	PC-1OC192-SON-XFP	1	3	9.4

SEE ALSO

- *MX Series FPC and PIC Overview*
- *FPCs Supported by MX240, MX480, and MX960 Routers*
- *High Availability Features*

MX480 Interface Modules—MPCs and MICs

IN THIS SECTION

- MIC/MPC Compatibility | **126**
- MX480 Modular Interface Card (MIC) Description | **138**
- MX480 MIC Port and Interface Numbering | **139**
- MX480 Modular Interface Card (MIC) LEDs | **143**
- MICs Supported by MX Series Routers | **143**
- MX480 Modular Port Concentrator (MPC) Description | **157**
- MX480 Modular Port Concentrator (MPC) LEDs | **161**
- MPCs Supported by MX Series Routers | **161**
- MX480 Application Services Modular Line Card Description | **168**
- MX480 Application Services Modular Storage Card Description | **171**
- MX480 Application Services Modular Processing Card Description | **172**
- MX480 AS MSC LEDs | **173**
- MX480 AS MXC LEDs | **174**

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 65: MIC/MPC1 Compatibility

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

Table 65: MIC/MPC1 Compatibility *(Continued)*

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
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 65: 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

Table 65: MIC/MPC1 Compatibility *(Continued)*

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
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 66: 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

Table 66: 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-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 66: 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

Table 66: 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-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 66: 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 67: 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
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

Table 67: MIC/MPC3 Compatibility *(Continued)*

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
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
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

Table 67: MIC/MPC3 Compatibility *(Continued)*

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
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
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 68: 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 69: 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 70: MIC/MPC9 Compatibility

MIC Name	MPC9E
MIC-MRATE *MIC MRATE*	• 15.1F5 with Junos Continuity • 16.1R1

Table 70: MIC/MPC9 Compatibility *(Continued)*

MIC Name	MPC9E
MIC-MACSEC-MRATE *Multi-Rate Ethernet MIC*	17.4

Table 71: MIC/MPC10003 Compatibility

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

MX480 Modular Interface Card (MIC) 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 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.

SEE ALSO

Maintaining MX480 MICs | **373**

Troubleshooting the MX480 MICs | **470**

Replacing an MX480 MIC | **375**

MX480 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 MX480 router, the MPCs are represented in the CLI as `FPC 0` through `FPC 5`.
- *pic*—Logical PIC on the *MIC*, numbered 0 or 1 when installed in slot 0, and 2 or 3 when installed in 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 slot 0, or 2 and 3 when installed in slot 1.
  - 4-port 10-Gigabit Ethernet MIC has two logical PICs numbered 0 and 1 when installed in slot 0, or 2 and 3 when installed in slot 1.
  - 100-Gigabit Ethernet MIC with CFP has one logical PIC numbered 0 when installed in slot 0, or 2 when installed in slot 1.

  For more information on specific MICs, see "MICs Supported by MX Series Routers" on page 143 in the *MX Series Interface Module Reference*.
- *port*—Port number.

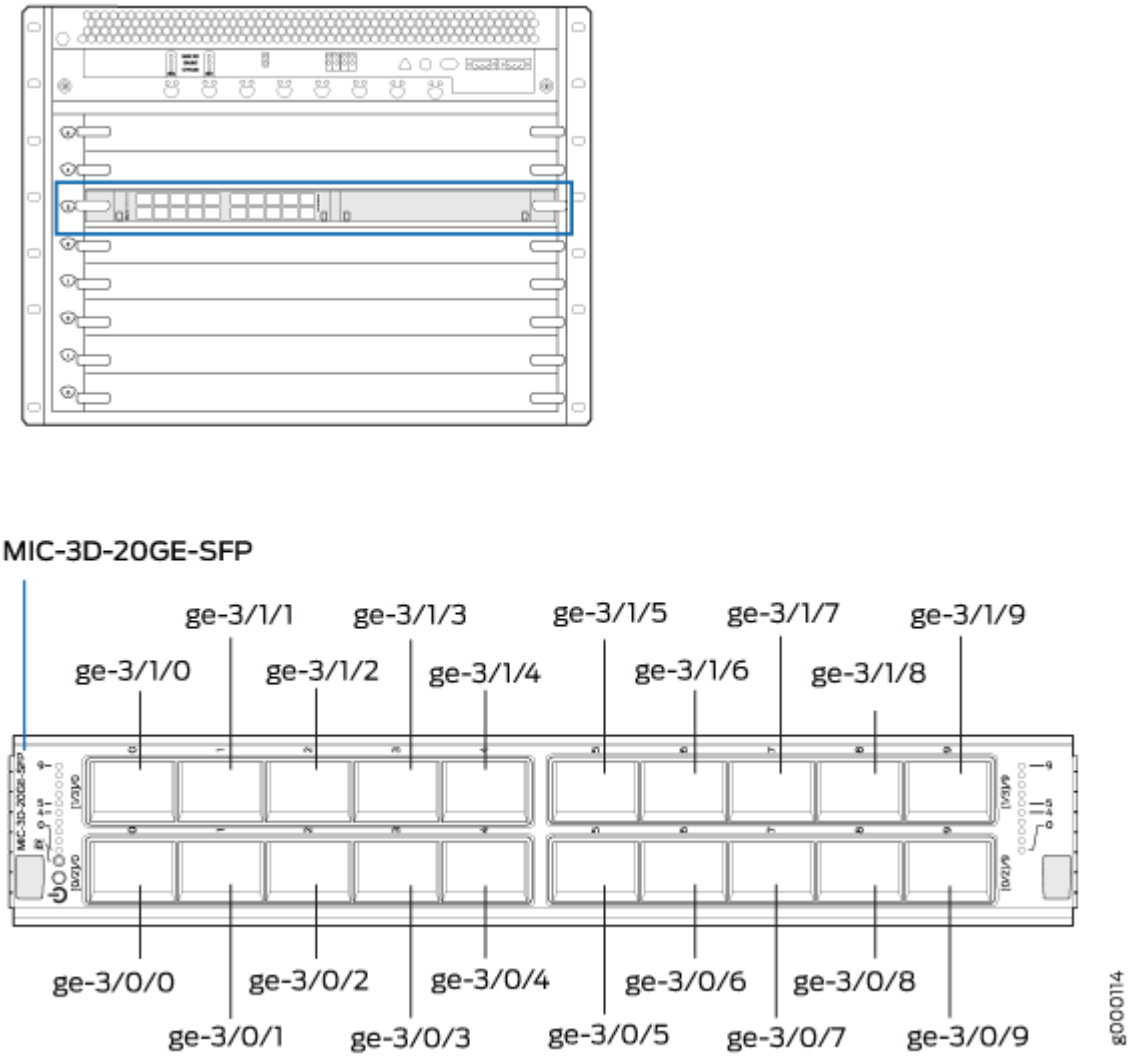
NOTE: The MIC number is not included in the interface name.

The MX480 router supports up to six MPCs that install horizontally and are numbered from bottom to top. Each MPC accepts up to two MICs.

Figure 39 on page 141 shows a 20-port Gigabit Ethernet MIC with SFP installed in 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 39: MX480 MIC Interface Port Mapping



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 following sample CLI output displays a 20-port Gigabit Ethernet MIC with SFP — **3D 20x 1GE(LAN) SFP** — installed in slot 0 of an MPC in slot 3.

```
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 chassis hardware` command output shows an MPC (**MPC Type 2 3D EQ**) installed in slot **3** and is shown as `FPC 3` in the CLI. The MIC's two logical PICs — `10x 1GE(LAN) SFP` — are shown as `PIC 0` and `PIC 1`.

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
```

SEE ALSO

- MX480 Router Hardware and CLI Terminology Mapping | **9**

MX480 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*.

SEE ALSO

- Maintaining MX480 MICs | **373**
- Troubleshooting the MX480 MICs | **470**
- Replacing an MX480 MIC | **375**

MICs Supported by MX Series Routers

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

- Table 72 on page 144 lists the first supported Junos OS release for MICs on MX240, MX480, MX960, and MX2008 routers.

- Table 73 on page 148 lists the first supported Junos OS release for MICs on MX2010 and MX2020 routers.
- Table 74 on page 151 list the first supported Junos OS release for MICs on MX5, MX10, and MX40 routers.
- Table 75 on page 154 lists the first supported Junos OS release for MICs on MX80 and MX104 routers.
- Table 76 on page 157 lists the first supported Junos OS release for MICs on MX10003 router.

Table 72: 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

Table 72: MICs Supported by MX240, MX480, MX960 and MX2008 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
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
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

Table 72: MICs Supported by MX240, MX480, MX960 and MX2008 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
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

Table 72: MICs Supported by MX240, MX480, MX960 and MX2008 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
Channelized SONET/SDH OC3/ STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4 CHOC12	8	11.4	15.1F7
Channelized OC3/ STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1C OC12-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 73: MICs Supported by MX2010 and MX2020 Routers

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
ATM				
ATM MIC with SFP	MIC-3D-8OC3-2 OC12-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				
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

Table 73: MICs Supported by MX2010 and MX2020 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
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
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

Table 73: MICs Supported by MX2010 and MX2020 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
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
Tri-Rate				
Tri-Rate MIC	MIC-3D-40GE-TX	40	12.3	12.3

Table 73: MICs Supported by MX2010 and MX2020 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
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 74: 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

Table 74: MICs Supported by MX5, MX10, and MX40 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
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
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

Table 74: MICs Supported by MX5, MX10, and MX40 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
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 74: 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 75: 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

Table 75: MICs Supported by MX80 and MX104 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX80	MX104
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				
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

Table 75: MICs Supported by MX80 and MX104 Routers *(Continued)*

MIC Name	MIC Model Number	Ports	MX80	MX104
Channelized OC3/ STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1C OC12-CE	4	12.2	13.2R2
Channelized OC3/ STM1 (Multi-Rate) Circuit Emulation MIC with SFP (H)	MIC-4COC3-1COC 12-CE-H	-	-	13.2R2
Tri-Rate				
Tri-Rate MIC	MIC-3D-40GE-TX	40	10.2	13.2R2
Services				
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 76: 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

SEE ALSO

MX Series MIC Overview

MIC/MPC Compatibility

MX480 Modular Port Concentrator (MPC) Description

IN THIS SECTION

- MPC Components | **160**

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 MX480 router supports up to six MPCs. You must install a high-capacity fan tray to use an MPC. For power requirements, see "Calculating Power Requirements for MX480 Routers" on page 219.

The router has six dedicated line card slots for DPCs, MPCs, or FPCs that are numbered **0** through **5** bottom to top. An MPC can be installed in any slot on the router that supports MPCs. You can install any combination of line card 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 41 on page 160 shows a typical MPC supported on the MX480 router. For more information about MPCs, see the *MX Series Interface Module Reference*.

Figure 40: Typical MPC Supported on the MX Series Router

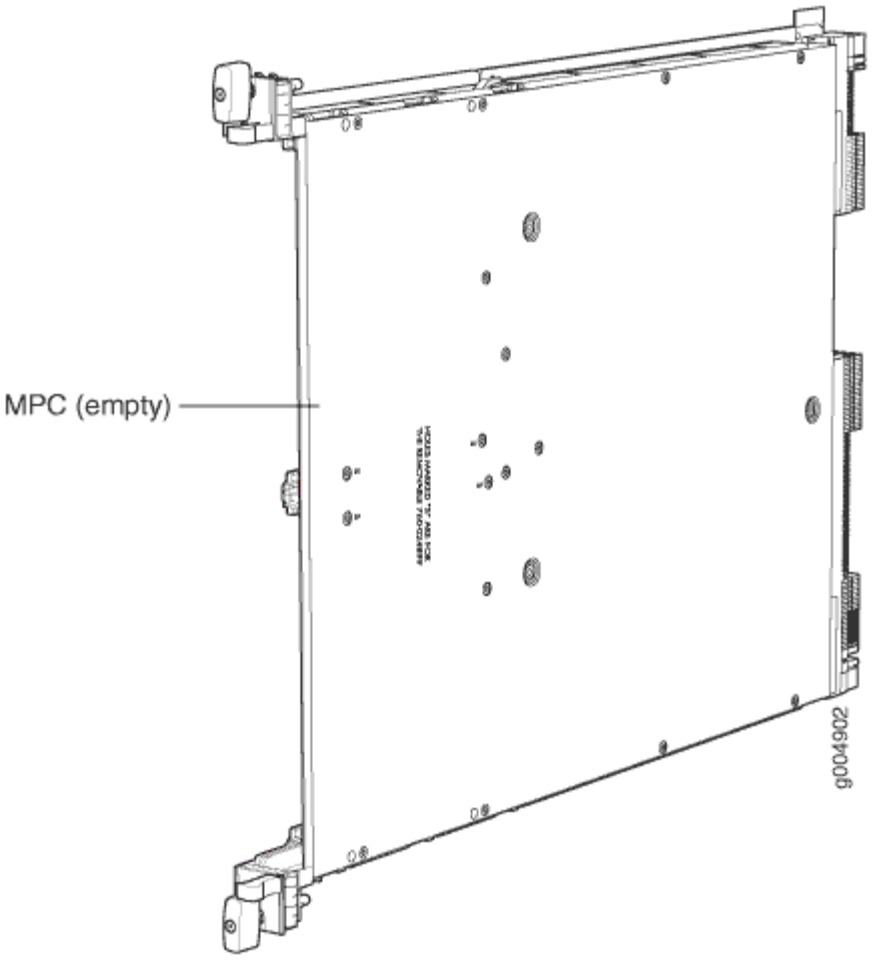
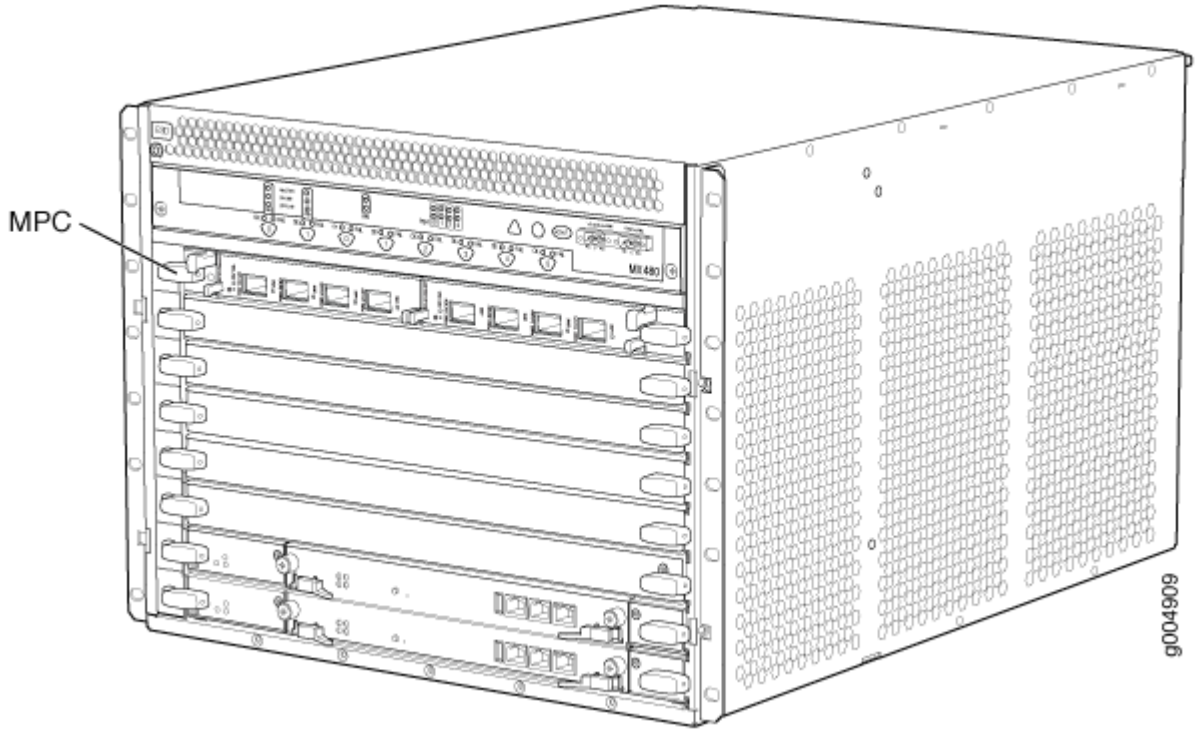


Figure 41: MPC Installed Horizontally in the MX480 Router



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**.

SEE ALSO

MX480 Field-Replaceable Units (FRUs) | **299**

Replacing an MX480 MPC | **387**

MX480 Modular Port Concentrator (MPC) 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 "DPC and MPC LEDs on the MX480 Craft Interface" on page 15.

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*.

SEE ALSO

Maintaining MX480 MPCs | **384**

Troubleshooting the MX480 MPCs | **471**

Replacing an MX480 MPC | **387**

MPCs Supported by MX Series Routers

Table 77 on page 162 lists the MPCs and their first supported Junos OS release on MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 routers.

Table 77: 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	First Junos OS Release on MX10008 Routers
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	–	–

Table 77: 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	First Junos OS Release on MX10008 Routers
2x100GE + 4x10GE MPC5EQ	MPC5EQ-100G10G	13.3R3	15.1F7	13.3R3	13.3R3	–	–
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	–	–	–	–	–

Table 77: 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	First Junos OS Release on MX10008 Routers
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.	-	-
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	–	–

Table 77: 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	First Junos OS Release on MX10008 Routers
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	–	
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	–	–

Table 77: 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	First Junos OS Release on MX10008 Routers
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	–	–
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	–	–

Table 77: 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	First Junos OS Release on MX10008 Routers
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	
MX10003 MPC (Multi-Rate)	MX10003-LC2103-V2	–	–	–	–	21.3R1	

SEE ALSO

MX Series MPC Overview

MX Series MPC Overview

MX Series MIC Overview

MICs Supported by MX Series Routers

MIC/MPC Compatibility

Pathfinder: Hardware Supported by Junos Continuity Software

MX480 Application Services Modular Line Card Description

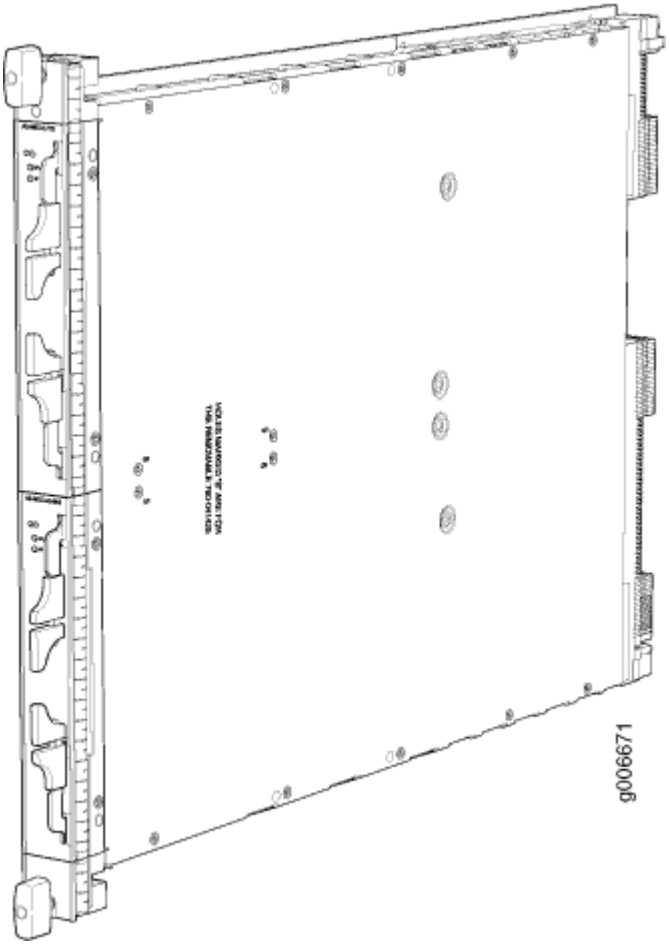
IN THIS SECTION

- MX480 AS MLC Function | **169**
- AS MLC Components | **170**
- MX480 SCB, Power Supply, and Cooling System Requirements for AS MLC | **170**

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.

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 42: Application Services Modular Line Card (AS MLC)



MX480 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.

AS MLC Components

Each AS MLC consists of the following components:

- AS MLC Modular Carrier Card (AS MCC), which fits horizontally in front of the MX480 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 of 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 contains the host processor and supporting peripherals.
- LED on the AS MCC, which displays the status of the AS MLC

MX480 SCB, Power Supply, and Cooling System Requirements for AS MLC

Each MX480 router requires specific SCB, power supply, and cooling system models to run the AS MLC:

- SCB—Enhanced MX Switch Control Board (SCBE-MX). See MX480 SCBE-MX Description for details
- Power supply:
  - 2520W AC power supply—Model PWR-MX480-2520-AC
  - 2400W DC power supply—Model PWR-MX480-2400-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-MX480-AC-HC-U and PWR-MX480-2520-AC-S
    - For DC power supply: PWR-FAN-MX480-DC-HC-U and PWR-MX480-2520-DC-S
  - Fan tray—FFANTRAY-MX480-HC

SEE ALSO

Replacing an MX480 AS MLC | **399**

Replacing an MX480 AS MSC | **403**

Replacing an MX480 AS MXC | **408**

MX480 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 43 on page 172) 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:

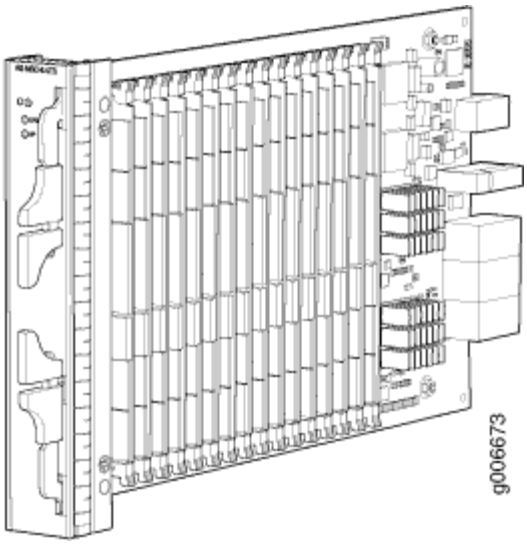
- 400 GB NAND Flash memory
- Up to 48K of write cycle
- Multilevel cell (MLC) NAND memory support
- Best-in-class NAND controller for maximum performance and reliability

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-port, 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 43: Application Services Modular Storage Card



SEE ALSO

Replacing an MX480 AS MSC | **403**

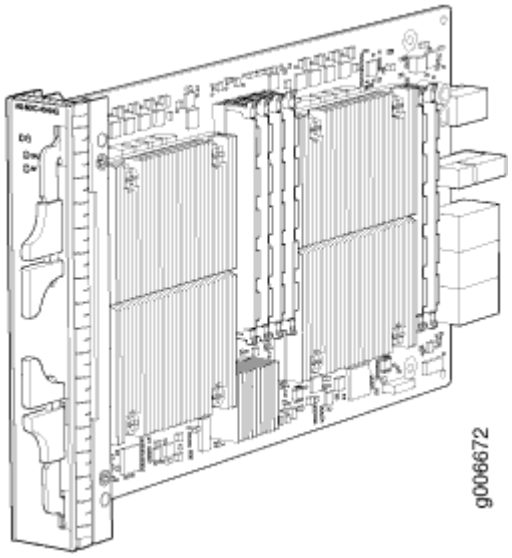
MX480 Application Services Modular Processing Card Description

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 44 on page 173) 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 44: Application Services Modular Processing Card (AS MXC)



SEE ALSO

Replacing an MX480 AS MXC | 408

MX480 AS MSC LEDs

Two LEDs (**CPU** and **AP**) indicate the status of the AS MSC and are located on the AS MSC. Table 78 on page 173 describes the functions of the AS MSC LEDs.

Table 78: AS MSC LEDs

Label	Color	State	Description
CPU	Green	On steadily	AS MSC operates normally.

Table 78: AS MSC LEDs *(Continued)*

Label	Color	State	Description
	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.

SEE ALSO

Replacing an MX480 AS MSC | **403**

MX480 AS MXC LEDs

Two LEDs (**CPU** and **AP**) indicate the status of the AS MXC and are located on the AS MXC. Table 79 on page 174 describes the functions of the AS MXC LEDs.

Table 79: 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.

Table 79: AS MXC LEDs *(Continued)*

Label	Color	State	Description
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.

SEE ALSO

Replacing an MX480 AS MXC | **408**

Services Processing Card—MX-SPC3 Services Card

IN THIS SECTION

- MX-SPC3 Services Card Overview and Support on MX240, MX480, and MX960 Routers | **175**
- MX-SPC3 Services Card | **178**

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 80 on page 176 shows the SPC and its first supported Junos OS release on MX240, MX480, and MX960, routers.

Table 80: 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	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 81 on page 176.

Table 81: 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-BB	MPC2E-3D
	RE-S-1800X4-16G-UPG-BB	MPC2-3D-NG
	RE-S-1800X4-16G-S	MPC3E and MPC3E-3D-NG
	RE-S-1800X4-16G-R	MPC4E-3D
	RE-S-1800X4-32G-BB	MPC-3D-16XGE
	RE-S-1800X4-32G-UB	
	RE-S-1800X4-32G-S	
	RE-S-1800X4-32G-R	

Table 81: MX-SPC3 Services Card Compatibility with MX Series Switch Fabrics, Routing Engines and MPC Line Cards *(Continued)*

Switch Fabric	Route Engine	MPC Line Cards
SCBE2	RE-S-1800X4-16G-BB RE-S-1800X4-16G-UPG-BB RE-S-1800X4-16G-S RE-S-1800X4-16G-R RE-S-1800X4-32G-BB RE-S-1800X4-32G-UB RE-S-1800X4-32G-S RE-S-1800X4-32G-R RE-S-X6-64G-UB RE-S-X6-64G-S RE-S-X6-64G-R RE-S-X6-64G-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 81: MX-SPC3 Services Card Compatibility with MX Series Switch Fabrics, Routing Engines and MPC Line Cards *(Continued)*

Switch Fabric	Route Engine	MPC Line Cards
SCBE3	RE-S-1800X4-16G-BB RE-S-1800X4-16G-UPG-BB RE-S-1800X4-16G-S RE-S-1800X4-16G-R RE-S-1800X4-32G-BB RE-S-1800X4-32G-UB RE-S-1800X4-32G-S RE-S-1800X4-32G-R RE-S-X6-64G-BB RE-S-X6-64G-UB RE-S-X6-64G-S RE-S-X6-64G-R RE-S-X6-128G-S-BB RE-S-X6-128G-S-S RE-S-X6-128G-S-R	MPC2-3D-NG MPC4E-3D MPC5E and MPC5EQ MPC7E and MPC7EQ MPC-3D-16XGE MPC10E-10C MPC10E-15C

SEE ALSO

Protocols and Applications Supported by MX-SPC3 Services Card

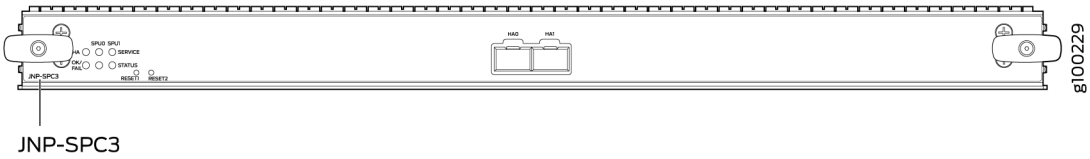
MX-SPC3 Services Card

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 45 on page 179).

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 45: 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 82 on page 182:

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 82: 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-BB RE-S-1800X4-16G-UPG-BB RE-S-1800X4-16G-S RE-S-1800X4-16G-R RE-S-1800X4-32G-BB RE-S-1800X4-32G-UB RE-S-1800X4-32G-S RE-S-1800X4-32G-R	MPC2E-3D MPC2-3D-NG MPC3E and MPC3E-3D-NG MPC4E-3D MPC-3D-16XGE

Table 82: MX-SPC3 Services Card Compatibility with MX Series Switch Fabrics, Routing Engines and MPC Line Cards *(Continued)*

Switch Fabric	Route Engine	MPC Line Cards
SCBE2	RE-S-1800X4-16G-BB RE-S-1800X4-16G-UPG-BB RE-S-1800X4-16G-S RE-S-1800X4-16G-R RE-S-1800X4-32G-BB RE-S-1800X4-32G-UB RE-S-1800X4-32G-S RE-S-1800X4-32G-R RE-S-X6-64G-UB RE-S-X6-64G-S RE-S-X6-64G-R RE-S-X6-64G-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 82: MX-SPC3 Services Card Compatibility with MX Series Switch Fabrics, Routing Engines and MPC Line Cards *(Continued)*

Switch Fabric	Route Engine	MPC Line Cards
SCBE3	RE-S-1800X4-16G-BB RE-S-1800X4-16G-UPG-BB RE-S-1800X4-16G-S RE-S-1800X4-16G-R RE-S-1800X4-32G-BB RE-S-1800X4-32G-UB RE-S-1800X4-32G-S RE-S-1800X4-32G-R RE-S-X6-64G-BB RE-S-X6-64G-UB RE-S-X6-64G-S RE-S-X6-64G-R RE-S-X6-128G-S-BB RE-S-X6-128G-S-S RE-S-X6-128G-S-R	MPC2-3D-NG MPC4E-3D MPC5E and MPC5EQ MPC7E and MPC7EQ MPC-3D-16XGE MPC10E-10C MPC10E-15C

Table 83 on page 184 provides a summary of Next Gen Services supported by MX-SPC3.

Table 83: Next Gen Services Supported by MX-SPC3 Services Card

Feature Category / Feature		First Supported Junos OS Release
Carrier Grade NAT	Basic-NAT44	19.3R2
	Basic-NAT66	19.3R2
	Dynamic-NAT44	19.3R2

Table 83: Next Gen Services Supported by MX-SPC3 Services Card *(Continued)*

Feature Category / Feature		First Supported Junos OS Release
	Static Destination NAT	19.3R2
	Basic-NAT-PT	19.3R2
	NAPT-PT	19.3R2
	NAPT44	19.3R2
	NAPT66	19.3R2
	Port Block Allocation	19.3R2
	Deterministic-nat44 and nat64	19.3R2
	End Point Independent Mapping (EIM)/End Point	19.3R2
	Independent Filtering (EIF)	19.3R2
	Persistent NAT – Application Pool Pairing (APP)	19.3R2
	Twice-NAT44 – Basic, Dynamic and NAPT	19.3R2
	NAT64	19.3R2
	XLAT-464	19.3R2
	NPTv6	19.3R2

Table 83: Next Gen Services Supported by MX-SPC3 Services Card *(Continued)*

Feature Category / Feature		First Supported Junos OS Release
	Port Control Protocol (PCP) – v1 and v2	20.1R1
	DS-Lite	20.2R1
	NAT46	20.2R1
Stateful Firewall Services		19.3R2
Intrusion Detection Services (IDS)		19.3R2
Traffic Load Balancer		19.3R2
DNS Request Filtering		19.3R2
Aggregated Multiservices Interfaces		19.3R2
Inter-chassis High Availability	CGNAT, Stateful Firewall, and IDS Flows	19.3R2
URL Filtering		20.1R1
IPsec		21.1R1

SEE ALSO

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

MX-Series Switch Control Board (SCB) Description

IN THIS SECTION

- CLI Identification | 189
- Power Requirements for Switch Control Boards | 191

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 84 on page 188 compares the SCB capacities of the MX Series 5G Universal Routing Platforms.

Table 85 on page 189 lists the supported routing engines per SCB.

Table 84: 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 85: 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
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	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	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	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	SCBE3-MX (applies to MX240, MX480, and MX960)	275 W at 55° C 260 W at 40° C 245 W at 25 C°

2

CHAPTER

Site Planning, Preparation, and Specifications

MX480 Site Preparation Checklist | 193

MX480 Site Guidelines and Requirements | 194

MX480 Power Planning | 207

MX480 Network Cable and Transceiver Planning | 224

MX480 Management, and Console Port Specifications and Pinouts | 229

MX480 Site Preparation Checklist

The checklist in Table 86 on page 193 summarizes the tasks you must perform when preparing a site for router installation.

Table 86: 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.	"MX480 Router Environmental Specifications" on page 197		
Select the type of rack or cabinet.	"MX480 Router Rack Requirements" on page 203, "MX480 Router Cabinet Size and Clearance Requirements" on page 206		
Plan rack or cabinet location, including required space clearances.	"MX480 Router Rack Requirements" on page 203, "MX480 Router Clearance Requirements for Airflow and Hardware Maintenance" on page 205, "MX480 Router Cabinet Size and Clearance Requirements" on page 206		
If a rack is used, secure rack to floor and building structure.	"MX480 Router Rack Requirements" on page 203		
Acquire cables and connectors.			

Table 86: Site Preparation Checklist *(Continued)*

Item or Task	For More Information	Performed By	Date
Locate sites for connection of system grounding.	"MX480 Chassis Grounding Specifications" on page 198, MX480 Router Grounding Cable Lug Specifications, MX480 Router Grounding Cable Specifications		
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 224		

RELATED DOCUMENTATION

- MX480 Router Rack Requirements | **203**
- MX480 Router Clearance Requirements for Airflow and Hardware Maintenance | **205**
- MX480 Router Cabinet Size and Clearance Requirements | **206**

MX480 Site Guidelines and Requirements

IN THIS SECTION

- MX480 Router Physical Specifications | **195**
- MX480 Router Environmental Specifications | **197**
- MX480 Chassis Grounding Specifications | **198**
- MX480 Router Rack Requirements | **203**
- MX480 Router Clearance Requirements for Airflow and Hardware Maintenance | **205**

- MX480 Router Cabinet Size and Clearance Requirements | 206
- MX480 Router Cabinet Airflow Requirements | 206

MX480 Router Physical Specifications

Table 87 on page 195 summarizes the physical specifications for the router chassis.

Table 87: Physical Specifications

Description	Weight	Width	Depth	Height
Chassis dimensions	Chassis with midplane, fan tray, air filter, and cable management brackets: 65.5 lb (29.7 kg) Maximum configuration: 221.03 lb (100.26 kg)	17.45 in. (44.3 cm)	24.5 in. (62.2 cm) (from front to chassis rear) Total depth (including cable management brackets) 27.75 in. (70.5 cm)	14.0 in. (35.6 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)
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 87: 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)
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)
FPC	FPC2: 13 lb (5.9 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 (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)
Craft interface	1.1 lb (0.5 kg)	21.25 in (54 cm)	8.5 in (21.6 cm)	6.25 in (15.9 cm)
Fan tray	6.8 lb (3.08 kg)	17 in (43.2 cm)	22 in (55.9 cm)	1.5 in (3.8 cm)
Air filter	1.0 lb (0.5 kg)	0.31 in (0.8 cm)	22.23 in (56.5 cm)	10.1 in (25.6 cm)
Cable management brackets	0.3 lb (0.14 kg)	0.25 in (0.6 cm)	4.5 in (11.4 cm)	9.9 in (25.0 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)

Table 87: Physical Specifications *(Continued)*

Description	Weight	Width	Depth	Height
High-capacity DC power supply	6.2 lb (2.81 kg)	14.5 in (36.8 cm)	4 in (10.2 cm)	1.75 in (4.4 cm)
AC power supply	5.0 lb (2.3 kg)	14.5 in (36.8 cm)	4 in (10.2 cm)	1.75 in (4.4 cm)
High-capacity AC power supply	6.6 lb (2.99 kg)	14.5 in (36.8 cm)	4 in (10.2 cm)	1.75 in (4.4 cm)

SEE ALSO

- MX480 Chassis Lifting Guidelines | 510
- MX480 Router Description | 2
- MX480 Chassis Description | 6

MX480 Router Environmental Specifications

Table 88 on page 197 specifies the environmental specifications required for normal router operation. In addition, the site should be as dust-free as possible.

Table 88: Router Environmental Specifications

Description	Value
Altitude	No performance degradation to 10,000 ft (3048 m)
Relative humidity	Normal operation ensured in relative humidity range of 5% to 90%, noncondensing
Temperature	Normal operation ensured in temperature range of 32°F (0°C) to 104°F (40°C) Nonoperating storage temperature in shipping container: –40°F (–40°C) to 158°F (70°C)

Table 88: Router Environmental Specifications *(Continued)*

Description	Value
Seismic	Designed to meet Telcordia Technologies Zone 4 earthquake requirements
Maximum thermal output	AC power: 11,322 BTU/hour (3,318 W) DC power: 9,632 BTU/hour (2,823 W) **NOTE**: These specifications are estimates and subject to change.

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.

SEE ALSO

Tools and Parts Required to Maintain the MX480 Router

In Case of an Electrical Accident

MX480 Chassis Grounding Specifications

IN THIS SECTION

- MX480 Chassis Grounding Points Specifications | **199**
- MX480 Router Grounding Cable Lug Specifications | **201**
- MX480 Router Grounding Cable Specifications | **202**

MX480 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 upper rear of the chassis for connecting the router to earth ground. The grounding points fit UNC 1/4–20 screws (American). The grounding points are spaced at 0.625-in. (15.86-mm) centers (see Figure 46 on page 200 or Figure 47 on page 201).

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

You must install the MX480 router in a restricted-access location and ensure that the chassis is always properly grounded. The MX480 router has a two-hole protective grounding terminal provided on the chassis. See Figure 46 on page 200 or Figure 47 on page 201. We recommend that you use this protective grounding terminal as the preferred method for grounding the chassis regardless of the power supply configuration. However, if additional grounding methods are available, you can also use those methods. For example, you can use the grounding wire in the AC power cord or use the grounding

terminal or lug on a DC power supply. This tested system meets or exceeds all applicable EMC regulatory requirements with the two-hole protective grounding terminal.

Figure 46: Connecting AC Power to the Router

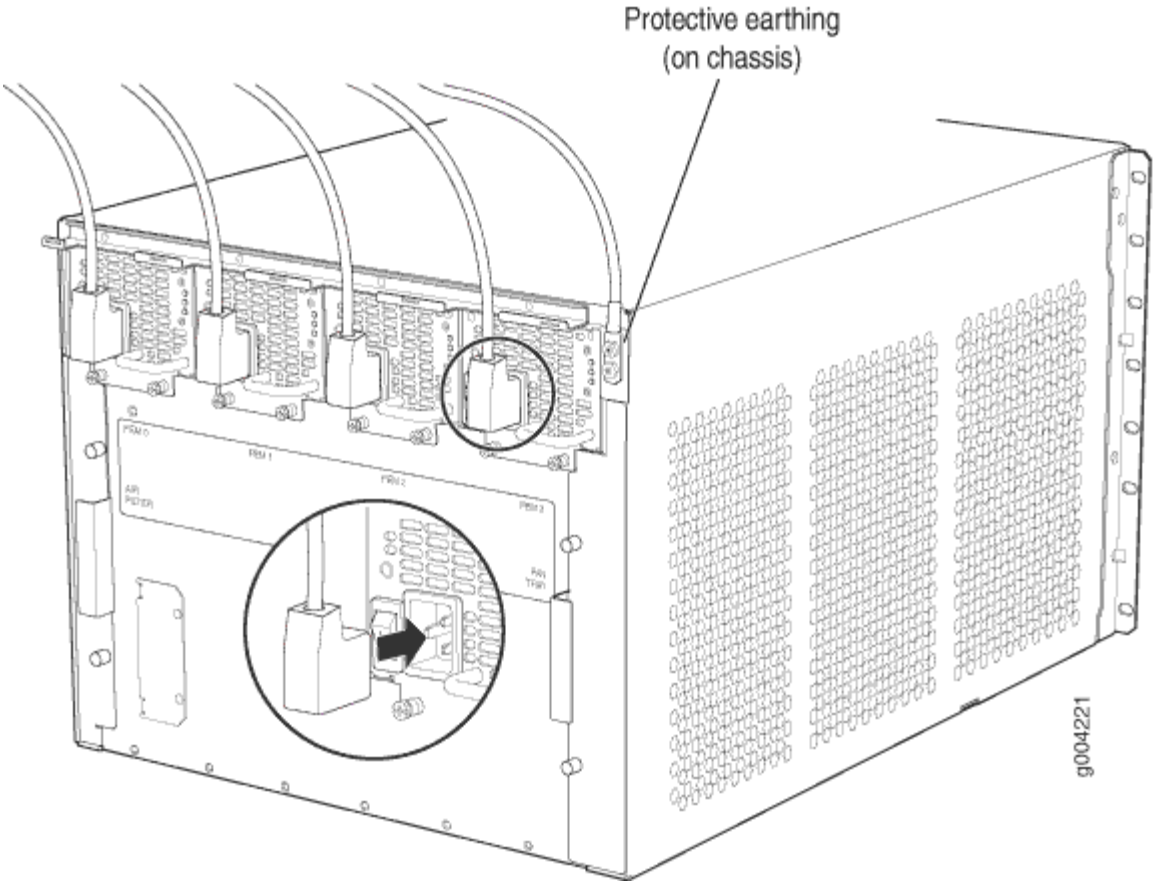
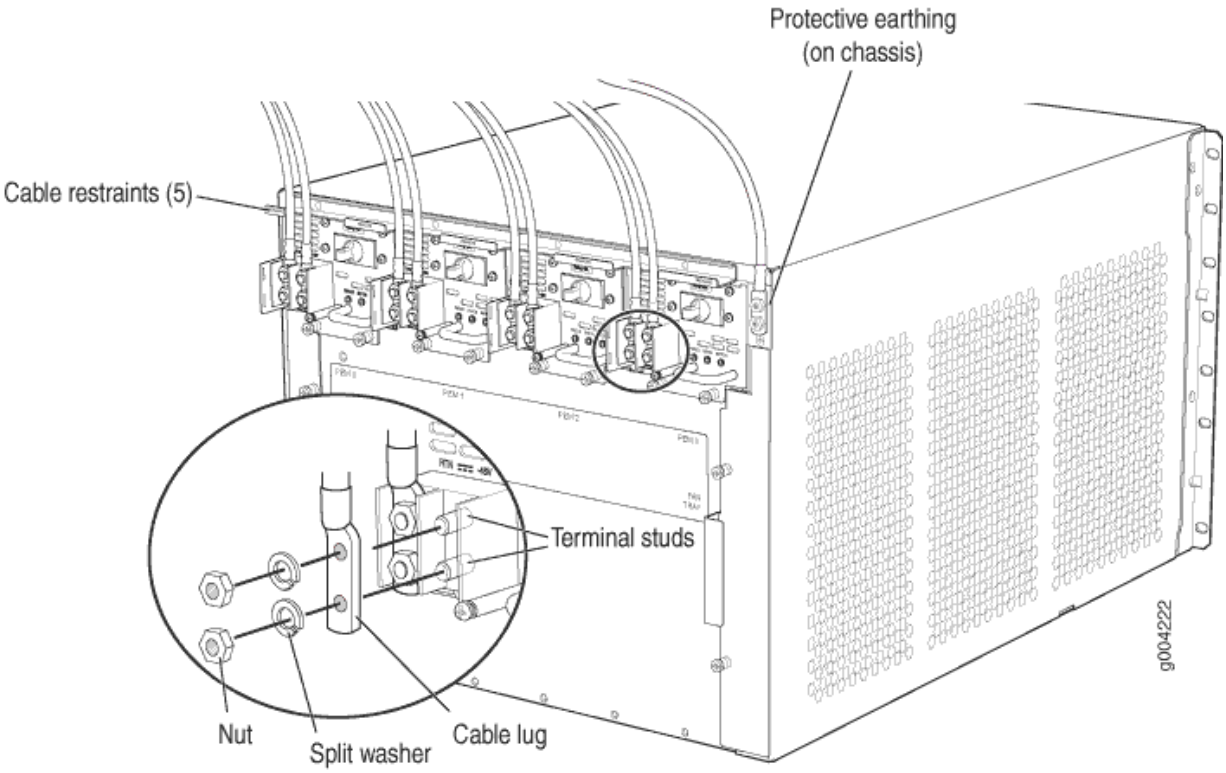


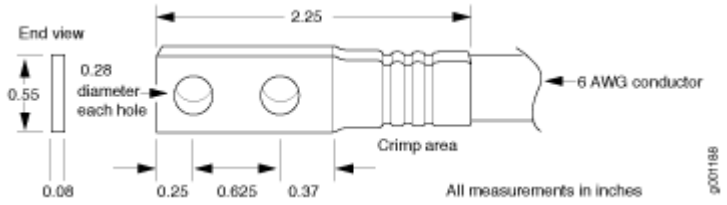
Figure 47: Connecting DC Power to the Router



MX480 Router Grounding Cable Lug Specifications

The accessory box shipped with the router includes one cable lug that attaches to the grounding cable (see Figure 48 on page 201) and two UNC 1/4–20 screws used to secure the grounding cable to the grounding points.

Figure 48: Grounding Cable Lug



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

NOTE: The same cable lug is used for the DC power cables.

MX480 Router Grounding Cable Specifications

The grounding cable that you provide must meet the specifications in Table 89 on page 202.

Table 89: Grounding Cable Specifications

Cable Type	Quantity and Specification
Grounding	One 6-AWG (13.3 mm^2), minimum 60°C wire, or as required by the local code

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

SEE ALSO

Tools and Parts Required for MX480 Router Grounding and Power Connections | 272

Grounding the MX480 Router | 272

Preventing Electrostatic Discharge Damage to an MX480 Router | 508

MX480 Router Rack Requirements

IN THIS SECTION

- Rack Size and Strength | 203
- Spacing of Mounting Bracket Holes | 204
- Connection to Building Structure | 204

The router can be installed in a rack. Many types of racks are acceptable, including four-post (telco) racks and open-frame racks. An example of an open-frame rack appears in Figure 49 on page 204.

Rack Size and Strength

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

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

The rack rails must be spaced widely enough to accommodate the router chassis's external dimensions: 14.0 in. (356 mm) high, 24.5 in. (622 mm) deep, and 17.45 in. (443 mm) wide. The spacing of rails and adjacent racks must also allow for the clearances around the router and rack that are specified in "MX480 Router Clearance Requirements for Airflow and Hardware Maintenance" on page 205.

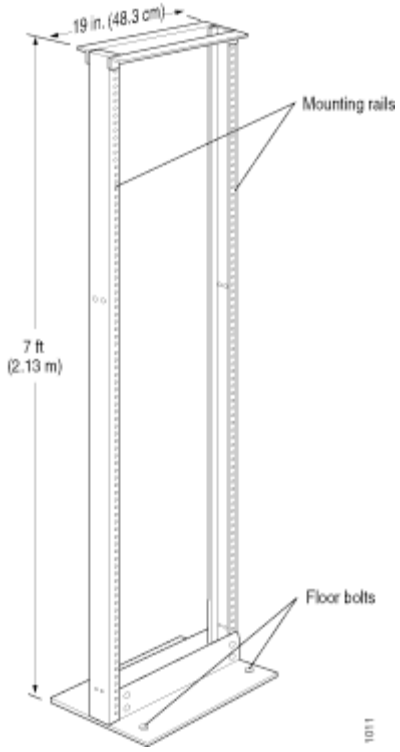
In general, a center-mount rack is preferable to a front-mount rack because the more even distribution of weight in the center-mount rack provides greater stability.

For instructions about installing the mounting hardware, see "Installing the MX480 Router Mounting Hardware for a Rack or Cabinet" on page 239.

The chassis height of 14.0 in. (35.6 cm) is approximately 8 U. 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). You can stack five MX480 routers in a rack that has at least 48 U (84 in. or 2.13 m) of usable vertical space.

The rack must be strong enough to support the weight of the fully configured router, up to 163.5 lb (74.2 kg). If you stack five fully configured routers in one rack, it must be capable of supporting up to 818 lb (371.0 kg).

Figure 49: Typical Open-Frame Rack



Spacing of Mounting Bracket Holes

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

Connection to Building Structure

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

SEE ALSO

> *Installation Safety Warnings for Juniper Networks Devices*

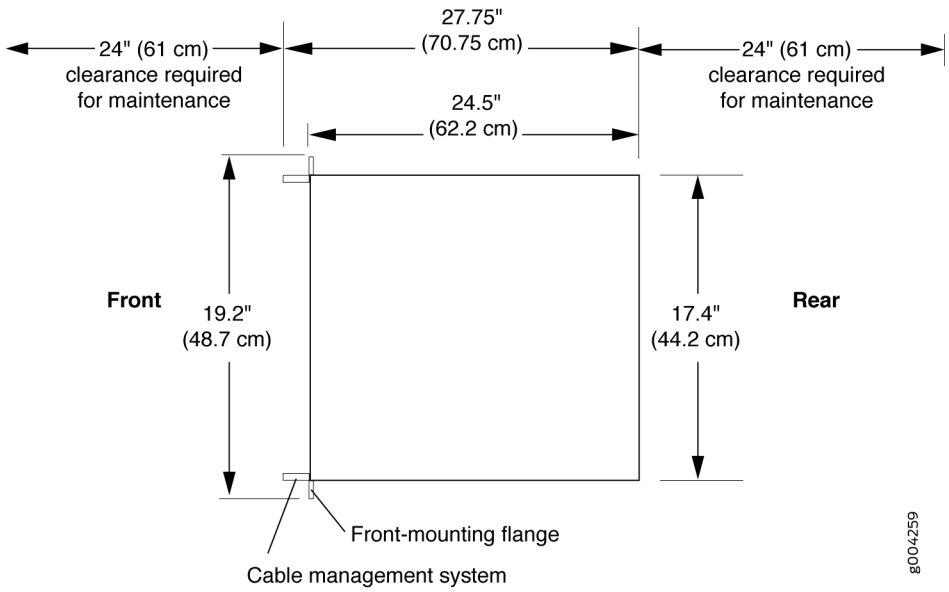
MX480 Router Clearance Requirements for Airflow and Hardware Maintenance

When planning the installation site, you need to allow sufficient clearance around the rack (see Figure 50 on page 205):

- For the cooling system to function properly, the airflow around the chassis must be unrestricted. Allow at least 8 in. (20.3 cm) of clearance between side-cooled routers. Allow 5.5 in. (14 cm) between the side of the chassis and any non-heat-producing surface such as a wall.
- For service personnel to remove and install hardware components, there must be adequate space at the front and back of the router. At least 24 in. (61 cm) is required both in front of and behind the router. NEBS GR-63 recommends that you allow at least 30 in. (72.6 cm) in front of the rack and 24 in. (61.0 cm) behind the rack.

  Airflow must always be from front to back with respect to the rack. If the device has side to rear airflow, then provisions must be made to ensure that fresh air from the front of the rack is supplied to the inlets, and exhaust exits the rear of 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.

Figure 50: Clearance Requirements for Airflow and Hardware Maintenance for an MX480 Router Chassis



SEE ALSO

Installation Safety Warnings for Juniper Networks Devices

MX480 Router Cabinet Size and Clearance Requirements

The minimum size cabinet that can accommodate the router is 482 mm wide and 800 mm deep. A cabinet larger than the minimum requirement provides better airflow and reduces the chance of overheating. To accommodate a single router, the cabinet must be at least 13 U high. If you provide adequate cooling air and airflow clearance, you can stack five routers in a cabinet that has at least 48 U (84 in. or 2.13 m) of usable vertical space.

The minimum front and rear clearance requirements depend on the mounting configuration you choose. The minimum total clearance inside the cabinet is 30.7 in. between the inside of the front door and the inside of the rear door.

SEE ALSO

Installation Safety Warnings for Juniper Networks Devices

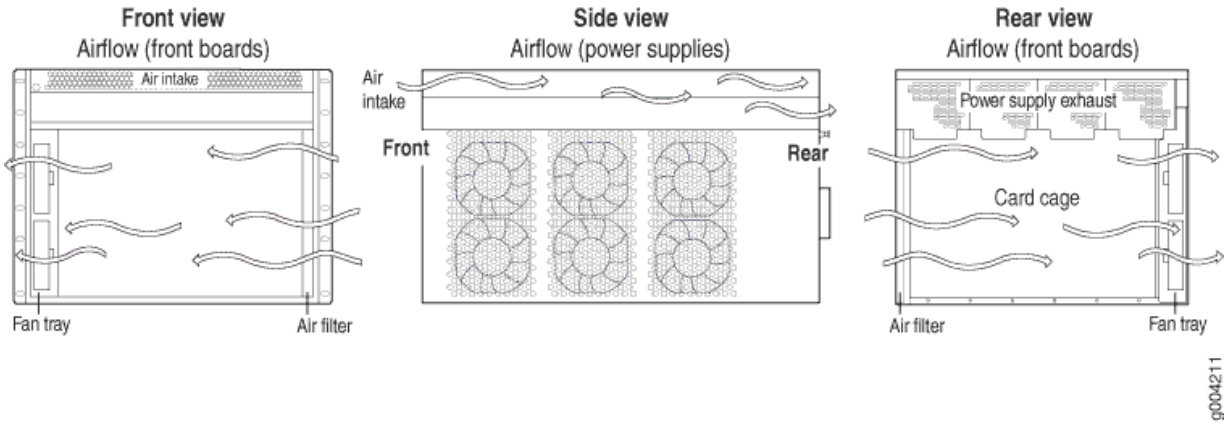
MX480 Router Cabinet Airflow Requirements

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 207.
- 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



SEE ALSO

MX480 Site Preparation Checklist | **193**

Installation Safety Warnings for Juniper Networks Devices

MX480 Power Planning

IN THIS SECTION

- Power Requirements for an MX480 Router | **207**
- Calculating Power Requirements for MX480 Routers | **219**

Power Requirements for an MX480 Router

The following tables list the MX480 component power requirements. Table 90 on page 208 lists the MX480 base system power requirements. Table 91 on page 208 lists the Switch Control Board (SCB) power requirements. Table 92 on page 209 lists the FRU power requirements for Routing Engines,

Modular Port Concentrators (MPCs), Modular Interface Cards (MICs), and Dense Port Concentrators (DPCs).

Table 90: MX480 Router Common Component Power Requirements

Component	Power Requirement (Watts)
Base system	40 W
Normal-capacity cooling system	110 W
High-capacity cooling system	160 W

NOTE: The power for the cooling system comes from a different tap on the power supply, reserved for the cooling system only. The cooling system power requirement does not need to be deducted from the output power budget of the power supply.

Table 91: Power Requirements for MX480 SCBs

Component	Ambient Temperature	Maximum Power Requirement
SCB-MX	131° F (55° C) 104° F (40° C) 77° F (25° C)	185 W 160 W 155 W
SCBE-MX	131° F (55° C) 104° F (40° C) 77° F (25° C)	160 W 130 W 120 W
SCBE2-MX	131° F (55° C) 104° F (40° C) 77° F (25° C)	185 W 160 W 155 W

Table 91: Power Requirements for MX480 SCBs *(Continued)*

Component	Ambient Temperature	Maximum Power Requirement
SCBE3-MX	131° F (55° C) 104° F (40° C) 77° F (25° C)	295 W (SCB 0 (Primary); 425 W SCB 1 (Backup) 200 W (SCB 0 (Primary); 400 W SCB 1 (Backup) 265 W (SCB 0 (Primary); 385 W SCB 1 (Backup)

Table 92: 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 92: 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 92: 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 92: 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 92: 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)

Table 92: FRU Power Requirements *(Continued)*

Component	Part Number	Maximum Power Requirement
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
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

Table 92: FRU Power Requirements *(Continued)*

Component	Part Number	Maximum Power Requirement
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)
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)

Table 92: FRU Power Requirements *(Continued)*

Component	Part Number	Maximum Power Requirement
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)		

Table 92: FRU Power Requirements *(Continued)*

Component	Part Number	Maximum Power Requirement
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
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

Table 92: FRU Power Requirements *(Continued)*

Component	Part Number	Maximum Power Requirement
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)

SEE ALSO

DC Power Supply Electrical Specifications for MX240 and MX480 | **42**

AC Electrical Specifications for the MX480 Router | **31**

Calculating Power Requirements for MX480 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 power is calculated. Finally, you calculate the thermal output. A sample configuration is provided in Table 94 on page 220.

We recommend that you provision power according to the maximum input current listed in the power supply electrical specifications (see "AC Electrical Specifications for the MX480 Router" on page 31and "DC Power Supply Electrical Specifications for MX240 and MX480" on page 42).

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 MX480 chassis with DC power supplies are zoned, meaning that certain components are powered by specific power supplies (see Table 93 on page 219 for information on zoning). When calculating power requirements, be sure that there is adequate power for each zone.

For an AC-powered chassis, there is one overall zone. Two AC power supplies are mandatory for high-line, and three AC power supplies are mandatory for low-line power.

Table 93: MX480 DC Zoning

Zone	Power Supply (PEM)	Components Receiving Power
Zone 0	PEM 0 or 2	• Fan Tray • DPC/MPC slots 0 and 1 • SCB slots 0 and 1
Zone 1	PEM 1 or 3	• Fan Tray • DPC slots 2 through 5

The following sample configuration shows a DC-powered MX480 with:

- Two 16-port 10-Gigabit Ethernet MPCs with SFP+(slots 0 and 1)
- Two SCBs with two (redundant) RE-1800x2 routing engines (SCB slot 0 and SCB slot 1)
- One DPCE-R-4XGE-XFP (slot 3)
- High-capacity cooling system

> **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 MX480 Router" on page 207 as shown in Table 94 on page 220.

Table 94: Sample Power Requirements for an MX480 Router

Chassis Component	Part Number	Power Requirement	Zone
Base system	MX480BASE-DC-HIGH	40 W	Zone 0 and Zone 1
High-capacity cooling system	FFANTRAY-MX480-HC	160 W	Zone 0 and Zone 1
MPC - Slot 2	MPC-3D-16XGE-SFPP-R-B	440 W	Zone 1
MPC - Slot 1	MPC-3D-16XGE-SFPP-R-B	440 W	Zone 0
SCB 1	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 0
SCB 0	SCBE2 with RE-S-1800X2-8G	185 W 90 W	Zone 0

Table 94: Sample Power Requirements for an MX480 Router *(Continued)*

Chassis Component	Part Number	Power Requirement	Zone
DPC - Slot 3	DPCE-R-4XGE-XFP	310 W	Zone 1
Zone 0 total output power Zone 1 total output power		1090 W 850 W	
Zone 0 total output power (excluding cooling system) Zone 1 total output power (excluding cooling system)		1010 W 770 W	

2. Evaluate the power budget. In the case of a DC-powered chassis, evaluate the budget for each zone. In this step, we check the required power against the maximum output power of available power supply options.

> **NOTE**: The power for the cooling system comes from a different tap on the power supply, reserved for the cooling system only. The cooling system power requirement does not need to be deducted from the output power budget of the power supply.

Table 95 on page 221 lists the power supplies, their maximum output power, and unused power (or a power deficit) for MX480 AC chassis.Table 96 on page 222 lists the power supplies, their maximum output power, and unused power (or a power deficit) for MX480 DC chassis. See "AC Electrical Specifications for the MX480 Router" on page 31 and "DC Power Supply Electrical Specifications for MX240 and MX480" on page 42 for more information about the MX480 power supply electrical specifications.

Table 95: Calculating Power Budget for a MX480 AC Chassis

Power Supply	Maximum System Output Power	Unused Power[1]
MX480 AC Normal-capacity (low-line)	3081 W	2071 W

Table 95: Calculating Power Budget for a MX480 AC Chassis *(Continued)*

Power Supply	Maximum System Output Power	Unused Power[1]
MX480 AC Normal-capacity (high-line)	3200 W	2190 W
MX480 AC High-capacity (low-line)	3501 W	2491 W
MX480 AC High-capacity (high-line)	4100 W	3090 W

[1] For this configuration, output power excluding the cooling system is 1360 W.

Table 96: Calculating Power Budget for a MX480 DC Chassis

Power Supply	Maximum System Output Power	Zone 0 Unused Power[1]	Zone 1 Unused Power[2]
MX480 DC Normal-capacity	3200 W	2190 W	2430 W
MX480 DC High-capacity (DIP=0) **NOTE**: The DIP switch position is expected input current; the correct feeds must be present to obtain the desired output power.	4800 W	3790 W	4030 W
MX480 DC High-capacity (DIP=1) **NOTE**: The DIP switch position is expected input current; the correct feeds must be present to obtain the desired output power.	5200 W	4190W	4430W

[1] For this configuration, output power excluding the cooling system is 1010 W.

[2] For this configuration, output power excluding the cooling system is 770 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 97 on page 223.

Table 97: Calculating Input Power Examples

Power Supply	Power Supply Efficiency[1]	Input Power Requirement[2]
MX480 AC Normal-capacity (high-line)	85 %	1282 W
MX480 AC High-capacity (high-line)	89 %	1225 W
MX480 DC Normal-capacity	~98 %	1112 W[3]
MX480 DC High-capacity	~98 %	1112 W[3]

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

[2] For this configuration, total power is 1090 W.

[3] Zone 0 requirement.

4. Calculate thermal output (BTUs). To calculate this, multiply the input power requirement (in watts) by 3.41.

Table 98: Calculating Thermal Output

Power Supply	Thermal Output (BTUs per hour)
MX480 AC Normal-capacity (high-line)	1282 * 3.41 = 4372 BTU/hr
MX480 AC High-capacity (high-line)	1225 * 3.41 = 4177 BTU/hr
MX480 DC Normal-capacity	1112 * 3.41 = 3792 BTU/hr[1]
MX480 DC High-capacity	1112 * 3.41 = 3792 BTU/hr[1]

[1] Zone 0 output.

SEE ALSO

AC Electrical Specifications for the MX480 Router | 31

DC Power Supply Electrical Specifications for MX240 and MX480 | 42

MX480 Network Cable and Transceiver Planning

IN THIS SECTION

- Calculating Power Budget and Power Margin for Fiber-Optic Cables | 224
- Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion | 227
- Routing Engine Interface Cable and Wire Specifications for MX Series Routers | 228

Calculating Power Budget and Power Margin for Fiber-Optic Cables

IN THIS SECTION

- How to Calculate Power Budget for Fiber-Optic Cables | 225
- How to Calculate Power Margin for Fiber-Optic Cables | 225

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 Cables

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

$P_B = P_T - P_R$

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

$P_B = P_T - P_R$

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

$P_B = 13 \text{ dB}$

How to Calculate Power Margin for Fiber-Optic Cables

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 99 on page 225 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 99: 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

Table 99: Estimated Values for Factors Causing Link Loss *(Continued)*

Link-Loss Factor	Estimated Link-Loss Value
Modal and chromatic dispersion	Single mode—None Multimode—None, if product of bandwidth and distance is less than 500 MHz-km
Faulty 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 99 on page 225. This example calculates 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 99 on page 225. This example calculates 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.

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

IN THIS SECTION

- Signal Loss in Multimode and Single-Mode Fiber-Optic Cables | 227
- Attenuation and Dispersion in Fiber-Optic Cable | 227

To determine the power budget and power margin needed for fiber-optic connections, you need to understand how signal loss, attenuation, and dispersion affect transmission. The MX10008 router uses various types of network cables, including multimode and single-mode fiber-optic cables.

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

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 light sources. They spray varying wavelengths of light into the multimode fiber, which reflect 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 (layers of lower refractive index material in close contact with a core material of higher refractive index), higher-order mode loss occurs. Together, these factors reduce the transmission distance of multimode fiber compared to that of single-mode fiber.

Single-mode fiber is so small in diameter that rays of light 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 to multimode fiber, single-mode fiber has a higher bandwidth and can carry signals for longer distances. It is consequently more expensive.

Attenuation and Dispersion in Fiber-Optic Cable

An optical data link functions correctly provided that modulated light reaching the receiver has enough power to be demodulated correctly. *Attenuation* is the reduction in strength of the light signal during

transmission. Passive media components such as cables, cable splices, and connectors cause attenuation. 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 transmit enough light to overcome attenuation.

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

- Chromatic dispersion, which is the spreading of the signal over time caused by the different speeds of light rays.
- Modal dispersion, which is the spreading of the signal over time caused by 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 limits the 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 within the limits specified for the type of link in the 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 100 on page 229 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 100: 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	—

MX480 Management, and Console Port Specifications and Pinouts

IN THIS SECTION

- RJ-45 Connector Pinouts for an MX Series Routing Engine ETHERNET Port | **230**
- RJ-45 Connector Pinouts for MX Series Routing Engine AUX and CONSOLE Ports | **230**

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 101 on page 230 describes the RJ-45 connector pinout.

Table 101: RJ-45 Connector Pinout for the Routing Engine ETHERNET Port

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

RJ-45 Connector Pinouts for 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 102 on page 231 describes the RJ-45 connector pinout.

Table 102: RJ-45 Connector Pinout for the AUX and CONSOLE Ports

Pin	Signal	Description
1	RTS	Request to Send
2	DTR	Data Terminal Ready
3	TXD	Transmit Data
4	Ground	Signal Ground
5	Ground	Signal Ground
6	RXD	Receive Data
7	DSR/DCD	Data Set Ready
8	CTS	Clear to Send

CHAPTER 3

Initial Installation and Configuration

Installing an MX480 Router Overview | 233

Unpacking the MX480 | 234

Installing the MX480 | 238

Connecting the MX480 to Power | 271

Connecting the MX480 to the Network | 285

Initially Configuring the MX480 Router | 291

Installing an MX480 Router Overview

To install the router:

1. Prepare the installation site.

   See "MX480 Site Preparation Checklist" on page 193.
2. Review the safety guidelines and warnings.
   - *General Safety Guidelines for Juniper Networks Devices*
   - *General Safety Warnings for Juniper Networks Devices*
3. Unpack the router and verify that all parts have been received.
   a. See "Unpacking the MX480 Router" on page 234.
   b. See "Verifying the MX480 Router Parts Received" on page 236.
4. Install the mounting hardware.

   See "Installing the MX480 Router Mounting Hardware for a Rack or Cabinet" on page 239.
5. Install the router.

   See "Installing the MX480 Router Using a Mechanical Lift" on page 249.
6. Connect cables to external devices.

   See Connecting the MX480 Router to Management and Alarm Devices.
7. Connect the grounding cable.

   See "Grounding the MX480 Router" on page 272.
8. Connect the power cables.
   - "Connecting Power to an AC-Powered MX480 Router with Normal-Capacity Power Supplies" on page 273
   - "Connecting Power to a DC-Powered MX480 Router with Normal Capacity Power Supplies" on page 276
9. Power on the router.
   - "Powering On an AC-Powered MX480 Router" on page 275
   - "Powering On a DC-Powered MX480 Router with Normal Capacity Power Supplies" on page 279
10. Perform the initial system configuration.

    See "Initially Configuring the MX480 Router" on page 291.

Unpacking the MX480

IN THIS SECTION

- Tools and Parts Required to Unpack the MX480 Router | 234
- Unpacking the MX480 Router | 234
- Verifying the MX480 Router Parts Received | 236

Tools and Parts Required to Unpack the MX480 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

Unpacking the MX480 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.

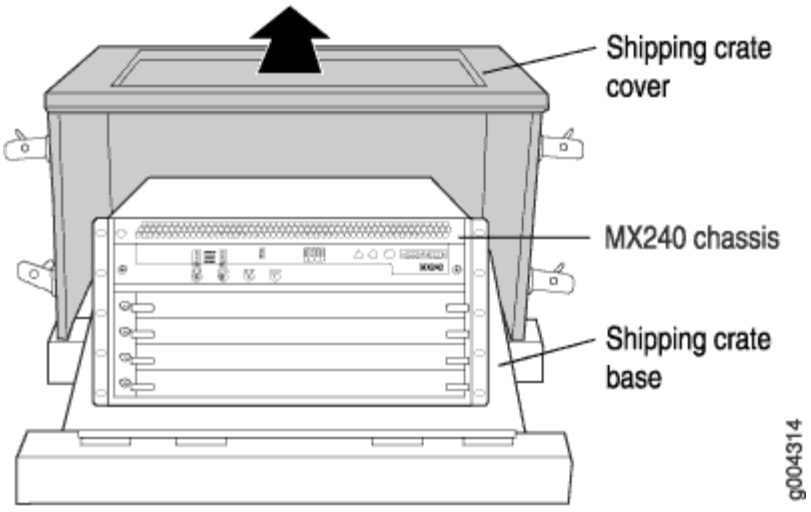
The shipping container measures 21 in. (53.3 cm) high, 23.5 in. (60.0 cm) wide, and 32.5 in. (82.5 cm) deep. The total weight of the container containing the router and accessories can range from 93 lb (42.2 kg) to 169 lb (76.7 kg).

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 52 on page 235):

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 52: Contents of the Shipping Crate



Verifying the MX480 Router Parts Received

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

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

A fully configured router contains the router chassis with installed components, listed in Table 103 on page 236, and an accessory box, which contains the parts listed in Table 104 on page 237. The parts shipped with your router can vary depending on the configuration you ordered.

Table 103: Parts List for a Fully Configured Router

Component	Quantity
Chassis, including midplane, craft interface, and center-mounting brackets	1
DPCs	Up to 6
FPCs	Up to 3
MPCs	Up to 6
MICs	Up to 12
PICs	Up to 6
Routing Engines	1 or 2
SCBs	1 or 2
Power supplies	Up to 4
Fan tray	1
Air filter	1

Table 103: Parts List for a Fully Configured Router *(Continued)*

Component	Quantity
Air filter tray	1
Quick start installation instructions	1
Small mounting shelf	1
Blank panels for slots without components installed	One blank panel for each slot not occupied by a component

Table 104: Accessory Box Parts List

Part	Quantity
Screws to mount chassis and small shelf	22
DC power terminal Lugs, 6-AWG	9
RJ-45-to-DB-9 cable to connect the router through the serial port	1
Cable management brackets	2
Terminal block plug, 3–pole, 5.08 mm spacing, 12A, to connect the router alarms	2
Label, accessories contents, MX480	1
USB flash drive with Junos OS	1
Read me first document	1
Affidavit for T1 connection	1

Table 104: Accessory Box Parts List *(Continued)*

Part	Quantity
Juniper Networks Product Warranty	1
End User License Agreement	1
Document sleeve	1
3 in. x 5 in. pink bag	2
9 in. x 12 in. pink bag, ESD	2
Accessory Box, 19 in. x 12 in. x 3 in.	1
Ethernet cable, RJ-45/RJ-45, 4-pair stranded UTP, Category 5E, 15'	1
ESD wrist strap with cable	1

Installing the MX480

IN THIS SECTION

- Installing the MX480 Router Mounting Hardware for a Rack or Cabinet | **239**
- Moving the Mounting Brackets for Center-Mounting the MX480 Router | **242**
- Tools Required to Install the MX480 Router with a Mechanical Lift | **243**
- Removing Components from the MX480 Router Before Installing It with a Lift | **243**
- Installing the MX480 Router Using a Mechanical Lift | **249**
- Reinstalling Components in the MX480 Router After Installing It with a Lift | **251**

- Tools Required to Install the MX480 Router Without a Mechanical Lift | **256**
- Removing Components from the MX480 Router Before Installing It Without a Lift | **257**
- Installing the MX480 Chassis in the Rack Manually | **262**
- Reinstalling Components in the MX480 Router After Installing It Without a Lift | **265**
- Installing the MX480 Router Cable Management Bracket | **270**

Installing the MX480 Router Mounting Hardware for a Rack or Cabinet

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

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

Table 105 on page 239 specifies the holes in which you insert cage nuts and screws to install the mounting hardware required (an **X** indicates a mounting hole location). The hole distances are relative to one of the standard U divisions on the rack. The bottom of all mounting shelves is at 0.04 in. (0.02 U) above a “U” division.

Table 105: Four-Post Rack or Cabinet Mounting Hole Locations

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

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

1. If needed, install cage nuts in the holes specified in Table 105 on page 239.

2. On the back of each rack rail, partially insert a mounting screw into the lowest hole specified in Table 105 on page 239.
3. Install the small shelf on the back of the rack rails. Rest the bottom slot of each flange on a mounting screw.
4. Partially insert the remaining screws into the open holes in each flange of the small shelf (see Figure 53 on page 241 or Figure 54 on page 242).

5. Tighten all the screws completely.

Figure 53: Installing the Front-Mounting Hardware for a Four-Post Rack or Cabinet

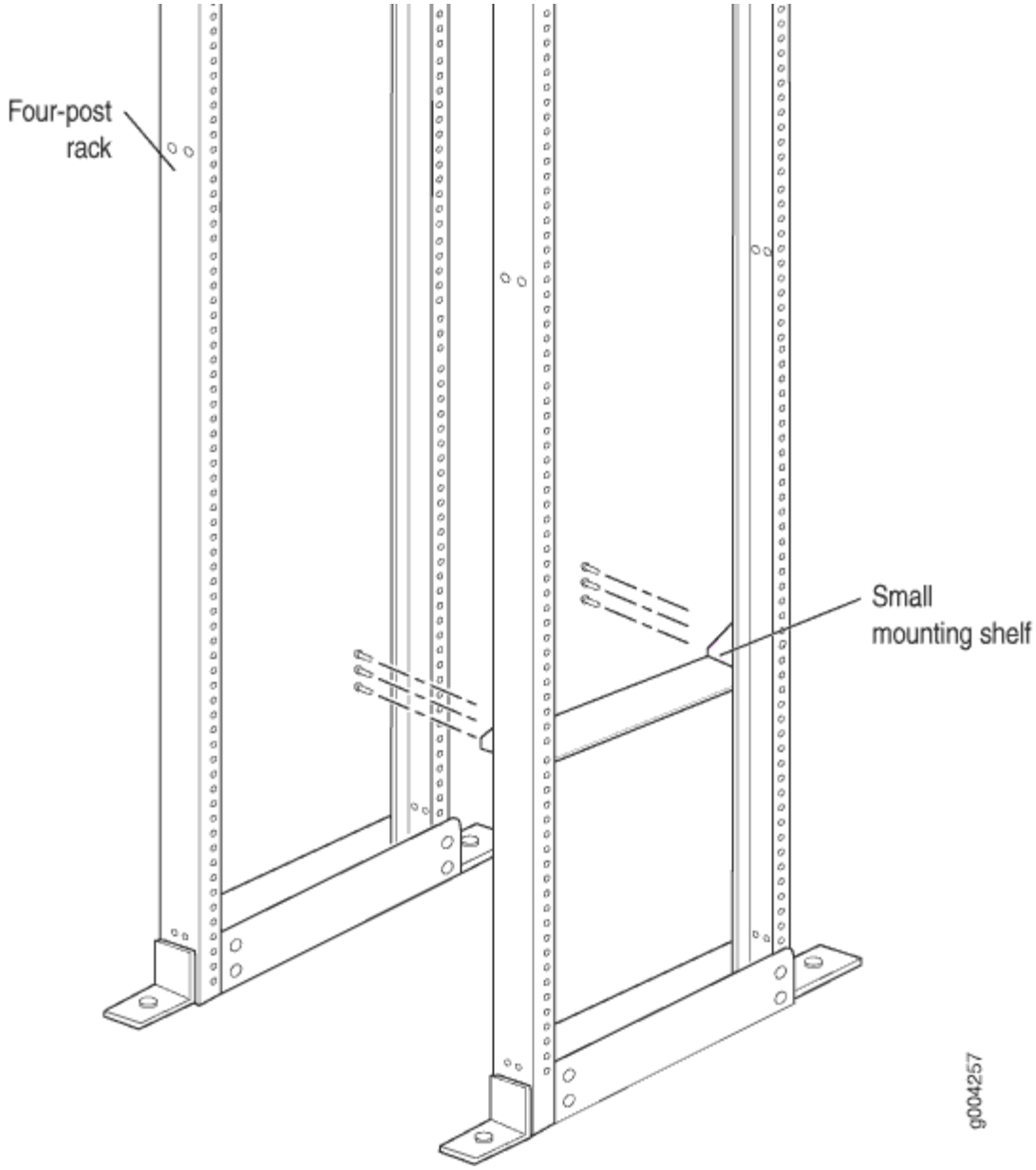
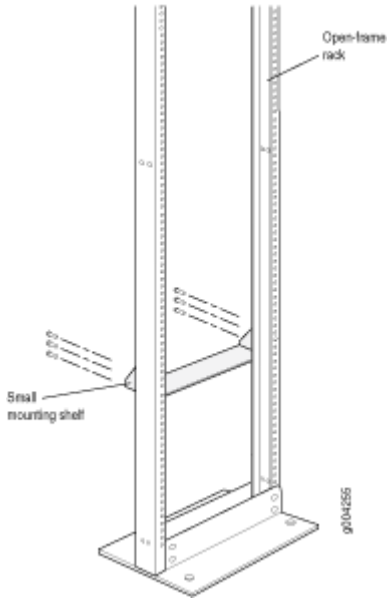


Figure 54: Installing the Mounting Hardware for an Open-Frame Rack



Moving the Mounting Brackets for Center-Mounting the MX480 Router

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

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

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

   There is no mounting hole in the center of the chassis that corresponds to the hole in the center of the bracket.
6. Insert the two screws at the top of the bracket and tighten each partially.

   Two screws are needed for mounting the bracket on the center of the chassis. You do not need the third screw.
7. Tighten the two screws completely.
8. Repeat the procedure for the other bracket.

Tools Required to Install the MX480 Router with a Mechanical Lift

To install the router, you need the following tools:

- Mechanical lift
- Phillips (+) screwdrivers, numbers 1 and 2
- 7/16-in. (11 mm) nut driver
- ESD grounding wrist strap

Removing Components from the MX480 Router Before Installing It with a Lift

IN THIS SECTION

- Removing the Power Supplies Before Installing the MX480 Router with a Lift | 243
- Removing the Fan Tray Before Installing the MX480 Router with a Lift | 244
- Removing the SCBs Before Installing the MX480 Router with a Lift | 245
- Removing the DPCs Before Installing the MX480 Router with a Lift | 246
- Removing the FPCs Before Installing the MX480 Router with a Lift | 247

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

Removing the Power Supplies Before Installing the MX480 Router with a Lift

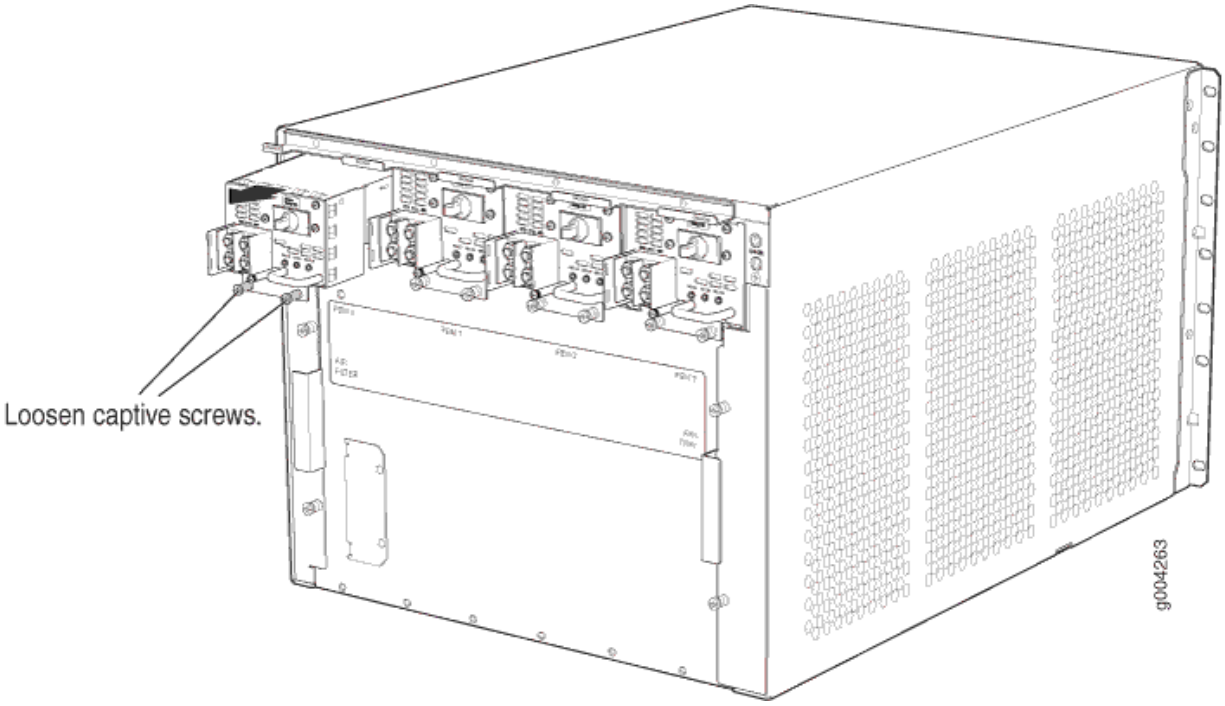
Remove the leftmost power supply first and then work your way to the right. To remove the AC or DC power supplies for each power supply (see Figure 3):

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, switch the AC input switch on each power supply to the off (O) position. On a DC-powered router, Move the DC circuit breaker on each DC power supply to the off (O) position.

   We recommend this even though the power supplies are not connected to power sources.
3. Loosen the captive screws on the bottom edge of the power supply faceplate.
4. Pull the power supply straight out of the chassis.

Figure 55: Removing a Power Supply Before Installing the Router



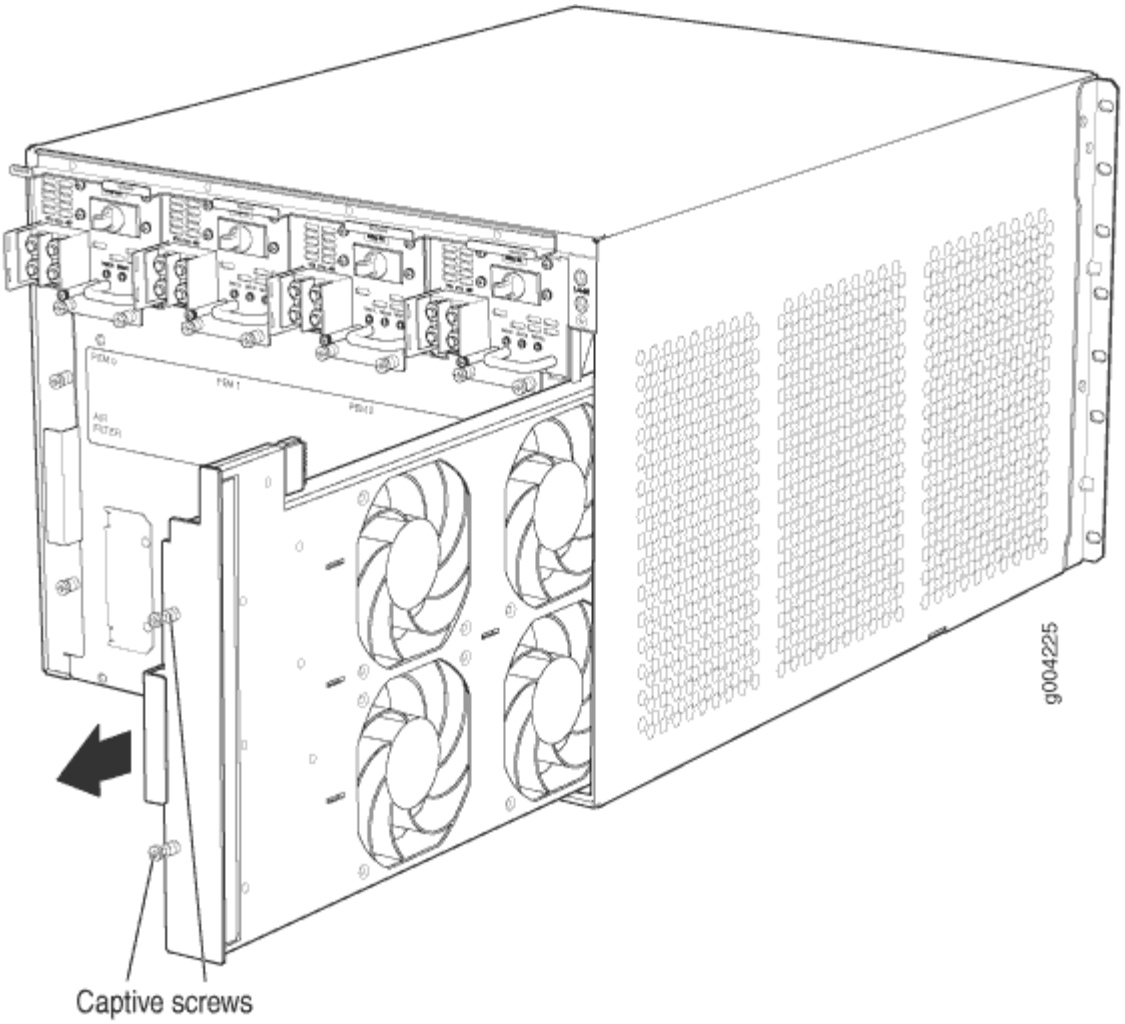
Removing the Fan Tray Before Installing the MX480 Router with a Lift

To remove the fan tray (see Figure 56 on page 245):

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 screws on the fan tray faceplate.
3. Grasp the fan tray handle, and pull it out approximately 1 to 3 inches.
4. Press the latch located on the inside of the fan tray to release it from the chassis.

5. Place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.

Figure 56: Removing the Fan Tray



Removing the SCBs Before Installing the MX480 Router with a Lift

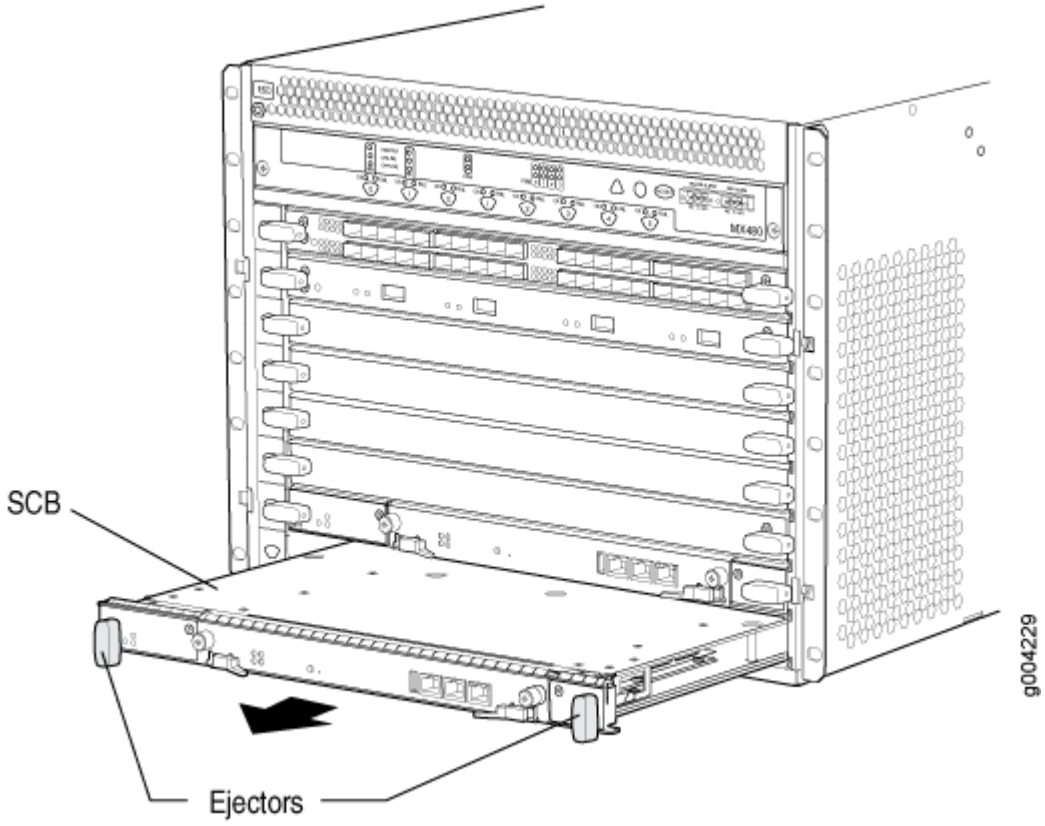
To remove the SCBs (see Figure 57 on page 246):

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 57: Removing an SCB



Removing the DPCs Before Installing the MX480 Router with a Lift

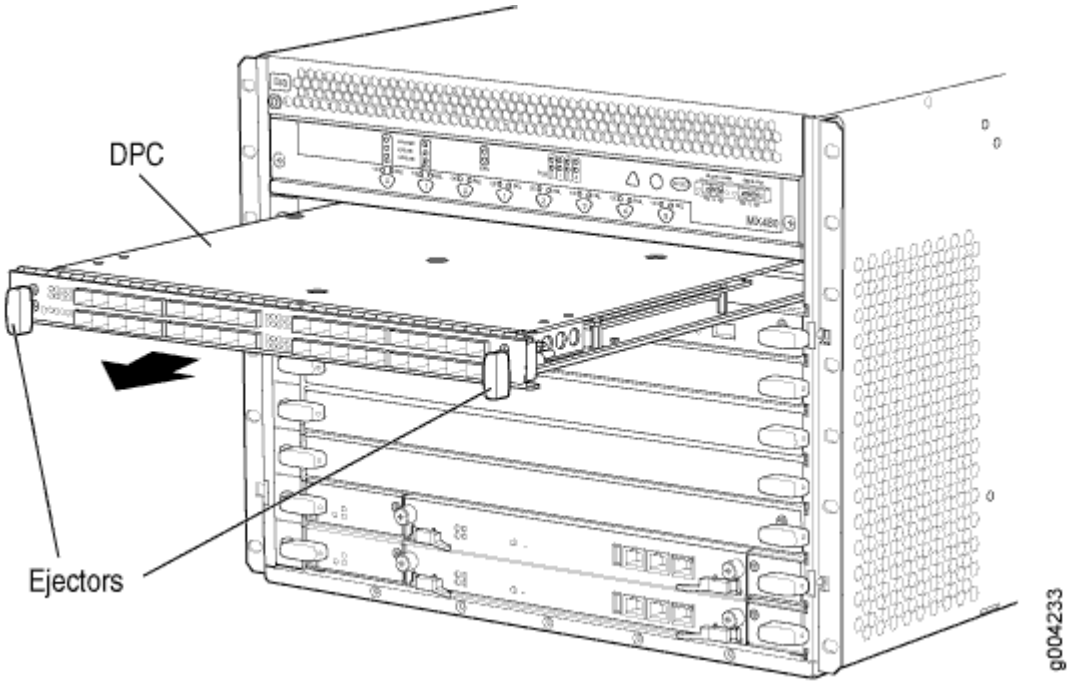
To remove a DPC (see Figure 58 on page 247):

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 58: Removing a DPC



Removing the FPCs Before Installing the MX480 Router with a Lift

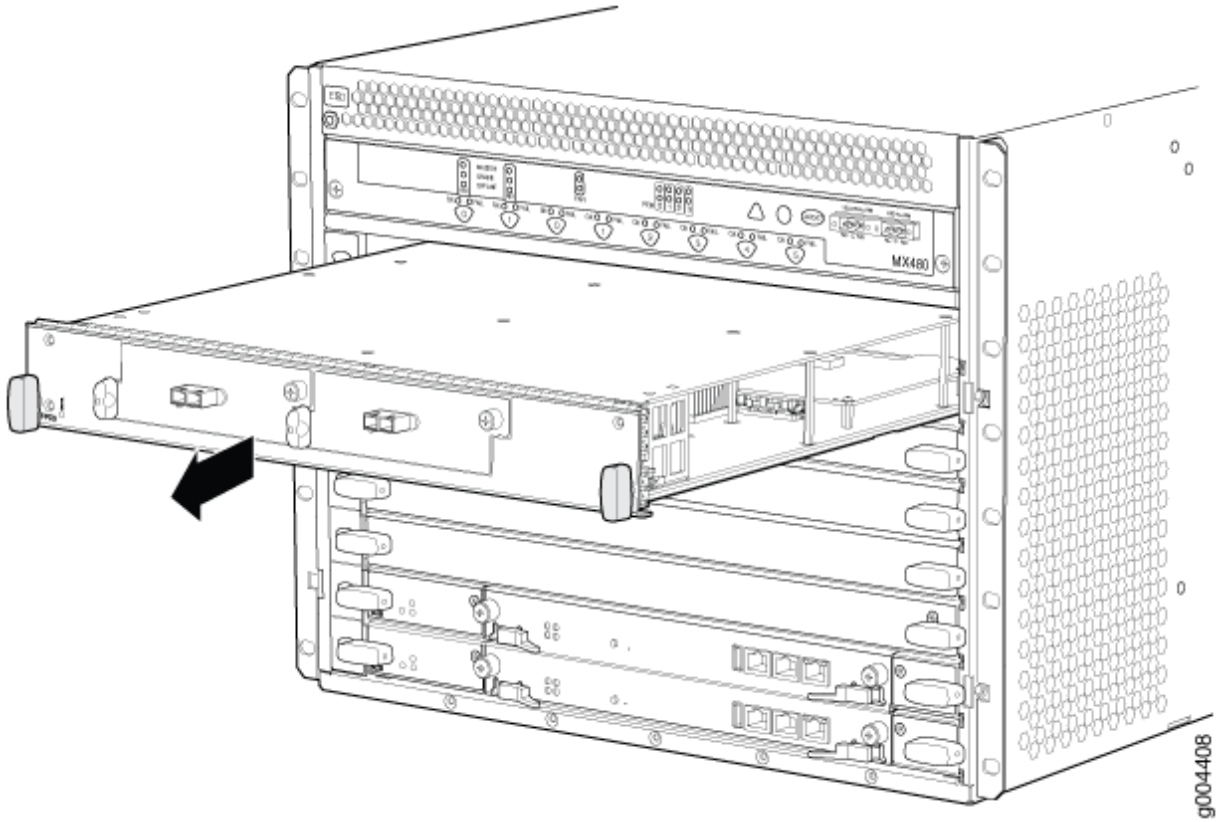
To remove an FPC (see Figure 59 on page 248):

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 59: Removing an FPC



Installing the MX480 Router Using a Mechanical Lift

Because of the router's size and weight—up to 163.5 lb (74.2 kg) depending on the configuration—we strongly recommend that you install the router using a mechanical lift. To make the router light enough to install with a lift, you must first remove most components from the chassis.



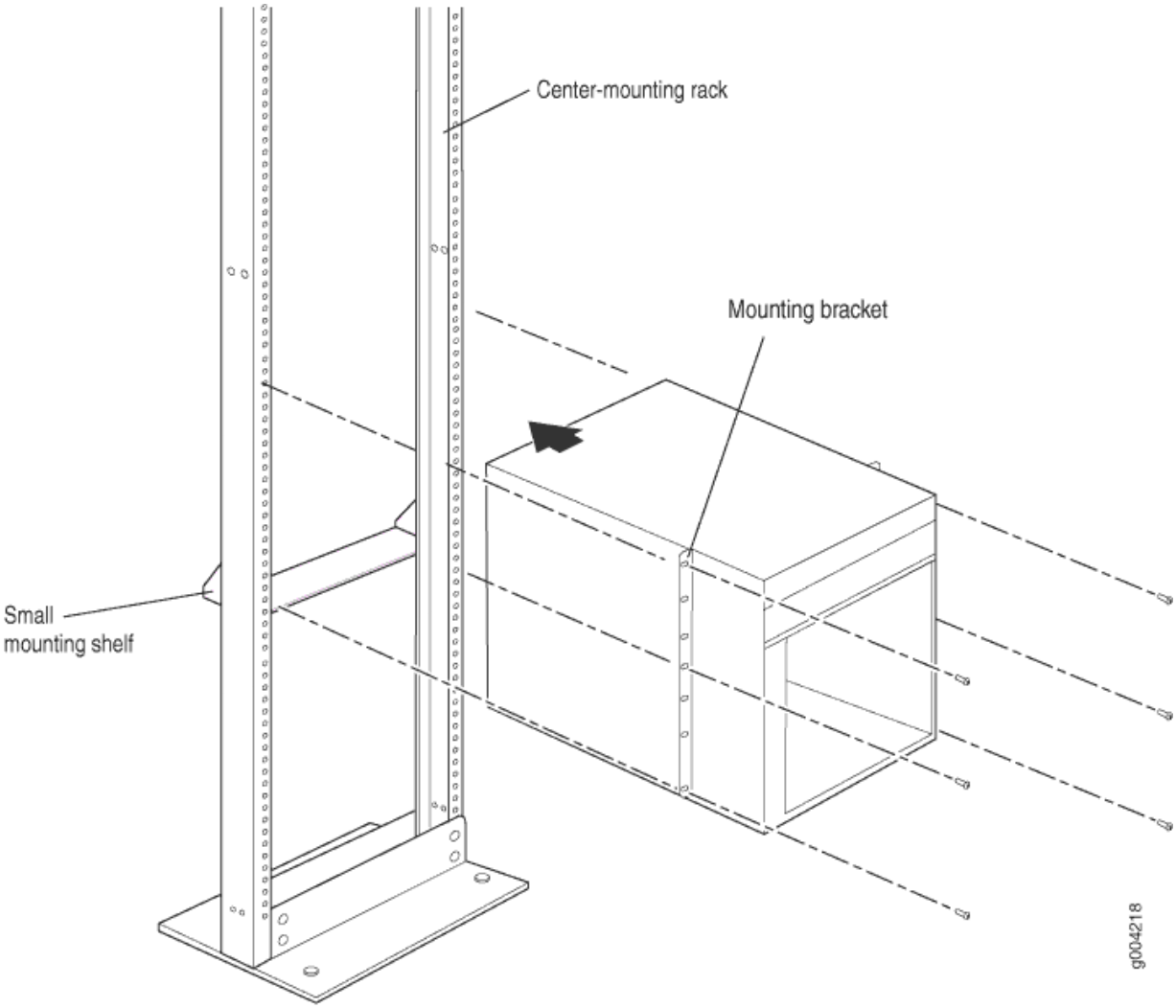
CAUTION: Before front mounting the router in a rack, have a qualified technician verify that the rack is strong enough to support the router's weight and is adequately supported at the installation site.

To install the router using a lift (see Figure 60 on page 250):

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 shelf until the mounting brackets contact the rack rails. The shelf ensures that the holes in the mounting brackets of the chassis align with the holes in the rack rails.
7. Move the lift away from the rack.
8. Install a mounting screw into each of the open mounting holes aligned with the rack, starting from the bottom.

9. Visually inspect the alignment of the router. If the router is installed properly in the rack, all the mounting screws on one side of the rack should be aligned with the mounting screws on the opposite side and the router should be level.

Figure 60: Installing the Router in the Rack



NOTE: This illustration depicts the router being installed in an open-frame rack. For an illustration of the mounting hardware required for a four-post rack or cabinet.

SEE ALSO

MX480 Site Preparation Checklist | 193

Preventing Electrostatic Discharge Damage to an MX480 Router | 508

Reinstalling Components in the MX480 Router After Installing It with a Lift

IN THIS SECTION

- Reinstalling the Power Supplies After Installing the MX480 Router with a Lift | 251
- Reinstalling the Fan Tray After Installing the MX480 Router with a Lift | 252
- Reinstalling the SCBs After Installing the MX480 Router with a Lift | 253
- Reinstalling the DPCs After Installing the MX480 Router with a Lift | 254
- Reinstalling the FPCs After Installing the MX480 Router with a Lift | 255

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

Reinstalling the Power Supplies After Installing the MX480 Router with a Lift

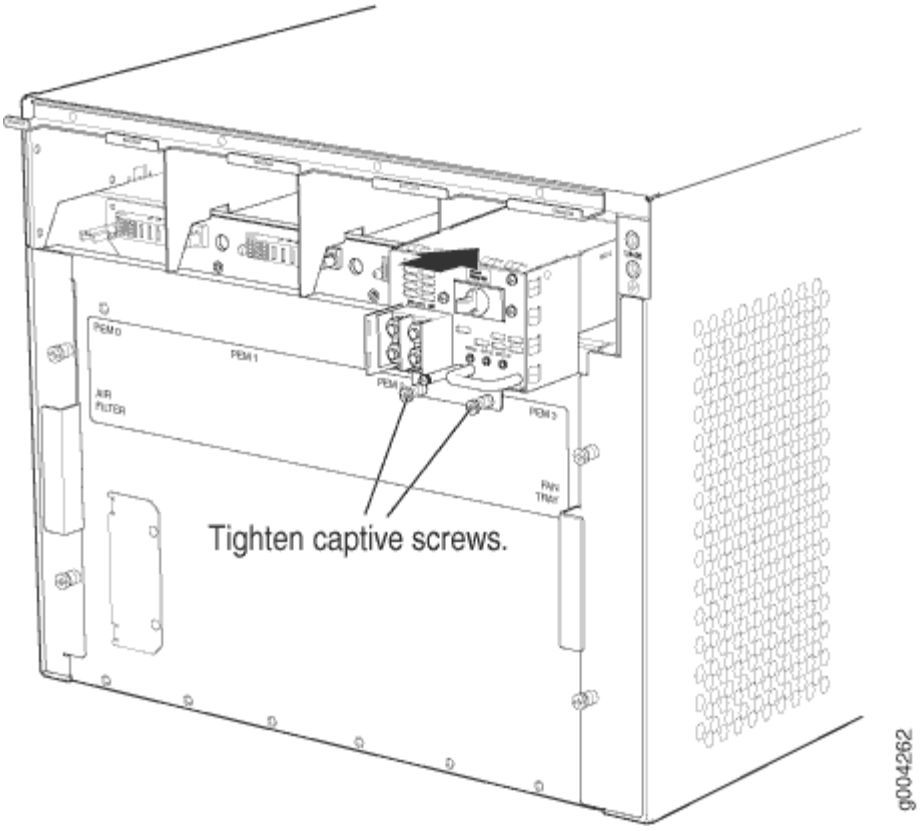
Reinstall the rightmost power supply first and then work your way to the left. To reinstall the AC or DC power supplies, follow this procedure for each power supply (see Figure 9, which shows the installation of the DC power supplies):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. On an AC-powered router, switch the AC input switch on each power supply to the off (**O**) position. On a DC-powered router, Move the DC circuit breaker on each DC power supply to the off (**O**) position.

   We recommend this even though the power supplies are not connected to power sources.
3. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplate or blank installed in the power supply slot.

4. Tighten the captive screws.

Figure 61: Reinstalling a Power Supply



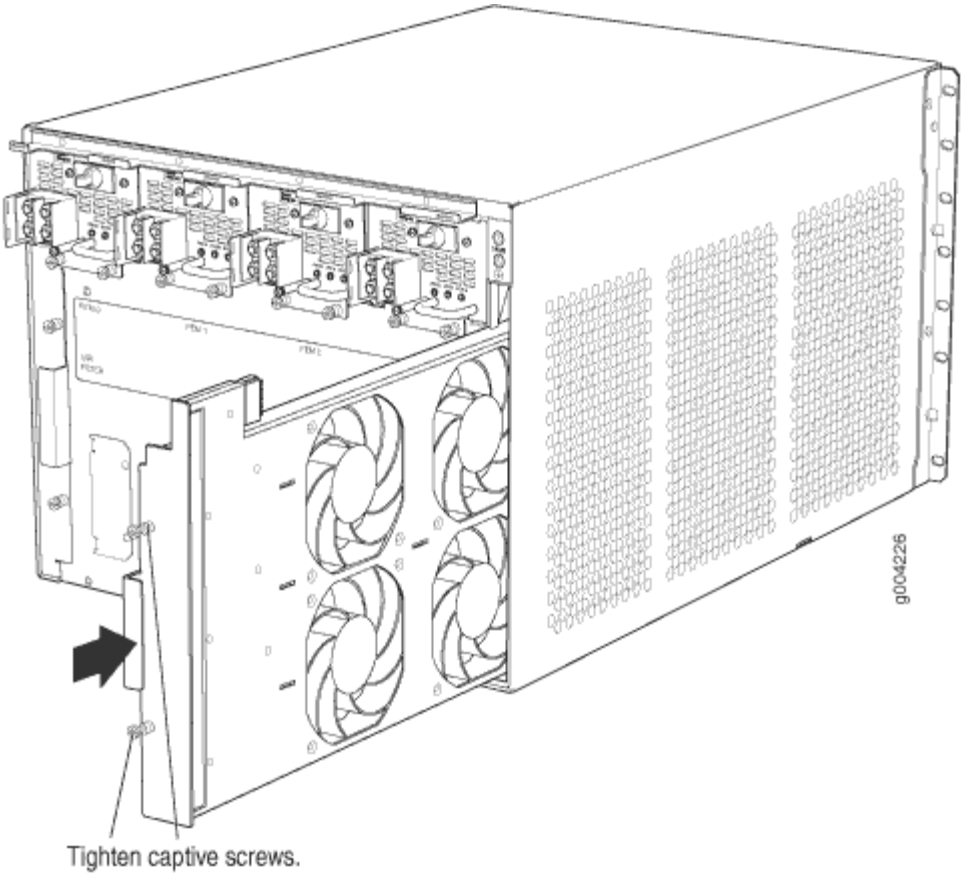
Reinstalling the Fan Tray After Installing the MX480 Router with a Lift

To reinstall the fan tray (see Figure 62 on page 253):

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 the fan tray faceplate to secure it in the chassis.

Figure 62: Reinstalling a Fan Tray



Reinstalling the SCBs After Installing the MX480 Router with a Lift

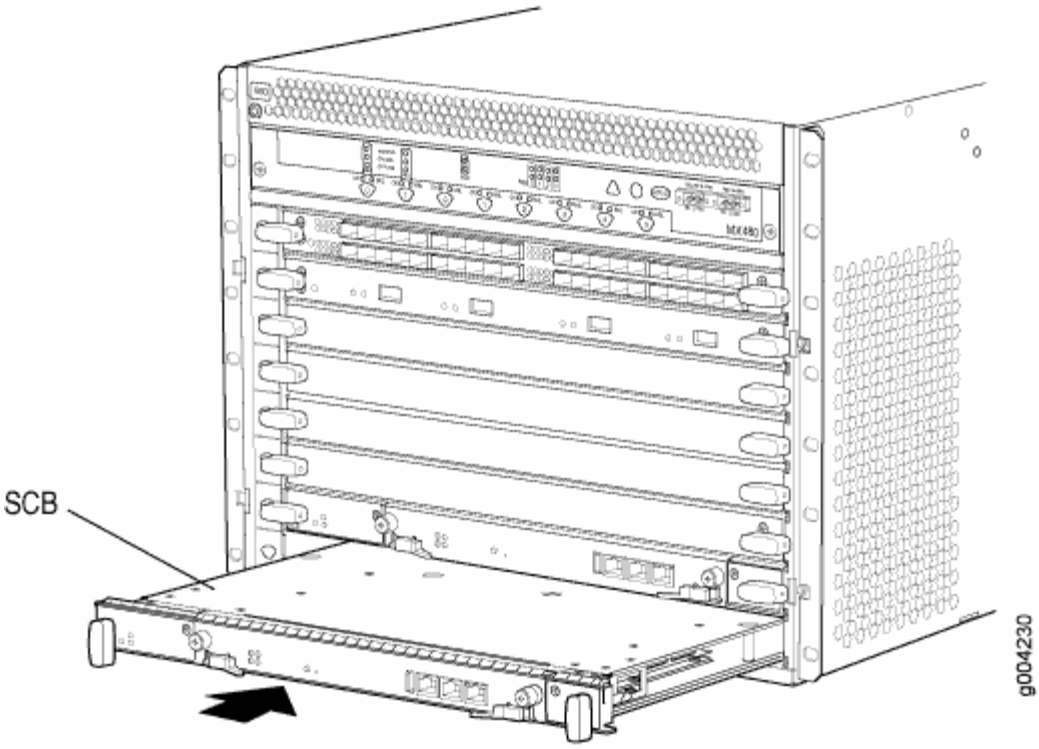
To reinstall an SCB (see Figure 63 on page 254):

> **CAUTION**: Before removing or replacing an SCB, ensure that the ejector handles are stored vertically and pressed toward the center of the SCB.

1. Attach an 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, horizontally and toward the center of the board. To avoid blocking the visibility of the LEDs position the ejectors over the PARK icon.

Figure 63: Reinstalling an SCB



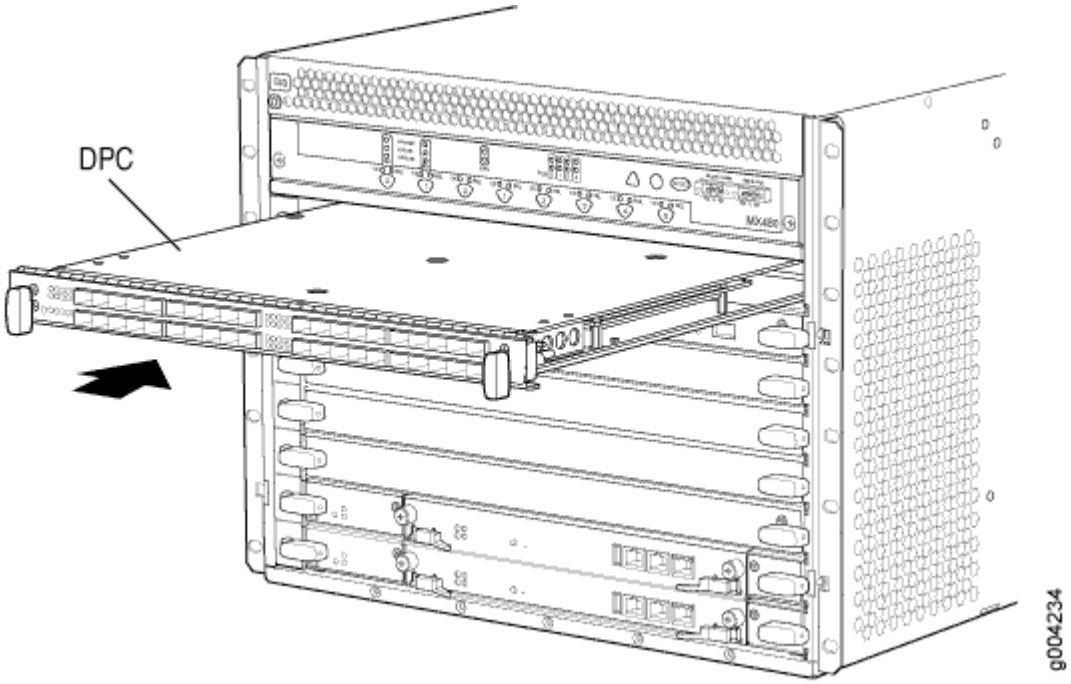
Reinstalling the DPCs After Installing the MX480 Router with a Lift

To reinstall a DPC (see Figure 64 on page 255):

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 by a rubber safety cap. If it does not, cover the transceiver with a safety cap.
5. Orient the DPC so that the faceplate faces you.
6. Lift the DPC into place, and carefully align the sides of the DPC with the guides inside the card cage.
7. Slide the DPC all the way into the card cage until you feel resistance.

8. Grasp both ejector handles, and rotate them clockwise simultaneously until the DPC is fully seated.

Figure 64: Reinstalling a DPC



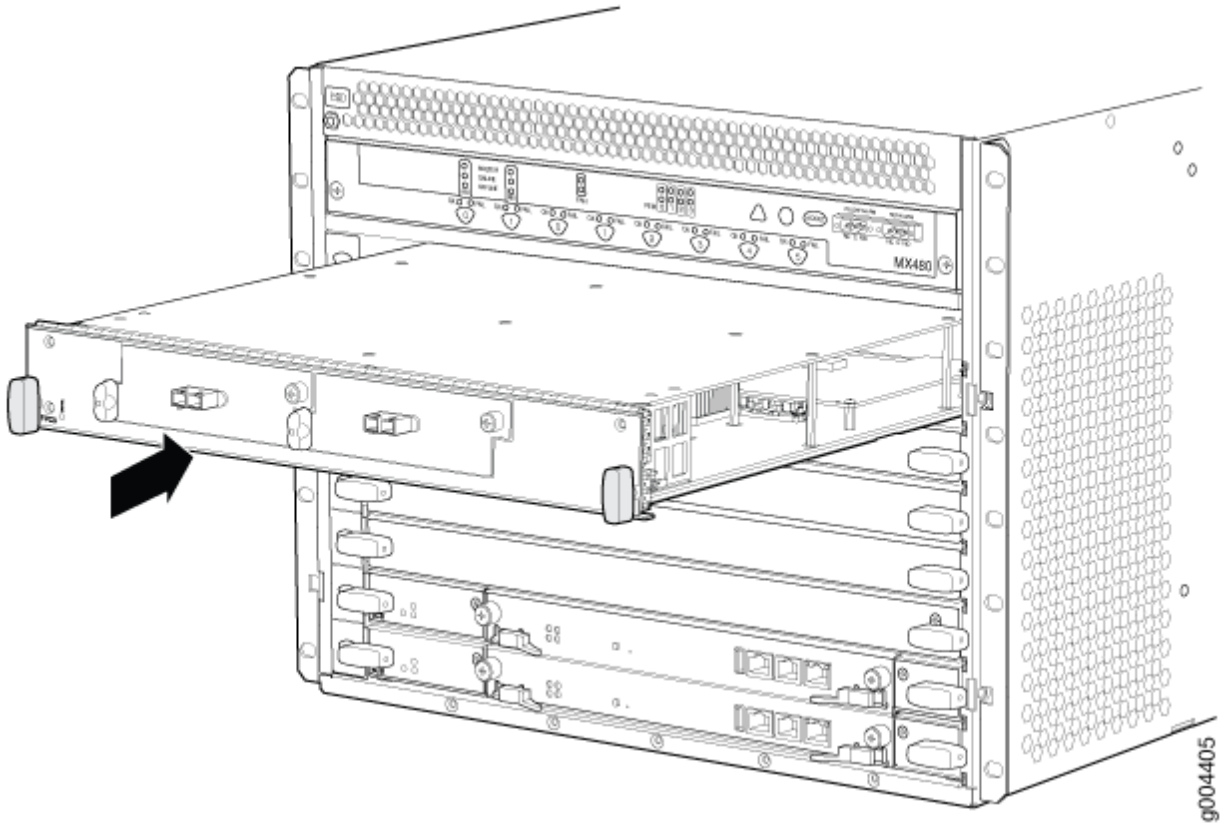
Reinstalling the FPCs After Installing the MX480 Router with a Lift

To reinstall an FPC (see Figure 65 on page 256):

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 65: Reinstalling an FPC



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX480 Router | 508

Tools Required to Install the MX480 Router Without a Mechanical Lift

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

- Phillips (+) screwdrivers, numbers 1 and 2
- 7/16-in. (11 mm) nut driver
- ESD grounding wrist strap

Removing Components from the MX480 Router Before Installing It Without a Lift

IN THIS SECTION

- Removing the Power Supplies Before Installing the MX480 Router Without a Lift | 257
- Removing the Fan Tray Before Installing the MX480 Router Without a Lift | 258
- Removing the SCBs Before Installing the MX480 Router Without a Lift | 259
- Removing the DPCs Before Installing the MX480 Router Without a Lift | 260
- Removing the FPCs Before Installing the MX480 Router Without a Lift | 261

If you cannot use a mechanical lift to install the router (the preferred method), you can install it manually. To make the router light enough to install manually, you first remove most components from the chassis. The procedures for removing components from the chassis are for initial installation only, and assume that you have not connected power cables to the router. The following procedures describe how to remove components from the chassis, first from the rear and then from the front:

Removing the Power Supplies Before Installing the MX480 Router Without a Lift

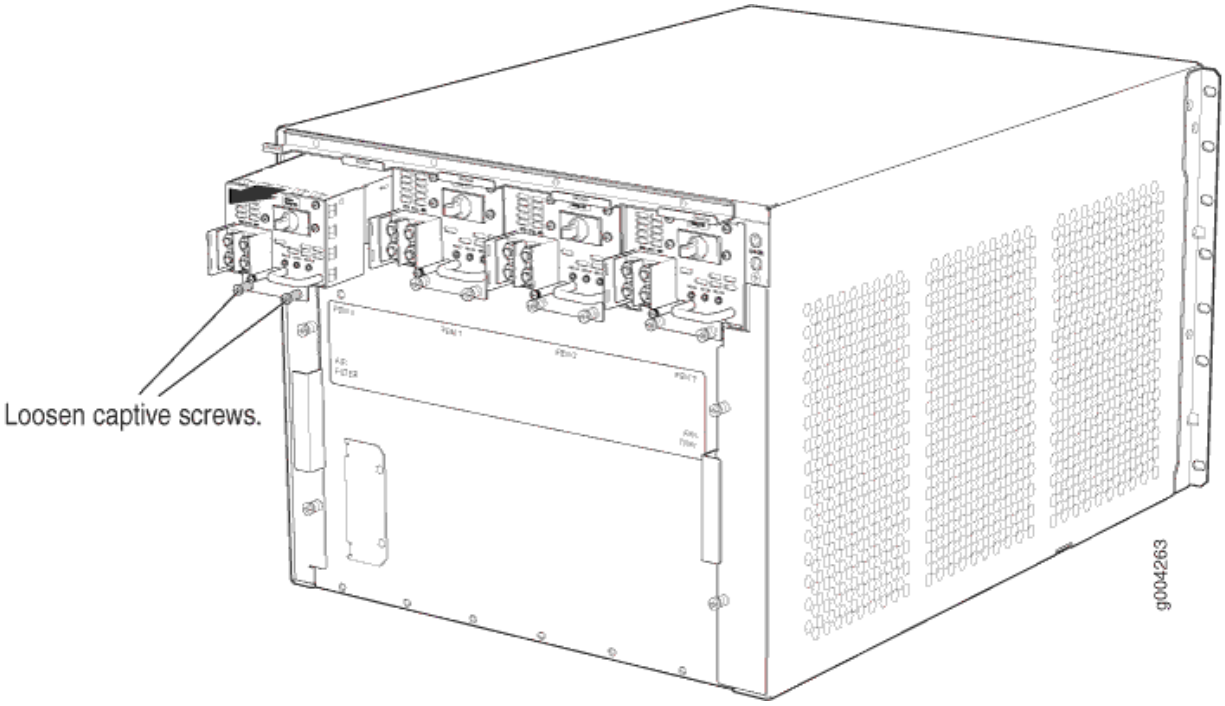
Remove the leftmost power supply first and then work your way to the right. To remove the AC or DC power supplies for each power supply (see Figure 14):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. On an AC-powered router, switch the AC input switch on each power supply to the off (**O**) position. On a DC-powered router, Move the DC circuit breaker on each DC power supply to the off (**O**) position.

   We recommend this even though the power supplies are not connected to power sources.
3. Loosen the captive screws on the bottom edge of the power supply faceplate.

4. Pull the power supply straight out of the chassis.

Figure 66: Removing a Power Supply Before Installing the Router



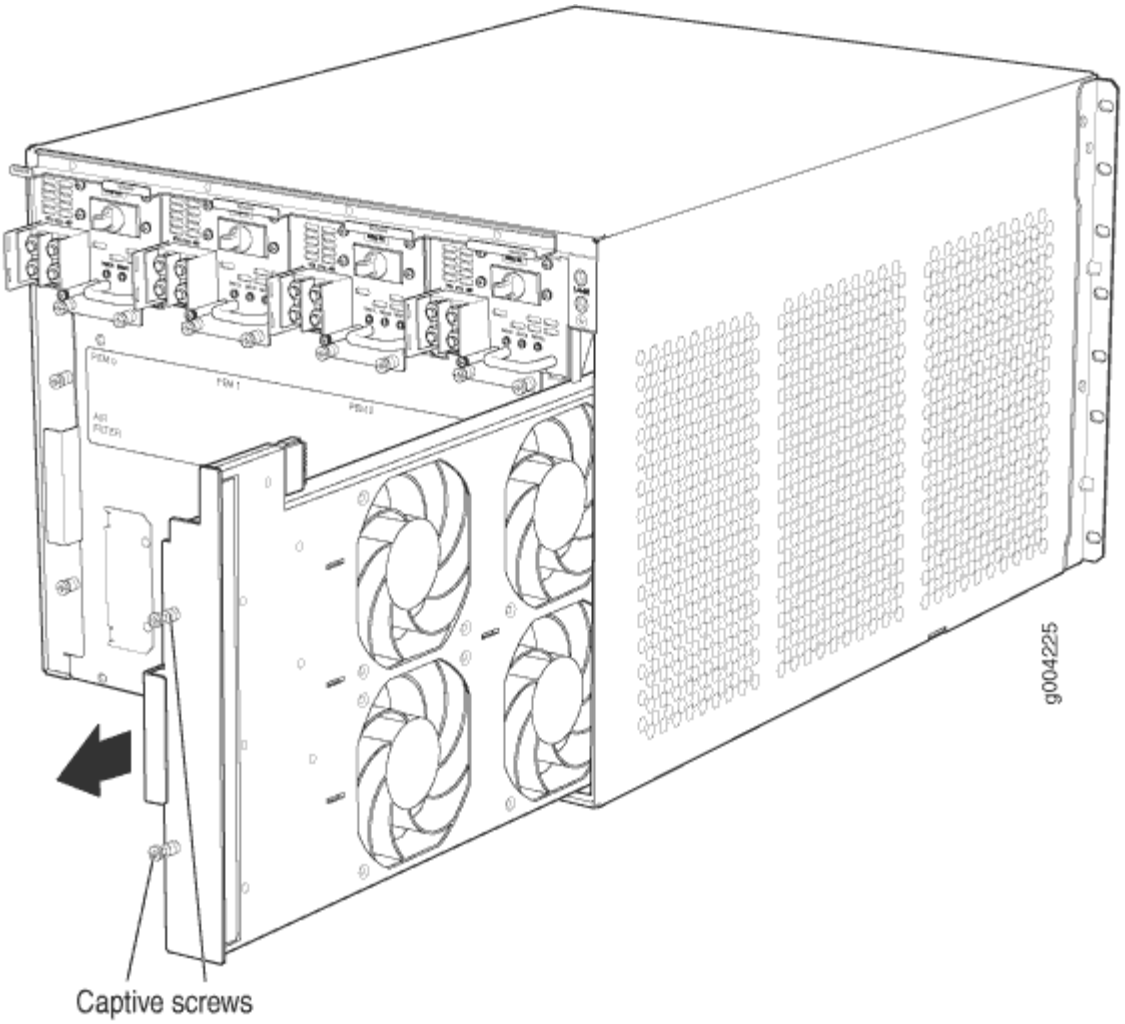
Removing the Fan Tray Before Installing the MX480 Router Without a Lift

To remove the fan tray (see Figure 67 on page 259):

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 screws on the fan tray faceplate.
3. Grasp the fan tray handle, and pull it out approximately 1 to 3 inches.
4. Press the latch located on the inside of the fan tray to release it from the chassis.

5. Place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.

Figure 67: Removing the Fan Tray



Removing the SCBs Before Installing the MX480 Router Without a Lift

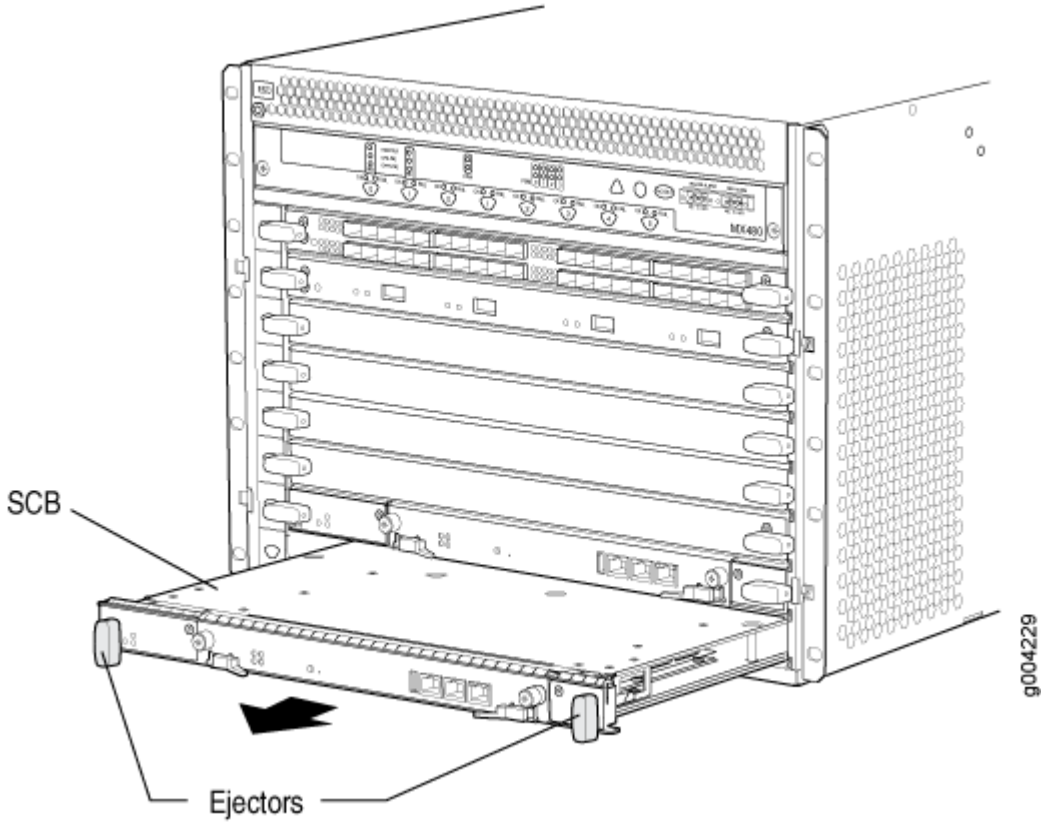
To remove the SCBs (see Figure 68 on page 260):

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 68: Removing an SCB



Removing the DPCs Before Installing the MX480 Router Without a Lift

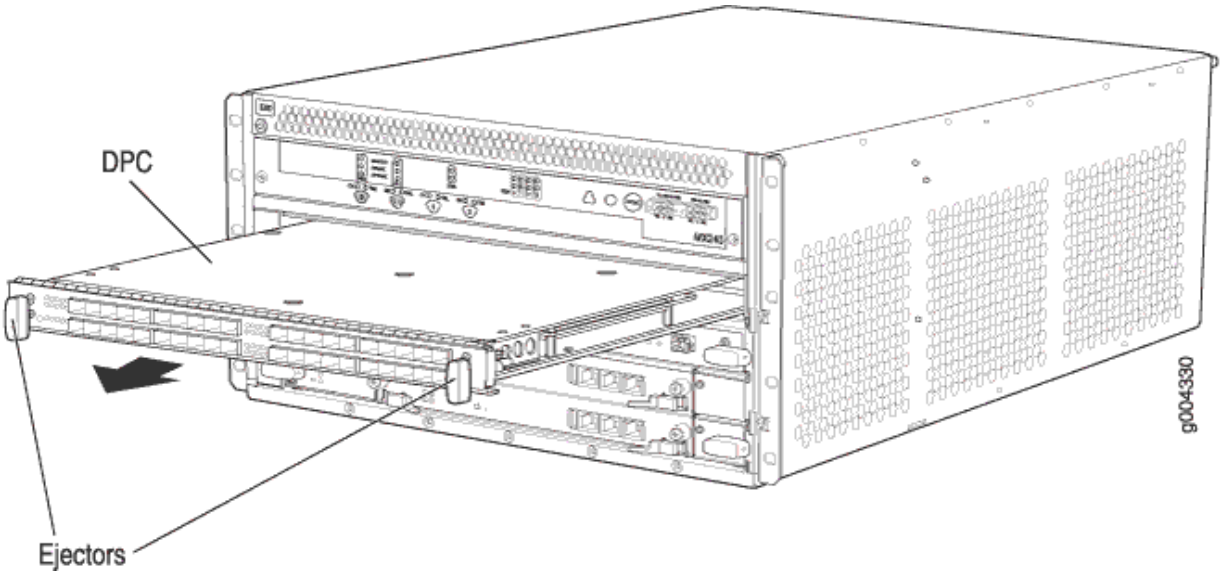
To remove a DPC (see Figure 69 on page 261):

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 69: Removing a DPC



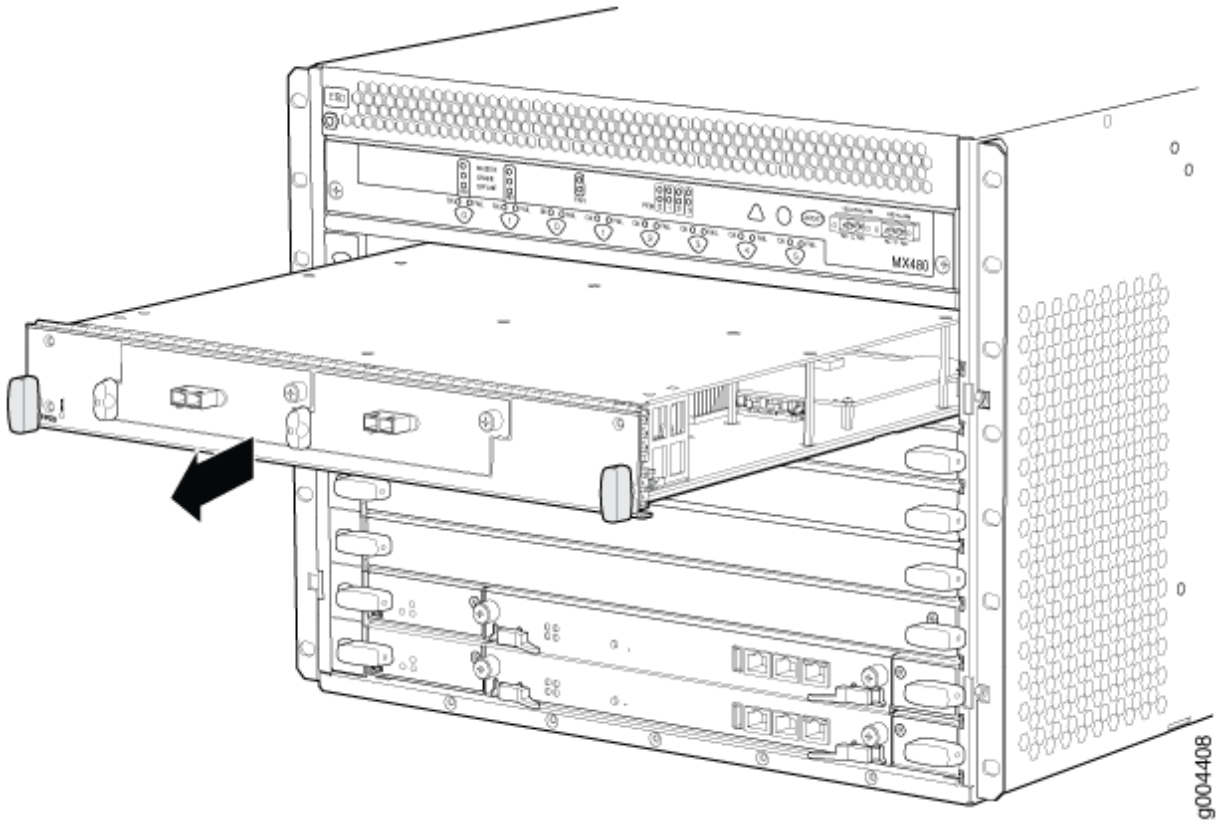
Removing the FPCs Before Installing the MX480 Router Without a Lift

To remove an FPC (see Figure 70 on page 262):

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 ESD grounding point.
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 70: Removing an FPC



Installing the MX480 Chassis in the Rack Manually

To install the router in the rack (see Figure 71 on page 264):

CAUTION: If you are installing more than one router in a rack, install the lowest one first. Installing a router in an upper position in a rack or cabinet requires a lift.

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

CAUTION: Lifting the chassis and mounting it in a rack requires two people. The empty chassis weighs approximately 65.5 lb (29.7 kg).

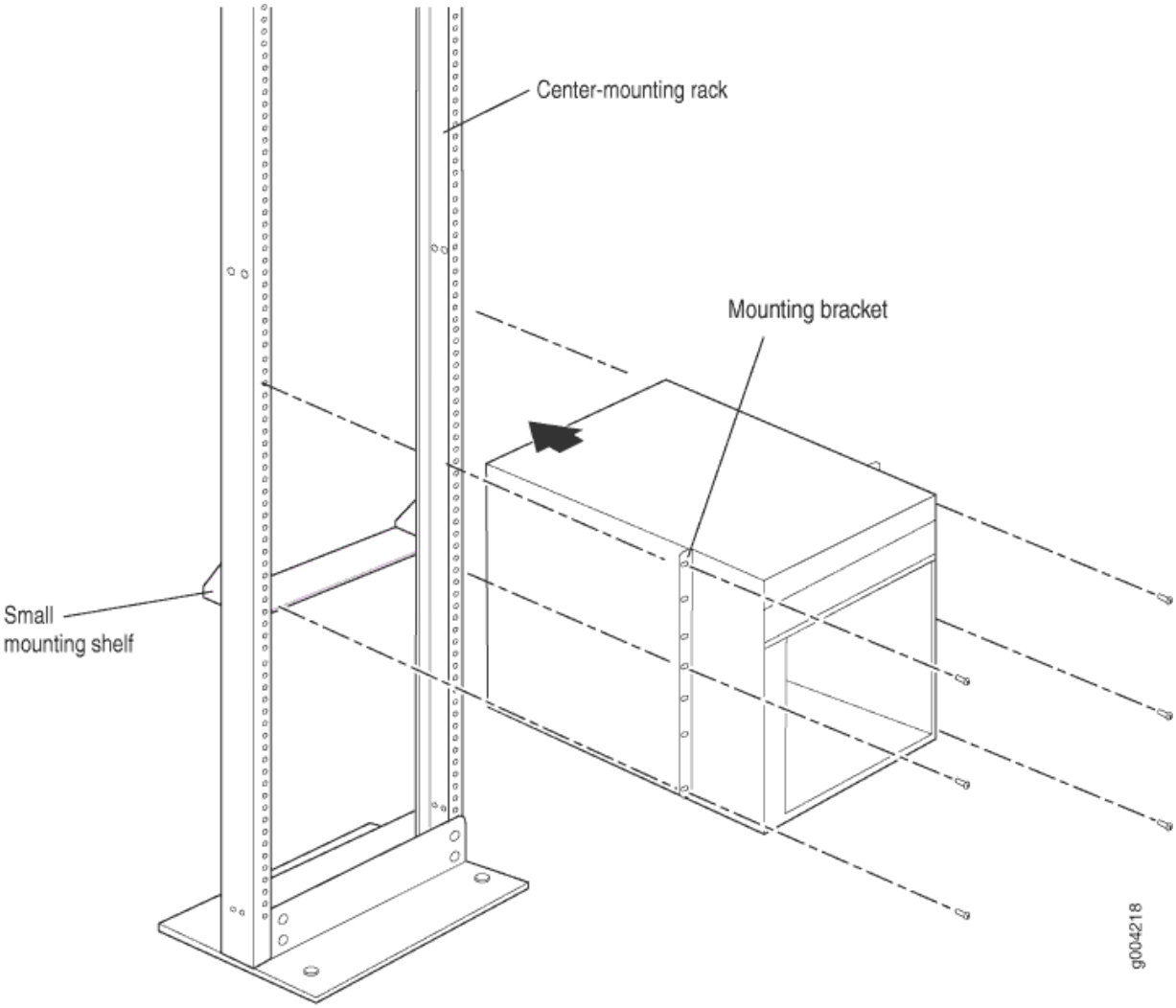
1. Ensure that the rack is in its permanent location and is secured to the building. Ensure that the installation site allows adequate clearance for both airflow and maintenance.
2. Position the router in front of the rack or cabinet, centering it in front of the mounting shelf. Use a pallet jack if one is available.
3. With one person on each side, hold onto the bottom of the chassis and carefully lift it onto the mounting shelf.

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

4. Slide the router onto the mounting shelf until the mounting brackets contact the rack rails. The shelf ensures that the holes in the mounting brackets of the chassis align with the holes in the rack rails.
5. Install a mounting screw into each of the open mounting holes aligned with the rack, starting from the bottom.

6. Visually inspect the alignment of the router. If the router is installed properly in the rack, all the mounting screws on one side of the rack should be aligned with the mounting screws on the opposite side and the router should be level.

Figure 71: Installing the Router in the Rack



NOTE: This illustration depicts the router being installed in an open-frame rack.

Reinstalling Components in the MX480 Router After Installing It Without a Lift

IN THIS SECTION

- Reinstalling the Power Supplies After Installing the MX480 Router Without a Lift | 265
- Reinstalling the Fan Tray After Installing the MX480 Router Without a Lift | 266
- Reinstalling the SCBs After Installing the MX480 Router Without a Lift | 267
- Reinstalling the DPCs After Installing the MX480 Router Without a Lift | 268
- Reinstalling the FPCs After Installing the MX480 Router Without a Lift | 269

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

Reinstalling the Power Supplies After Installing the MX480 Router Without a Lift

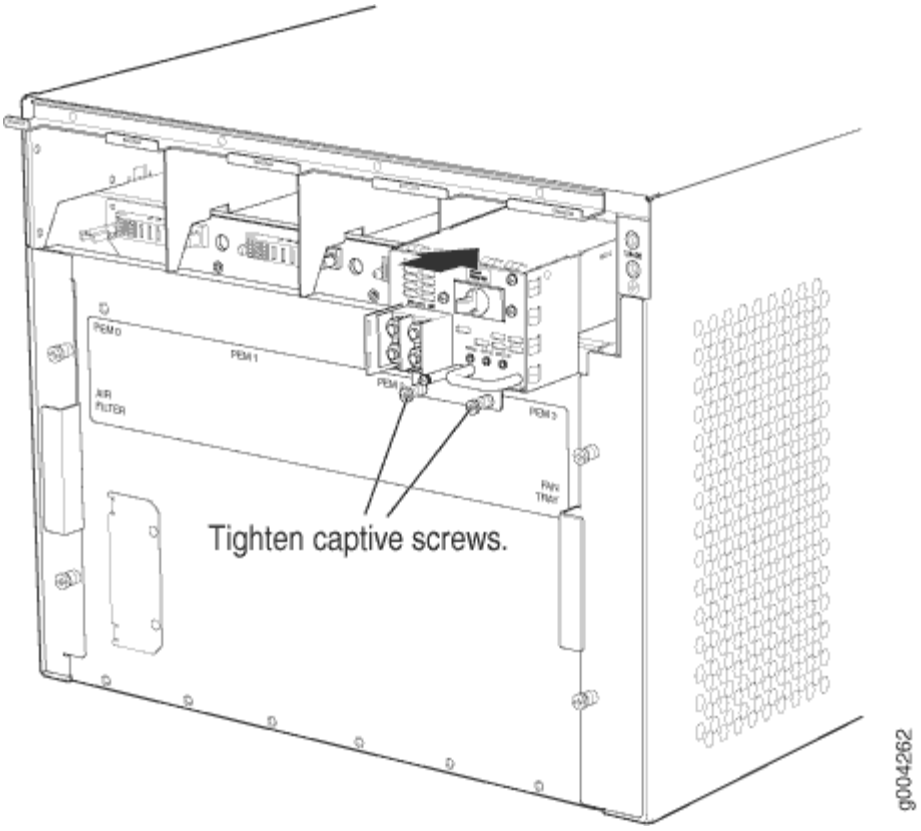
Reinstall the rightmost power supply first, and then work your way to the left. To reinstall the AC or DC power supplies, follow this procedure for each power supply (see Figure 20, which shows the installation of the DC power supplies):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. On an AC-powered router, switch the AC input switch on each power supply to the off (**O**) position. On a DC-powered router, Move the DC circuit breaker on each DC power supply to the off (**O**) position.

   We recommend this even though the power supplies are not connected to power sources.
3. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplate or blank installed in the power supply slot.

4. Tighten the captive screws.

Figure 72: Reinstalling a Power Supply



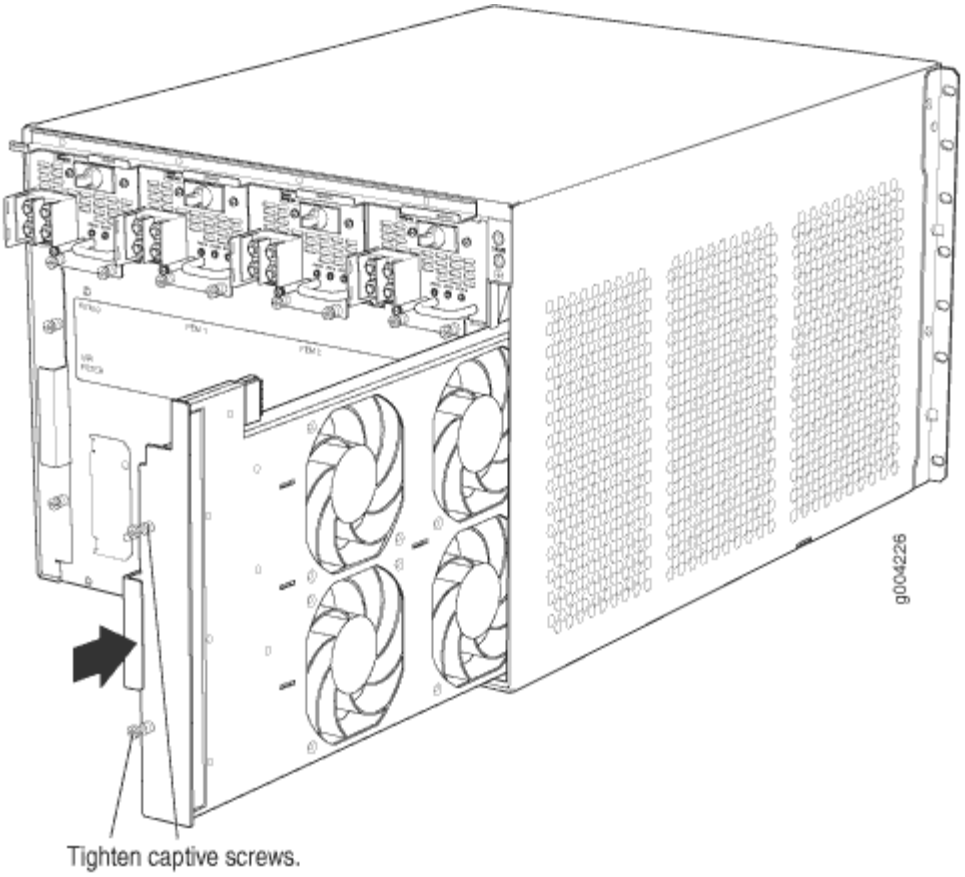
Reinstalling the Fan Tray After Installing the MX480 Router Without a Lift

To reinstall the fan tray (see Figure 73 on page 267):

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 the fan tray faceplate to secure it in the chassis.

Figure 73: Reinstalling a Fan Tray



Reinstalling the SCBs After Installing the MX480 Router Without a Lift

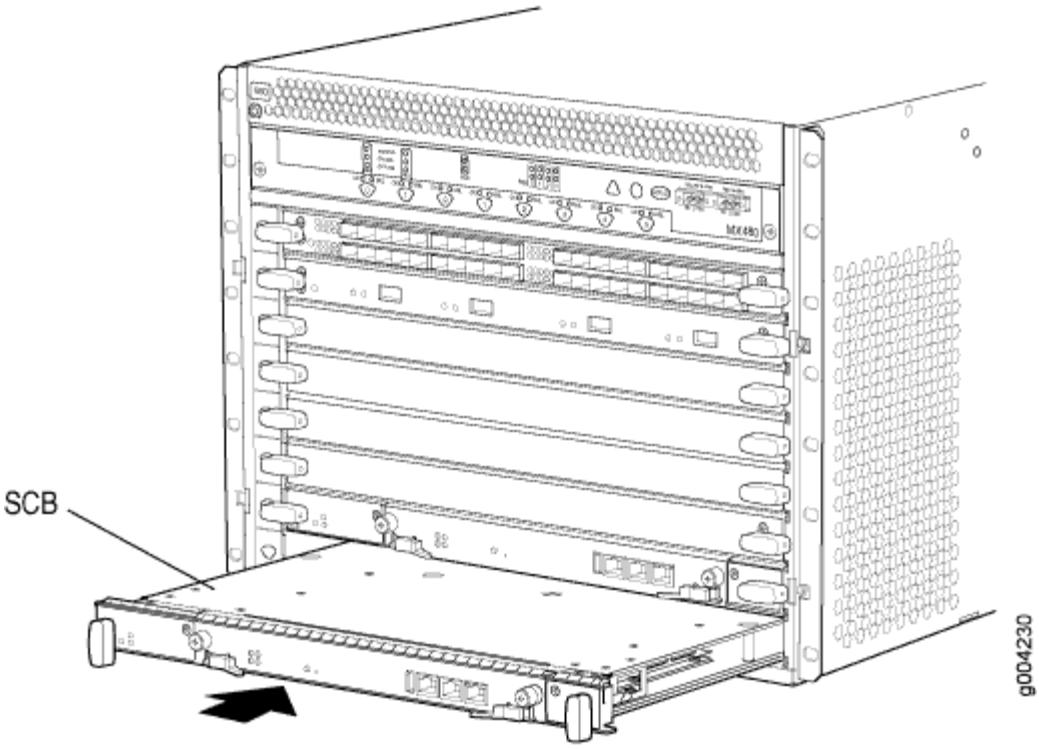
To reinstall an SCB (see Figure 74 on page 268):

> **CAUTION**: Before removing or replacing an SCB, ensure that the ejector handles are stored vertically and pressed toward the center of the SCB.

1. Attach an 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, horizontally and toward the center of the board. To avoid blocking the visibility of the LEDs position the ejectors over the PARK icon.

Figure 74: Reinstalling an SCB



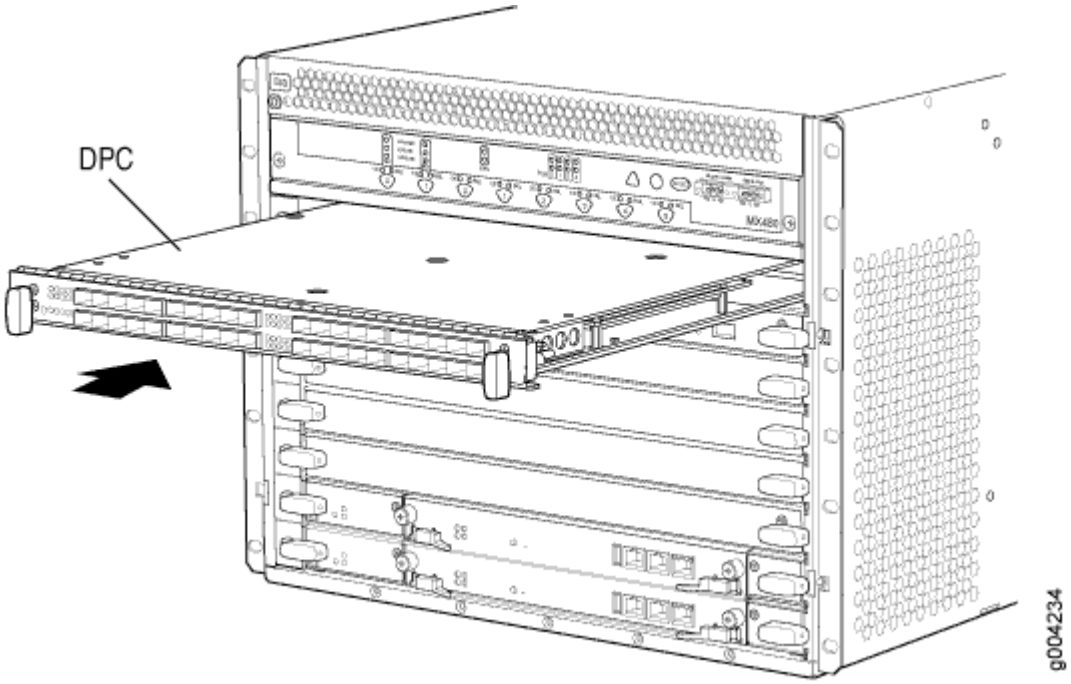
Reinstalling the DPCs After Installing the MX480 Router Without a Lift

To reinstall a DPC (see Figure 75 on page 269):

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 by a rubber safety cap. If it does not, cover the transceiver with a safety cap.
5. Orient the DPC so that the faceplate faces you.
6. Lift the DPC into place, and carefully align the sides of the DPC with the guides inside the card cage.
7. Slide the DPC all the way into the card cage until you feel resistance.

8. Grasp both ejector handles, and rotate them clockwise simultaneously until the DPC is fully seated.

Figure 75: Reinstalling a DPC



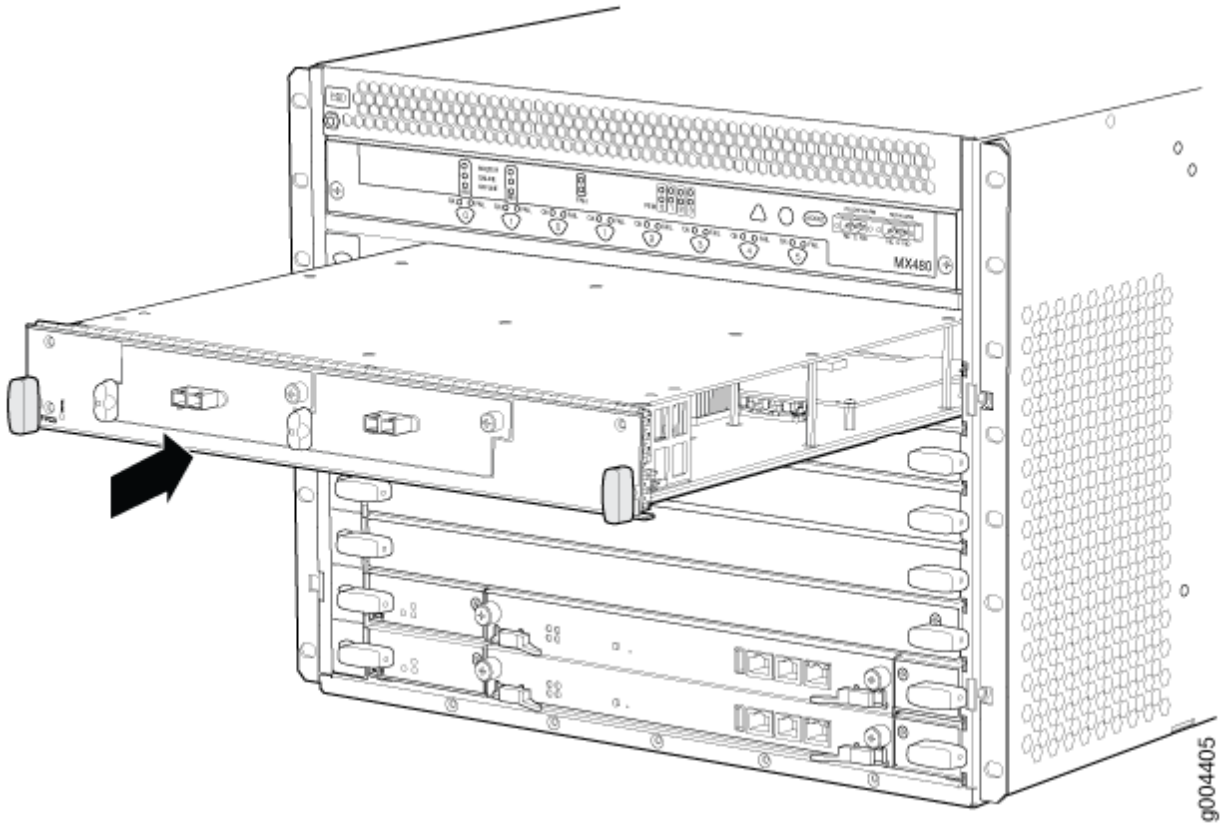
Reinstalling the FPCs After Installing the MX480 Router Without a Lift

To reinstall a DPC (see Figure 76 on page 270):

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 76: Reinstalling an FPC



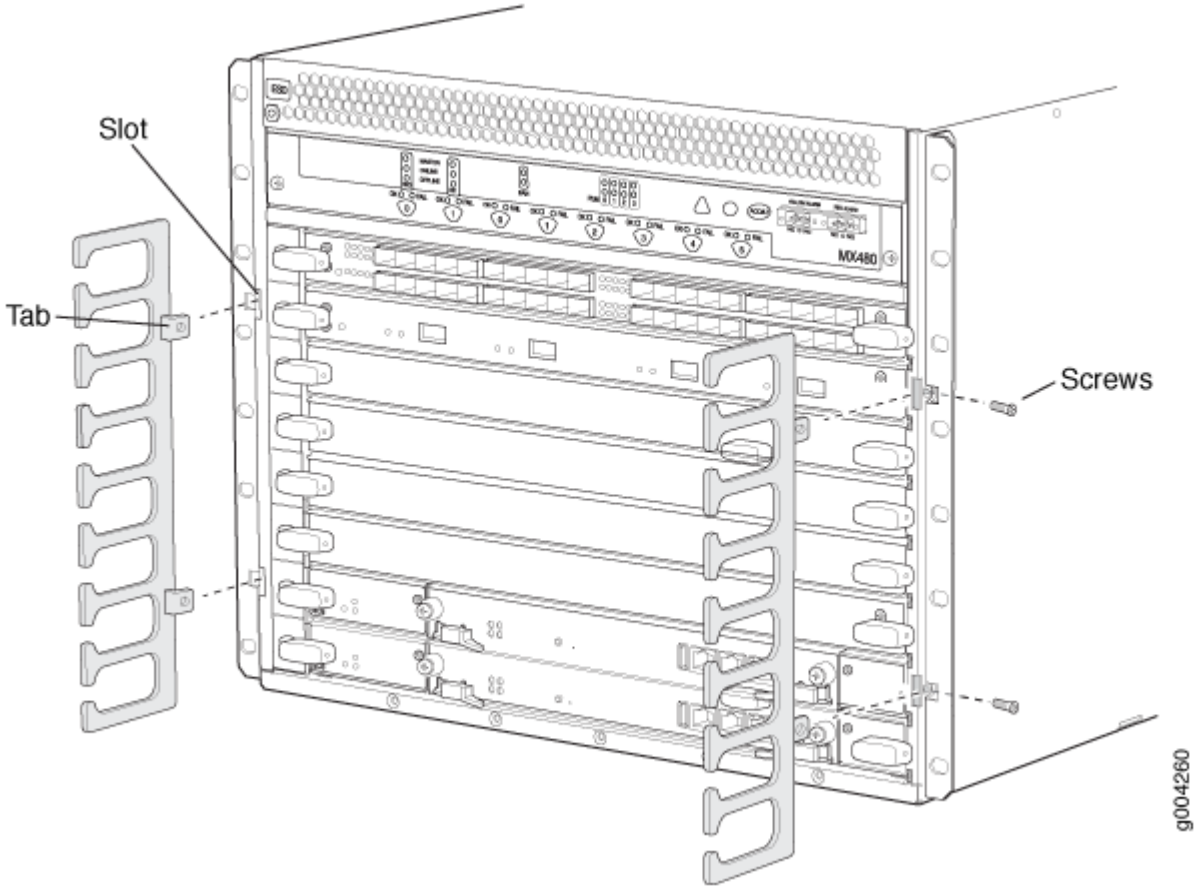
Installing the MX480 Router Cable Management Bracket

The cable management brackets attach to both sides of the router. To install the cable management brackets (see Figure 77 on page 271):

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 management brackets on the front sides of the chassis.
3. Insert the tabs into the slots.

4. Tighten the captive screws completely.

Figure 77: Installing the Cable Management Brackets



Connecting the MX480 to Power

IN THIS SECTION

- Tools and Parts Required for MX480 Router Grounding and Power Connections | **272**
- Grounding the MX480 Router | **272**
- Connecting Power to an AC-Powered MX480 Router with Normal-Capacity Power Supplies | **273**
- Powering On an AC-Powered MX480 Router | **275**

- Connecting Power to a DC-Powered MX480 Router with Normal Capacity Power Supplies | **276**
- Powering On a DC-Powered MX480 Router with Normal Capacity Power Supplies | **279**
- Powering Off the MX480 Router | **281**
- Connecting an MX480 AC Power Supply Cord | **281**
- Connecting an MX480 DC Power Supply Cable | **282**

Tools and Parts Required for MX480 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), 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 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. Use an appropriately-sized driver or socket wrench, with a maximum torque capacity of 50 lb-in. or less. 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.

Grounding the MX480 Router

You ground the router by connecting a grounding cable to earth ground and then attaching it to the chassis grounding points using UNC 1/4-20 two screws. You must provide the grounding cable (cable lugs are supplied with the router). To ground the router:

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 upper rear of the chassis. The bolts are sized for UNC 1/4-20 bolts.
8. Secure the grounding cable lug to the grounding points, first with the washers, then with the screws.
9. Dress the grounding cable and verify that it does not touch or block access to router components, and that it does not drape where people could trip on it.

SEE ALSO

Preventing Electrostatic Discharge Damage to an MX480 Router | **508**

Connecting Power to an AC-Powered MX480 Router with Normal-Capacity Power Supplies



CAUTION: Do not mix AC and DC power supply modules within the same device. Mixing currents can damage the device.

You connect AC power to the router by attaching power cords from the AC power sources to the AC appliance inlets located on the power supplies. For power cord and AC power specifications, see "AC Power Cord Specifications for the MX480 Router" on page 33.

To connect the AC power cords to the router (see Figure 78 on page 274):

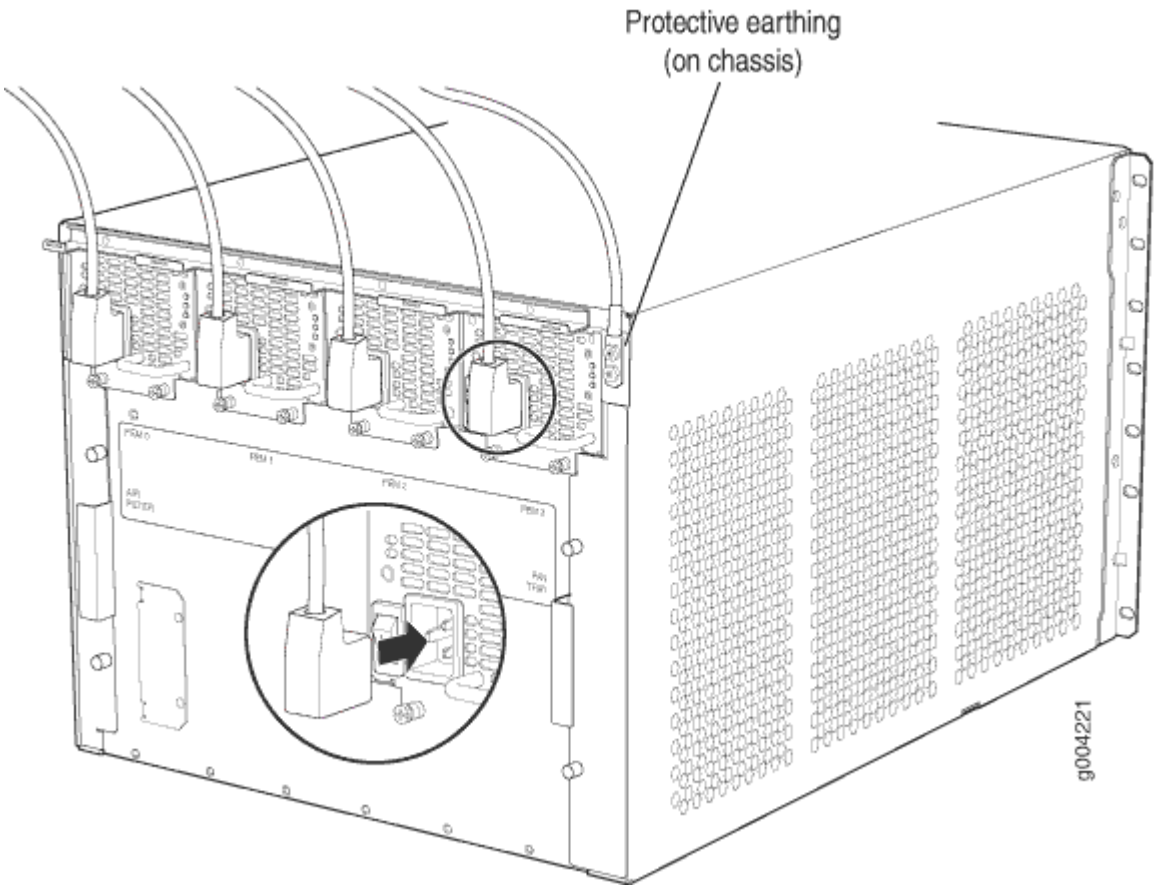
1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Locate the power cords shipped with the router, which should have a plug appropriate for your geographical location (see "AC Power Cord Specifications for the MX480 Router" on page 33).
3. Move the AC input switch next to the appliance inlet on the power supply to the off **(O)** position.

4. Connect the power cord to the 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 external circuit breaker.

6. Route the power cord along the cable restraint toward the left or right corner of the chassis. If needed to hold the power cord in place, thread plastic cable ties, which you must provide, through the openings on the cable restraint.
7. Verify that the power cord does not block the air exhaust and access to router components, or drape where people could trip on it.
8. Repeat Step 2 through Step 6 for the remaining power supplies.

Figure 78: Connecting AC Power to the Router (110V)



Powering On an AC-Powered MX480 Router

To power on an AC-powered router:

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Verify that the power supplies are fully inserted in the chassis.
3. Verify that each AC power cord is securely inserted into its appliance inlet.
4. Verify that an external management device is connected to one of the Routing Engine ports (**AUX**, **CONSOLE**, or **ETHERNET**).
5. Turn on the power to the external management device.
6. Switch on the dedicated customer site circuit breakers for the power supplies. Follow the ESD and safety instructions for your site.
7. Move the AC input switch on 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, the **AC OK** and **DC OK** LEDs light steadily, and the **PS Fail** LED is not lit.

   If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures.

   NOTE: After you power off a power supply, wait at least 60 seconds before you turn it back on. Likewise, after you power on a power supply, wait at least 60 seconds beforeyou turn it off.

   If the system is completely powered off when you power on the power supply, the Routing Engine (or RCB) boots as the power supply completes its startup sequence. If the Routing Engine finishes booting and you need to power off the system again, first issue the CLI `request system halt` command.

   After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the status LEDs on the power supply and the `show chassis` command display—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.
8. On the external management device connected to the Routing Engine, monitor the startup process to verify that the system has booted properly.

SEE ALSO

Replacing an MX480 AC Power Supply | 420

Connecting Power to a DC-Powered MX480 Router with Normal Capacity Power Supplies

> **CAUTION**: Do not mix AC and DC power supply modules within the same device. Mixing currents can damage the device.

> **WARNING**: Before you perform DC power procedures, ensure there is no power to 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. 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.
6. Install heat-shrink tubing insulation around the power cables.

To install heat-shrink tubing:

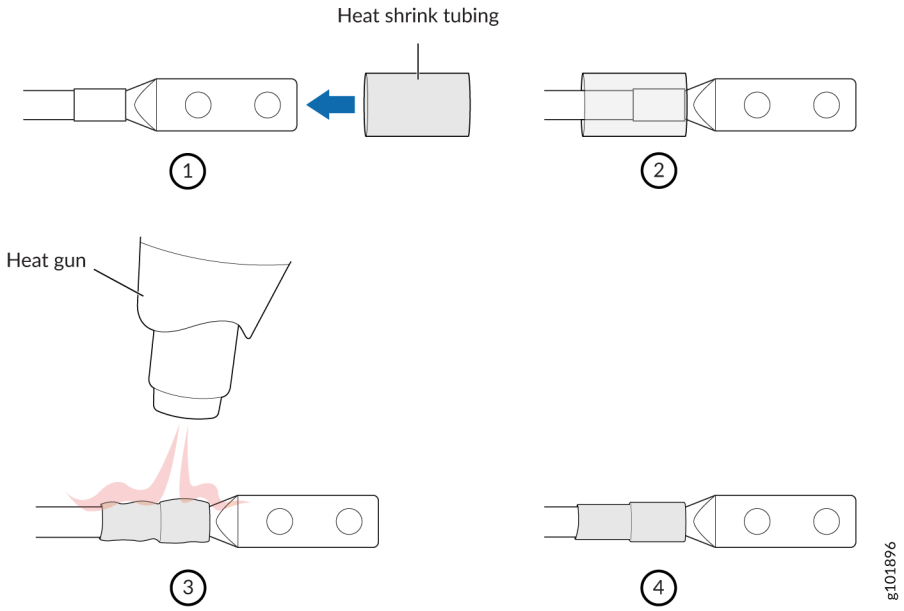
a. Slide the tubing over the portion of the cable where it is attached to the lug barrel. Ensure that tubing covers the end of the wire and the barrel of the lug attached to it.

b. Shrink the tubing with a heat gun. Ensure that you heat all sides of the tubing evenly so that it shrinks around the cable tightly.

Figure 1 shows the steps to install heat-shrink tubing.

NOTE: Do not overheat the tubing.

Figure 79: How to Install Heat-Shrink Tubing



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 flat washer, then with the nut (see Connecting an MX480 DC Power Supply Cable). 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.

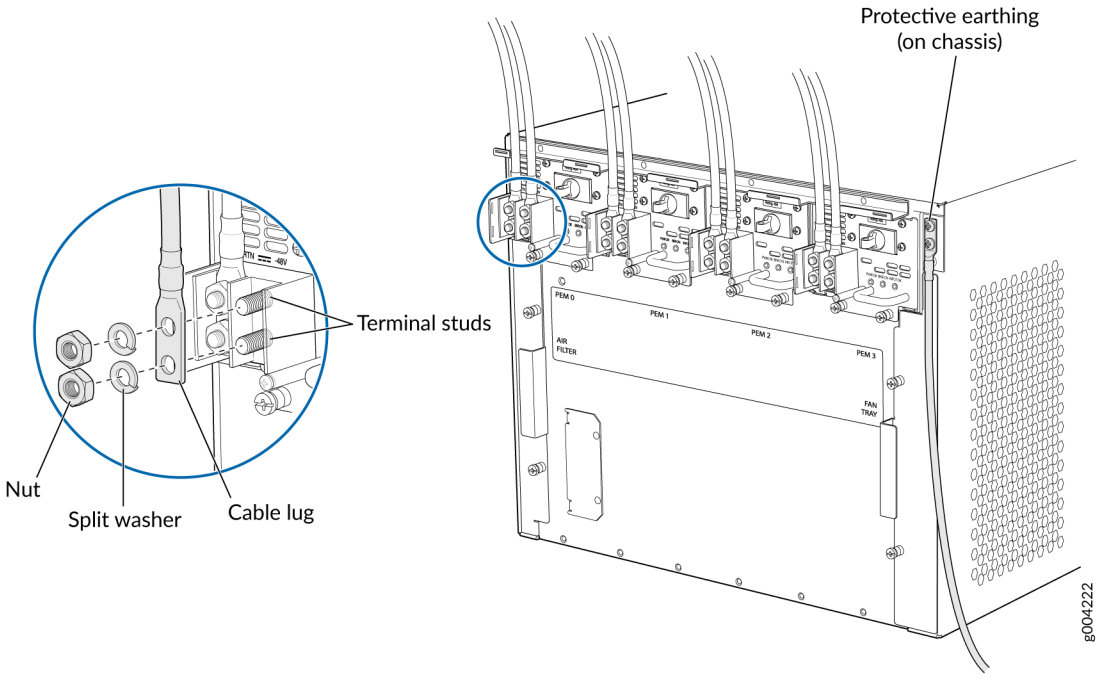
CAUTION: The maximum torque rating of the terminal studs on the DC power supply is 36 lb-in. (4.0 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

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. Route the power cables along the cable restraint toward the left or right corner of the chassis. If needed, thread plastic cable ties, which you must provide, through the openings on the cable restraint to hold the power cables in place.
10. Replace the clear plastic cover over the terminal studs on the faceplate.
11. 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.

12. Repeat Steps 3 through 11 for the remaining power supplies.

Figure 80: Connecting Power Cables to the DC Power Supply



Powering On a DC-Powered MX480 Router with Normal Capacity Power Supplies

To power on a DC-powered router:

1. Verify that an external management device is connected to one of the Routing Engine ports (**CONSOLE**, **AUX**, or **ETHERNET**).
2. Turn on the power to the external management device.
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 power supplies are fully inserted in the chassis.
5. Verify that the source power cables are connected to the appropriate terminal: the positive (+) source cable to the return terminal (labeled **RETURN**) and the negative (–) source cable to the input terminal (labeled **-48V**).

6. Switch on the dedicated customer site circuit breakers to provide power to the DC power cables.
7. Check the **INPUT OK** LED is lit steadily green to verify that power is present.
8. If power is not present:
   - Verify that the fuse is installed correctly and turn on the breaker at the battery distribution fuse board or fuse bay.
   - Check the voltage with a meter at the terminals of the power supply for correct voltage level and polarity.
9. 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.

   If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures described in "Replacing an MX480 DC Power Supply" on page 425.
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.

    If the power supply is not functioning normally, repeat the installation and cabling procedures described in "Replacing an MX480 DC Power Supply" on page 425.

    NOTE: After you power off a power supply, wait at least 60 seconds before you turn it back on. Likewise, after you power on a power supply, wait at least 60 seconds beforeyou turn it off.

    If the system is completely powered off when you power on the power supply, the Routing Engine (or RCB) boots as the power supply completes its startup sequence. If the Routing Engine finishes booting and you need to power off the system again, first issue the CLI `request system halt` command.

    After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the status LEDs on the power supply and the `show chassis` command display—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.
12. On the external management device connected to the Routing Engine, monitor the startup process to verify that the system has booted properly.

SEE ALSO

Installing an MX480 DC High-Capacity Power Supply

Powering Off the MX480 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.

Connecting an MX480 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 MX480 Router" on page 33).
2. Connect the power cord to the power supply.
3. Route the power cord along the cable restraint toward the left or right corner of the chassis. If needed to hold the power cord in place, thread plastic cable ties, which you must provide, through the openings on the cable restraint.
4. 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. Attach the power cord to the AC power source, and switch on the dedicated customer site circuit breaker for the power supply. Follow the ESD and connection instructions for your site.
6. Switch the AC input switch on the each power supply to the on (—) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

SEE ALSO

Replacing an MX480 AC Power Supply | **420**

AC Electrical Specifications for the MX480 Router | **31**

Connecting an MX480 DC Power Supply Cable



WARNING: Before you perform DC power procedures, ensure there is no power to 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 "DC Power Cable Specifications for the MX480 Router" on page 46.
2. Verify that a licensed electrician has attached a cable lug to the replacement power cable.
3. Install heat-shrink tubing insulation around the power cables.

   To install heat-shrink tubing:

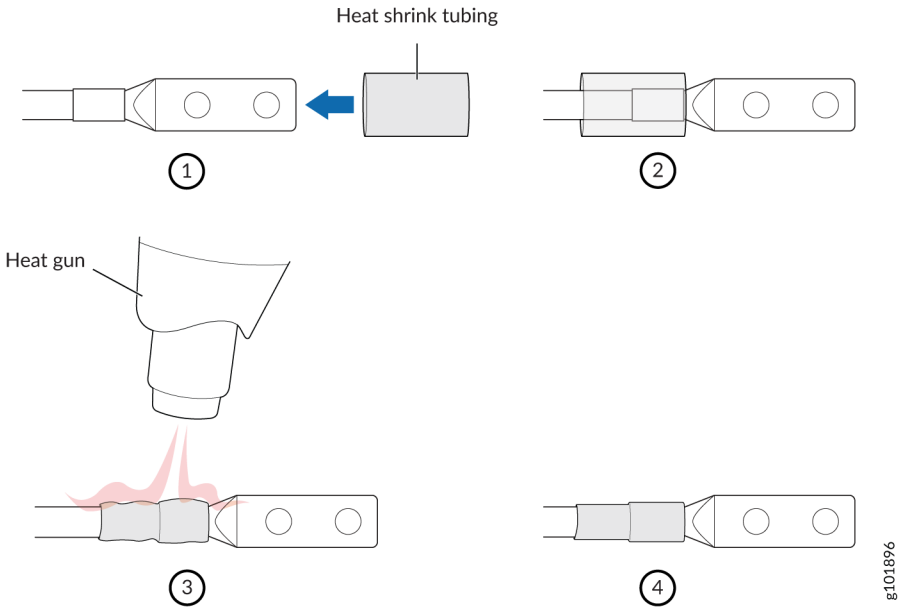
   a. Slide the tubing over the portion of the cable where it is attached to the lug barrel. Ensure that tubing covers the end of the wire and the barrel of the lug attached to it.

   b. Shrink the tubing with a heat gun. Ensure that you heat all sides of the tubing evenly so that it shrinks around the cable tightly.

   Figure 81 on page 283 shows the steps to install heat-shrink tubing.

NOTE: Do not overheat the tubing.

Figure 81: How to Install Heat-Shrink Tubing

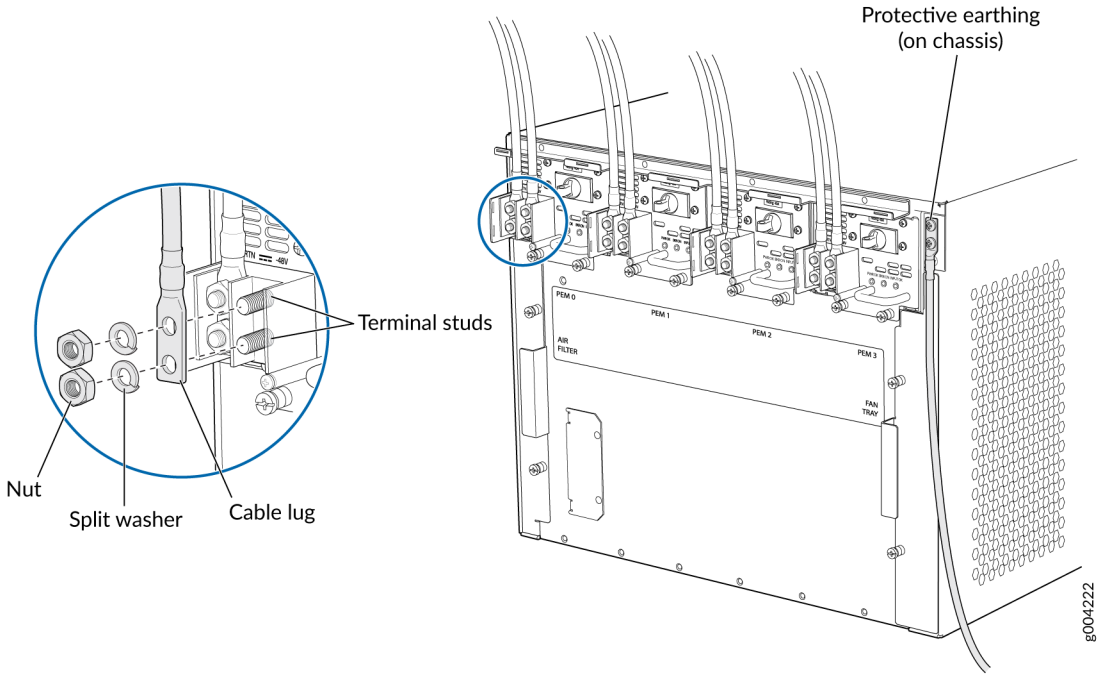


4. Verify that the **INPUT OK** LED is off.
5. Secure the power cable lug to the terminal studs, first with the flat washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut (see Figure 82 on page 284). Do not overtighten the nut. (Use a 7/16-in. [11 mm] 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 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.

Figure 82: Connecting Power Cables to the DC Power Supply



6. Route the power cable along the cable restraint toward the left or right corner of the chassis. If needed, thread plastic cable ties, which you must provide, through the openings on the cable restraint to hold the power cable 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. 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.

Connecting the MX480 to the Network

IN THIS SECTION

- Tools and Parts Required for MX480 Router Connections | **285**
- Connecting the MX480 Router to a Network for Out-of-Band Management | **286**
- Connecting the MX480 Router to a Management Console or Auxiliary Device | **286**
- Connecting the MX480 Router to an External Alarm-Reporting Device | **287**
- Connecting DPC, MPC, MIC, or PIC Cables to the MX480 Router | **288**
- Connecting the Alarm Relay Wires to the MX480 Craft Interface | **291**

Tools and Parts Required for MX480 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

Connecting the MX480 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 84 on page 286 shows the connector) into the **ETHERNET** port on the Routing Engine. Figure 83 on page 286 shows the port.
3. Plug the other end of the cable into the network device.

Figure 83: Ethernet Port

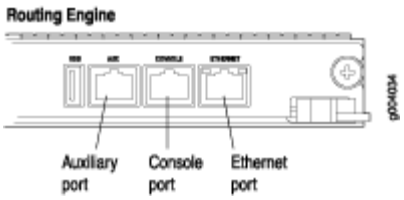
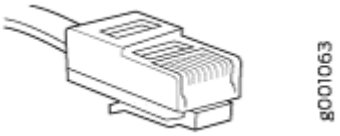


Figure 84: Routing Engine Ethernet Cable Connector



Connecting the MX480 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 86 on page 287 shows the connector) into the **AUX** port or **CONSOLE** port on the Routing Engine. Figure 85 on page 287 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 85: Auxiliary and Console Ports

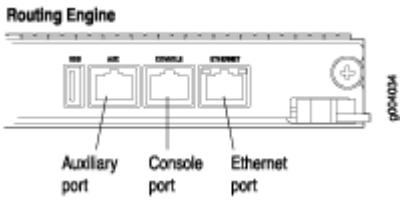
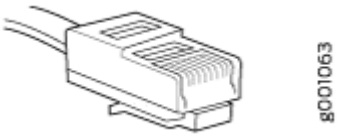


Figure 86: Routing Engine Console and Auxiliary Cable Connector



Connecting the MX480 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 87 on page 288.) A system condition that triggers the red or yellow alarm LED on the craft interface also activates the corresponding alarm relay contact.

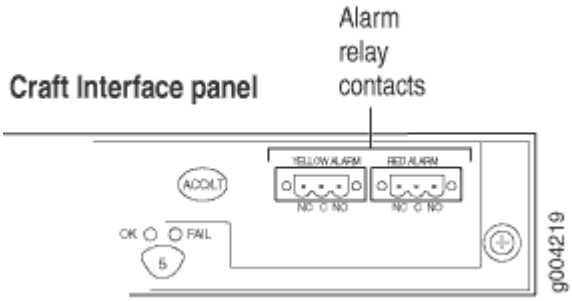
The terminal blocks that plug into the alarm relay contacts are supplied with the router. They accept wire of any gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm^2), which is not provided. Use the gauge of wire appropriate for the external device you are connecting.

To connect an external device to an alarm relay contact (see Figure 87 on page 288):

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 87: Alarm Relay Contacts



Connecting DPC, MPC, MIC, or PIC Cables to the MX480 Router

To connect the DPCs, MPCs, MICs, or PICs to the network (see Figure 88 on page 290 and Figure 89 on page 290):

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.

LASER 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 protects your eyes from 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 88: Attaching a Cable to a DPC

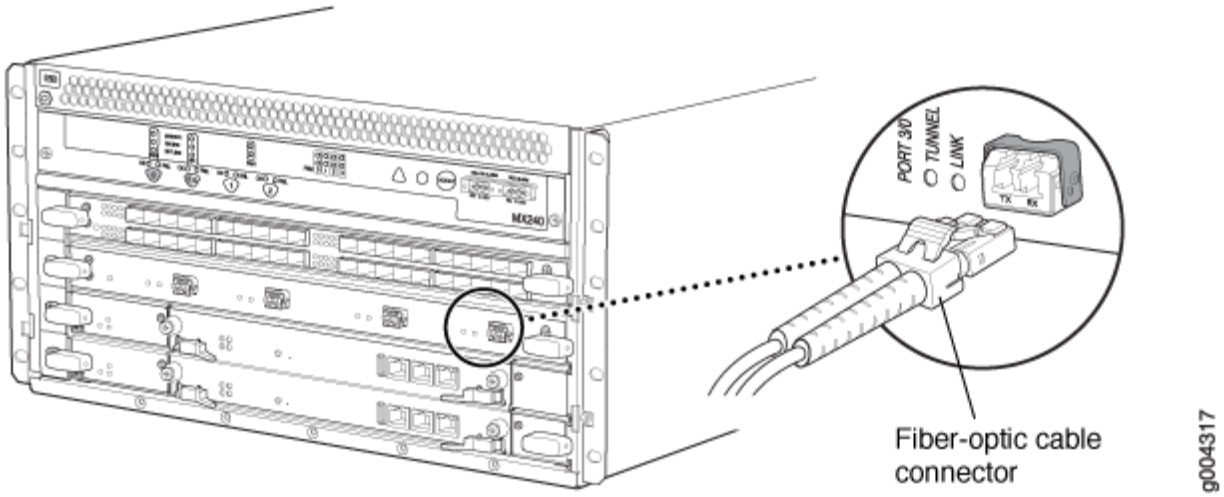
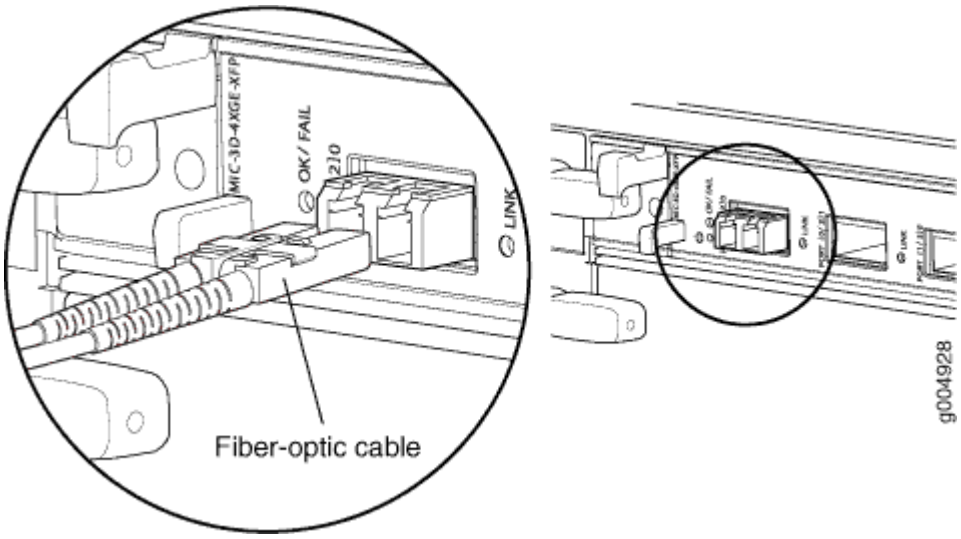


Figure 89: Attaching a Cable to a MIC

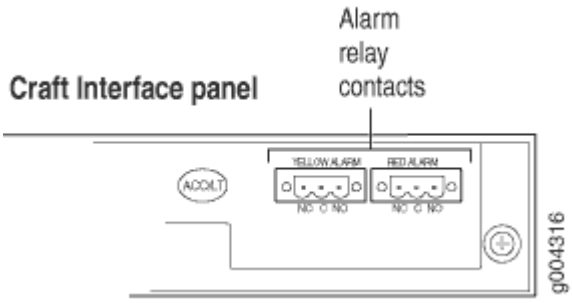


Connecting the Alarm Relay Wires to the MX480 Craft Interface

To connect the alarm relay wires between a router and an alarm-reporting device (see Figure 90 on page 291):

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 90: Alarm Relay Contacts



Initially Configuring the MX480 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 for Routing Devices.

```
[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 MX480 Router | **275**

Powering On a DC-Powered MX480 Router with Normal Capacity Power Supplies | **279**

CHAPTER 4

Maintaining Components

Maintaining MX480 Components | 298

Maintaining MX480 Cooling System Components | 309

Maintaining MX480 Host Subsystem Components | 318

Maintaining MX480 Interface Modules | 344

Maintaining MX-SPC3 Services Card | 413

Maintaining MX480 Power System Components | 419

Maintaining MX480 SFP and XFP Transceivers | 434

Maintaining MX480 Switch Control Boards | 436

Maintaining MX480 Components

IN THIS SECTION

- Routine Maintenance Procedures for the MX480 Router | 298
- MX480 Field-Replaceable Units (FRUs) | 299
- Tools and Parts Required to Replace MX480 Hardware Components | 300
- Replacing the MX480 Craft Interface | 303
- Replacing the MX480 Cable Management Brackets | 306
- Replacing the Management Ethernet Cable on an MX Series Router | 307
- Replacing the Console or Auxiliary Cable on an MX480 Router | 308

Routine Maintenance Procedures for the MX480 Router

IN THIS SECTION

- Purpose | 298
- Action | 298

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.

SEE ALSO

Maintaining the MX480 Air Filter | 309

MX480 Field-Replaceable Units (FRUs)

Field-replaceable units (FRUs) are router components that can be replaced at the customer site. Replacing most FRUs requires minimal router downtime. The router uses the following types of FRUs:

- Hot-removable and hot-insertable FRUs—You can remove and replace these components without powering off the router or disrupting the routing functions.
- Hot-pluggable FRUs—You can remove and replace these components without powering off the router, but the routing functions of the system are interrupted when the component is removed.

Table 106 on page 300 lists the FRUs for the MX960 router. Before you replace an SCB or a Routing Engine, you must take the host subsystem offline.

Table 106: 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

SEE ALSO

MX480 Component Redundancy | 8

Tools and Parts Required to Replace MX480 Hardware Components | 300

Tools and Parts Required to Replace MX480 Hardware Components

To replace hardware components, you need the tools and parts listed in Table 107 on page 301.

Table 107: Tools and Parts Required

Tool or Part	Components
2.5-mm flat-blade (–) screwdriver	• Alarm relay terminal block
7/16-in. (11 mm) nut driver or socket wrench	• DC power supply • Cables and connectors
Blank panels (if component is not reinstalled)	• DPC • FPC • PIC • MPC • MIC • Power supply • Routing Engine • SCB
Electrostatic bag or antistatic mat	• Craft Interface • DPC • FPC • PIC • MPC • MIC • Routing Engine • SCB

Table 107: Tools and Parts Required *(Continued)*

Tool or Part	Components
Electrostatic discharge (ESD) grounding wrist strap	• All
Flat-blade (–) screwdriver	• DPC • Cables and connectors
Phillips (+) screwdrivers, numbers 1 and 2	• Air filter • Craft interface • Fan tray • SCB • Routing Engine • Cables and connectors
Rubber safety cap	• DPC • MPC • MIC • PIC
Wire cutters	• Cables and connectors • DC power supply

SEE ALSO

MX480 Component Redundancy | 8

MX480 Field-Replaceable Units (FRUs) | 299

Replacing the MX480 Craft Interface

IN THIS SECTION

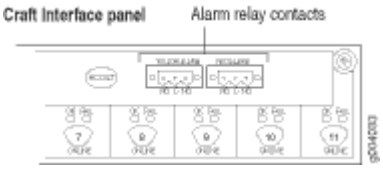
- Disconnecting the Alarm Relay Wires from the MX480 Craft Interface | 303
- Removing the MX480 Craft Interface | 303
- Installing the MX480 Craft Interface | 304
- Connecting the Alarm Relay Wires to the MX480 Craft Interface | 305

Disconnecting the Alarm Relay Wires from the MX480 Craft Interface

To disconnect the alarm relay wires from the router and an alarm-reporting device (see Figure 1):

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 91: Alarm Relay Contacts



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX480 Router | 508

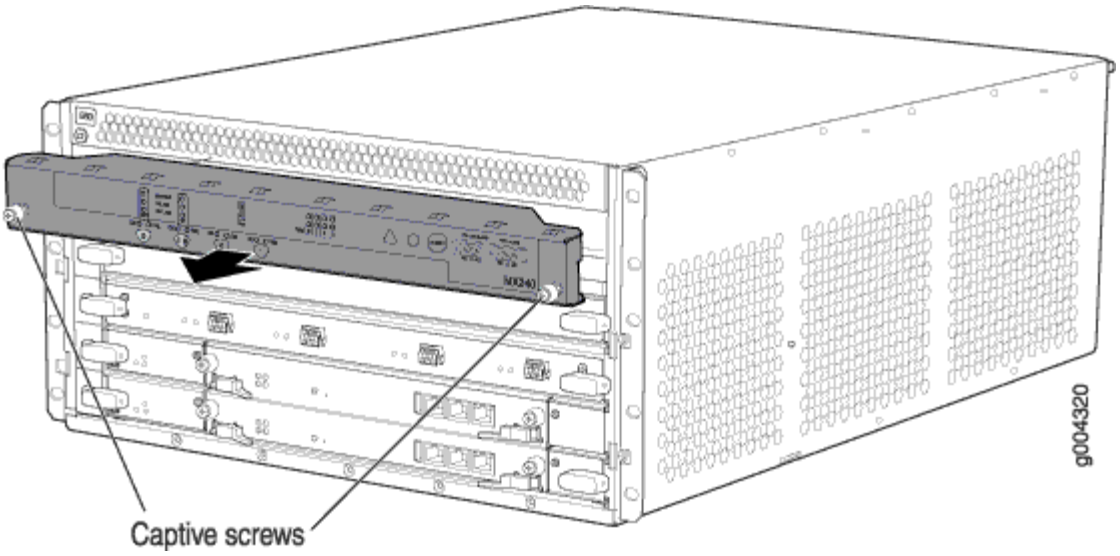
Connecting the Alarm Relay Wires to the MX480 Craft Interface | 291

Removing the MX480 Craft Interface

To remove the craft interface (see Figure 2):

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 92: Removing the Craft Interface



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX480 Router | 508

Replacing the MX480 Craft Interface | 303

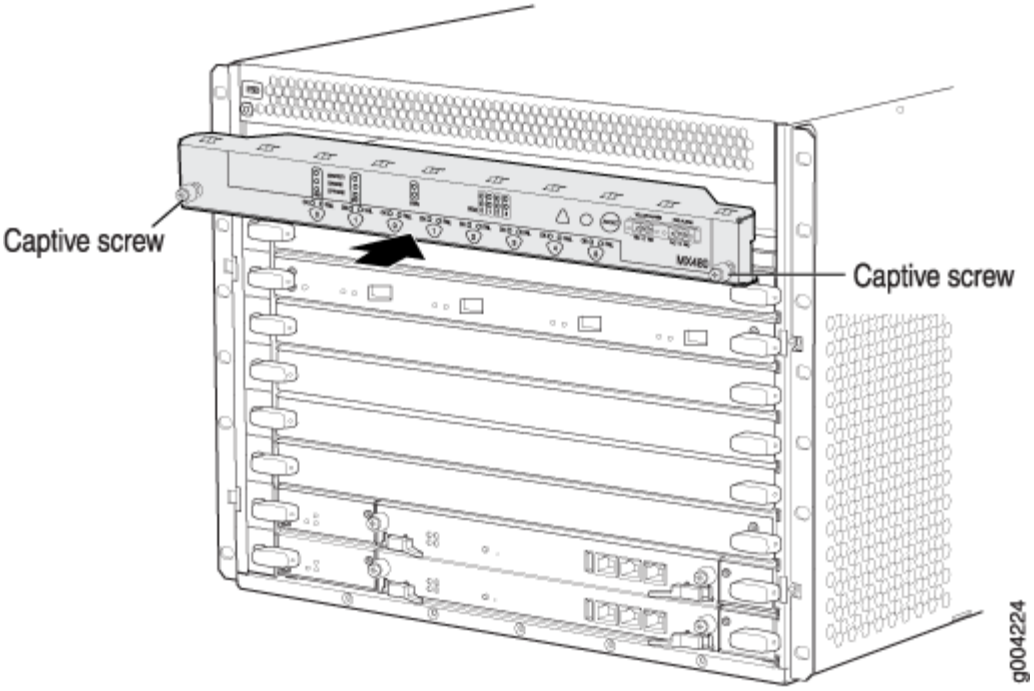
Installing the MX480 Craft Interface

To install the craft interface (see Figure 3):

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 93: Installing the Craft Interface



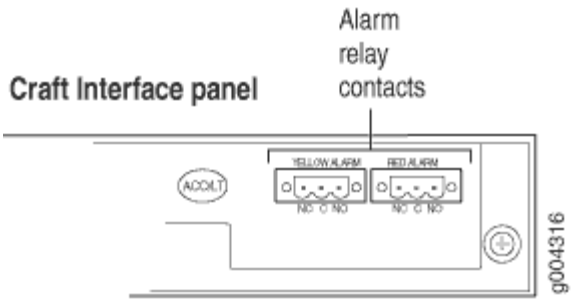
Connecting the Alarm Relay Wires to the MX480 Craft Interface

To connect the alarm relay wires between a router and an alarm-reporting device (see Figure 4):

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 94: Alarm Relay Contacts



Replacing the MX480 Cable Management Brackets

To remove the cable management brackets (see Figure 95 on page 307):

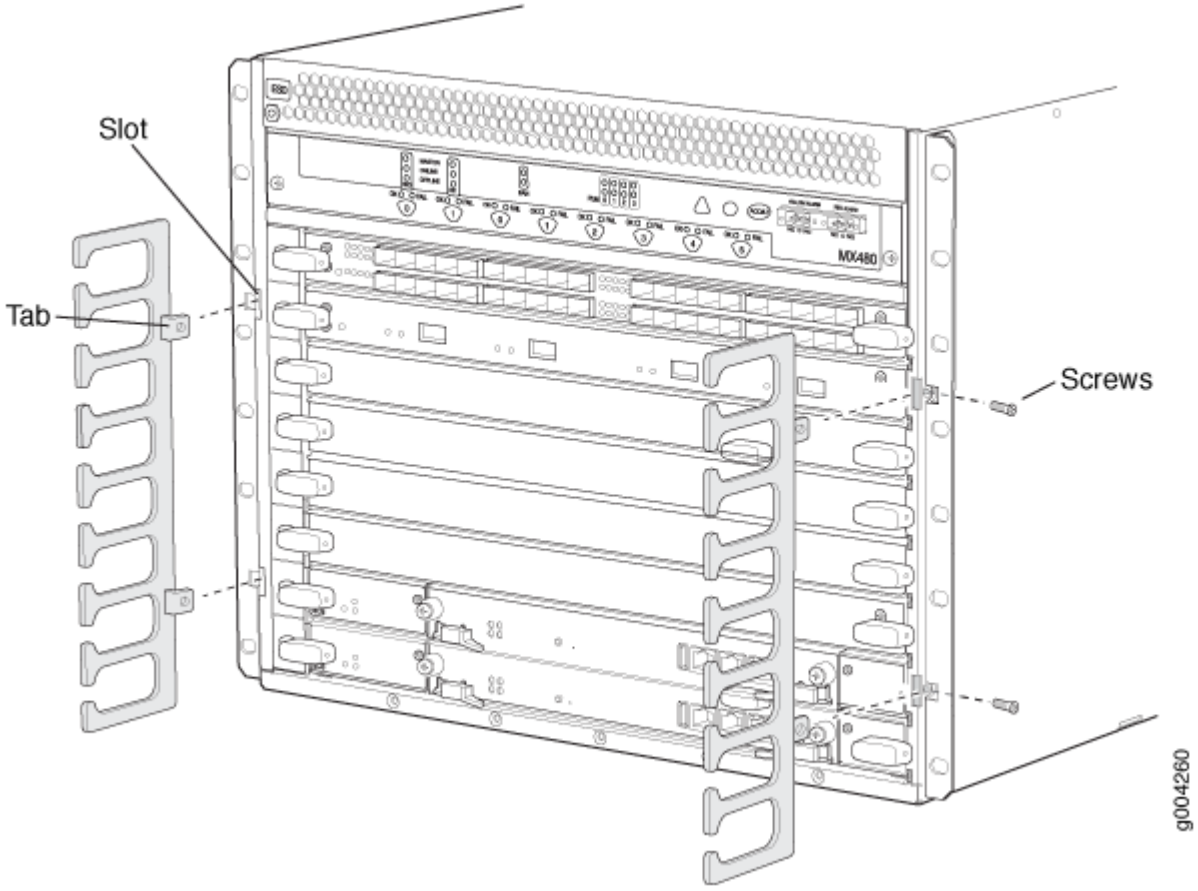
1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Loosen the captive screws on either side of the chassis.
3. Remove the cable management brackets.

To install the cable management brackets (see Figure 95 on page 307):

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 on the front sides of the chassis.
3. Insert the tabs into the slots.

4. Tighten the screws completely.

Figure 95: Removing the Cable Management Brackets



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 96 on page 308 shows the connector.
3. Disconnect the cable from the network device.
4. Plug one end of the replacement cable into the **ETHERNET** port. Figure 97 on page 308 shows the port.

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

Figure 96: Cable Connector

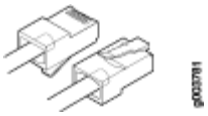
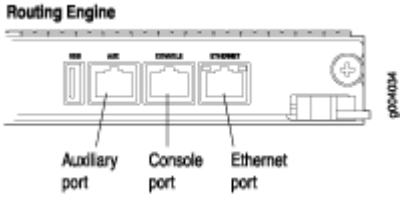


Figure 97: Ethernet Port



SEE ALSO

> *Replacing an MX960 Routing Engine*

Replacing the Console or Auxiliary Cable on an MX480 Router

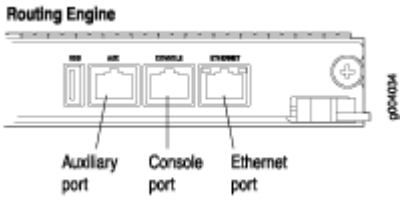
To use a system console to configure and manage the Routing Engine, connect it to the **CONSOLE** port on the Routing Engine. To use a laptop, modem, or other auxiliary device, connect it to the **AUX** port on the Routing Engine. Both ports accept a cable with an RJ-45 connector. One RJ-45/DB-9 cable 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 98 on page 309 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 98: Auxiliary and Console Ports



Maintaining MX480 Cooling System Components

IN THIS SECTION

- Maintaining the MX480 Air Filter | 309
- Replacing the MX480 Air Filter | 310
- Maintaining the MX480 Fan Tray | 312
- Replacing the MX480 Fan Tray | 315

Maintaining the MX480 Air Filter

IN THIS SECTION

- Purpose | 309
- Action | 310

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. The fans are very powerful and can pull small bits of wire or other materials into the device if the air filter isn't in place. These materials can 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.

Replacing the MX480 Air Filter

IN THIS SECTION

- Removing the MX480 Air Filter | **310**
- Installing the MX480 Air Filter | **311**

Removing the MX480 Air Filter

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

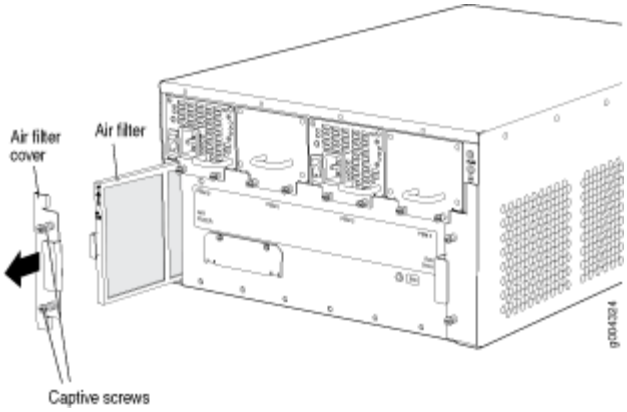
CAUTION: Always keep the air filter in place while the device is operating, except during replacement. The fans are very powerful and can pull small bits of wire or other

materials into the device if the air filter isn't in place. These materials can damage device components.

To remove the air filter (see Figure 1):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Loosen the captive screws on the air filter cover.
3. Remove the air filter cover.
4. Slide the air filter out of the chassis.

Figure 99: Removing the Air Filter



SEE ALSO

MX480 Cooling System Description | **21**

Troubleshooting the MX480 Cooling System | **463**

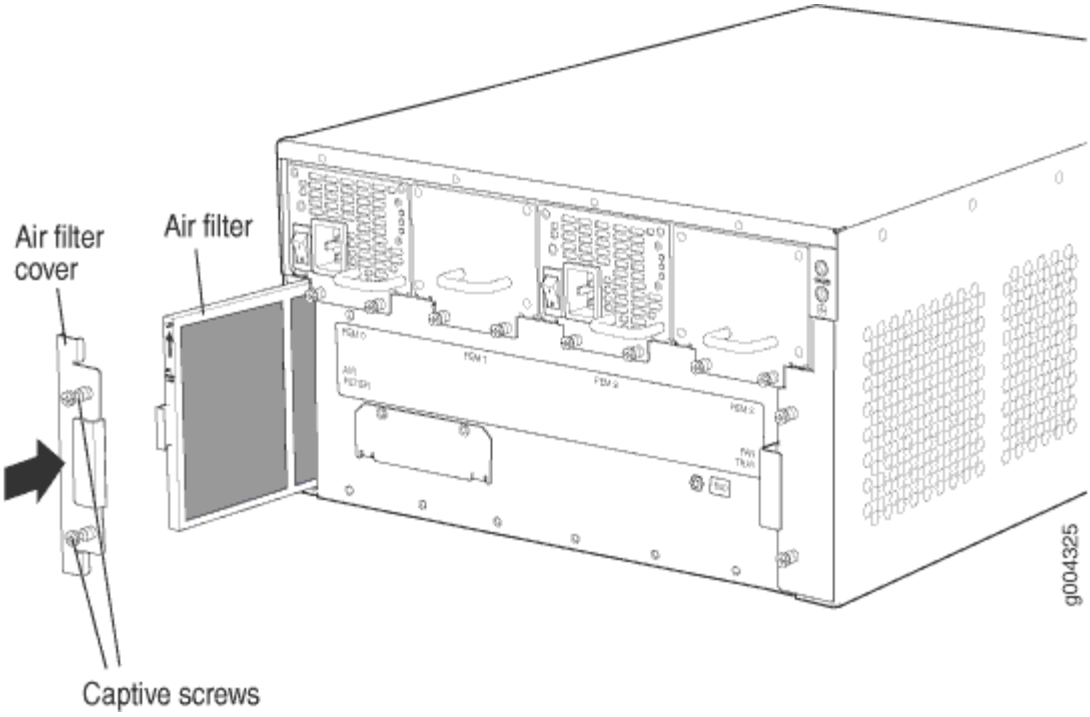
Installing the MX480 Air Filter

To install the air filter (see Figure 2):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Locate the up arrow and ensure that the air filter is right side up.
3. Slide the air filter straight into the chassis until it stops.
4. Align the captive screws of the air filter cover with the mounting holes on the chassis.

5. Tighten the captive screws on the air filter cover.

Figure 100: Installing the Air Filter



RELATED DOCUMENTATION

- Preventing Electrostatic Discharge Damage to an MX480 Router | **508**
- MX480 Cooling System Description | **21**
- Troubleshooting the MX480 Cooling System | **463**

Maintaining the MX480 Fan Tray

IN THIS SECTION

- Purpose | **313**
- Action | **313**

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
```

SEE ALSO

Routine Maintenance Procedures for the MX480 Router | 298

Replacing the MX480 Fan Tray

IN THIS SECTION

- Removing the MX480 Fan Tray | 315
- Installing the MX480 Fan Tray | 317

Removing the MX480 Fan Tray

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

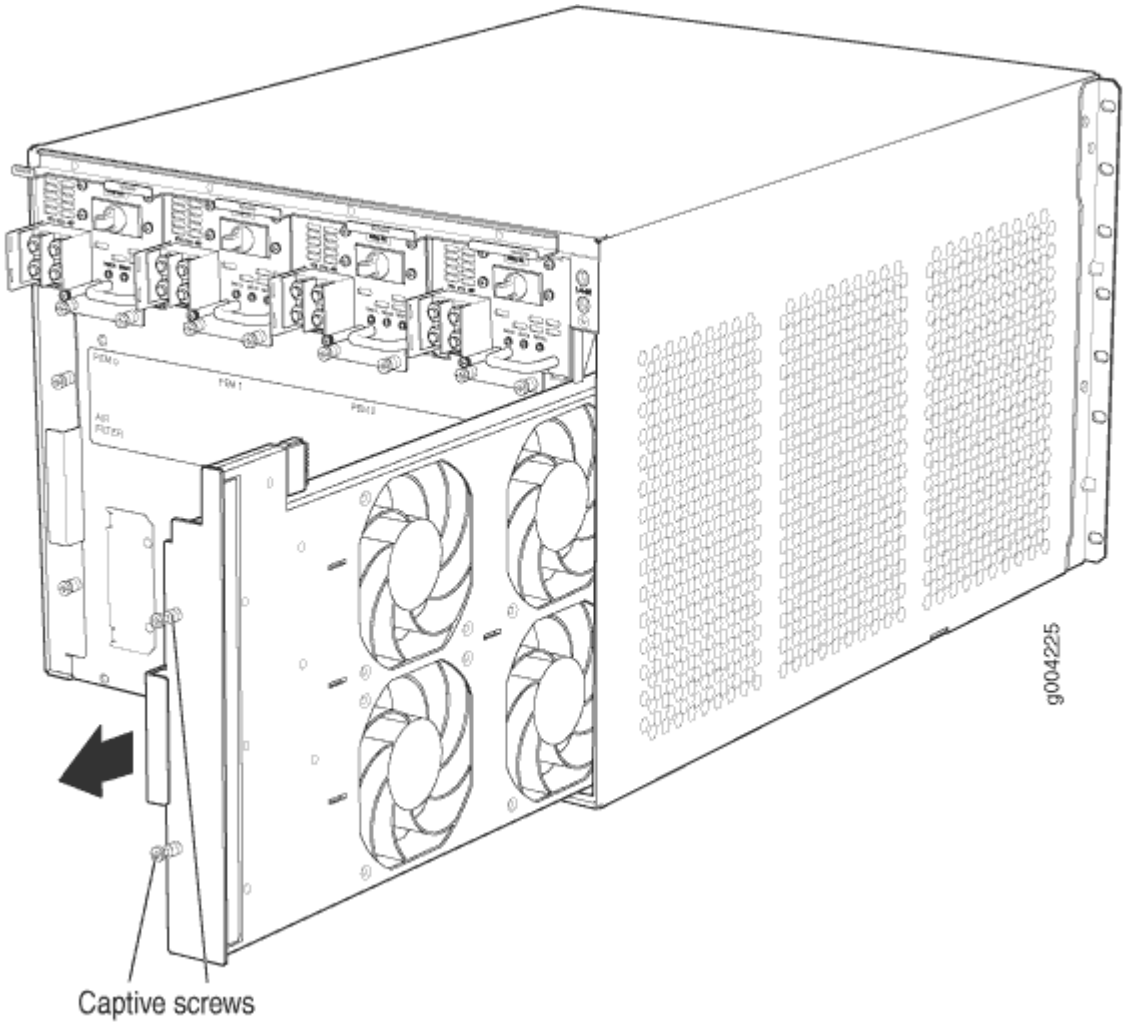
To remove the fan tray (see Figure 3):

1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Loosen the captive screws on the fan tray faceplate.
3. Grasp the fan tray handle, and pull it out approximately 1 to 3 inches.

> **WARNING**: To prevent 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.

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

Figure 101: Removing the Fan Tray

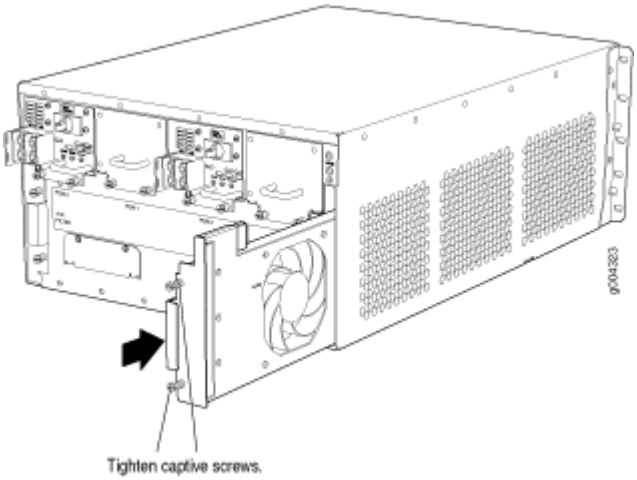


Installing the MX480 Fan Tray

To install the fan tray (see Figure 4):

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

Figure 102: Installing the Fan Tray



SEE ALSO

- Preventing Electrostatic Discharge Damage to an MX480 Router | **508**
- Replacing the MX480 Fan Tray | **315**
- Maintaining the MX480 Fan Tray | **312**
- MX480 Cooling System Description | **21**
- Troubleshooting the MX480 Cooling System | **463**

RELATED DOCUMENTATION

- Preventing Electrostatic Discharge Damage to an MX480 Router | **508**

Maintaining MX480 Host Subsystem Components

IN THIS SECTION

- Maintaining the MX480 Host Subsystem | 318
- Replacing an MX480 Routing Engine | 322
- Replacing an SSD Drive on an RE-S-1800 | 326
- Replacing an SSD Drive on an RE-S-X6-64G | 327
- Replacing Connections to MX480 Routing Engine Interface Ports | 332
- Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem | 334
- Upgrading to the RE-S-X6-64G Routing Engine in a Nonredundant Host Subsystem | 342

Maintaining the MX480 Host Subsystem

IN THIS SECTION

- Purpose | 318
- Action | 318

Purpose

For optimum router performance, verify the condition of the host subsystem. The host subsystem comprises an SCB and a Routing Engine installed directly into an 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.

- Check the LEDs on the Routing Engine faceplate.
- To check the status of the Routing Engines, issue the `show chassis routing-engine` command. The output is similar to the following:

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 45 degrees C / 113 degrees F
    CPU temperature             43 degrees C / 109 degrees F
    DRAM                      2048 MB
    Memory utilization          15 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     8 percent
      Interrupt                  0 percent
      Idle                      92 percent
    Model                          RE-S-1300
    Serial ID                      1000694968
    Start time                     2007-07-10 12:27:39 PDT
    Uptime                         1 hour, 40 minutes, 37 seconds
    Load averages:                 1 minute   5 minute  15 minute
                                       0.11       0.06       0.01
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 46 degrees C / 114 degrees F
    CPU temperature             42 degrees C / 107 degrees F
    DRAM                      2048 MB
    Memory utilization          13 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                     100 percent
    Model                          RE-S-1300
    Serial ID                      1000694976
```

```
    Start time                    2007-06-19 14:17:00 PDT
    Uptime                        20 days, 23 hours, 51 minutes, 4 seconds
```

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

```
user@host> show chassis environment cb
CB 0 status:
  State                      Online Master
  Temperature                40 degrees C / 104 degrees F
  Power 1
    1.2 V                     1208 mV
    1.5 V                     1521 mV
    1.8 V                     1807 mV
    2.5 V                     2507 mV
    3.3 V                     3319 mV
    5.0 V                     5033 mV
    12.0 V                   12142 mV
    1.25 V                    1243 mV
    3.3 V SM3                 3312 mV
    5 V RE                    5059 mV
    12 V RE                  11968 mV
  Power 2
    11.3 V bias PEM          11253 mV
    4.6 V bias MidPlane       4814 mV
    11.3 V bias FPD          11234 mV
    11.3 V bias POE 0        11176 mV
    11.3 V bias POE 1        11292 mV
  Bus Revision               42
  FPGA Revision              1
CB 1 status:
  State                      Online Standby
  Temperature                40 degrees C / 104 degrees F
  Power 1
    1.2 V                     1202 mV
    1.5 V                     1514 mV
    1.8 V                     1807 mV
    2.5 V                     2500 mV
    3.3 V                     3293 mV
    5.0 V                     5053 mV
    12.0 V                   12200 mV
    1.25 V                    1260 mV
```

```
    3.3 V SM3                 3319 mV
    5 V RE                    5059 mV
    12 V RE                  12007 mV
  Power 2
    11.3 V bias PEM          11311 mV
    4.6 V bias MidPlane       4827 mV
    11.3 V bias FPD          11330 mV
    11.3 V bias POE 0        11292 mV
    11.3 V bias POE 1        11311 mV
  Bus Revision               42
  FPGA Revision              1
```

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

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

For more information about using the CLI, see the Junos OS manuals.

SEE ALSO

MX480 Craft Interface Description | 13

MX480 Routing Engine Description | 50

Replacing an MX480 Routing Engine

IN THIS SECTION

- Removing an MX480 Routing Engine | 322
- Installing an MX480 Routing Engine | 323

Removing an MX480 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.

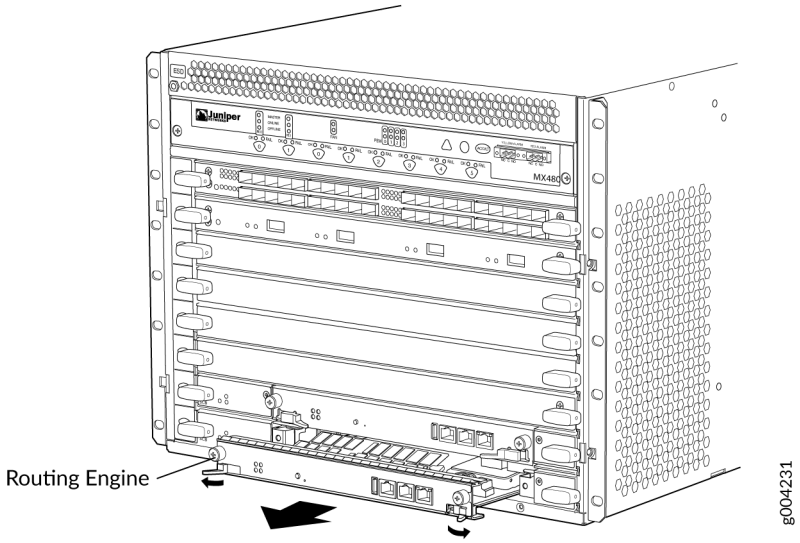
CAUTION: If the Routing Engine to be replaced is currently functioning as the master Routing engine, switch it to be the backup before removing it.

To remove a Routing Engine from an SCB (see Figure 1):

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 103: Removing a Routing Engine



Installing an MX480 Routing Engine

To install a Routing Engine into an SCB (Figure 2):

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 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 SCB.
5. 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.

6. Press both of the ejector handles inward to seat the Routing Engine.

7. Tighten the captive screws on the left and right of the Routing Engine.
8. 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.

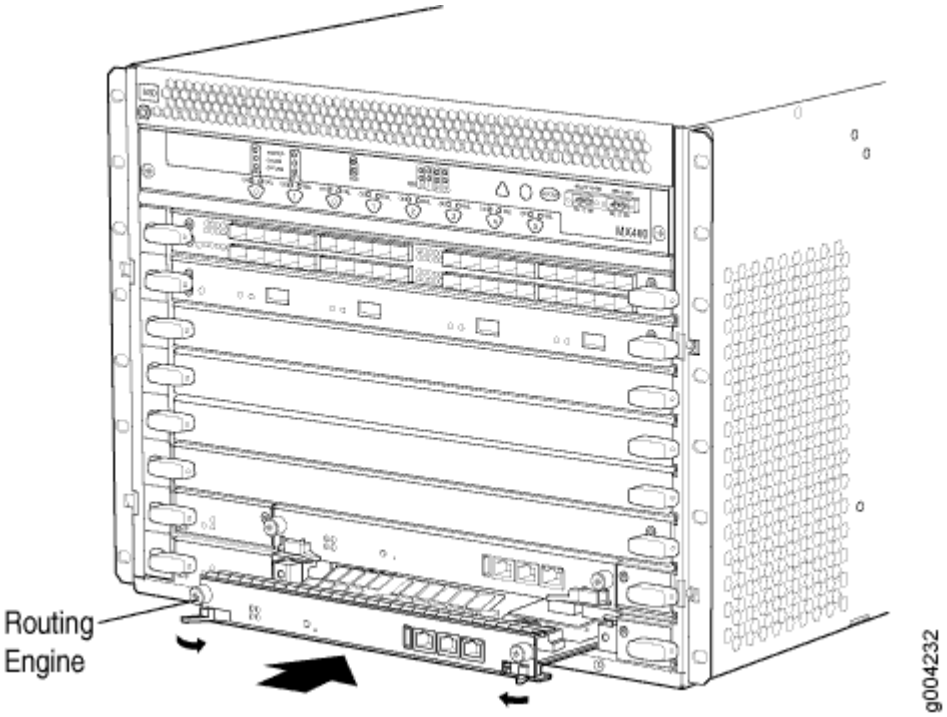
To check the status of the Routing Engine, use the CLI command:

```
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 104: Installing an MX480 Routing Engine



SEE ALSO

Preventing Electrostatic Discharge Damage to an MX480 Router | 508

Replacing Connections to MX480 Routing Engine Interface Ports | 332

RELATED DOCUMENTATION

Replacing Connections to MX480 Routing Engine Interface Ports | 332

Effect of Taking the MX480 Host Subsystem Offline

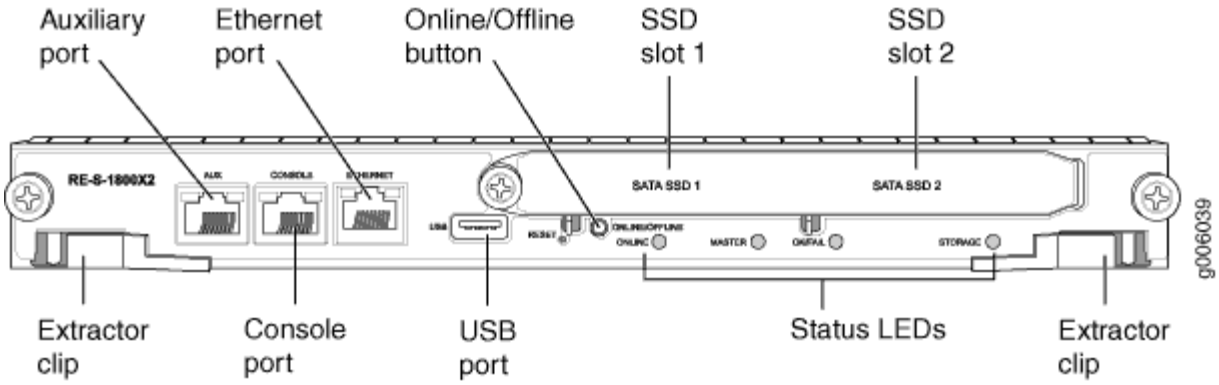
Preventing Electrostatic Discharge Damage to an MX480 Router | 508

Replacing Connections to MX480 Routing Engine Interface Ports | 332

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 105 on page 326 shows the arrangement of storage drive slots on a RE-S-1800 Routing Engine.

Figure 105: 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.

SEE ALSO

> *How to Return a Hardware Component to Juniper Networks, Inc.*

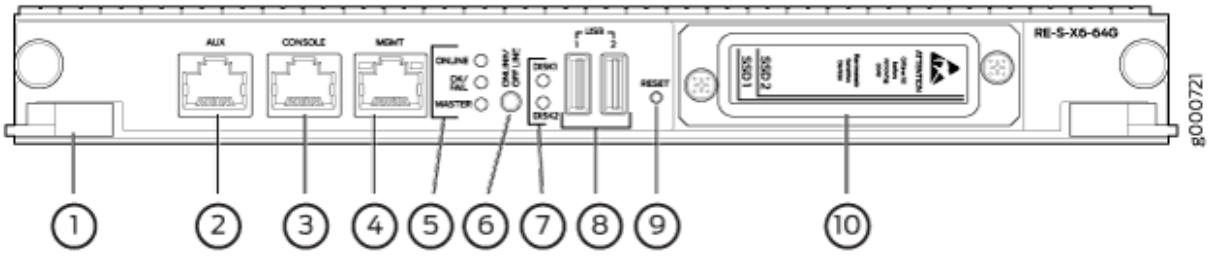
Replacing an SSD Drive on an RE-S-X6-64G

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 106 on page 327 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 106: 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**:
   - 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.

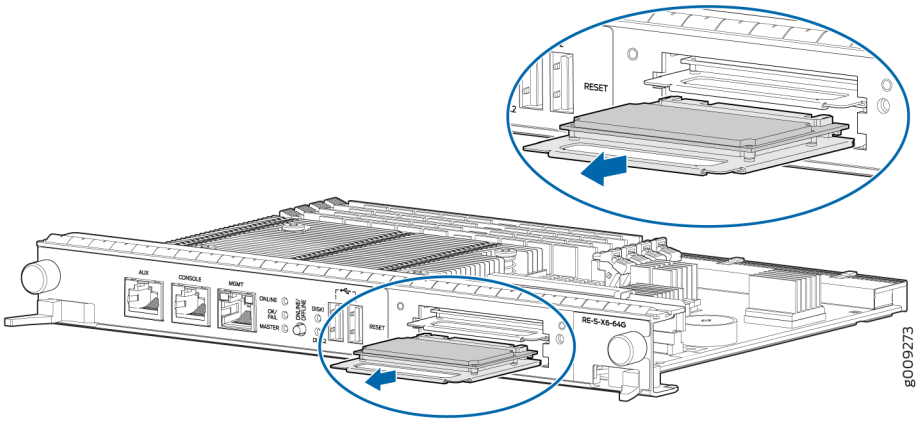
   For more information about ESD, see *Preventing Electrostatic Discharge Damage* in the hardware guide for your router.

   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 107: 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:

      i. Insert the USB disk in the **USB** slot on the Routing Engine.

      ii. 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.

      iii. 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:

i. Set up the PXEBoot server. See *Copying VM Host Installation Package to the PXE Boot Server*.

ii. Bring the Routing Engine online by pressing the ONLINE/OFFLINE button

iii. 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.

iv. Using **Up** or **Down** arrow keys, navigate to **Boot Manager** and press the **Enter** key.

v. 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.

vi. `Booting `net boot console` is displayed and PXEBoot continues.

> **NOTE**: The booting process may take several minutes.

vii. 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.

viii. 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**

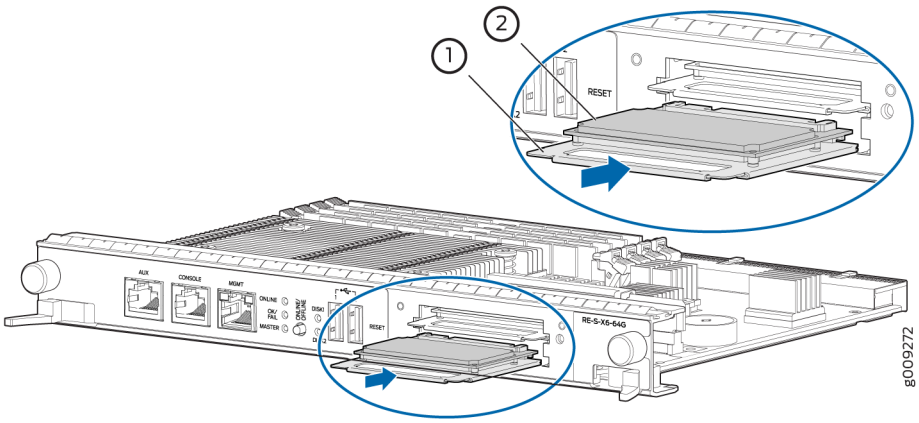
If only disk1 is replaced:

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 108: 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:

1. Bring the Routing Engine online by pressing the **ONLINE/OFFLINE** button.

2. 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**

SEE ALSO

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

Upgrading the SSD Firmware on Routing Engines with VM Host Support

Replacing Connections to MX480 Routing Engine Interface Ports

IN THIS SECTION

- Replacing the Management Ethernet Cable on an MX Series Router | 333
- Replacing the Console or Auxiliary Cable on an MX480 Router | 333

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 7 shows the connector.
3. Disconnect the cable from the network device.
4. Plug one end of the replacement cable into the **ETHERNET** port. Figure 8 shows the port.
5. Plug the other end of the cable into the network device.

Figure 109: Cable Connector

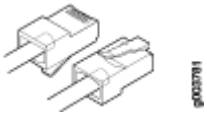
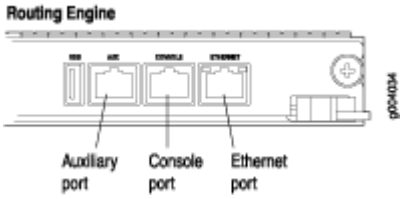


Figure 110: Ethernet Port



Replacing the Console or Auxiliary Cable on an MX480 Router

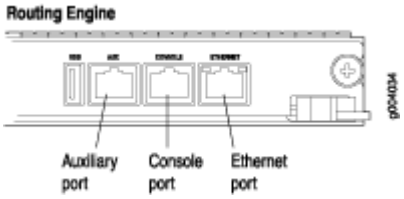
To use a system console to configure and manage the Routing Engine, connect it to the **CONSOLE** port on the Routing Engine. To use a laptop, modem, or other auxiliary device, connect it to the **AUX** port on the Routing Engine. Both ports accept a cable with an RJ-45 connector. One RJ-45/DB-9 cable 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 9 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 111: Auxiliary and Console Ports



RELATED DOCUMENTATION

- Routing Engine Interface Cable and Wire Specifications for MX Series Routers
- Preventing Electrostatic Discharge Damage to an MX480 Router | **508**

Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem

IN THIS SECTION

- Removing the Routing Engine | **335**
- Installing the Routing Engine RE-S-X6-64G | **338**
- Verifying and Configuring the Upgraded Routing Engine as the Primary | **341**
- Verifying and Configuring the Upgraded Routing Engine as the Backup | **342**

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 or SCBE3 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" on page 450 or *Upgrading an MX960 to Use the SCBE2-MX*, depending on the chassis on which the Routing Engine is being upgraded. To upgrade the Switch Control Board to SCBE3 "Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX" on page 456.

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 10, Figure 11, and Figure 12):

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 112: Removing a Routing Engine from an MX240 Router

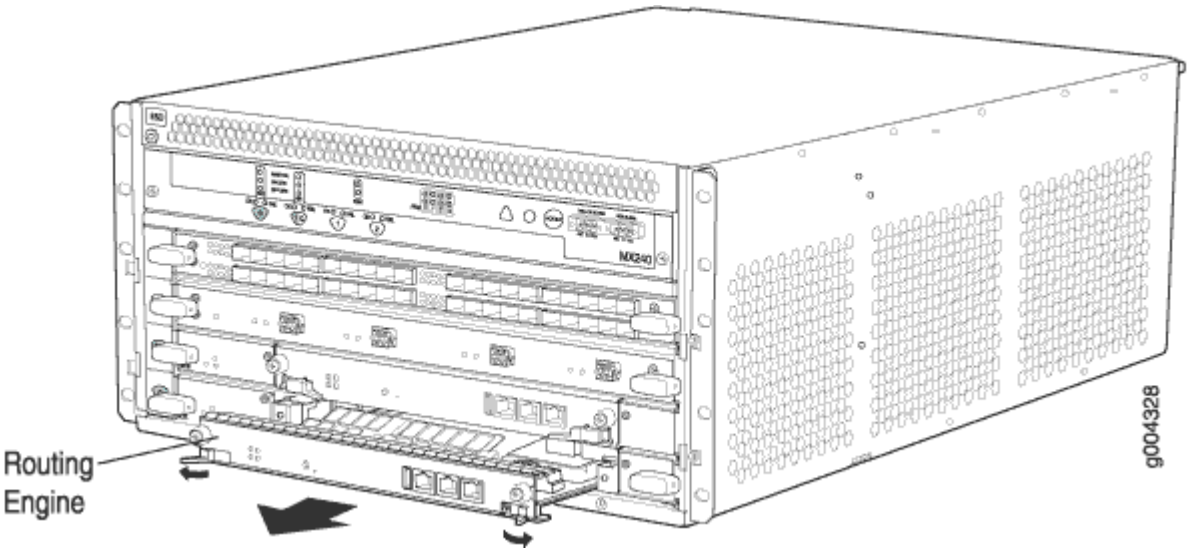


Figure 113: Removing a Routing Engine from an MX480 Router

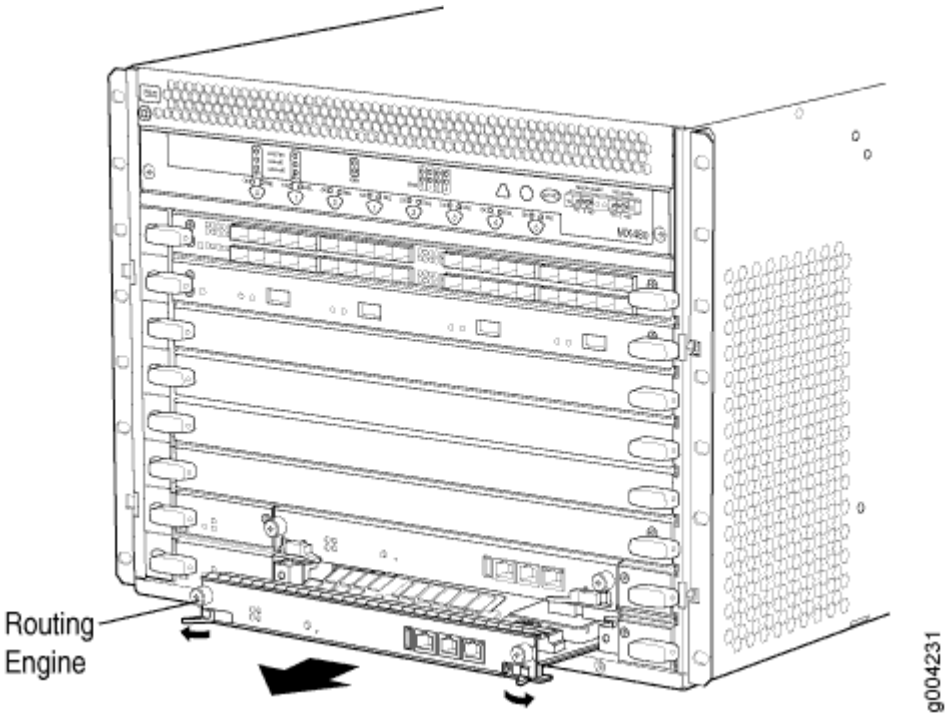
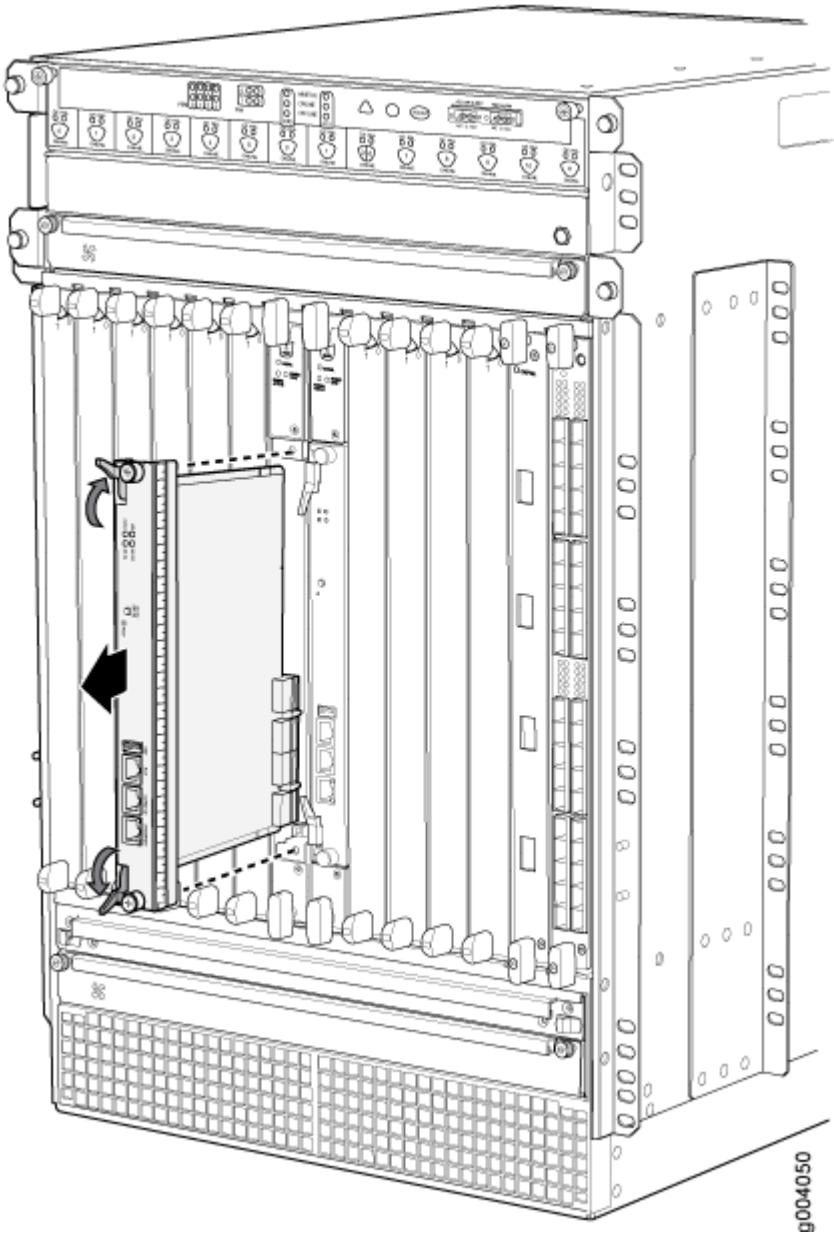


Figure 114: Removing a Routing Engine from an MX960 Router



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 or SCBE3.

   NOTE: The Routing Engine RE-S-X6-64G is supported only on the SCBE2 or SCBE3. RE-S-X6-64G is not compatible with the SCB or the SCBE.

4. Slide the Routing Engine into the SCBE2 or SCBE3 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 and SCBE3. 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 115: Installing a Routing Engine in an MX240 Router

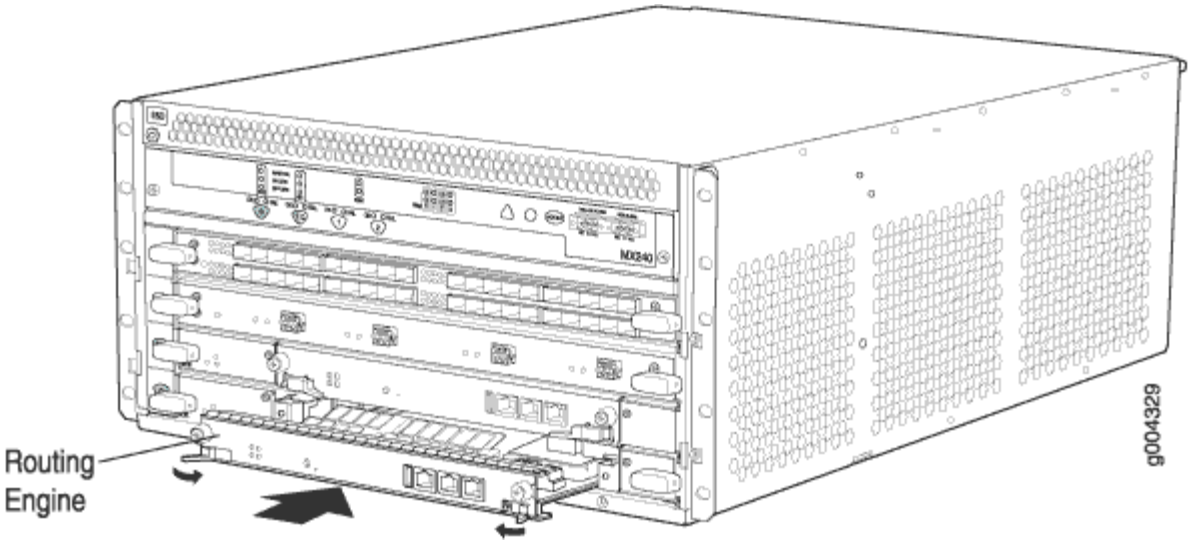


Figure 116: Installing a Routing Engine in an MX480 Router

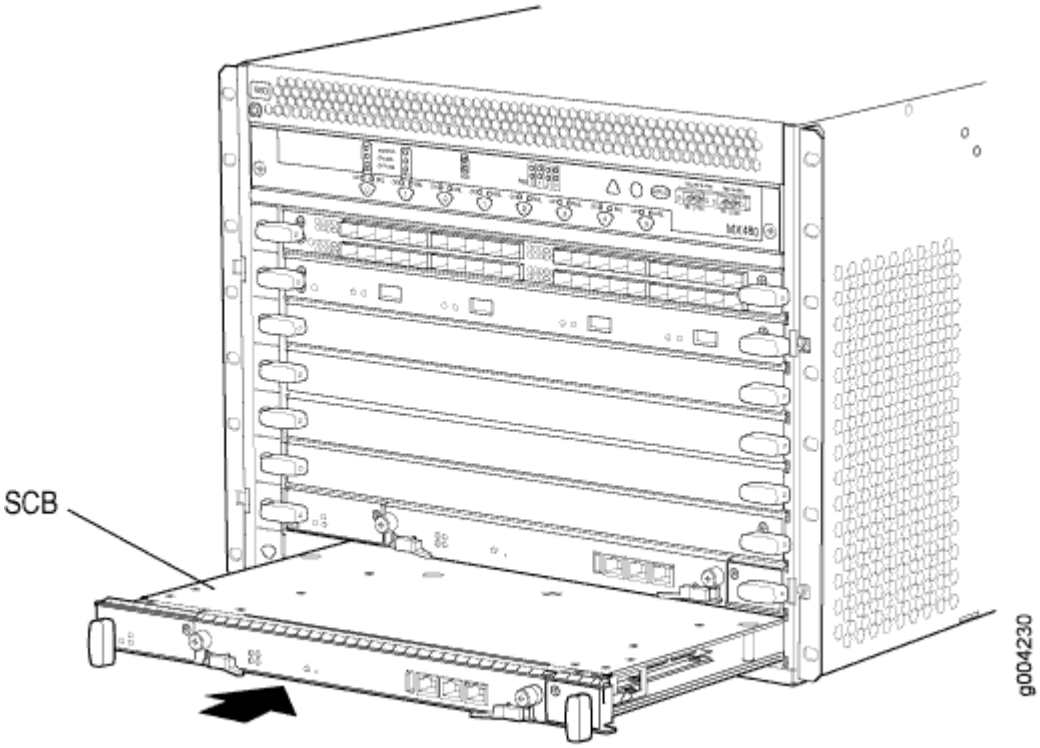
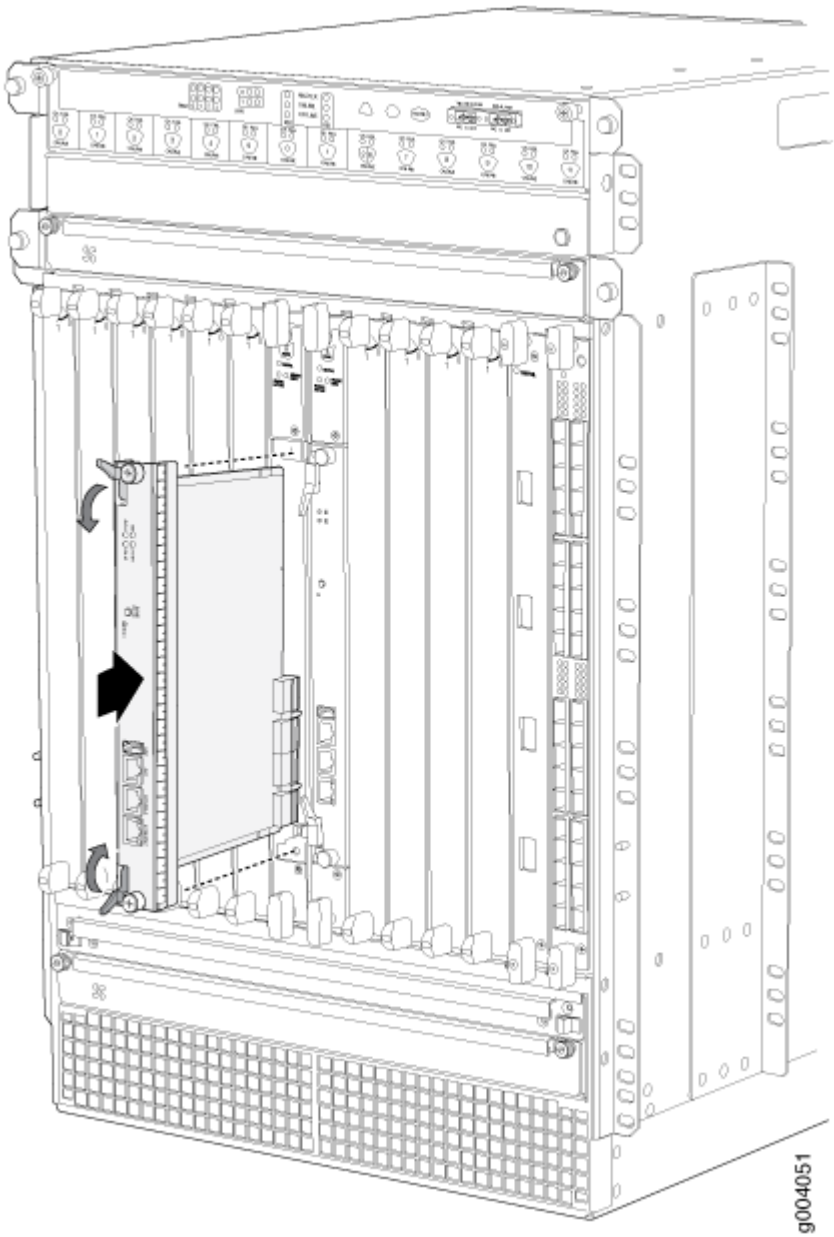


Figure 117: Installing a Routing Engine in an MX960 Router



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 or SCBE3 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 or SCBE3, 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 THIS SECTION

- Removing the Routing Engine | 343
- Installing the Routing Engine RE-S-X6-64G | 343

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"

on page 450or *Upgrading an MX960 to Use the SCBE2-MX*, 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

Maintaining MX480 Interface Modules

IN THIS SECTION

- Maintaining MX480 DPCs | **345**
- Holding an MX480 DPC | **348**
- Storing an MX480 DPC | **351**

- Replacing an MX480 DPC | **351**
- Replacing a Cable on an MX480 DPC, MPC, MIC, or PIC | **357**
- Maintaining MX480 FPCs | **360**
- Holding an MX480 FPC | **363**
- Storing an MX480 FPC | **366**
- Replacing an MX480 FPC | **367**
- Maintaining MX480 MICs | **373**
- Replacing an MX480 MIC | **375**
- Maintaining MX480 MPCs | **384**
- Replacing an MX480 MPC | **387**
- Maintaining MX480 PICs | **392**
- Replacing an MX480 PIC | **393**
- Replacing an MX480 AS MLC | **399**
- Replacing an MX480 AS MSC | **403**
- Replacing an MX480 AS MXC | **408**
- Maintaining Cables That Connect to MX480 DPCs, MPCs, MICs, or PICs | **412**

Maintaining MX480 DPCs

IN THIS SECTION

- Purpose | **345**
- Action | **346**

Purpose

The router can have up to six Dense Port Concentrators (DPCs) mounted horizontally 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  Online            41      9          0       1024       15         57
  1  Online            43      5          0       1024       16         57
  2  Online            43     11          0       1024       16         57
  3  Empty
  4  Empty
  5  Online            42      6          0       1024       16         57
```

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

```
user@host> show chassis fpc detail
Slot 0 information:
  State                                Online
  Temperature                       41 degrees C / 105 degrees F
  Total CPU DRAM                  1024 MB
  Total RLDRAM                     256 MB
  Total DDR DRAM                  4096 MB
  Start time:                          2007-07-10 12:28:33 PDT
  Uptime:                              1 hour, 33 minutes, 52 seconds
  Max Power Consumption             368 Watts
Slot 1 information:
  State                                Online
  Temperature                       43 degrees C / 109 degrees F
  Total CPU DRAM                  1024 MB
  Total RLDRAM                     256 MB
```

```
  Total DDR DRAM                   4096 MB
  Start time:                           2007-07-10 12:28:38 PDT
  Uptime:                               1 hour, 33 minutes, 47 seconds
  Max Power Consumption             249 Watts
Slot 2 information:
  State                                 Online
  Temperature                        43 degrees C / 109 degrees F
  Total CPU DRAM                   1024 MB
  Total RLDRAM                      256 MB
  Total DDR DRAM                   4096 MB
  Start time:                           2007-07-10 12:28:40 PDT
  Uptime:                               1 hour, 33 minutes, 45 seconds
  Max Power Consumption             335 Watts
Slot 5 information:
  State                                 Online
  Temperature                        42 degrees C / 107 degrees F
  Total CPU DRAM                   1024 MB
  Total RLDRAM                      256 MB
  Total DDR DRAM                   4096 MB
  Start time:                           2007-07-10 12:28:42 PDT
  Uptime:                               1 hour, 33 minutes, 43 seconds
  Max Power Consumption             333 Watts
```

- Issue the CLI `show chassis fpc pic-status` command. The DPC slots are numbered **0** through **5**, bottom to top:

```
user@host> show chassis fpc pic-status
Slot 0   Online       DPCE 4x 10GE R
  PIC 0  Online       1x 10GE(LAN/WAN)
  PIC 1  Online       1x 10GE(LAN/WAN)
  PIC 2  Online       1x 10GE(LAN/WAN)
  PIC 3  Online       1x 10GE(LAN/WAN)
Slot 1   Online       DPCE 40x 1GE R
  PIC 0  Online       10x 1GE(LAN)
  PIC 1  Online       10x 1GE(LAN)
  PIC 2  Online       10x 1GE(LAN)
  PIC 3  Online       10x 1GE(LAN)
Slot 2   Online       DPCE 40x 1GE R
  PIC 0  Online       10x 1GE(LAN)
  PIC 1  Online       10x 1GE(LAN)
  PIC 2  Online       10x 1GE(LAN)
```

```
  PIC 3  Online       10x 1GE(LAN)
Slot 5   Online       DPC 4x 10GE R
  PIC 0  Online       1x 10GE(LAN/WAN)
  PIC 1  Online       1x 10GE(LAN/WAN)
  PIC 2  Online       1x 10GE(LAN/WAN)
  PIC 3  Online       1x 10GE(LAN/WAN)
```

For further description of the output from the command, see the CLI Explorer.

SEE ALSO

MX480 Chassis Description | 6

MX480 Component LEDs on the Craft Interface | 15

Holding an MX480 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:

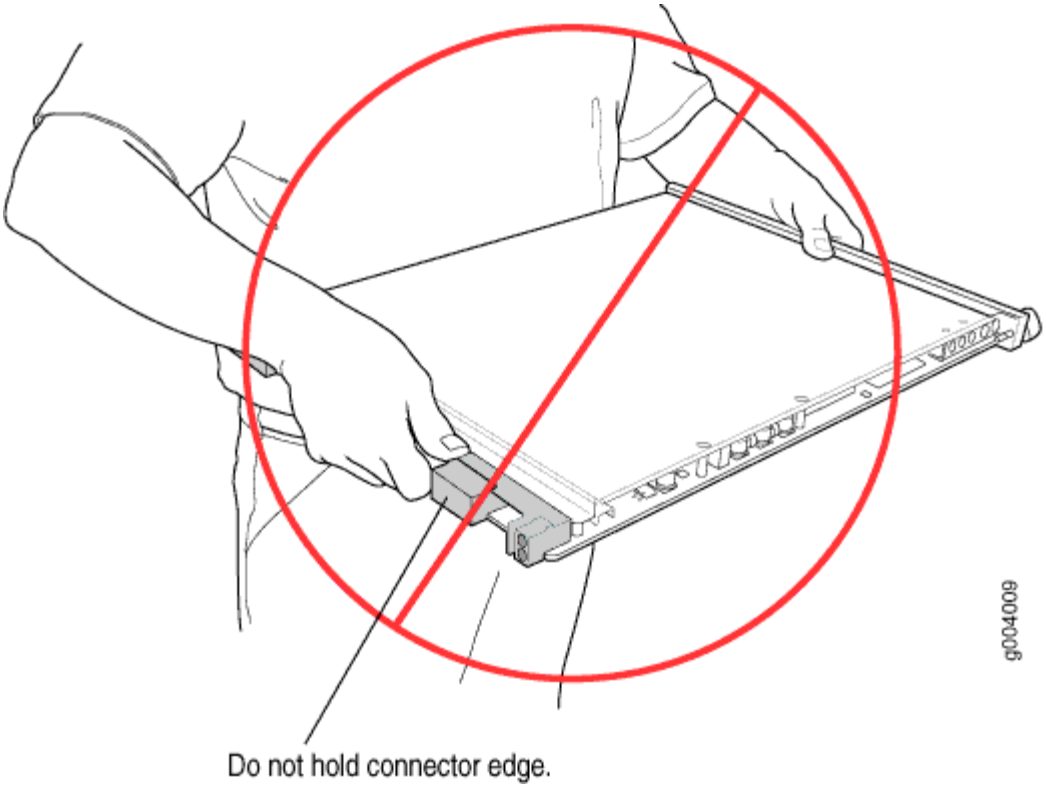
1. Orient the DPC so that the faceplate faces you.
2. Grasp the top edge with your left hand and the bottom edge with your right hand.

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 118 on page 349.

Figure 118: Do Not Grasp the Connector Edge

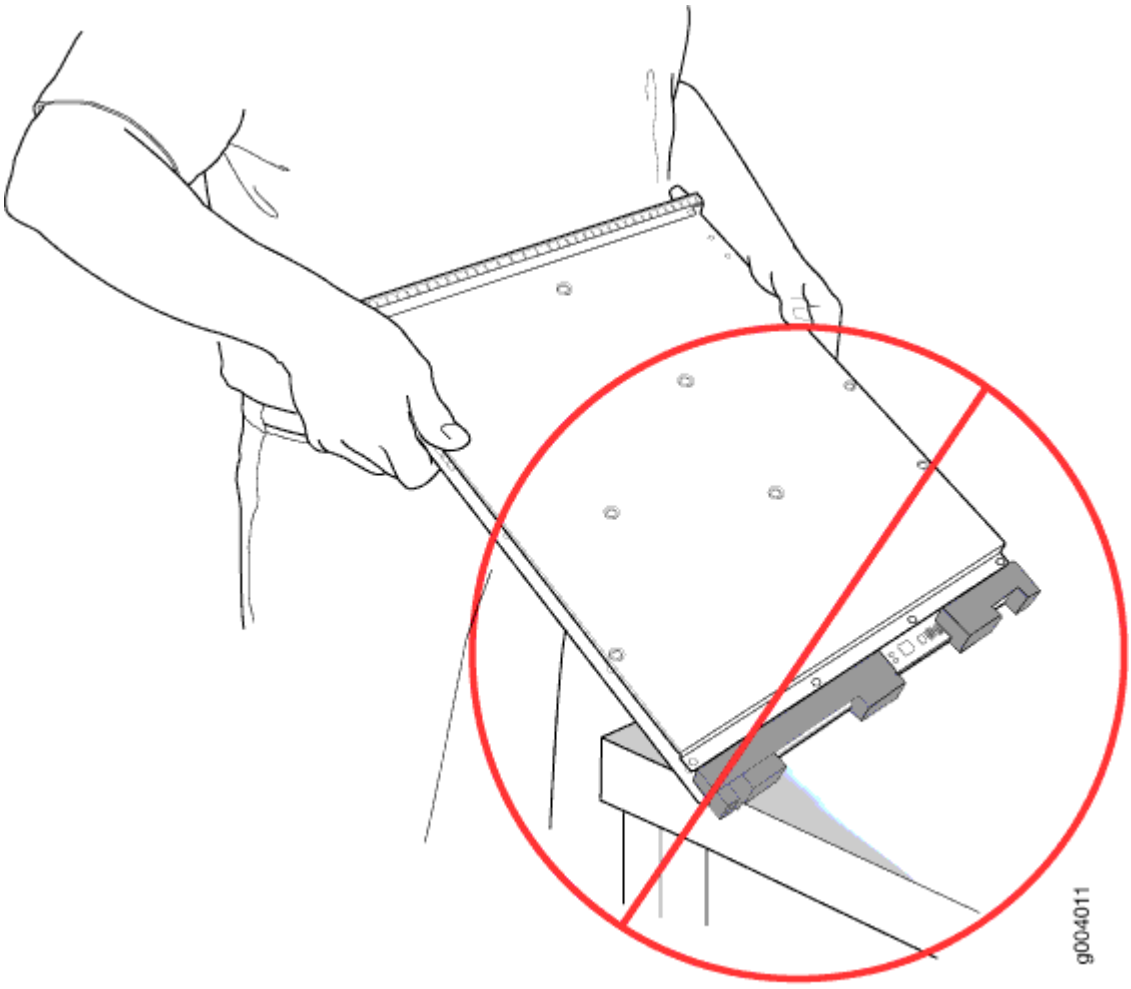


Never carry the DPC by the faceplate with only one hand.

Do not rest any edge of a DPC directly against a hard surface (see Figure 119 on page 350).

Do not stack DPCs.

Figure 119: Do Not Rest the DPC on an Edge



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.

SEE ALSO

- MX480 DPC Terminology

Storing an MX480 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.

SEE ALSO

MX480 DPC Terminology

Replacing an MX480 DPC

IN THIS SECTION

- Removing an MX480 DPC | **351**
- Installing an MX480 DPC | **354**

Removing an MX480 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 3):

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.

   LASER 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 protects your eyes from 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 cable management brackets 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.

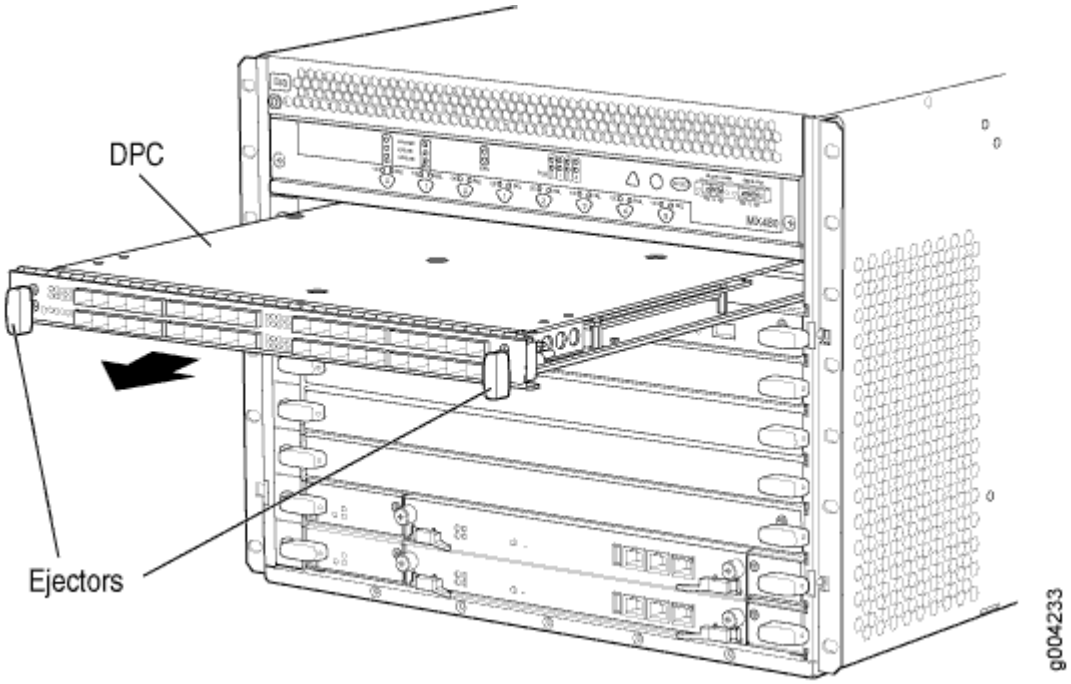
10. Place one hand around the front of the DPC and the other hand under it to support it. Slide the DPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.

> **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 120: Removing a DPC



Installing an MX480 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 4):

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.



LASER 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 5).
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 121: Installing a DPC

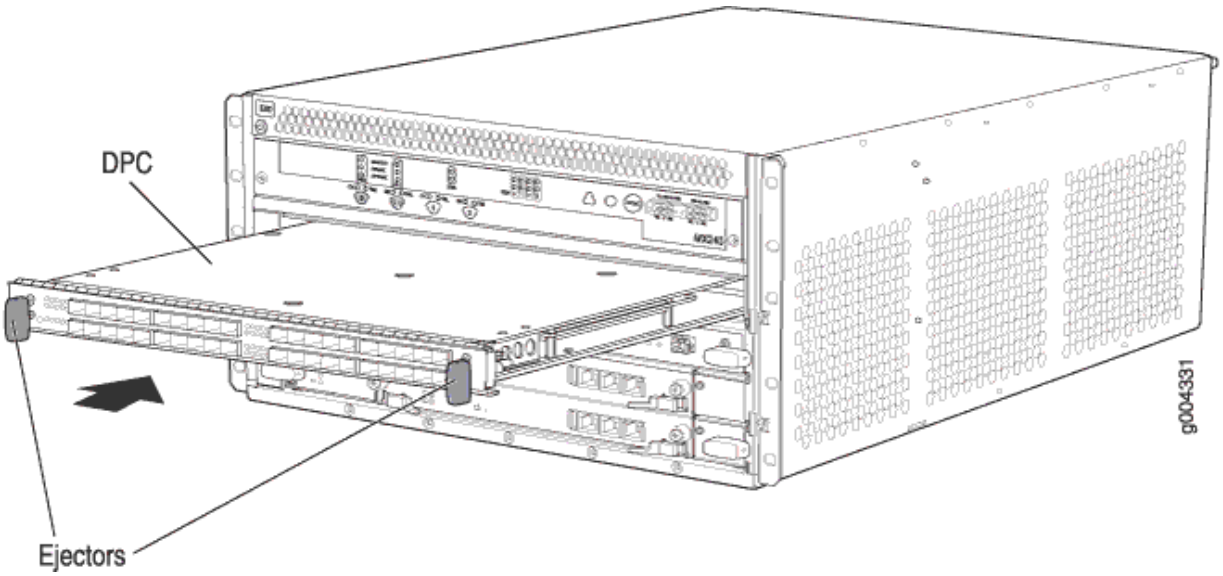
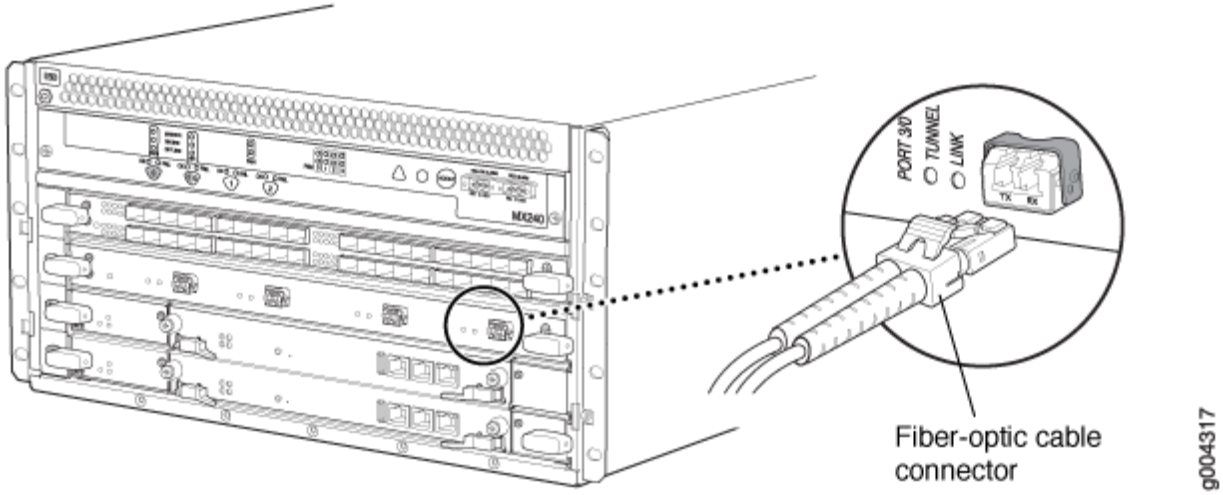


Figure 122: Attaching a Cable to a DPC



RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX480 Router | 508

MX480 Dense Port Concentrator (DPC) Description | 104

MX480 Dense Port Concentrator (DPC) LEDs | 111

Troubleshooting the MX480 DPCs | 464

Replacing a Cable on an MX480 DPC, MPC, MIC, or PIC

IN THIS SECTION

- Removing a Cable on an MX480 DPC, MPC, MIC, or PIC | 357
- Installing a Cable on an MX480 DPC, MPC, MIC, or PIC | 358

Removing a Cable on an MX480 DPC, MPC, MIC, or PIC

Removing and installing cables on a DPC, MPC, MIC, or PIC does not affect router function.

To remove a cable:

1. Have ready a rubber safety cap for each fiber-optic 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 off (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. Disconnect the cable from the cable connector port. If the component uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.



LASER 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 protects your eyes from accidental exposure to laser light.

4. Remove the cable from the cable management brackets.
5. Disconnect the cable from the destination port.

Installing a Cable on an MX480 DPC, MPC, MIC, or PIC

To install a cable:

1. Have ready a length of the type of cable used by the DPC, MPC, MIC, or PIC. For cable specifications, see the *MX Series Interface Module Reference*.
2. If the cable connector port is covered by a rubber safety plug, remove the plug.



LASER 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 protects your eyes from 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 cable management brackets 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.

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 the it online:
   - To bring a DPC or an 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 an FPC2 or 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 correct MIC or the PIC functioning by issuing the `show chassis fpc pic-status` command.

RELATED DOCUMENTATION

Preventing Electrostatic Discharge Damage to an MX480 Router | 508

Maintaining Cables That Connect to MX480 DPCs, MPCs, MICs, or PICs | 412

Maintaining MX480 FPCs

IN THIS SECTION

Purpose | 361

Action | 361

Purpose

The MX480 router can have up to three Flexible PIC Concentrators (FPCs) installed horizontally in 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         24      3          0       1024       13         21
  5  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
  Max Power Consumption              368 Watts
```

```
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
  Max Power Consumption                 294 Watts
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
  Max Power Consumption                 335 Watts
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
  Max Power Consumption                 333 Watts
```

- Issue the CLI `show chassis fpc pic-status` command. The following example shows an FPC installed in DPC slots **0**, and **1**:

```
user@host> show chassis fpc pic-status
Slot 0   Online       MX FPC Type 3
  PIC 0  Online       1x OC-192 SONET
  PIC 1  Online       1x OC-192 SONET
Slot 2   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 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+
```

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.

SEE ALSO

MX480 Flexible PIC Concentrator (FPC) LEDs | **119**

Troubleshooting the MX480 FPCs | **466**

Holding an MX480 FPC

CAUTION: Many components on the FPC are fragile. Failure to handle FPCs as specified in this document can cause irreparable damage.

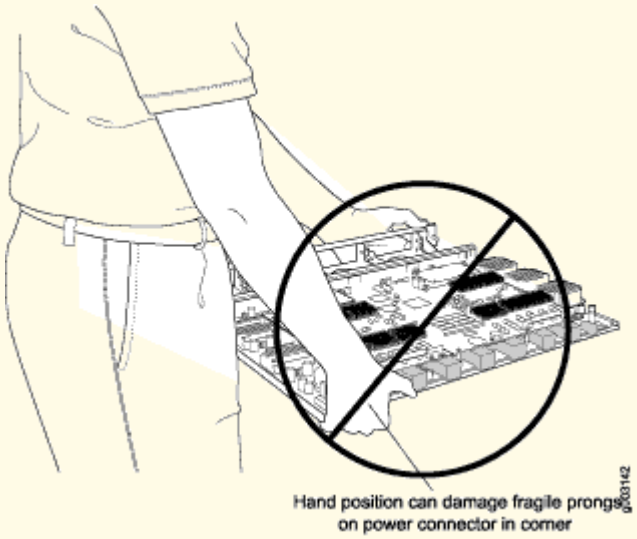
NOTE: An FPC configured with PICs installed can weigh as much as 18 lb (8.2 kg). Be prepared to accept the full weight of the FPC as you lift it.

CAUTION: To prevent damage when handling or carrying FPCs:

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

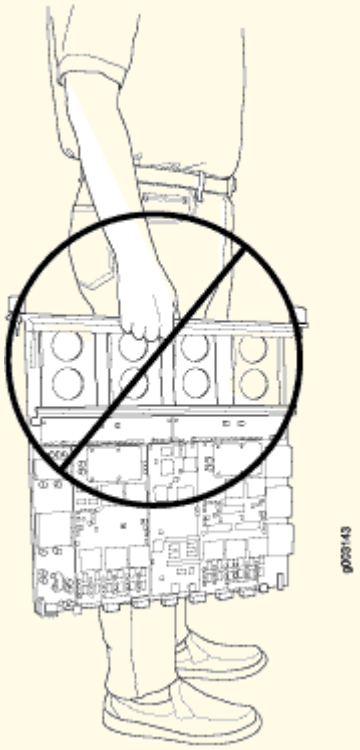
- Do not grasp the FPC anywhere except places that this document indicates. In particular, never grasp the connector edge, especially at the power connector in the corner where the connector and bottom edges meet (see Figure 123 on page 364).

Figure 123: Do Not Grasp the Connector Edge



- Do not carry the FPC by the faceplate with only one hand (see Figure 124 on page 365).

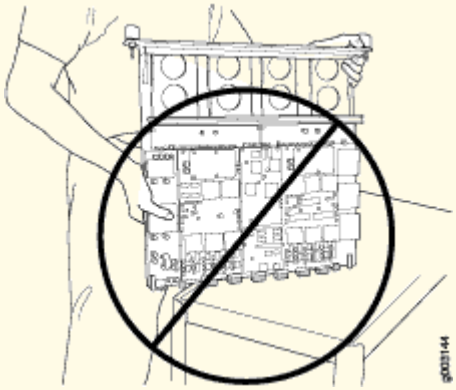
Figure 124: Do Not Carry an FPC with Only One Hand



- Do not rest any edge of an FPC directly against a hard surface (see Figure 125 on page 366). 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 125: Do Not Rest the FPC on an Edge



You hold an FPC horizontally when installing it into the chassis or an equipment rack.

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

To hold an FPC horizontally:

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

SEE ALSO

MX480 Flexible PIC Concentrator (FPC) Description | 116

MX480 FPC Terminology

Storing an MX480 FPC

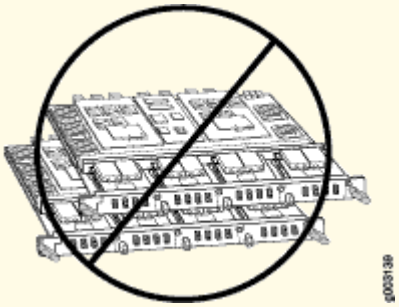
When not installed in the routing platforms, FPCs must be either stored in the container in which a spare FPC is shipped or stored horizontally with the component-side up on a flat, stable surface. When you store an FPC on a horizontal surface or in the shipping container, always place it inside an antistatic 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 126: Do Not Stack FPCs



- Never stack an FPC under or on top of any other component (see Figure 126 on page 367).

SEE ALSO

MX480 Flexible PIC Concentrator (FPC) Description | **116**

MX480 FPC Terminology

Replacing an MX480 FPC

IN THIS SECTION

Removing an MX480 FPC | **368**

- Installing an MX480 FPC | 370

Removing an MX480 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 MX480 router. Up to three FPCs can be installed horizontally in the front of the MX480 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 10):

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 off. 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.
6. Immediately cover each fiber-optic transceiver and the end of each fiber-optic cable with a rubber safety cap.



LASER 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.

7. Arrange the cable in the cable management brackets 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 cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



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

8. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.
9. Grasp the handles, and slide the FPC straight out of the card cage halfway.
10. Place one hand around the front of the FPC (the PIC housing) and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



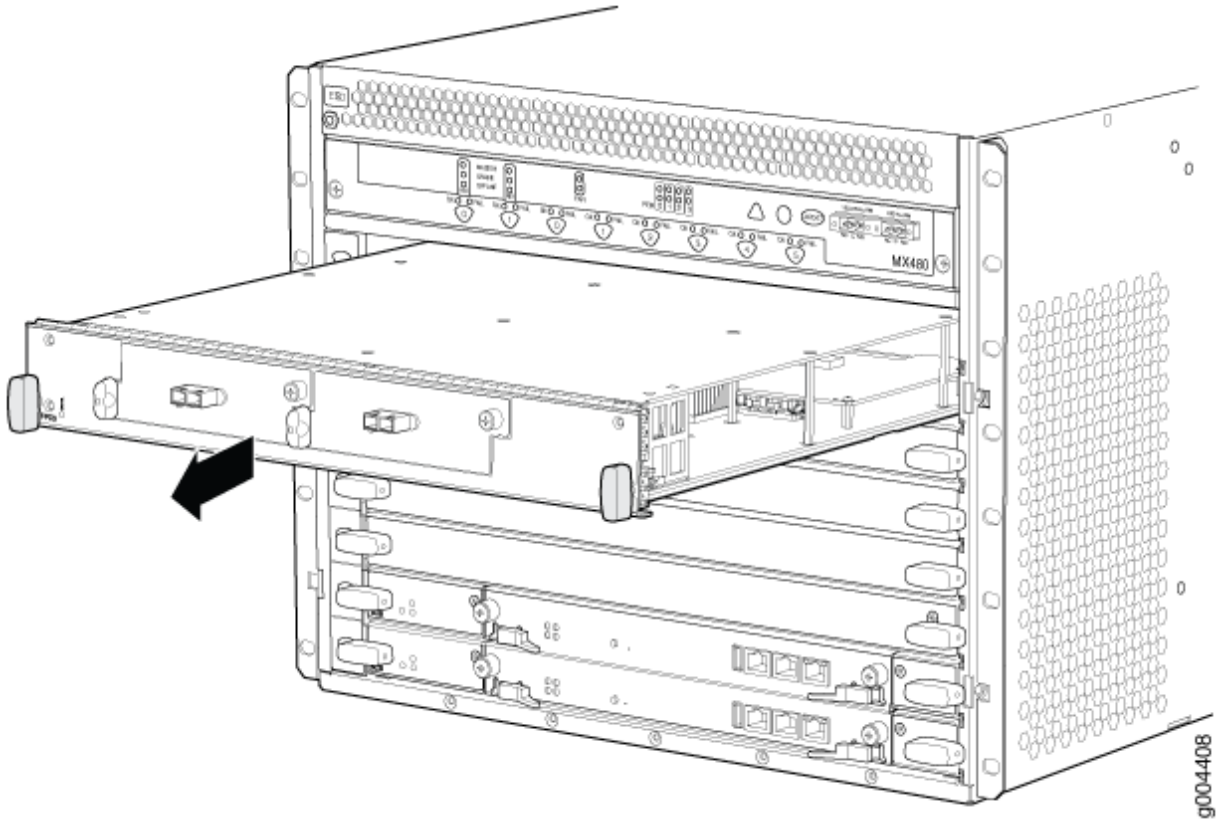
CAUTION: The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 18 lb (8.2 kg)—as you slide the FPC out of the chassis. When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

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.

11. If necessary, remove each installed PIC from the FPC.
12. After you remove each PIC, immediately place it on an antistatic mat or in an electrostatic bag.
13. 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 127: Removing an FPC



Installing an MX480 FPC

An FPC takes up two DPC slots on the MX480 router. Up to three FPCs can be installed horizontally 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 11):

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 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.



LASER 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 cable management brackets 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
```

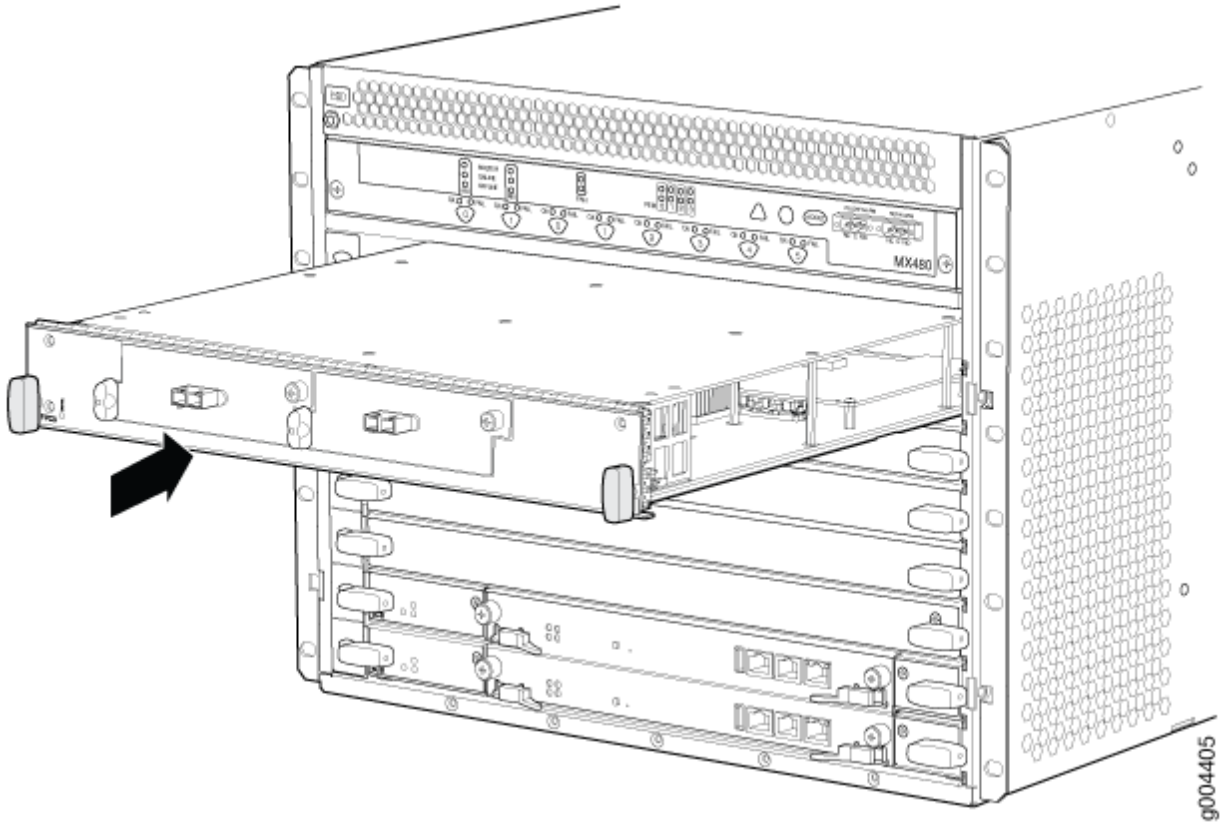
For more information about the command, see the CLI Explorer.



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 MX480 FPCs" on page 360 and "Maintaining MX480 PICs" on page 392.

Figure 128: Installing an FPC



Maintaining MX480 MICs

IN THIS SECTION

- Purpose | 374
- Action | 374

Purpose

For optimum router performance, verify the condition of the 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**, left to right:

```
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+
```

For further description of the output from the command, see the CLI Explorer.

SEE ALSO

MX480 Modular Interface Card (MIC) Description | 138

MX480 Modular Interface Card (MIC) LEDs | 143

Troubleshooting the MX480 MICs | 470

Replacing an MX480 MIC

IN THIS SECTION

- Removing an MX480 MIC | 375
- Installing an MX480 MIC | 377
- Installing an MX480 Dual-Wide MIC | 380

Removing an MX480 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 12 and Figure 13):

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 and hold the button until the MIC **OK/FAIL** LED goes off (about 5 seconds).
   - 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.



LASER 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 protects your eyes from 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. Pulling the ejector lever 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 129: Removing a MIC

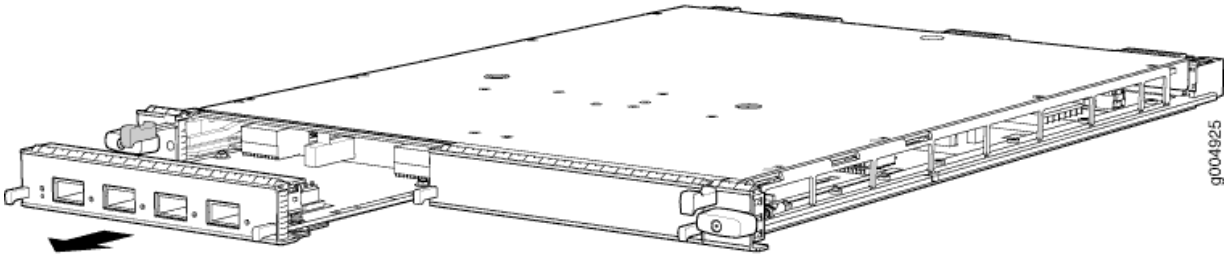
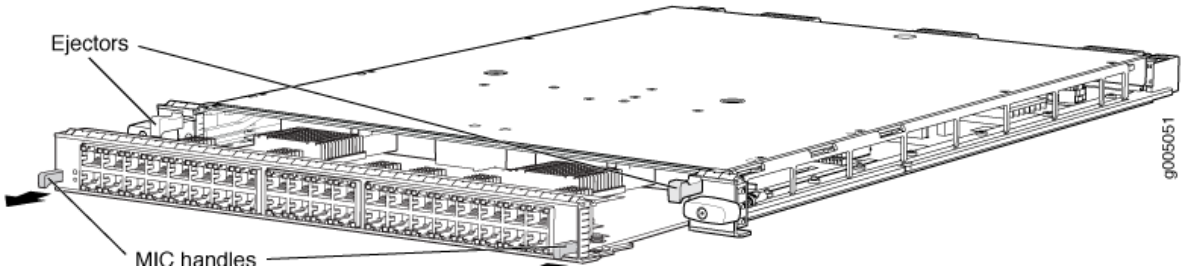


Figure 130: Removing a Dual-Wide MIC



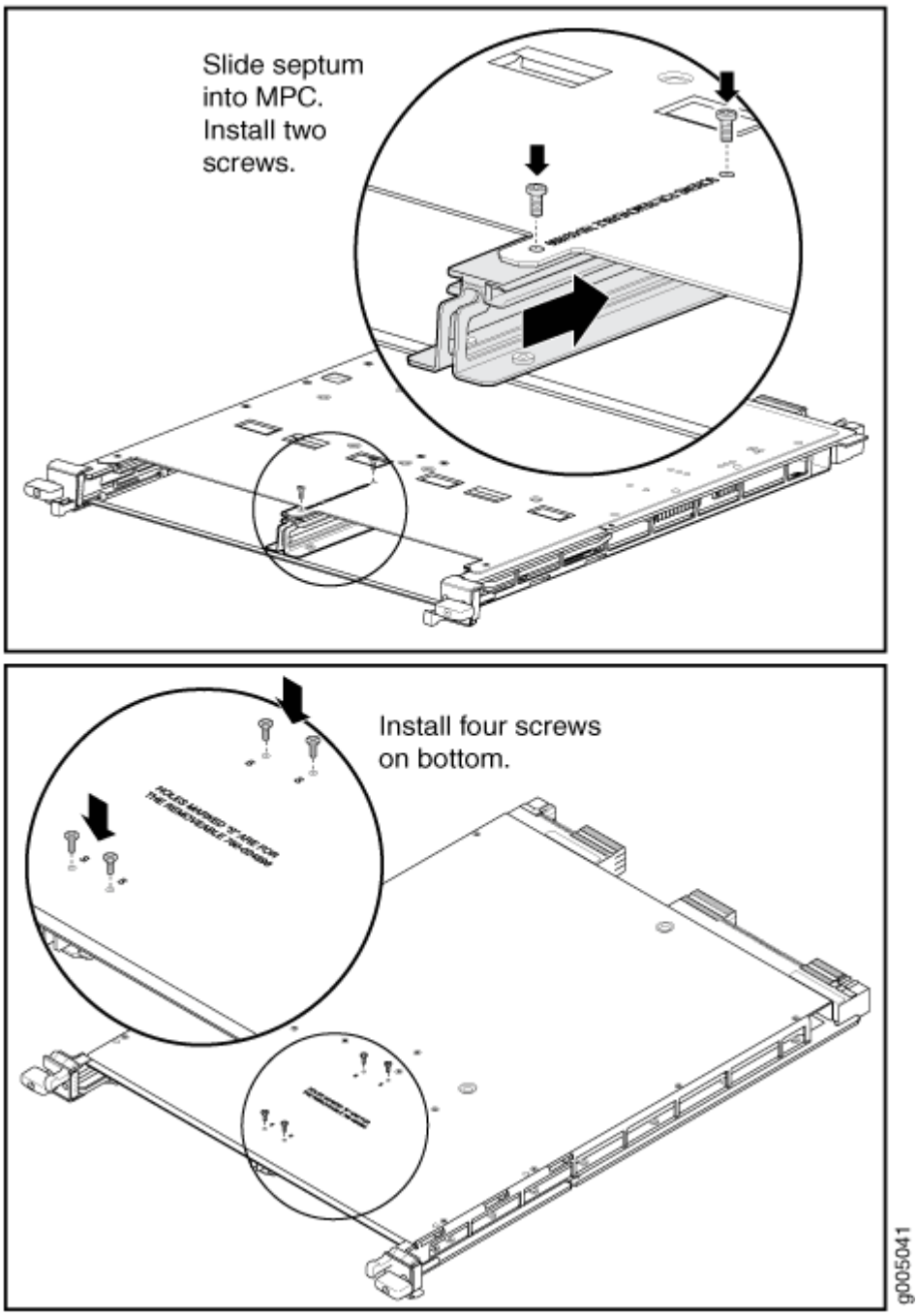
Installing an MX480 MIC

To install a MIC (see Figure 15):

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 14):
   a. Place the MPC on a flat surface (If necessary, remove the MPC from the router as described in "Replacing an MX480 MPC" on page 387).
   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 "Replacing an MX480 MPC" on page 387.

Figure 131: 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 toward 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.

> **LASER 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 protects your eyes from 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:

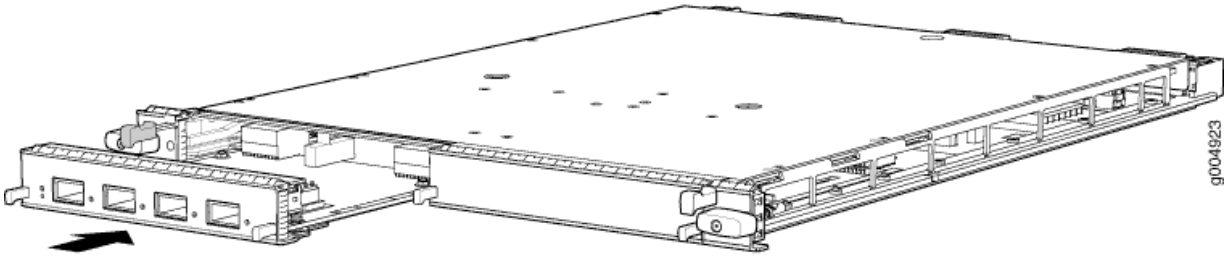
- Press the MIC offline/online button until the MIC **OK/FAIL** LED lights green.
- Issue the following CLI command:

```
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 MX480 MICs" on page 373.

Figure 132: Installing a MIC



SEE ALSO

MX480 Modular Interface Card (MIC) Description | 138

Troubleshooting the MX480 MICs | 470

MX480 MIC Serial Number Label | 489

Installing an MX480 Dual-Wide MIC

To install a dual-wide MIC (see Figure 17):

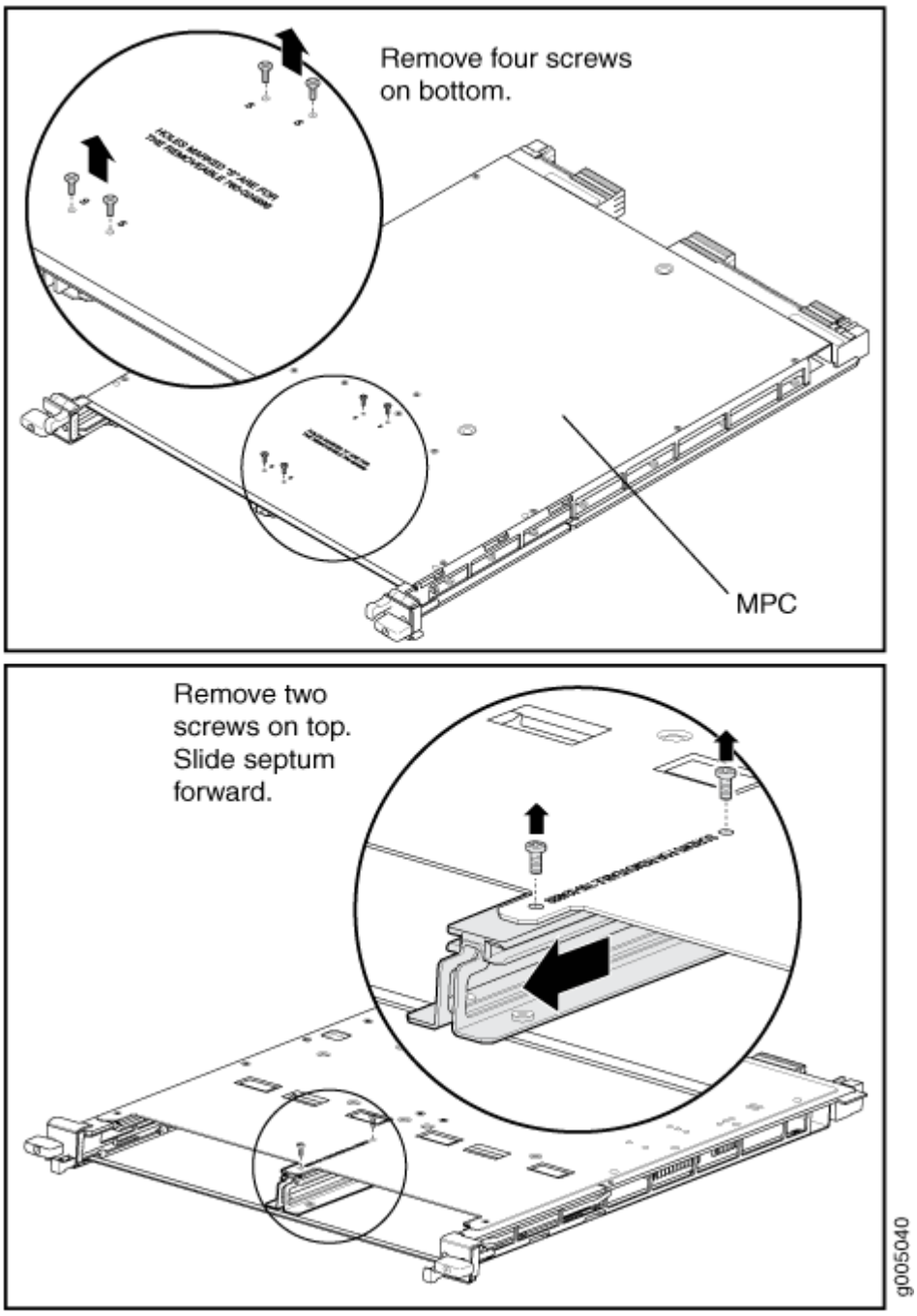
1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Remove the septum, if necessary (see Figure 16):
   a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in "Replacing an MX480 MPC" on page 387).
   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 "Replacing an MX480 MPC" on page 387.

Figure 133: 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.



LASER 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 protects your eyes from 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.

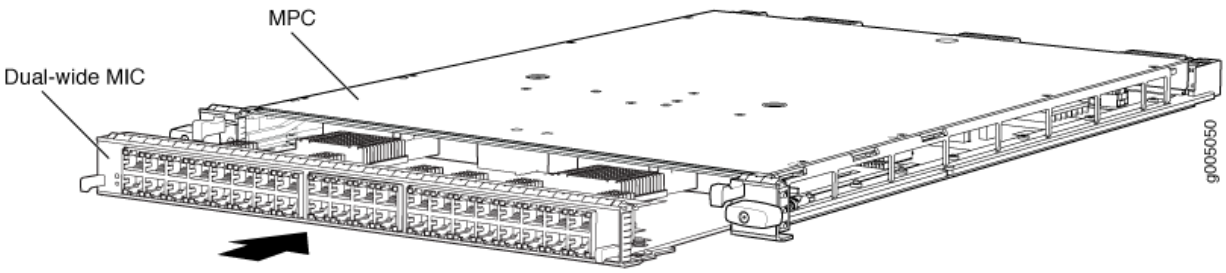
11. Use one of the following methods to bring the MIC online:

    - Press the MIC offline/online 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 MX480 MICs" on page 373.

Figure 134: Installing a Dual-Wide MIC



SEE ALSO

MX480 Modular Interface Card (MIC) Description | 138

Troubleshooting the MX480 MICs | 470

MX480 MIC Serial Number Label | 489

RELATED DOCUMENTATION

Troubleshooting the MX480 MICs | 470

Maintaining MX480 MPCs

IN THIS SECTION

- Purpose | 384
- Action | 384

Purpose

The router can have up to six MPCs mounted horizontally 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
```

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
```

- 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+
```

For further description of the output from the command, see the CLI Explorer.

SEE ALSO

MX480 Modular Port Concentrator (MPC) Description | 157

MX480 Modular Port Concentrator (MPC) LEDs | 161

Replacing an MX480 MPC

IN THIS SECTION

- Removing an MX480 MPC | 387
- Installing an MX480 MPC | 389

Removing an MX480 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 horizontally 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 18):

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.



LASER 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 protects your eyes from 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 management brackets 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.

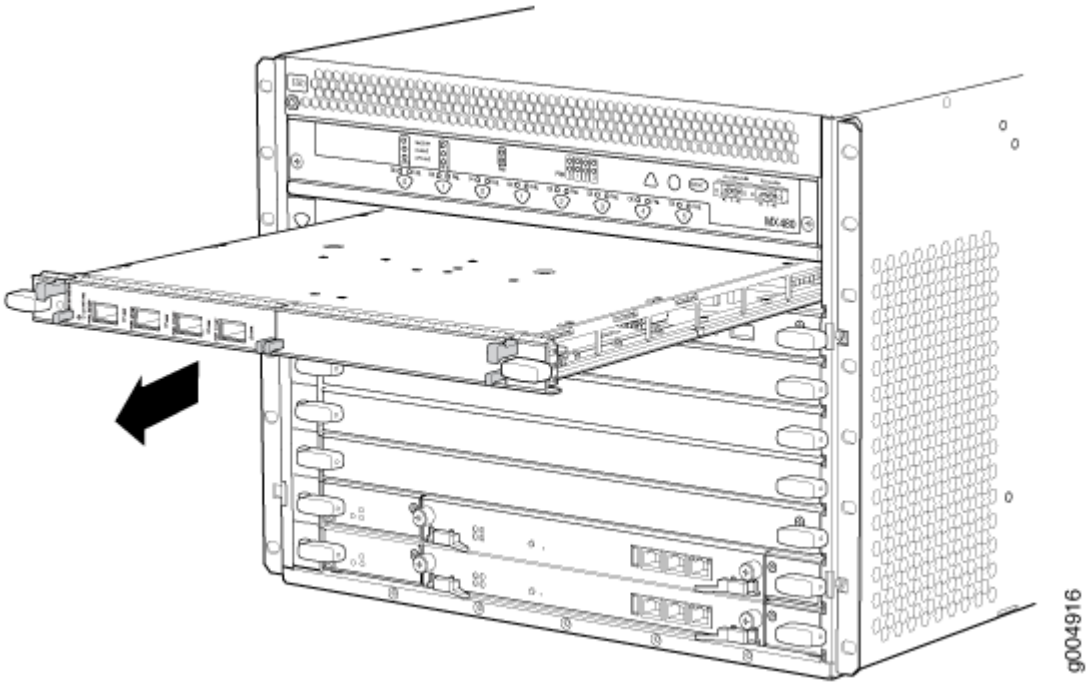
When the MPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

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 135: Removing an MPC



SEE ALSO

MX480 Modular Port Concentrator (MPC) Description | **157**

MX480 MPC Serial Number Label | **491**

Installing an MX480 MPC

An MPC installs horizontally 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 19):

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.



LASER 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:

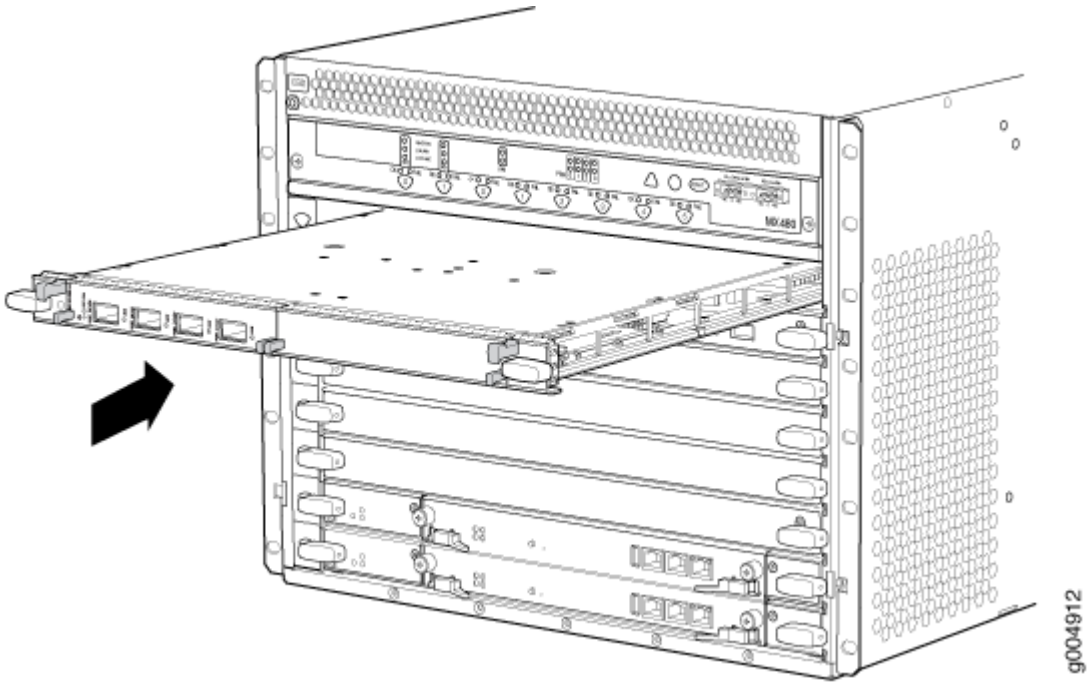
```
user@host>request chassis fpc slot slot-number online
```

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 MX480 MPCs" on page 384 and "Maintaining MX480 MICs" on page 373.

Figure 136: Installing an MPC



RELATED DOCUMENTATION

MX480 Modular Port Concentrator (MPC) Description | 157

Maintaining MX480 PICs

IN THIS SECTION

Purpose | 392
Action | 392

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**, left to right:

```
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
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+
```

For further description of the output from the command, see the CLI Explorer.

SEE ALSO

MX480 Flexible PIC Concentrator (FPC) Description | **116**

Troubleshooting the MX480 PICs | **474**

MX480 PIC Serial Number Label | **493**

Replacing an MX480 PIC

IN THIS SECTION

- Removing an MX480 PIC | **393**
- Installing an MX480 PIC | **395**

Removing an MX480 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 20):

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 off (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.

   LASER 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.

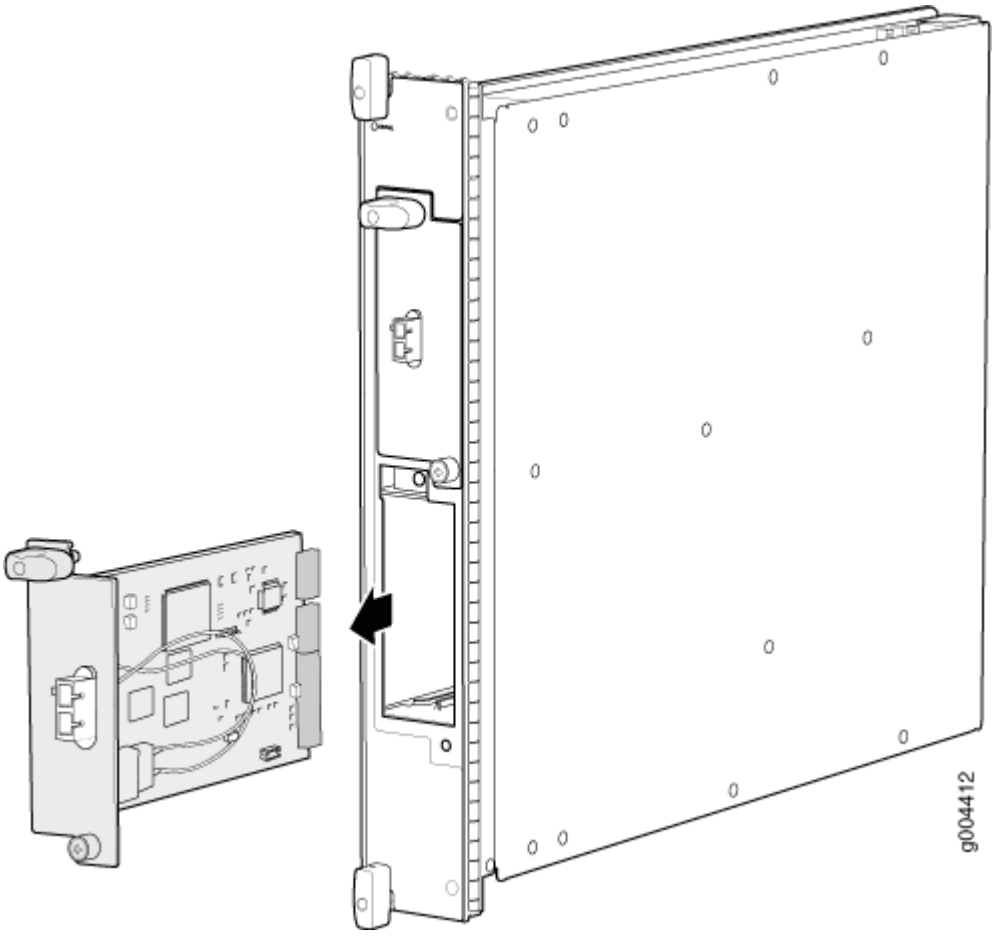
   CAUTION: Do not leave a fiber-optic transceiver uncovered, except when you are inserting or removing cable. The safety cap keeps the port clean and protects your eyes from accidental exposure to laser light.
6. Arrange the cable in the cable management brackets to prevent it from dislodging or developing 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.

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 137: Removing a PIC



Installing an MX480 PIC

To install a PIC (see Figure 21):

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.

   LASER 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 protects your eyes from accidental exposure to laser light.

6. Insert the appropriate cables into the cable connectors on the PIC.
7. Arrange the cable in the cable management brackets 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:

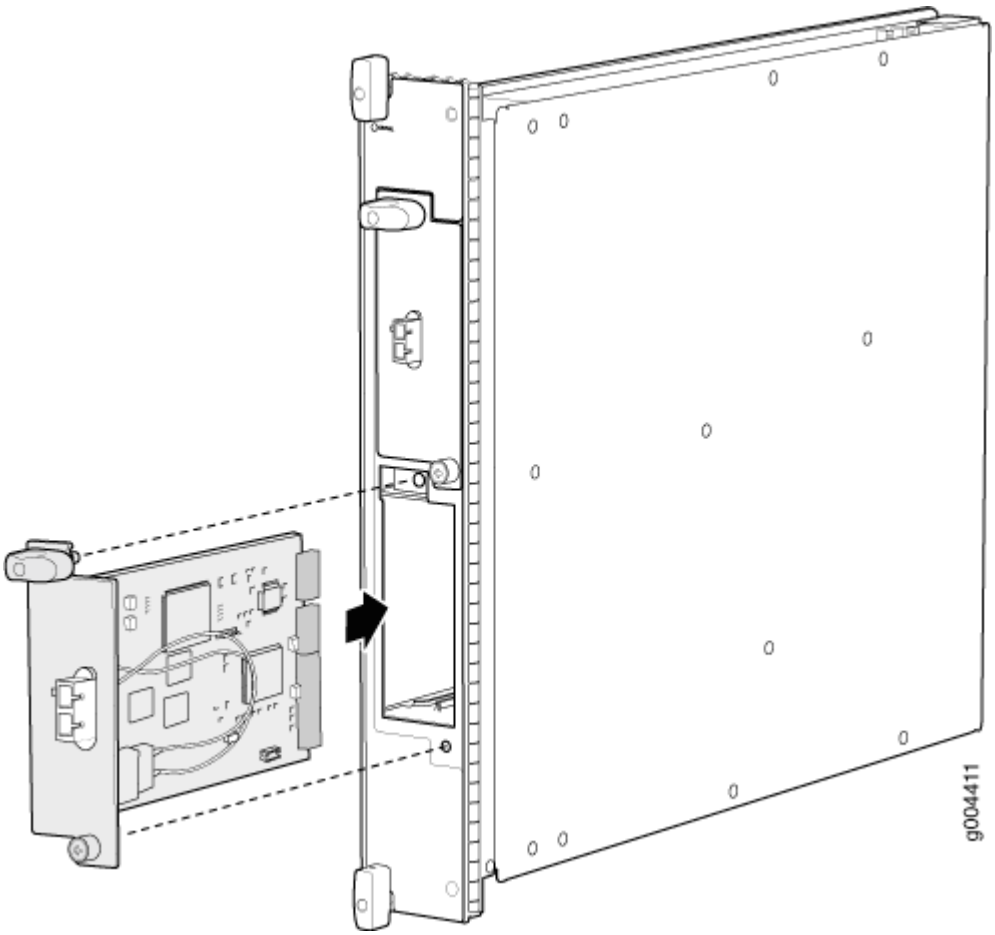
   - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in an FPC2 or FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.
   - Issue the following CLI command:

     ```
     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 MX480 PICs" on page 392.

Figure 138: Installing a PIC



RELATED DOCUMENTATION

- Preventing Electrostatic Discharge Damage to an MX480 Router | **508**
- Troubleshooting the MX480 PICs | **474**
- MX480 PIC Serial Number Label | **493**
- MX480 PIC Description | **120**

Replacing an MX480 AS MLC

IN THIS SECTION

- Removing an MX480 AS MLC | 399
- Installing an MX480 AS MLC | 401

Removing an MX480 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 five AS MLCs can be installed horizontally in the front of the MX480 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 22):

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.

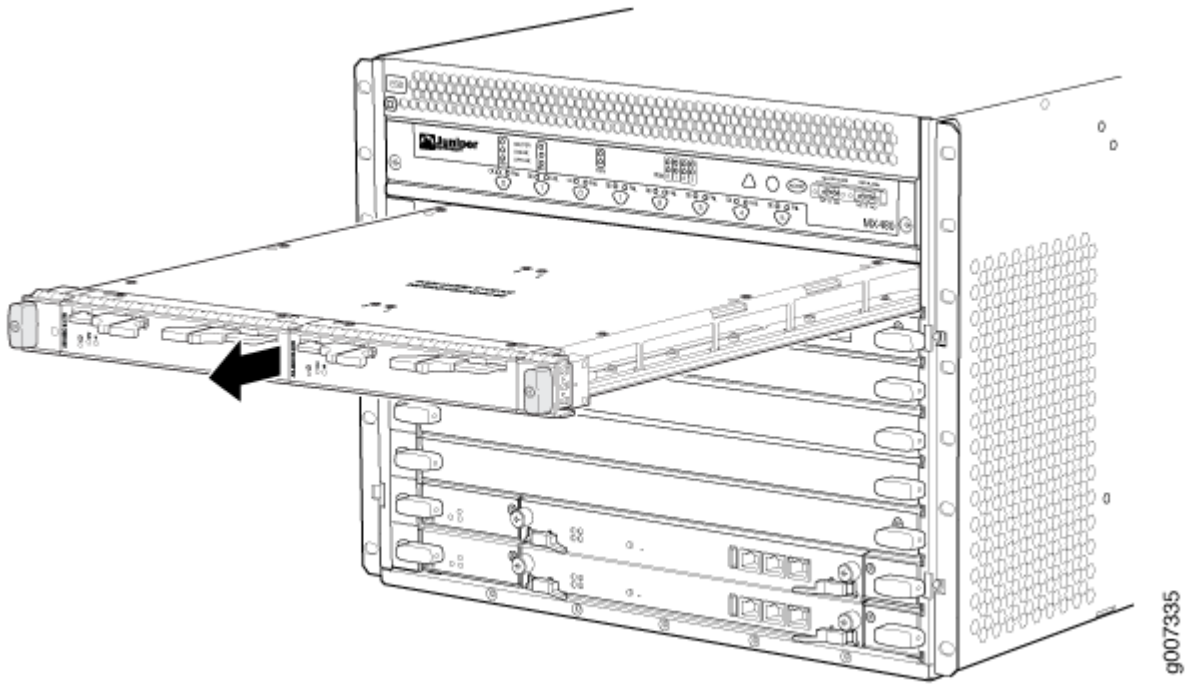
   When the AS MLC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

   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 139: Removing an AS MLC



Installing an MX480 AS MLC

You can install up to five Application Services Modular Line Cards (AS MLCs) horizontally in the front of the MX480 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 23):

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 left slot and the AS MXC in the right 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 above it on the craft interface.
    - Issue the following CLI command:

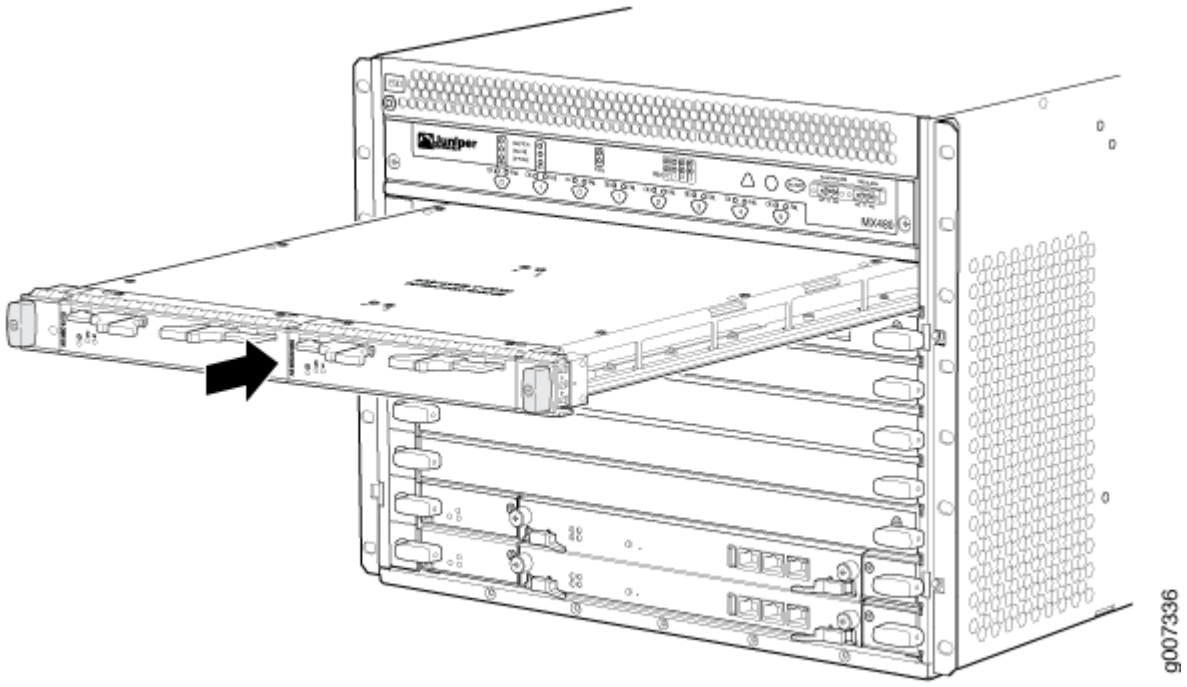
      ```
      user@host>request chassis fpc slot slot-number online
      ```

      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 140: Installing an AS MLC



Replacing an MX480 AS MSC

IN THIS SECTION

- Removing an MX480 AS MSC | **403**
- Installing an MX480 AS MSC | **405**

Removing an MX480 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 24):

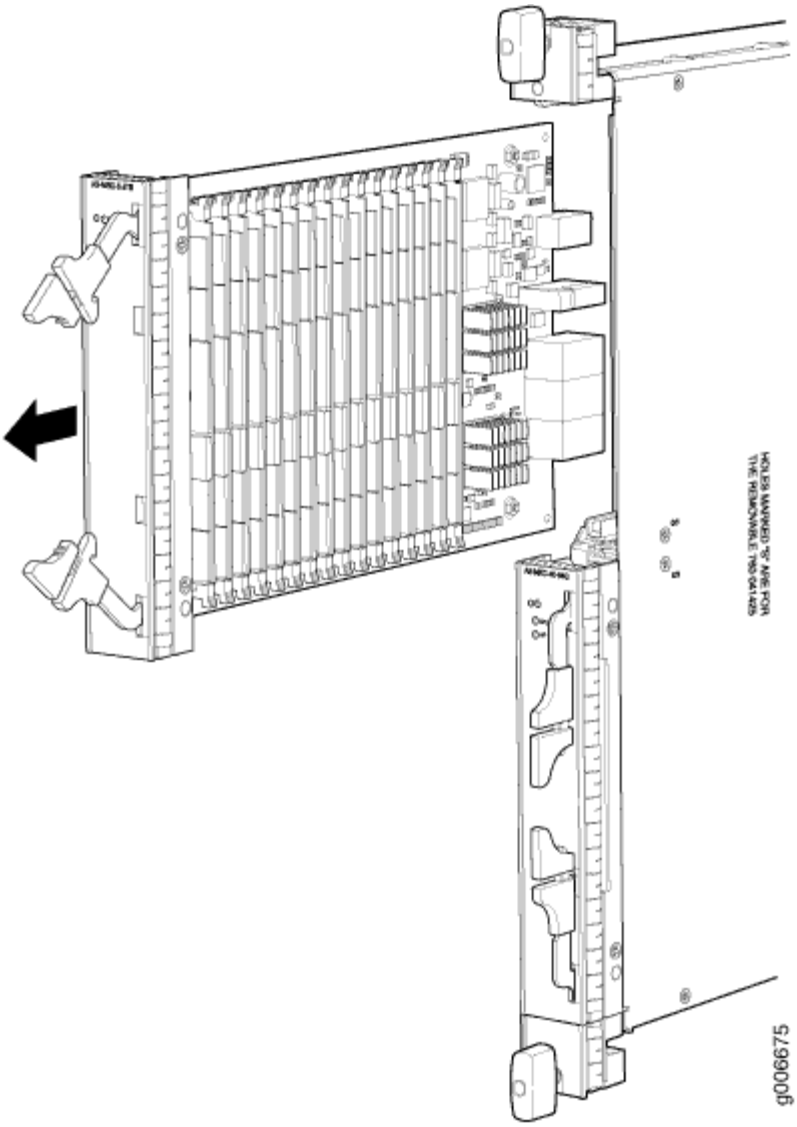
1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the AS MSC.
2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
3. Use one of the following methods to take the AS MSC offline:
   - Press its online/offline 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 141: Removing an AS MSC



SEE ALSO

MX480 Application Services Modular Storage Card Description | **171**

Installing an MX480 AS MSC

To install an AS MSC (see Figure 25):

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.

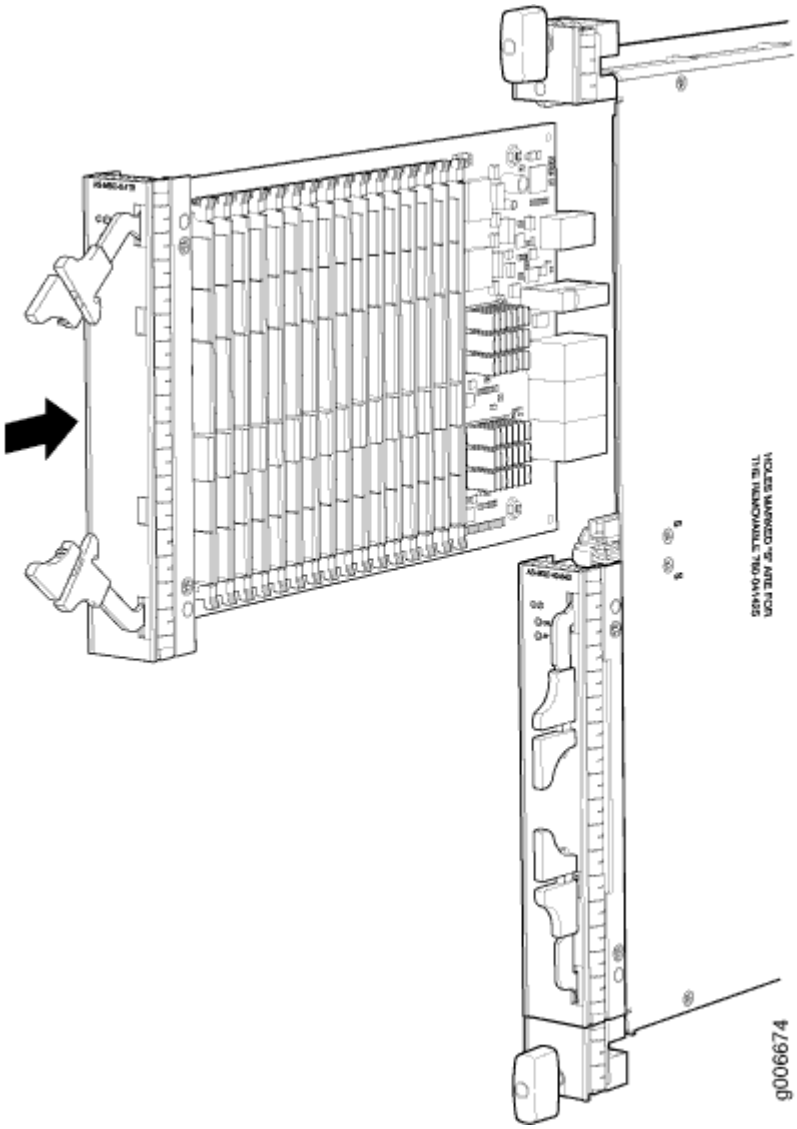
3. Use one of the following methods to bring the AS MSC online:
   - Press the AS MSC offline/online button until the LED light turns green.
   - Issue the following CLI command:

     ```
     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`.

Figure 142: Installing an AS MSC



RELATED DOCUMENTATION

- MX480 Application Services Modular Storage Card Description | **171**

Replacing an MX480 AS MXC

IN THIS SECTION

- Removing an MX480 AS MXC | **408**
- Installing an MX480 AS MXC | **410**

Removing an MX480 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 1.4 lb (0.6 kg).

To remove an AS MXC (see Figure 26):

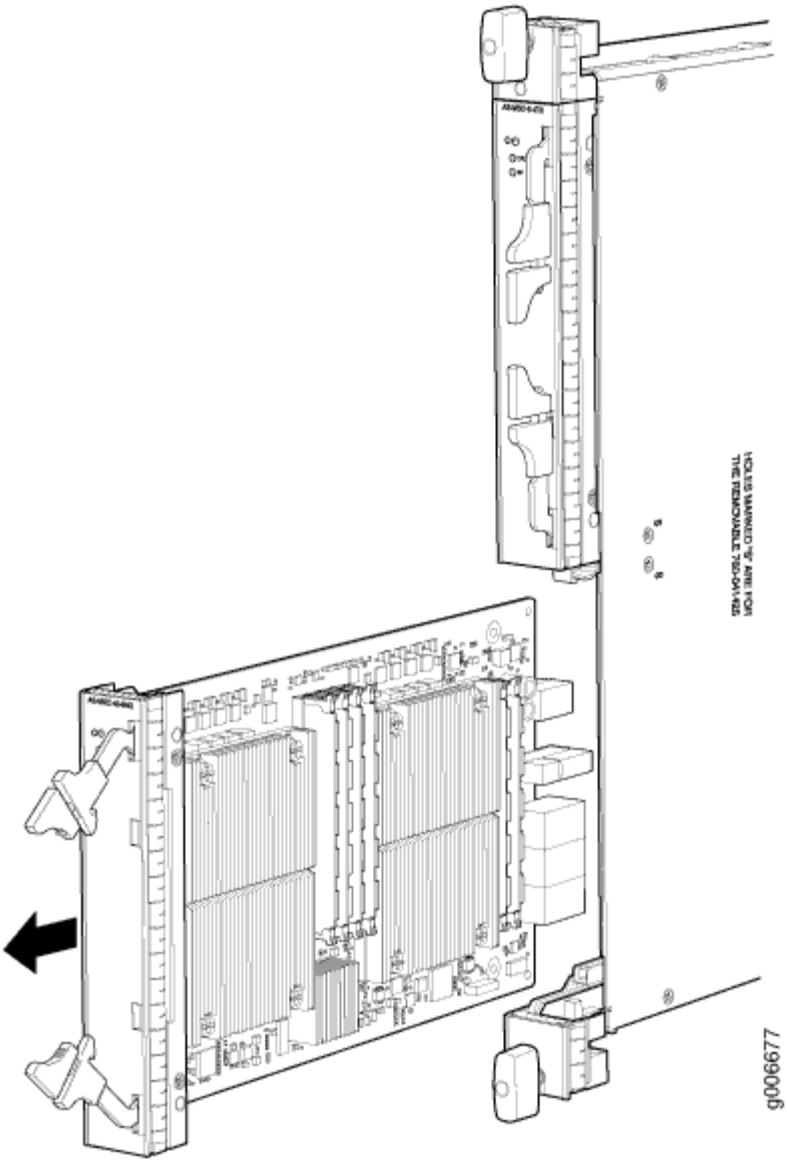
1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the AS MXC.
2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
3. Use one of the following methods to take the AS MXC offline:
   - Press its online/offline 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.
4.
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 143: Removing an AS MXC



SEE ALSO

MX480 Application Services Modular Processing Card Description | 172

Installing an MX480 AS MXC

To install an AS MXC (see Figure 27):

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.

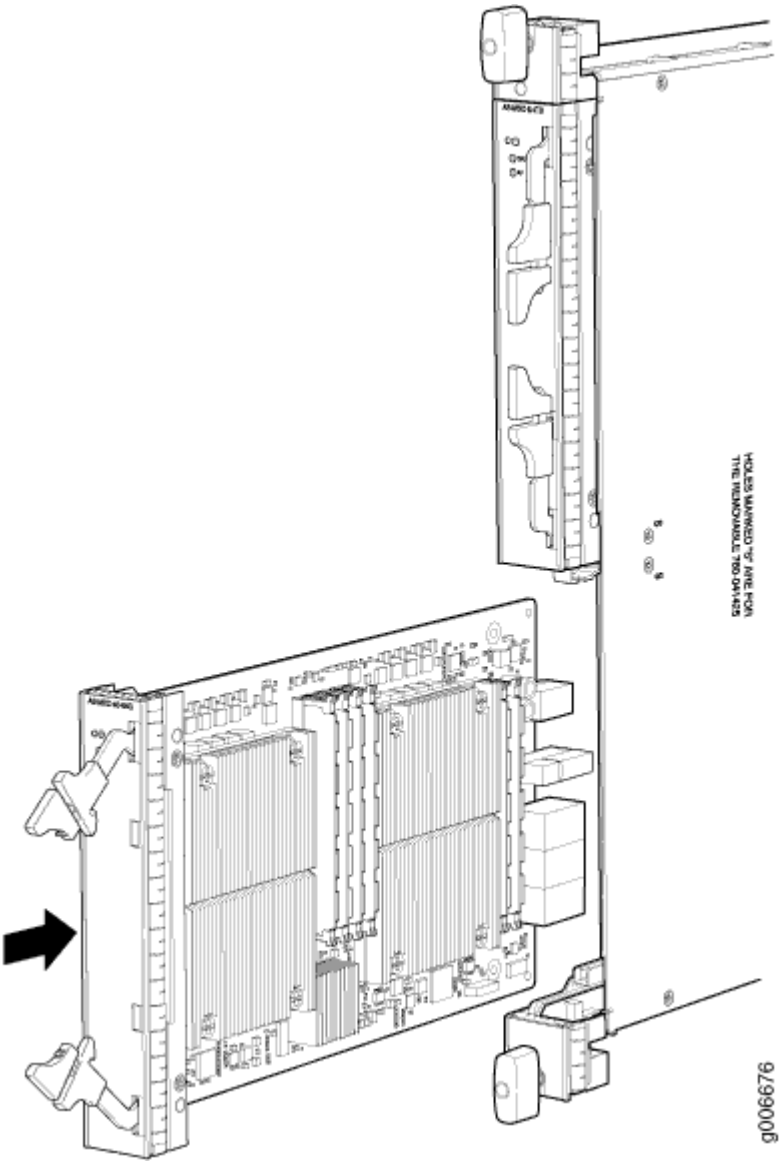
3. Use one of the following methods to bring the AS MXC online:
   - Press the AS MXC offline/online button until the LED light turns green.
   - Issue the following CLI command:

     ```
     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 144: Installing an AS MXC



Maintaining Cables That Connect to MX480 DPCs, MPCs, MICs, or PICs

IN THIS SECTION

- Purpose | 412
- Action | 412

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 the cable management brackets to support cables and prevent cables from dislodging or developing stress points.
- Place excess cable out of the way in the cable management brackets. Do not allow fastened loops of cable to dangle from the connector or cable management brackets, 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.

SEE ALSO

Maintaining MX480 DPCs | **345**

Maintaining MX480 MPCs | **384**

Maintaining MX480 MICs | **373**

Maintaining MX480 PICs | **392**

Maintaining MX-SPC3 Services Card

IN THIS SECTION

- Maintaining MX-SPC3 Services Card | **414**
- Replacing an MX-SPC3 | **415**

Maintaining MX-SPC3 Services Card

IN THIS SECTION

- Purpose | 414
- Action | 414

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 | 415
- Installing an MX-SPC3 | 417

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.

LASER 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 protects your eyes from 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.



LASER 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 MX480 Power System Components

IN THIS SECTION

- Maintaining the MX480 Power Supplies | 419
- Replacing an MX480 AC Power Supply | 420
- Replacing an MX480 AC Power Supply Cord | 423
- Replacing an MX480 DC Power Supply | 425
- Replacing an MX480 DC Power Supply Cable | 430

Maintaining the MX480 Power Supplies

IN THIS SECTION

- Purpose | 419
- Action | 419

Purpose

For optimum router performance, verify the condition of the power supplies.

Action

On a regular basis:

- ```
  PEM 0 status:
    State                       Online
    Temperature                 OK
    AC Input:                   OK
    DC Output          Voltage(V) Current(A)  Power(W)  Load(%)
                           59        0             0        0
  ```
  ```

```
PEM 1 status:
  State                       Online
  Temperature                 OK
  AC Input:                   OK
  DC Output           Voltage(V) Current(A)  Power(W)  Load(%)
                          59        18            1062     42
```

- 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.

SEE ALSO

MX480 Component LEDs on the Craft Interface | **15**

MX480 AC Power Supply Description | **28**

MX480 DC Power Supply Description | **39**

Troubleshooting Resources for MX480 Routers | **460**

MX480 Site Preparation Checklist | **193**

Replacing an MX480 AC Power Supply

IN THIS SECTION

Removing an MX480 AC Power Supply | **421**

- Installing an MX480 AC Power Supply | 422

Removing an MX480 AC 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.

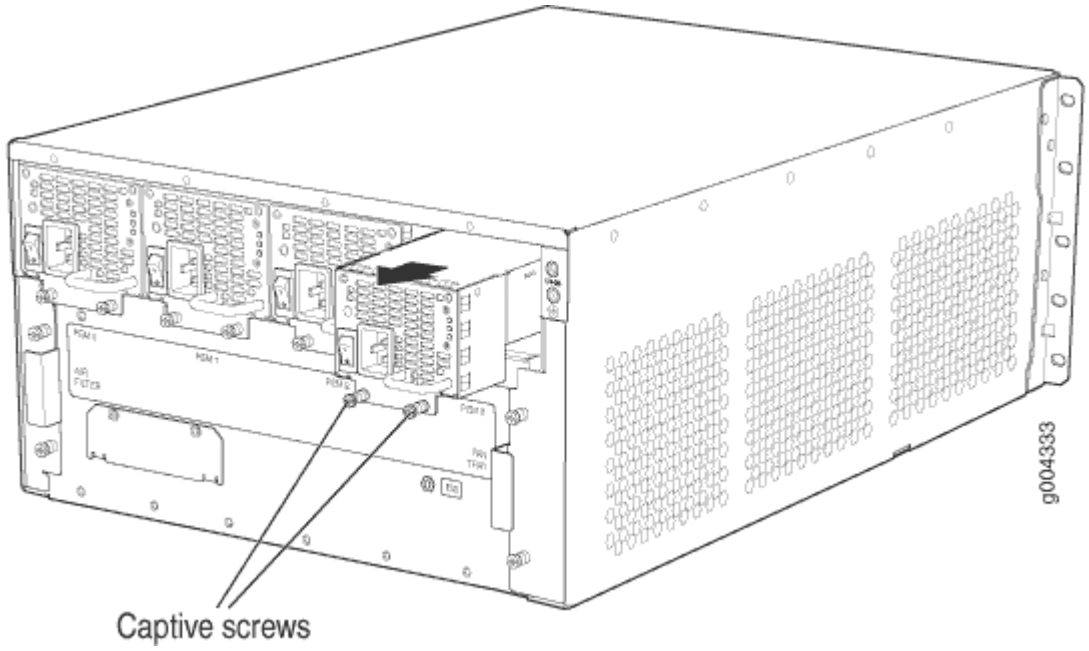
NOTE: After powering off a power supply, wait at least 60 seconds before turning it back on.

To remove an AC power supply (see Figure 1):

1. Switch off the dedicated customer site circuit breaker for the power supply, and remove the power cord from the AC power source. Follow the instructions for your site.
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 next to the appliance inlet on the power supply to the off (**O**) position.
4. Remove the power cord from the power supply.
5. Unscrew the captive screws on the bottom edge of the power supply.

6. Pull the power supply straight out of the chassis.

Figure 145: Removing an AC Power Supply



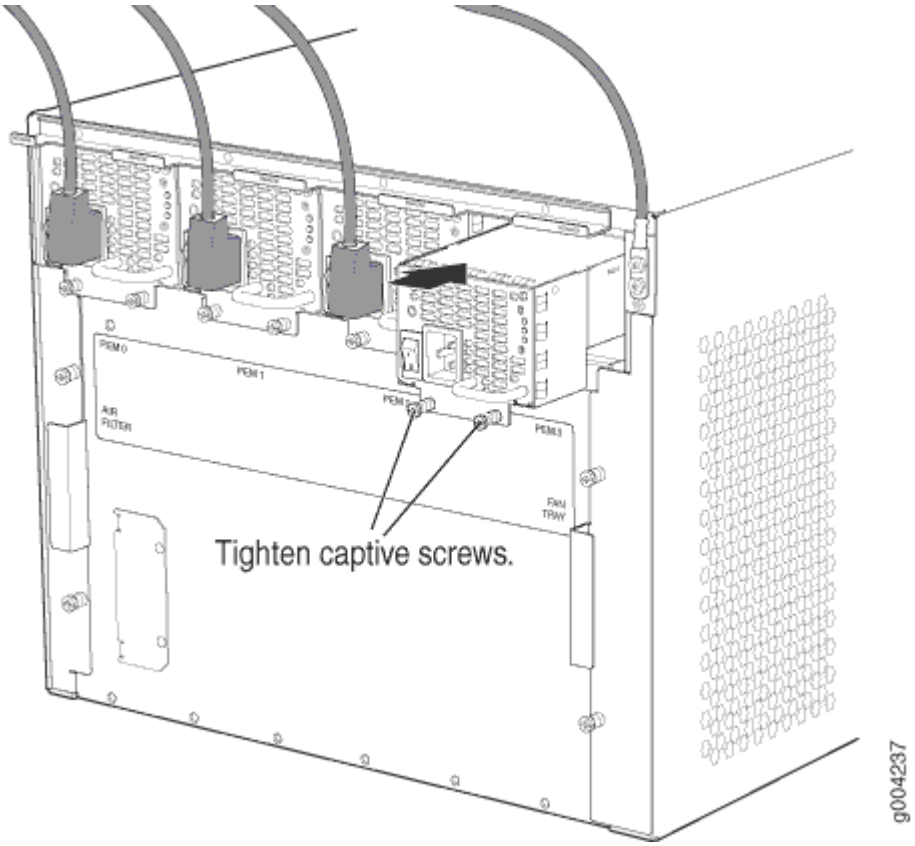
Installing an MX480 AC Power Supply

To install an AC power supply (see Figure 2):

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 next to the appliance inlet on the power supply to the off (**O**) position.
3. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplate or blank installed in the power supply slot.
4. Tighten both captive screws at the bottom of the power supply.
5. Attach the power cord to the power supply.
6. Route the power cord along the cable restraint toward the left or right corner of the chassis. If needed to hold the power cord in place, thread plastic cable ties, which you must provide, through the openings on the cable restraint.
7. Attach the power cord to the AC power source, and switch on the dedicated customer site circuit breaker for the power supply. Follow the ESD and connection instructions for your site.

8. Move the AC input switch next to the appliance inlet on the power supply to the on (|) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

Figure 146: Installing an AC Power Supply in an MX480 Router



Replacing an MX480 AC Power Supply Cord

IN THIS SECTION

- Disconnecting an MX480 AC Power Supply Cord | **424**
- Connecting an MX480 AC Power Supply Cord | **424**

Disconnecting an MX480 AC Power Supply Cord

To disconnect the AC power cord:

1. Switch off the dedicated customer site circuit breaker for the power supply, and remove the power cord from the AC power source. Follow the instructions for your site.
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 next to the appliance inlet on the power supply to the off (0) position.
4. Remove the power cord from the power supply.

Connecting an MX480 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 MX480 Router" on page 33).
2. Connect the power cord to the power supply.
3. Route the power cord along the cable restraint toward the left or right corner of the chassis. If needed to hold the power cord in place, thread plastic cable ties, which you must provide, through the openings on the cable restraint.
4. 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. Attach the power cord to the AC power source, and switch on the dedicated customer site circuit breaker for the power supply. Follow the ESD and connection instructions for your site.
6. Switch the AC input switch on the each power supply to the on (—) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

SEE ALSO

Replacing an MX480 AC Power Supply | **420**

AC Electrical Specifications for the MX480 Router | **31**

Replacing an MX480 DC Power Supply

IN THIS SECTION

- Removing an MX480 DC Power Supply | **425**
- Installing an MX480 DC Power Supply | **426**

Removing an MX480 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 you perform DC power procedures, ensure there is no power to 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.

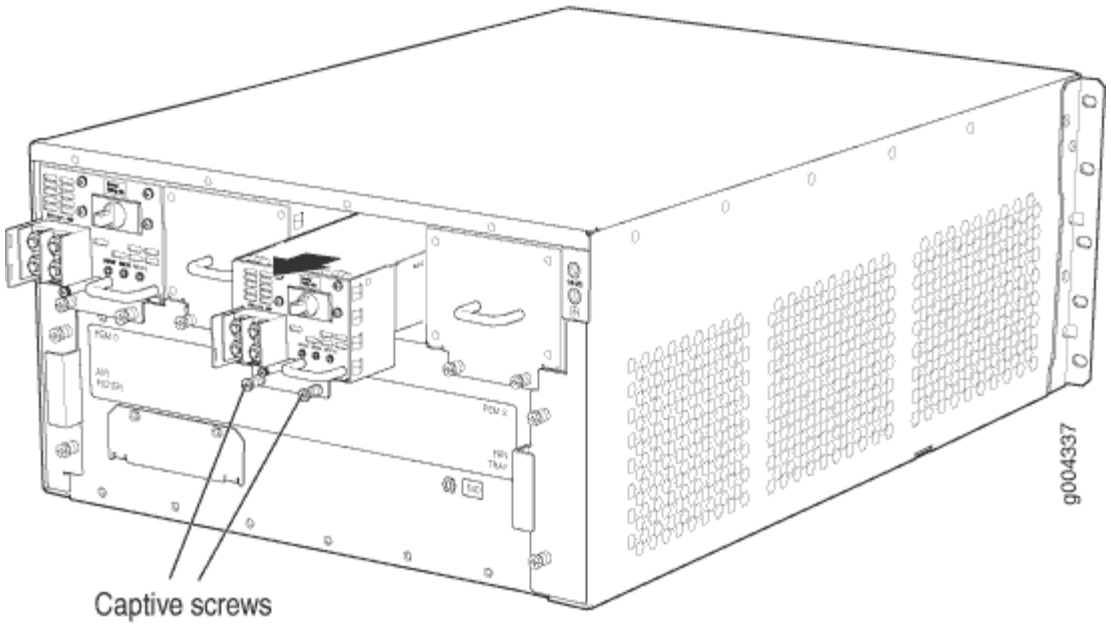
NOTE: After powering off a power supply, wait at least 60 seconds before turning it back on.

To remove a DC power supply (see Figure 3):

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. 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 DC circuit breaker on the DC power supply faceplate to the off (**O**) position.
5. Remove the clear plastic cover protecting the terminal studs on the faceplate.
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. Remove the cable lugs from the terminal studs.
8. Loosen the captive screws on the bottom edge of the power supply faceplate.
9. Carefully move the power cables out of the way.
10. Pull the power supply straight out of the chassis.

Figure 147: Removing a DC Power Supply from the Router



Installing an MX480 DC Power Supply

WARNING: Before you perform DC power procedures, ensure there is no power to 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 4):

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. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplate or blank installed in the power supply slot.
5. Tighten the captive screws on the lower edge of the power supply faceplate.
6. Remove the clear plastic cover protecting the terminal studs on the faceplate.
7. Remove the nut and washer from each of the terminal studs.
8. Secure each power cable lug to the terminal studs, first with the flat washer, then with the split washer, and then with the nut (see Figure 5). 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 the positive (+) DC source power cable lug to the RTN (return) terminal.

   b. Secure the negative (–) DC source power cable lug to the –48V (input) terminal.



CAUTION: 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.



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 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.

NOTE: For information about connecting to DC power sources, see "DC Power Supply Electrical Specifications for MX240 and MX480" on page 42.

9. Replace the clear plastic cover over the terminal studs on the faceplate.
10. Route the power cables along the cable restraint toward the left or right corner of the chassis. If needed to hold the power cables in place, thread plastic cable ties, which you must provide, through the openings on the cable restraint.
11. Verify that the power cabling is correct, that the cables are not touching or blocking access to router components, and that they do not drape where people could trip on them.
12. Switch on the dedicated customer site circuit breakers. Follow your site's procedures for safety and ESD.

    Verify that the **INPUT OK** LED on the power supply is lit green.
13. 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.

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

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

Figure 148: Installing a DC Power Supply in the Router

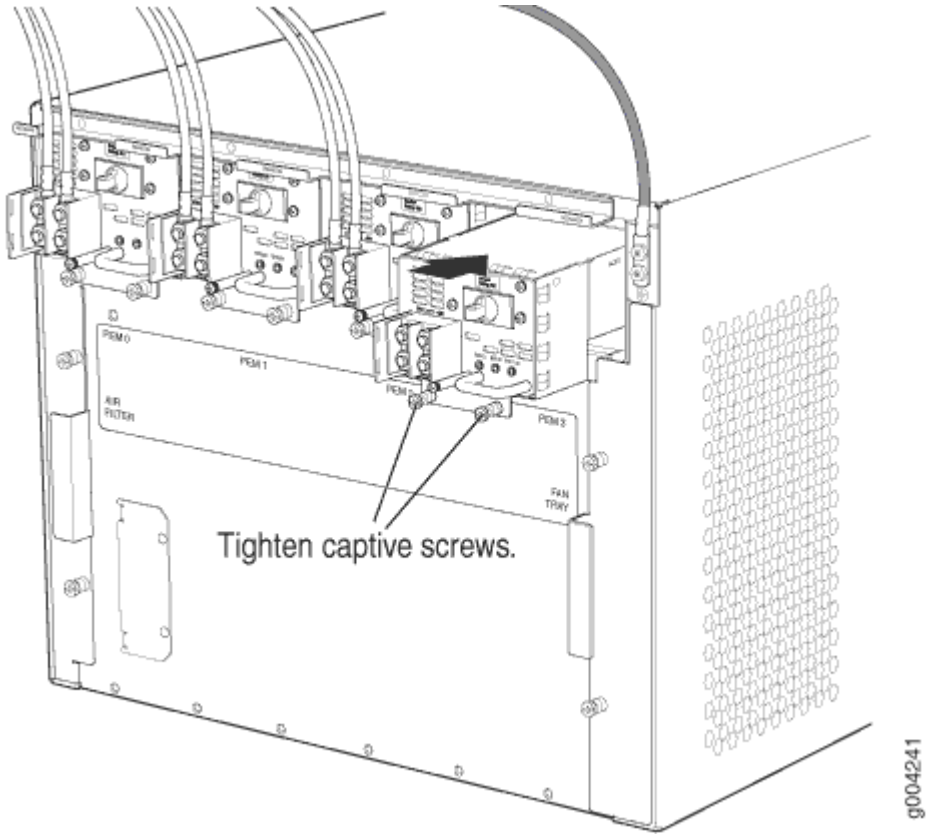
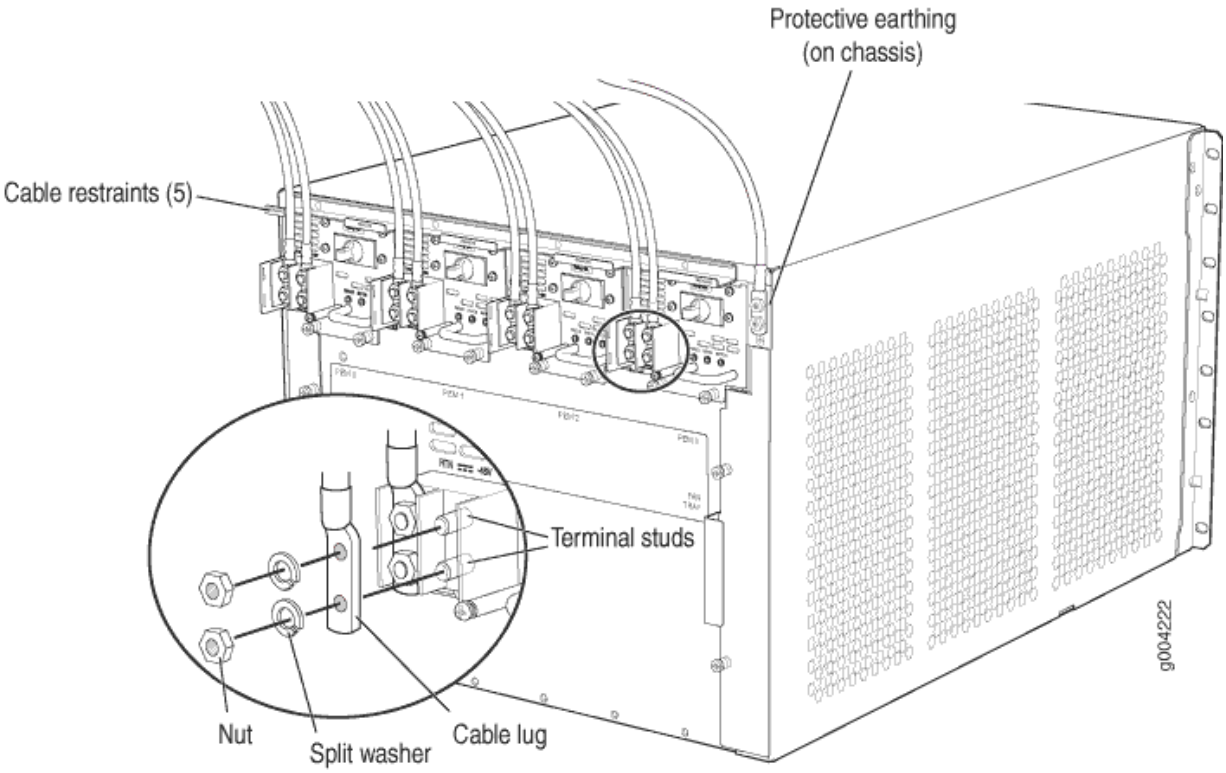


Figure 149: Connecting DC Power to the Router



RELATED DOCUMENTATION

- Preventing Electrostatic Discharge Damage to an MX480 Router | **508**
- MX480 DC Power Supply Description | **39**

Replacing an MX480 DC Power Supply Cable

IN THIS SECTION

- Disconnecting an MX480 DC Power Supply Cable | **431**
- Connecting an MX480 DC Power Supply Cable | **431**

Disconnecting an MX480 DC Power Supply Cable

WARNING: Before you perform DC power procedures, ensure there is no power to 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. Remove the power cable from the cable restraint, and then carefully move the cable out of the way.

Connecting an MX480 DC Power Supply Cable

WARNING: Before you perform DC power procedures, ensure there is no power to 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 "DC Power Cable Specifications for the MX480 Router" on page 46.
2. Verify that a licensed electrician has attached a cable lug to the replacement power cable.
3. Install heat-shrink tubing insulation around the power cables.

   To install heat-shrink tubing:

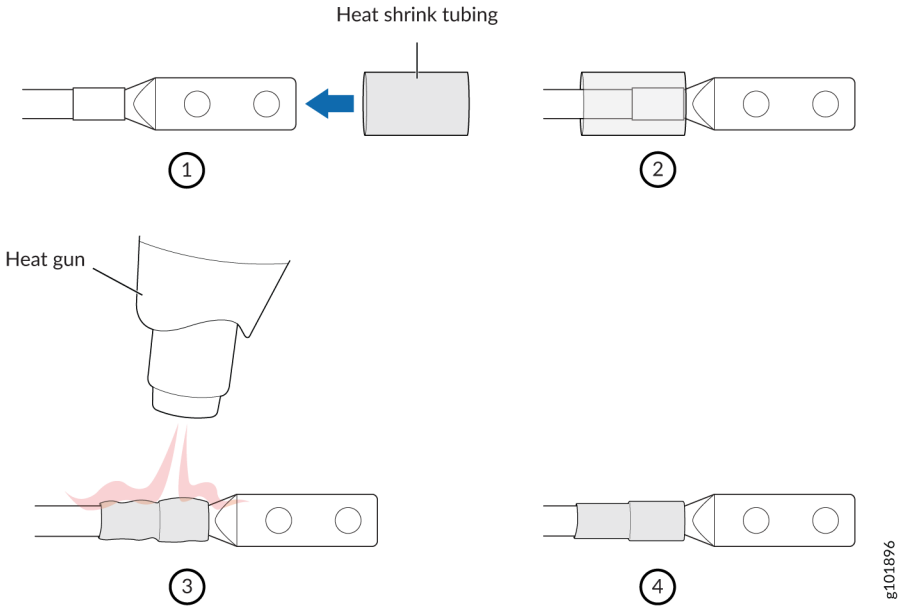
a. Slide the tubing over the portion of the cable where it is attached to the lug barrel. Ensure that tubing covers the end of the wire and the barrel of the lug attached to it.

b. Shrink the tubing with a heat gun. Ensure that you heat all sides of the tubing evenly so that it shrinks around the cable tightly.

Figure 6 shows the steps to install heat-shrink tubing.

NOTE: Do not overheat the tubing.

Figure 150: How to Install Heat-Shrink Tubing



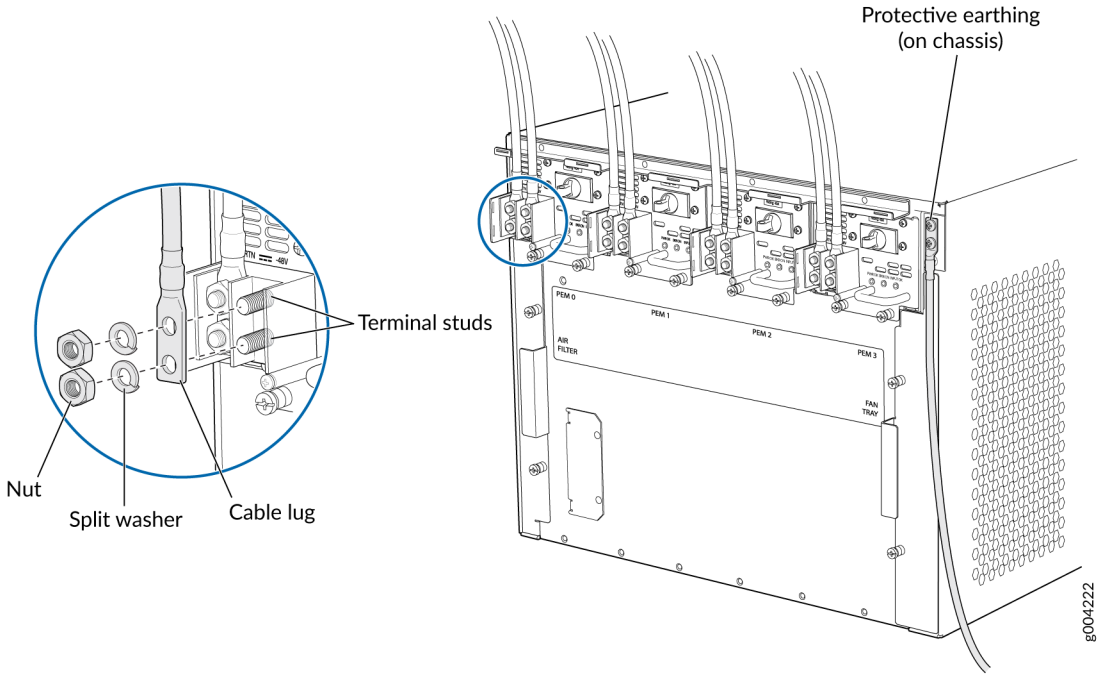
4. Verify that the **INPUT OK** LED is off.
5. Secure the power cable lug to the terminal studs, first with the flat washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut (see Figure 7). Do not overtighten the nut. (Use a 7/16-in. [11 mm] torque-controlled 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 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.

Figure 151: Connecting Power Cables to the DC Power Supply



6. Route the power cable along the cable restraint toward the left or right corner of the chassis. If needed, thread plastic cable ties, which you must provide, through the openings on the cable restraint to hold the power cable 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. 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.

Maintaining MX480 SFP and XFP Transceivers

IN THIS SECTION

- Replacing an SFP or XFP Transceiver on an MX480 DPC, MPC, MIC, or PIC | **434**

Replacing an SFP or XFP Transceiver on an MX480 DPC, MPC, MIC, or PIC

IN THIS SECTION

- Removing an SFP or XFP Transceiver from an MX480 DPC, MPC, MIC, or PIC | **434**
- Installing an SFP or XFP Transceiver into an MX480 DPC, MPC, MIC, or PIC | **436**

Removing an SFP or XFP Transceiver from an MX480 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 1):

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.

> **LASER 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.

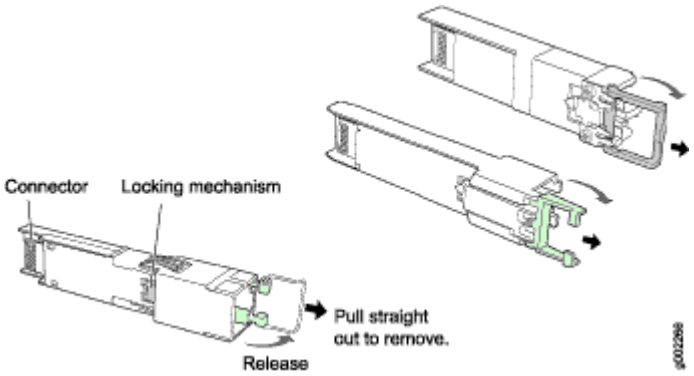
4. Remove the cable connector from the transceiver.
5. Pull the ejector handle out from the transceiver to unlock the transceiver.

> **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 152: 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.

Installing an SFP or XFP Transceiver into an MX480 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.

   LASER 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*.

Maintaining MX480 Switch Control Boards

IN THIS SECTION

Replacing an MX480 Switch Control Board | 437

- Upgrading an MX480 to Use the SCBE-MX | **441**
- Upgrading an MX480 to Use the SCBE2-MX | **450**
- Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX | **456**

Replacing an MX480 Switch Control Board

IN THIS SECTION

- Removing an MX480 SCB-MX | **437**
- Installing an MX480 Switch Control Board | **438**

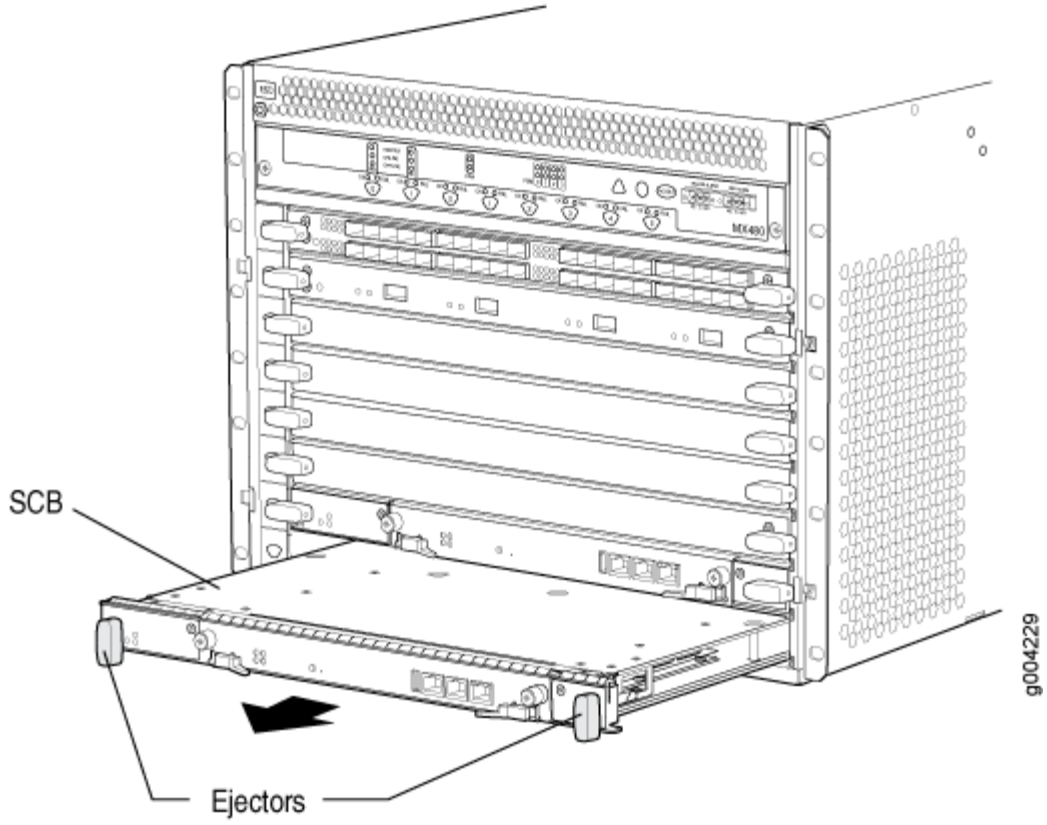
Before replacing a Switch Control Board (SCB), read the guidelines in Operating and Positioning the MX480 SCB Ejectors.

Removing an MX480 SCB-MX

1. Take the host subsystem offline.
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 strap to one of the ESD points on the chassis.
4. Rotate the ejector handles simultaneously counterclockwise to unseat the Switch Control Board.
5. Grasp the ejector handles, and slide the Switch Control Board about halfway out of the chassis.
6. Place one hand underneath the Switch Control Board to support it, and slide it completely out of the chassis.
7. Place the Switch Control Board on the antistatic mat.

8. If you are not replacing the Switch Control Board now, install a blank panel over the empty slot.

Figure 153: Removing a Switch Control Board from the MX480

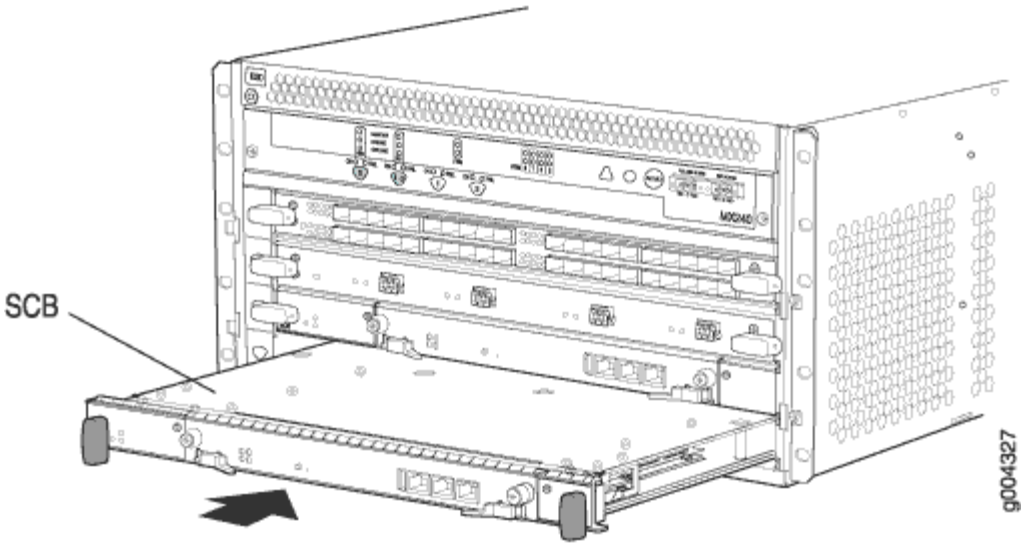


Installing an MX480 Switch Control Board

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 154: 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

- Operating and Positioning the MX480 SCB Ejectors
- Effect of Taking the MX480 Host Subsystem Offline
- Taking an MX480 Host Subsystem Offline

Upgrading an MX480 to Use the SCBE-MX

IN THIS SECTION

- Prepare for the Upgrade | 441
- Upgrade the SCB-MX in the Backup Routing Engine | 443
- Upgrade the MX480 SCB-MX in the Primary Routing Engine | 445
- Complete the SCBE-MX Upgrade | 447

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.

Prepare for the Upgrade

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.

To prepare the MX480 router for the Enhanced MX Switch Control Board (SCBE-MX) upgrade:

1. Verify that the system runs Junos OS Release 11.4 or later by issuing the `show version` command on the primary router.

```
user@host> show version
Model: mx480
Junos Base OS Software Suite [11.4-20110530];
```

> **NOTE**: The MX 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
```

   SCB-MX details are displayed as above, along with other hardware components. The MX480 router has only two SCB-MXs and each SCB-MX has four fabric planes.

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 is associated with RE0, and SCB 1 is associated with RE1.

> **NOTE**: Do not add or remove any router hardware during the upgrade procedure.

Upgrade the SCB-MX in the Backup Routing Engine

> **TIP**: The MX480 has two slots for the SCB-MX—that is, SCB 0 and SCB 1—and these correspond to RE0 and RE1 respectively, where SCB 1 is the first SCB-MX.

To upgrade the SCB-MX in the backup Routing Engine:

1. Power down the backup Routing Engine from the primary Routing Engine by issuing the `request system power-off other-routing-engine` command.
2. Verify 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
```

   Ensure that the Current State is Present, which indicates that the Routing Engine is offline.
3. Take the fabric plane offline by issuing the `request chassis fabric plane 4 offline` command. SCB 1 has four fabric planes numbered, 4, 5, 6, and 7.
4. Verify that the 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
```

5. Take the remaining fabric planes offline by issuing the `request chassis fabric plane 5/6/7 offline` command—that is, by changing the fabric plane number each time. Verify that the fabric planes are offline by issuing the command given in Step 2.
6. Take the SCB-MX in slot 1 offline by issuing the `request chassis cb offline slot 1` command.
7. Verify that SCB-MX is offline:

```
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 SCB-MX in slot 1 on the router with the SCBE-MX. Use the replacement procedure described in "Replacing an MX480 Switch Control Board" on page 437.
10. Verify that the installation is successful and the SCBE-MX is online:

```
user@host> show chassis environment cb 1
CB 1 status
State        Online
Temperature    30 degrees C / 86 degrees F
```

11. Verify that the fabric planes come online correctly:

```
user@host> show chassis fabric summary
Plane     State    Uptime
4    Online    2 minutes, 25 seconds
5    Online    2 minutes, 15 seconds
6    Online    2 minutes, 3 seconds
7    Online    1 minute, 49 seconds
```

12. Verify that the backup Routing Engine is back online:

```
user@host> show chassis routing-engine 1
Routing Engine Status:
```

```
Slot 1:
Current State        Backup
```

13. 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
```

As only one SCB-MX has been upgraded, the alarm indicates that the SCB-MXs are of mixed type. This alarm is cleared after all the control boards are upgraded.

Upgrade the MX480 SCB-MX in the Primary Routing Engine

1. Issue the `request chassis routing-engine master switch` command so that the backup RE becomes the primary RE. This ensures a Graceful RE Switchover (GRES) to gracefully switch between the primary and backup Routing Engines.
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. Issue the `show chassis routing-engine 0` command to verify that the Routing Engine is powered down.

```
user@host> show chassis routing-engine 0
Routing Engine Status:
Slot 0:
Current State     Present
```

Verify that the Current State is Present, which indicates that the Routing Engine is offline.

7. Take the first fabric plane of the backup Routing Engine offline by issuing the `request chassis fabric plane 0 offline` command. SCB0 has four fabric planes numbered, 0, 1, 2, and 3.
8. Issue the `show chassis fabric summary` command to verify that the fabric plane is offline.

```
user@host> show chassis fabric summary
Plane    State    Uptime
0    Offline
1     Online 3 minutes, 45 seconds
```

Verify that the state of plane 0 is Offline.

9. Take the remaining fabric planes offline by issuing the `request chassis fabric plane 1/2/3 offline` command—that is, by changing the fabric plane number each time. Verify that the fabric planes are offline by issuing the command given in Step 4.
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:

```
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-MX. Use the replacement procedure described in "Replacing an MX480 Switch Control Board" on page 437.
14. Verify that the installation is successful and SCB 0 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
```

Other details, such as power, are also displayed along with the state.

15. 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 minutes, 5 seconds
1    Online    1 minute, 55 seconds
2    Online    1 minute, 43 seconds
3    Online    1 minute, 33 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    Needs upgrade
2    Empty
3    Empty
4    Empty
5    Empty
```

In this example, the results indicate that slot 0 does not support the upgrade and slot 1 needs to be upgraded.

NOTE: The SCBE-MX line card supports only DPC, MS-DPC, MPC1, MPC2, and MPC3 line cards for the `upgrade-bandwidth`command. If line cards that do not support the `upgrade-bandwidth`command 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. Issue the `request chassis fabric upgrade-bandwidth fpc all` command to upgrade the bandwidth of all MPCs. 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 the MPC. Using this method may increase the traffic loss, because 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 the 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 also 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. You can delete that command 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.

11. 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
```

SEE ALSO

SCBE-MX Description

Upgrading an MX480 to Use the SCBE2-MX

IN THIS SECTION

- Prepare the MX480 Router for the SCBE2-MX Upgrade | **451**
- Power Off the MX480 Router | **452**
- Remove the MX480 Routing Engine | **452**

Install the MX480 Routing Engine into the SCBE2-MX | 453
Power On the MX480 Router | 453
Complete the SCBE2-MX Upgrade | 454

Consider the following scenarios when upgrading an MX480 SCB-MX or SCBE-MX to use the SCBE2-MX:

Scenario 1: SCBE2-MX; Routing Engine (RE) with Junos OS Release 13.3R1 or later installed.

- Replace the SCB-MXs. Ensure that you replace the SCB-MXs 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 SCB-MXs. Ensure that you replace the SCB-MXs 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 SCB-MXs. Ensure that you replace the SCB-MXs 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 MX480 to use the SCBE2-MX, perform the following steps:

NOTE: You cannot upgrade to SCBE2-MX without powering off the MX480 router.

Prepare the MX480 Router for the SCBE2-MX Upgrade

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: mx480
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 MX480 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. This 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 MX480 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 MX480 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 MX480 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 MX480 now has SCBE2-MXs.

SEE ALSO

SCBE2-MX Description

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

IN THIS SECTION

- Upgrade the Routing Engine | 456
- Install the Routing Engine into the SCBE3-MX | 457
- Install the SCBE3-MX into the Router Chassis | 457
- Complete the SCBE3-MX Upgrade | 457

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:

   Maintaining MX240 SFP and XFP Transceivers

"Maintaining MX480 Switch Control Boards" on page 436

Installing an MX960 Switch Control Board

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" on page 322

Installing an MX960 Routing Engine

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" on page 437

Installing an MX960 Switch Control Board

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

CHAPTER 5

Troubleshooting Hardware

Troubleshooting the MX480 | 460

Troubleshooting the MX480

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- Troubleshooting Resources for MX480 Routers | **460**
- Troubleshooting the MX480 Cooling System | **463**
- Troubleshooting the MX480 DPCs | **464**
- Troubleshooting the MX480 FPCs | **466**
- Troubleshooting the MX480 MICs | **470**
- Troubleshooting the MX480 MPCs | **471**
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Troubleshooting Resources for MX480 Routers

IN THIS SECTION

- Command-Line Interface | **460**
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- Craft Interface LEDs | **461**
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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 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.

Troubleshooting the MX480 Cooling System

IN THIS SECTION

- Problem | 463
- Solution | 463

Problem

Description

The fans in the 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).

SEE ALSO

Alarm LEDs and Alarm Cutoff/Lamp Test Button on the MX480 Craft Interface | 14

Replacing the MX480 Fan Tray | 315

Maintaining the MX480 Air Filter | 309

Maintaining the MX480 Fan Tray | 312

Troubleshooting the MX480 DPCs

IN THIS SECTION

Problem | 464

Solution | 464

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 for Routing Devices.

SEE ALSO

Replacing an MX480 DPC | 351

MX480 DPC Terminology

Maintaining MX480 DPCs | 345

Troubleshooting the MX480 FPCs

IN THIS SECTION

- Problem | 467
- Solution | 467

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 for Routing Devices.

SEE ALSO

- MX480 Flexible PIC Concentrator (FPC) LEDs | **119**
- Replacing an MX480 FPC | **367**
- Holding an MX480 FPC | **363**
- Storing an MX480 FPC | **366**
- Maintaining MX480 FPCs | **360**

Troubleshooting the MX480 MICs

IN THIS SECTION

- Problem | 470
- Solution | 470

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 Interface Module Reference*.
- 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**, left to right:

```
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+
```

For further description of the output from the command, see the CLI Explorer.

SEE ALSO

MX480 Modular Interface Card (MIC) Description | 138

Maintaining MX480 MICs | 373

Replacing an MX480 MIC | 375

Troubleshooting the MX480 MPCs

IN THIS SECTION

Problem | 471

Solution | 471

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
```

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
```

For further description of the output from the commands, see the Junos OS Administration Library for Routing Devices.

SEE ALSO

MX480 Modular Port Concentrator (MPC) Description | 157

Maintaining MX480 MPCs | 384

Replacing an MX480 MPC | 387

Troubleshooting the MX480 PICs

IN THIS SECTION

- Problem | 474
- Solution | 474

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**, left to right:

```
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
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+
```

For further description of the output from the command, see the CLI Explorer.

SEE ALSO

MX480 Flexible PIC Concentrator (FPC) Description | **116**

Replacing an MX480 PIC | **393**

Maintaining MX480 PICs | **392**

MX480 PIC Serial Number Label | **493**

Troubleshooting the MX480 Power System

IN THIS SECTION

- Problem | **475**
- Solution | **476**

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:

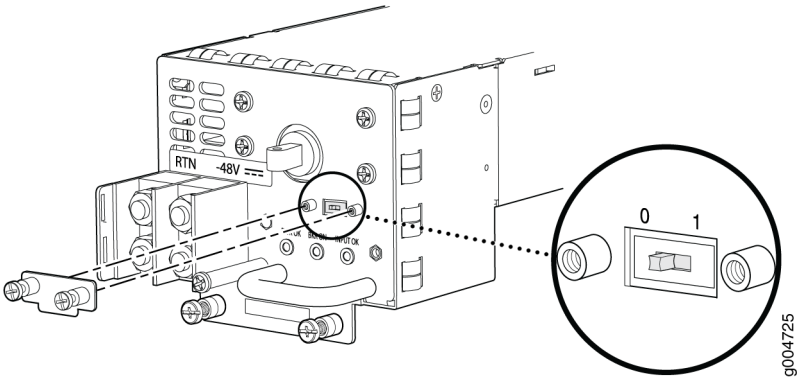
1. Switch off the circuit breaker(s) on the DC distribution panel to remove power to the chassis and power supplies.
2. Switch on the circuit breaker(s) on the distribution panel to power up the chassis and power supplies.

   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.

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. Refer to Figure 155 on page 478.

Figure 155: MX480 High-Capacity DC Power Supply 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.

SEE ALSO

MX480 AC Power Supply Description | **28**

MX480 DC Power Supply Description | **39**

Replacing an MX480 AC Power Supply | **420**

Troubleshooting Resources for MX480 Routers | **460**

CHAPTER 6

Contacting Customer Support and Returning the Chassis or Components

Contacting Customer Support and Returning the Chassis or Components | 480

Contacting Customer Support and Returning the Chassis or Components

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Displaying MX480 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                                 JN10B6596AFB      MX480
Midplane         REV 01   710-017414                      MX480
FPM Board
PEM 0            Rev 1E   740-017330   000083             PS 2.0kW; 90-264V AC
PEM 1            Rev 1E   740-017330   000089             PS 2.0kW; 90-264V AC
PEM 2            Rev 1E   740-017330   000109             PS 2.0kW; 90-264V AC
Routing Engine 0 REV 06   740-015113   1000694968         RE-S-1300
Routing Engine 1 REV 06   740-015113   1000694976         RE-S-1300
CB 0             REV 07   710-013385   KA5867             MX SCB
CB 1             REV 07   710-013385   KA5863             MX SCB
FPC 0            REV 01   750-018124   KA5710             DPCE 4x 10GE R
  CPU            REV 06   710-013713   KB4077             DPC PMB
  PIC 0                   BUILTIN      BUILTIN            1x 10GE(LAN/WAN)
    Xcvr 0       REV 01   740-014289   C712XU01J          XFP-10G-SR
  PIC 1                   BUILTIN      BUILTIN            1x 10GE(LAN/WAN)
    Xcvr 0       REV 01   740-014289   C712XU01E          XFP-10G-SR
  PIC 2                   BUILTIN      BUILTIN            1x 10GE(LAN/WAN)
  PIC 3                   BUILTIN      BUILTIN            1x 10GE(LAN/WAN)
FPC 1            REV 01   750-018122   JZ8183             DPCE 40x 1GE R
  CPU            REV 06   710-013713   KA0454             DPC PMB
  PIC 0                   BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 0       REV 01   740-011613   PAJ4SNB            SFP-SX
    Xcvr 9       REV 01   740-011782   P9M0TYY            SFP-SX
  PIC 1                   BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 3       REV 01   740-011613   PAJ4SQ9            SFP-SX
    Xcvr 4       REV 01   740-011613   PAJ4SQR            SFP-SX
    Xcvr 9       REV 01   740-011782   PAR1L2P            SFP-SX
  PIC 2                   BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 0                  NON-JNPR     MTC009778          SFP-T
    Xcvr 9       REV 01   740-011782   PAR1L2N            SFP-SX
  PIC 3                   BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 3       REV 01   740-011613   PAJ4SQD            SFP-SX
    Xcvr 9       REV 01   740-011782   PAR1L27            SFP-SX
FPC 2            REV 01   750-018122   KA5576             DPCE 40x 1GE R
  CPU            REV 06   710-013713   KB3961             DPC PMB
  PIC 0                   BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 0       REV 01   740-011782   PB83DK1            SFP-SX
    Xcvr 1       REV 01   740-011782   PB82174            SFP-SX
    Xcvr 2       REV 01   740-011782   PB81U9C            SFP-SX
    Xcvr 3       REV 01   740-011782   PB8329N            SFP-SX
    Xcvr 4       REV 01   740-011782   PB832A0            SFP-SX
    Xcvr 5       REV 01   740-011782   PB82A3T            SFP-SX
    Xcvr 6       REV 01   740-011782   PB835F7            SFP-SX
```

```
    Xcvr 7       REV 01   740-011782   PB81NBR          SFP-SX
    Xcvr 8       REV 01   740-011782   PB82CGR          SFP-SX
    Xcvr 9       REV 01   740-011782   PB81NC4          SFP-SX
  PIC 1                   BUILTIN      BUILTIN          10x 1GE(LAN)
    Xcvr 0       REV 01   740-011782   PB81NBS          SFP-SX
    Xcvr 1       REV 01   740-011782   PB8390V          SFP-SX
    Xcvr 2       REV 01   740-011782   PB75EFU          SFP-SX
    Xcvr 3       REV 01   740-011782   PB82VHH          SFP-SX
    Xcvr 4       REV 01   740-011782   PB832DA          SFP-SX
    Xcvr 5       REV 01   740-011782   P9M0U35          SFP-SX
    Xcvr 6       REV 01   740-011782   P9M0U37          SFP-SX
    Xcvr 7       REV 01   740-011782   P9M0U74          SFP-SX
    Xcvr 8       REV 01   740-011782   P9M0U3C          SFP-SX
    Xcvr 9       REV 01   740-011782   P9M0U3B          SFP-SX
  PIC 2                   BUILTIN      BUILTIN          10x 1GE(LAN)
    Xcvr 0       REV 01   740-011782   PAR1YWF          SFP-SX
    Xcvr 1       REV 01   740-011782   PAR1Z55          SFP-SX
    Xcvr 2       REV 01   740-011782   PAR1YXD          SFP-SX
    Xcvr 3       REV 01   740-011785   P6N0TQ1          SFP-LX
    Xcvr 4       REV 01   740-011782   PAR1Z4Q          SFP-SX
    Xcvr 5       REV 01   740-011782   PAR1XDZ          SFP-SX
    Xcvr 6       REV 01   740-011613   PAJ4SQQ          SFP-SX
    Xcvr 7       REV 01   740-011782   P8N1Y6L          SFP-SX
    Xcvr 8       REV 01   740-011613   PAJ4SYW          SFP-SX
    Xcvr 9       0        NON-JNPR     AM06211TK7       SFP-SX
  PIC 3                   BUILTIN      BUILTIN          10x 1GE(LAN)
    Xcvr 0       REV 01   740-011782   PAR1XB3          SFP-SX
    Xcvr 1       REV 01   740-011782   PAR1YHY          SFP-SX
    Xcvr 2       REV 01   740-011782   PAR1XDV          SFP-SX
    Xcvr 3       REV 01   740-011782   PAR1Z7B          SFP-SX
    Xcvr 4       REV 01   740-011782   PAR1YWE          SFP-SX
    Xcvr 5       REV 01   740-011782   PAR1X5W          SFP-SX
    Xcvr 6       REV 01   740-011782   PAR1Z5E          SFP-SX
    Xcvr 7       REV 01   740-011782   PAR1XB6          SFP-SX
    Xcvr 8       REV 01   740-011785   PAQ0ZAS          SFP-LX
    Xcvr 9       REV 01   740-011785   PAQ0ZA8          SFP-LX
FPC 5            REV 08   710-014219   KB0710           DPC 4x 10GE R
  CPU            REV 06   710-013713   KB1015           DPC PMB
  PIC 0                   BUILTIN      BUILTIN          1x 10GE(LAN/WAN)
    Xcvr 0       REV 01   740-014279   733019A00156     XFP-10G-LR
  PIC 1                   BUILTIN      BUILTIN          1x 10GE(LAN/WAN)
    Xcvr 0       REV 01   740-014279   733019A00192     XFP-10G-LR
  PIC 2                   BUILTIN      BUILTIN          1x 10GE(LAN/WAN)
```

```
  PIC 3                 BUILTIN      BUILTIN          1x 10GE(LAN/WAN)
Fan Tray                                            Left Fan Tray
```

Most components also have a small rectangular serial number ID label (see Figure 156 on page 483) attached to the component body.

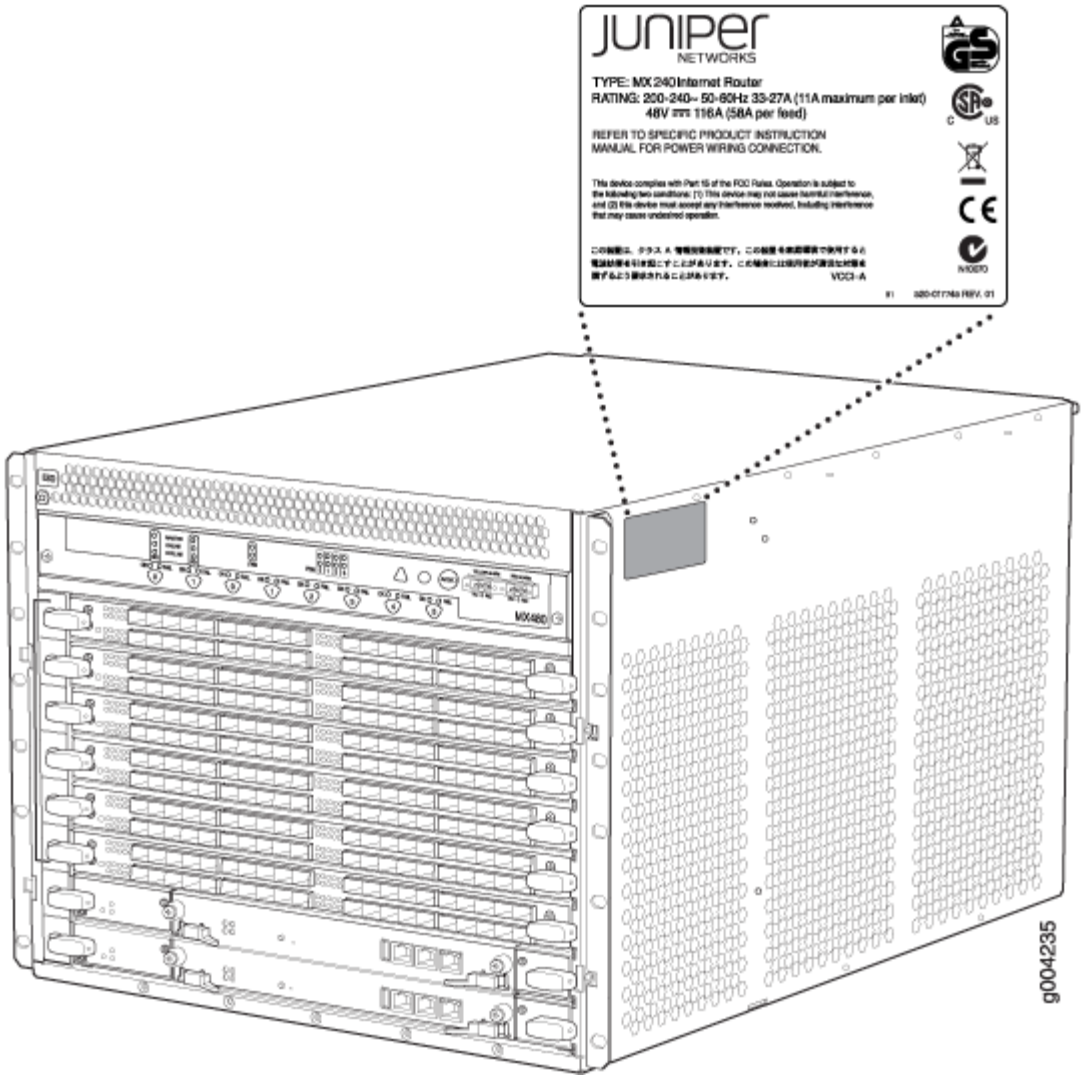
Figure 156: Serial Number ID Label



MX480 Chassis Serial Number Label

The chassis serial number is located on the side of the chassis (see Figure 157 on page 484).

Figure 157: MX480 Chassis Serial Number Label

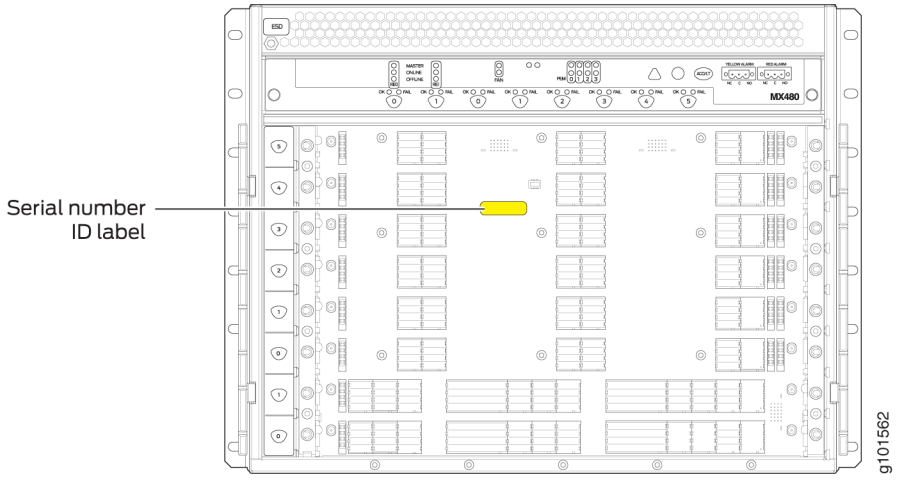


MX480 Midplane Serial Number Label

The midplane is located toward the rear of the chassis and forms the rear of the card cage.

The serial number label is located on the left side of the midplane (see Figure 158 on page 485). You need to remove DPC/FPCs in slot 4 and 5 to view the label. You can also remove DPC/FPCs in slot 2 and 3 to view the label more clearly.

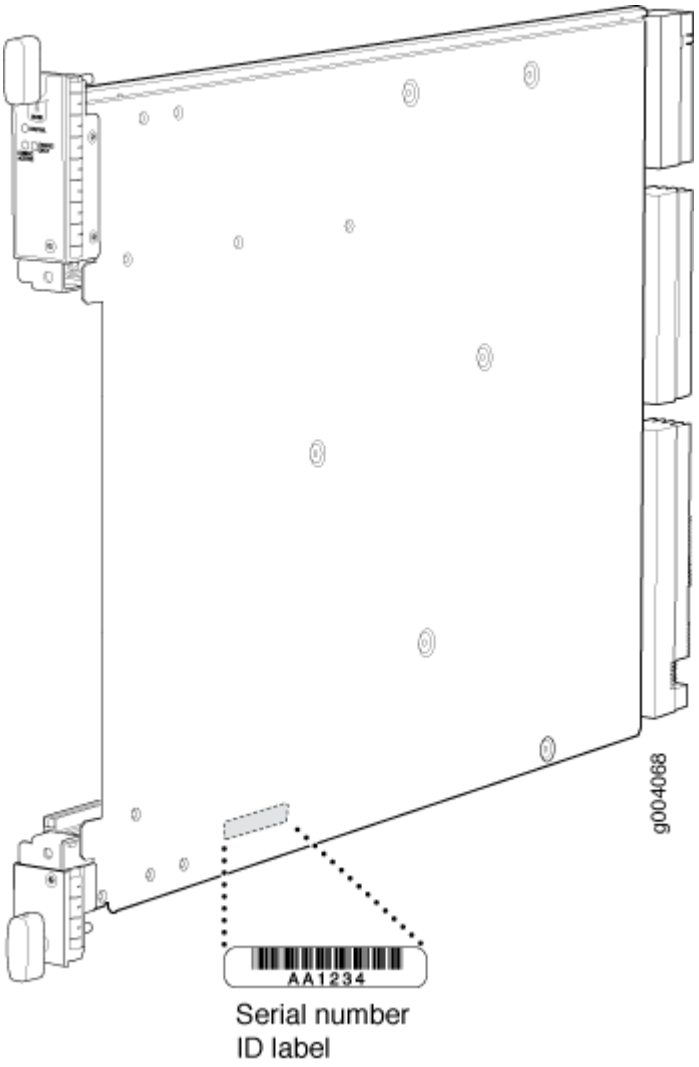
Figure 158: Midplane Serial Number Location



MX480 SCB Serial Number Label

The serial number is located on the right side of the top of the SCB (see Figure 159 on page 486).

Figure 159: SCB Serial Number Label



SEE ALSO

Replacing an MX480 Switch Control Board | **437**

Displaying MX480 Router Components and Serial Numbers | **480**

Contact Customer Support

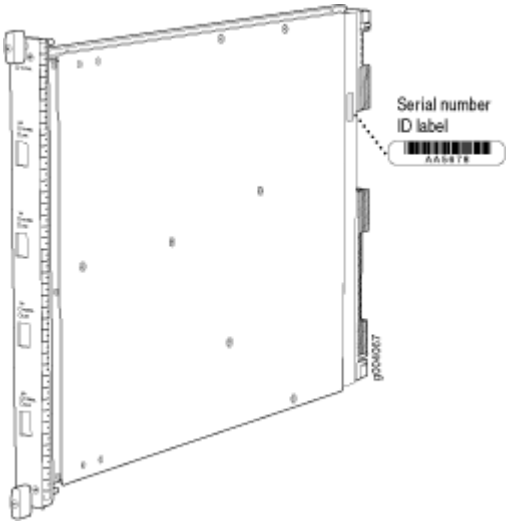
How to Return a Hardware Component to Juniper Networks, Inc. | 499

Guidelines for Packing Hardware Components for Shipment | 498

MX480 DPC Serial Number Label

The serial number label is located on the center of the right side of the DPC (see Figure 160 on page 487).

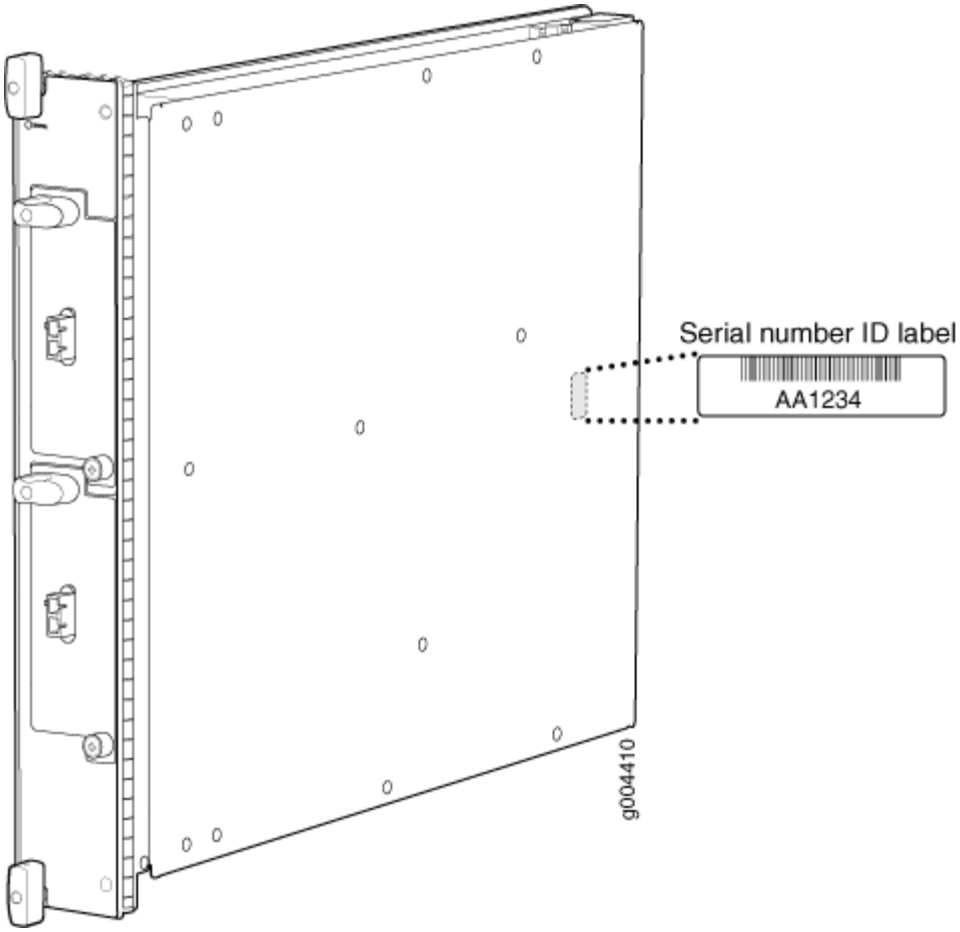
Figure 160: DPC Serial Number Label



MX480 FPC Serial Number Label

The serial number label is located on the center of the right side of the FPC (see Figure 161 on page 488).

Figure 161: FPC Serial Number Label



SEE ALSO

Replacing an MX480 FPC | 367

MX480 MIC Serial Number Label

The serial number label location varies per MIC (see Figure 163 on page 489 and Figure 164 on page 490). The exact location may be slightly different on different MICs, depending on the placement of components on the MIC board (see Figure 162 on page 489, Figure 163 on page 489, Figure 164 on page 490, and Figure 165 on page 490).

Figure 162: 2-Port MIC Serial Number Label

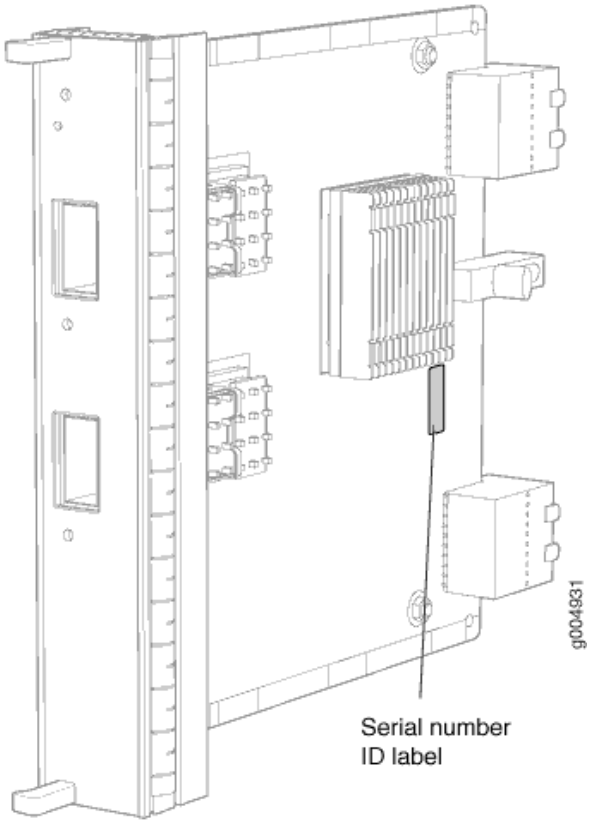


Figure 163: 4-Port MIC Serial Number Label

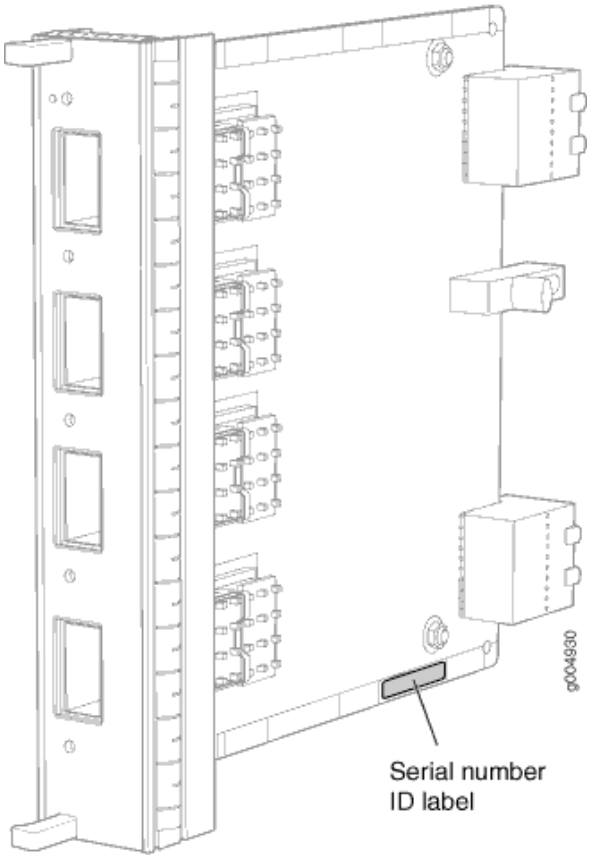


Figure 164: 20-Port MIC Serial Number Label

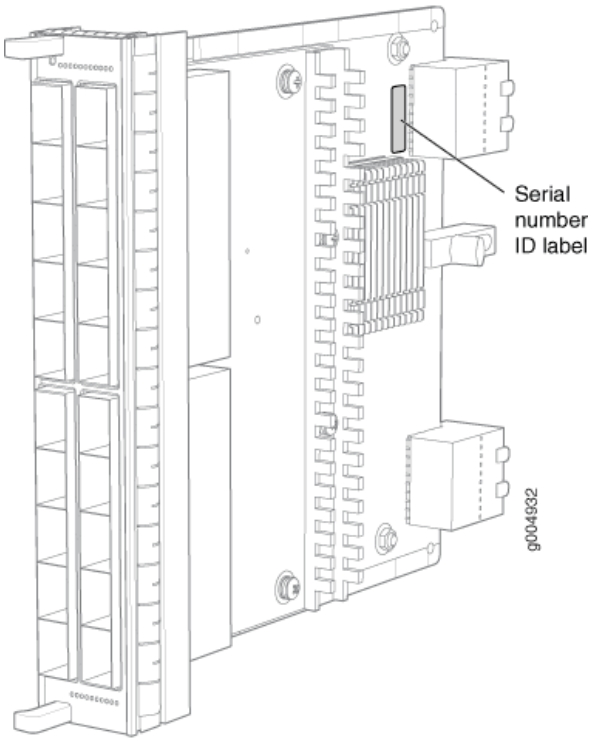
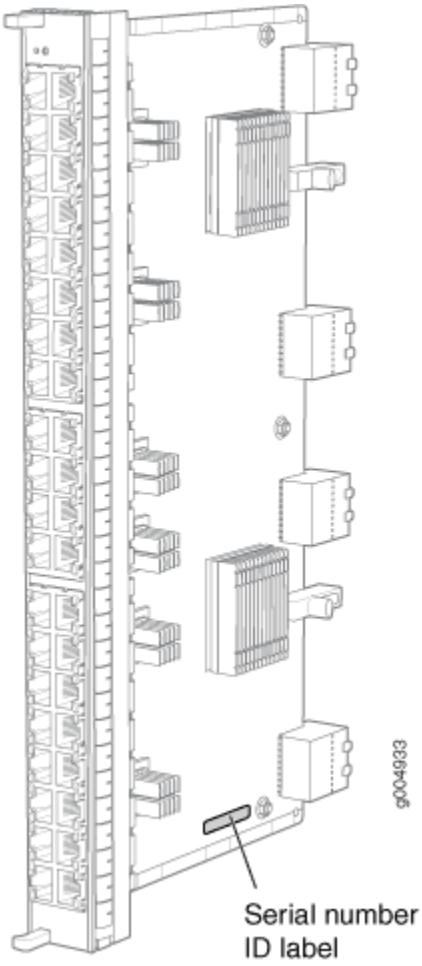


Figure 165: 40-Port MIC Serial Number Label



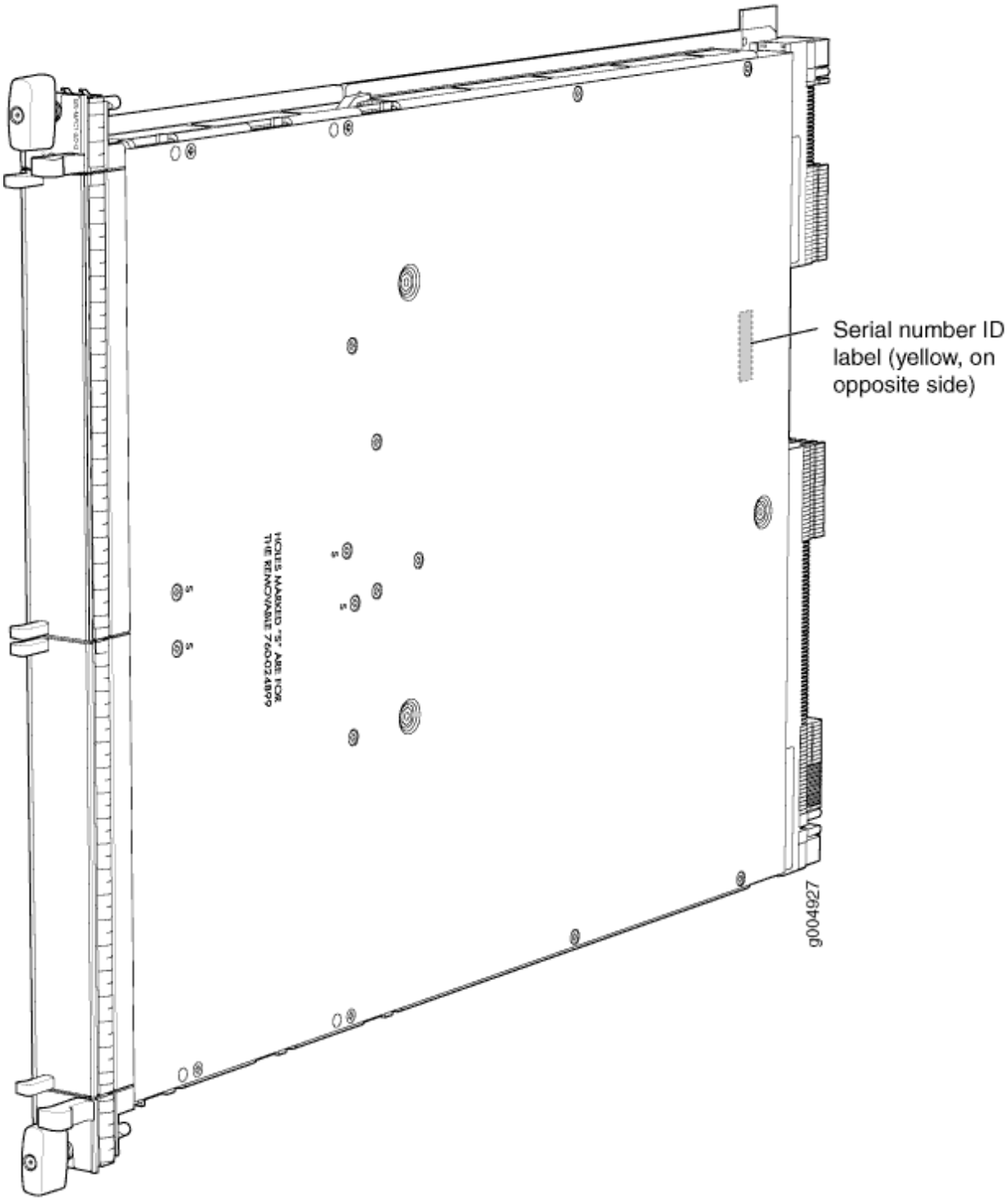
SEE ALSO

Replacing an MX480 MIC | 375

MX480 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 166 on page 492).

Figure 166: MPC Serial Number Label



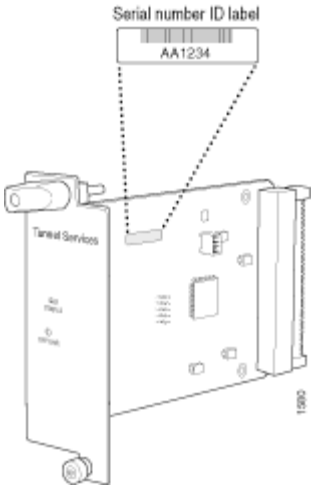
SEE ALSO

Replacing an MX480 MPC | 387

MX480 PIC Serial Number Label

The serial number label is located on the right side of the PIC (see Figure 167 on page 493), 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 167: PIC Serial Number Label



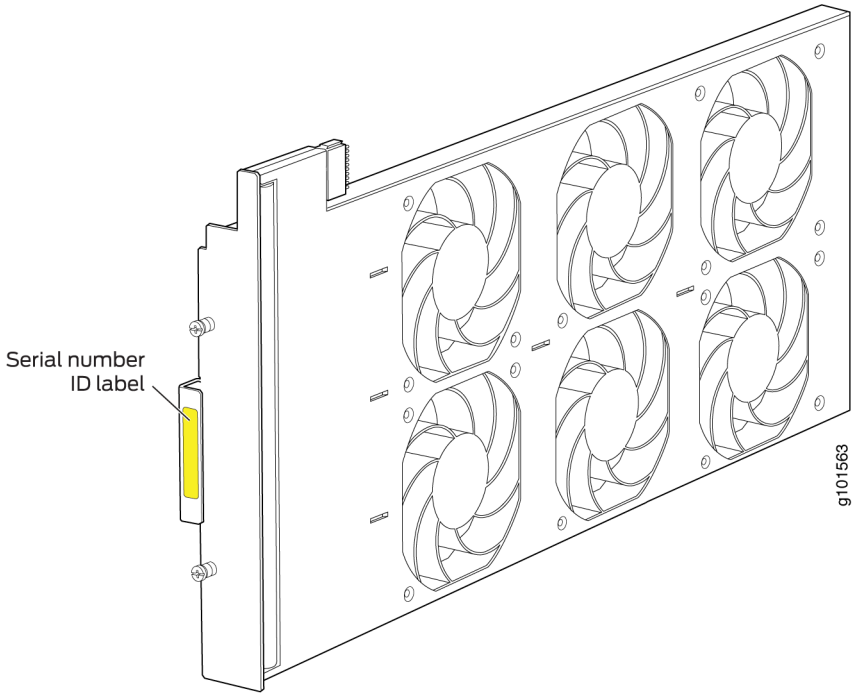
SEE ALSO

Replacing an MX480 PIC | 393

MX480 Fan Serial Number Label

The serial number label is located on the front side of the fan (see Figure 168 on page 494).

Figure 168: Fan Serial Number Location



SEE ALSO

Replacing an MX480 PIC | 393

MX480 Power Supply Serial Number Label

The serial number label is located on the top of the AC power supply (see Figure 169 on page 495).

The serial number label is located on the top of the DC power supply faceplate (see Figure 170 on page 495).

Figure 169: AC Power Supply Serial Number Label

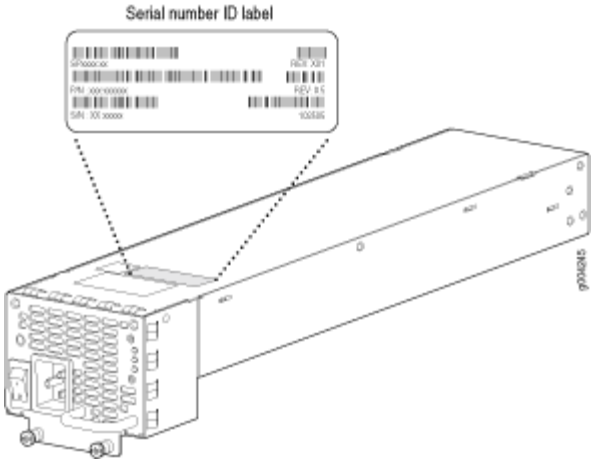
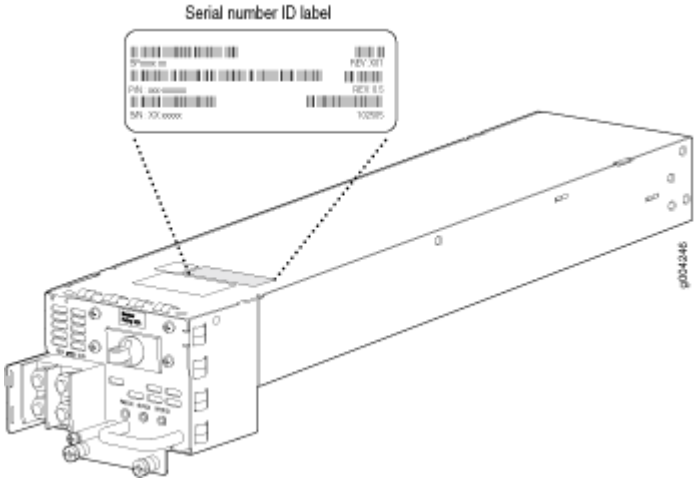


Figure 170: DC Power Supply Serial Number Label



SEE ALSO

Replacing an MX480 AC Power Supply | 420

Replacing an MX480 DC Power Supply | 425

MX480 Routing Engine Serial Number Label

The serial number label is located on the left side of the top of the Routing Engine (see Figure 171 on page 496 and Figure 172 on page 497).

Figure 171: Routing Engine Serial Number Label

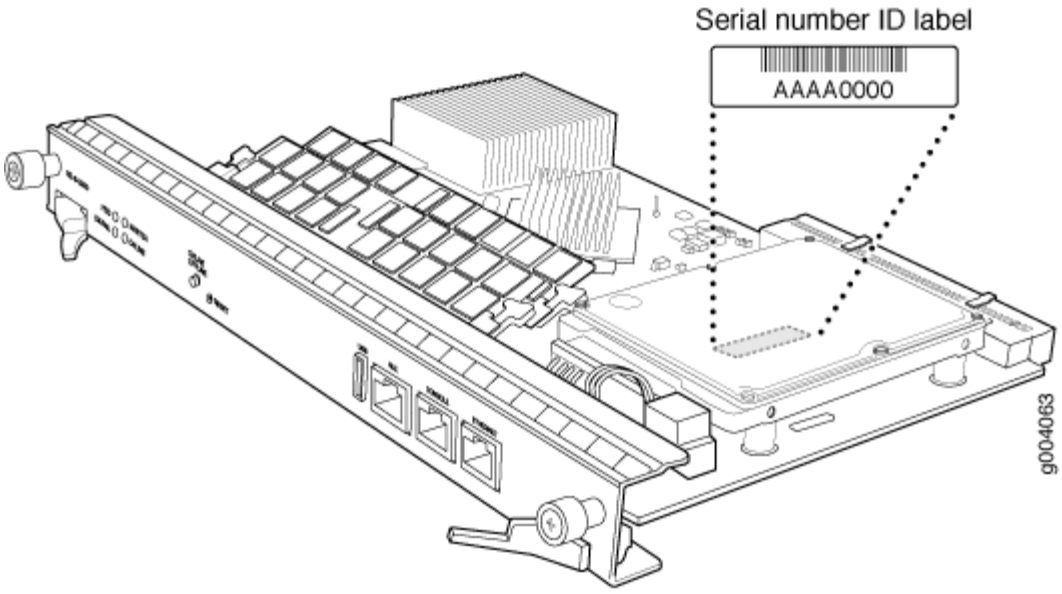
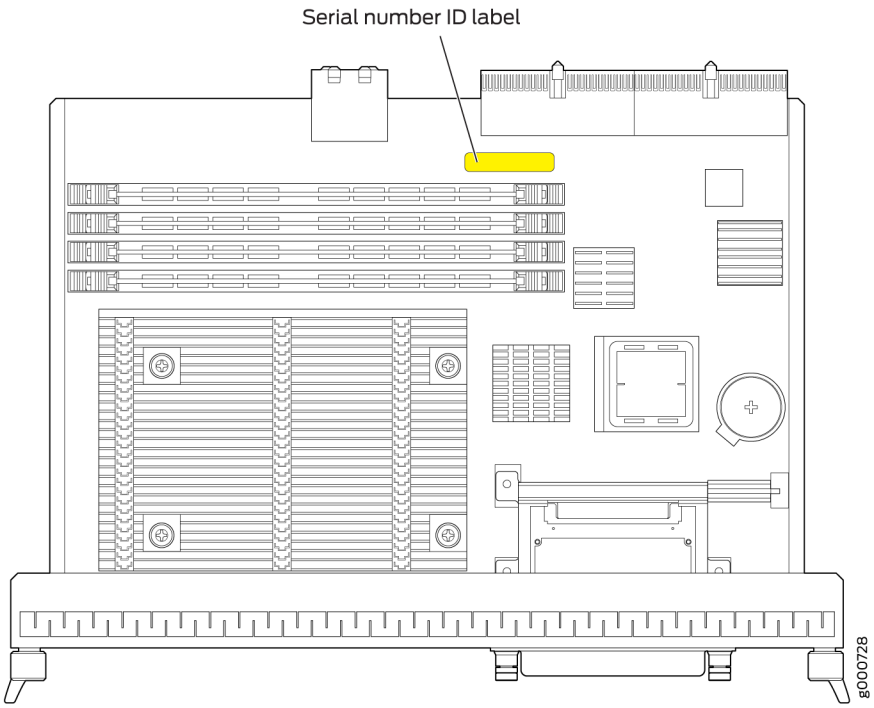


Figure 172: RE-S-X6-64G Routing Engine Serial Number Label



SEE ALSO

Replacing an MX480 Routing Engine | 322

Contact Customer Support to Obtain a Return Material Authorization

If you need to return 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). You must obtain an RMA number before you attempt to return the component.

After locating the serial number of the device or hardware component you want to return, open a service request with the 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.

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.

Packing the MX480 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.

CHAPTER 7

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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 for 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.

LASER 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 familiarize yourself 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 THIS SECTION

- Fire Suppression | **507**
- Fire Suppression Equipment | **507**

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.

Preventing Electrostatic Discharge Damage to an MX480 Router

Many device components are sensitive to damage from static electricity. Some components can be impaired by voltages as low as 30 V. You can easily generate potentially damaging static voltages whenever you handle plastic or foam packing material or if you move components across plastic or carpets. Observe the following guidelines to minimize the potential for electrostatic discharge (ESD) damage, which can cause intermittent or complete component failures:

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

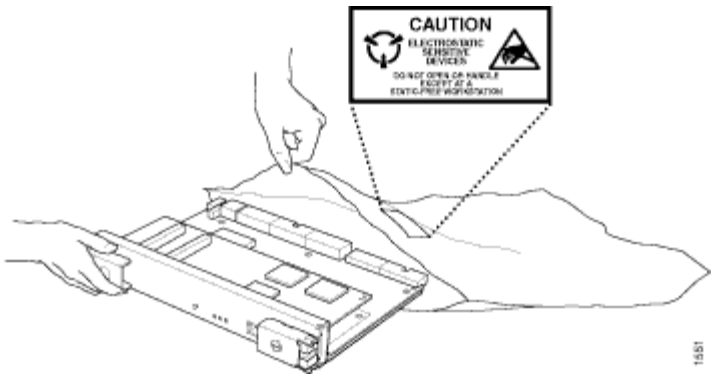
  

  CAUTION: For safety, periodically check the resistance value of the ESD strap. The measurement should be in the range of 1 through 10 Mohms.

- When handling any component that is removed from the chassis, make sure the equipment end of your ESD strap is attached to one of the ESD points on the chassis.
- Avoid contact between the component and your clothing. ESD voltages emitted from clothing can still damage components.

- When removing or installing a component, always place it component-side up on an antistatic surface, in an antistatic card rack, or in an electrostatic bag (see Figure 173 on page 509) . If you are returning a component, place it in an electrostatic bag before packing it.

Figure 173: Placing a Component into an Electrostatic Bag



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.

MX480 Chassis Lifting Guidelines

The weight of a fully configured chassis is about 163.5 lb (74.2 kg). Observe the following guidelines for lifting and moving the router:

- Before moving the router, verify that the intended site meets the specified power, environmental, and clearance requirements.
- Do not attempt to lift a fully configured router by yourself. Using a mechanical lift to maneuver the router into a rack is recommended. If a lift cannot be used, a minimum of two people must lift the router, and you must remove components from the chassis before lifting.

  To lift routing devices and components, use the following lifting guidelines:

  - Up to 39.7 lbs (18 kg) 1 person lift.
  - 39.7 lbs (18 kg) to 70.5 lbs (32 kg) 2 or more person lift.
  - 70.5 lbs (32 kg) to 121.2 lbs (55 kg) 3 or more person lift.
  - Above 121.2 lbs (55 kg) material handling systems (such as levers, slings, lifts and so on) must be used. When this is not practical, specially-trained persons or systems must be used (riggers or movers).
- Before lifting or moving the router, disconnect all external cables.
- As when lifting any heavy object, lift most of the weight with your legs rather than your back. Keep your knees bent and your back relatively straight and avoid twisting your body as you lift. Balance the load evenly and be sure that your footing is solid.

RELATED DOCUMENTATION

MX480 Site Preparation Checklist | **193**

Removing Components from the MX480 Router Before Installing It Without a Lift | **257**

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:

- Install the device in a rack that is secured to the building structure.
- Mount the device 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.

Laser and LED Safety Guidelines and Warnings

IN THIS SECTION

- General Laser Safety Guidelines | **517**
- Class 1 Laser Product Warning | **517**
- Class 1 LED Product Warning | **518**
- Laser Beam Warning | **518**

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 IEC/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.



LASER 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



LASER 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



LASER 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



LASER 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



LASER 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.

Maintenance and Operational Safety Guidelines and Warnings

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While performing the maintenance activities for devices, observe the following guidelines and warnings:

Battery Handling Warning



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.

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 (Network Equipment-Building System) 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 you clean grounding surface and give them a bright finish before making grounding connections.
- 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 174 on page 528) 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).

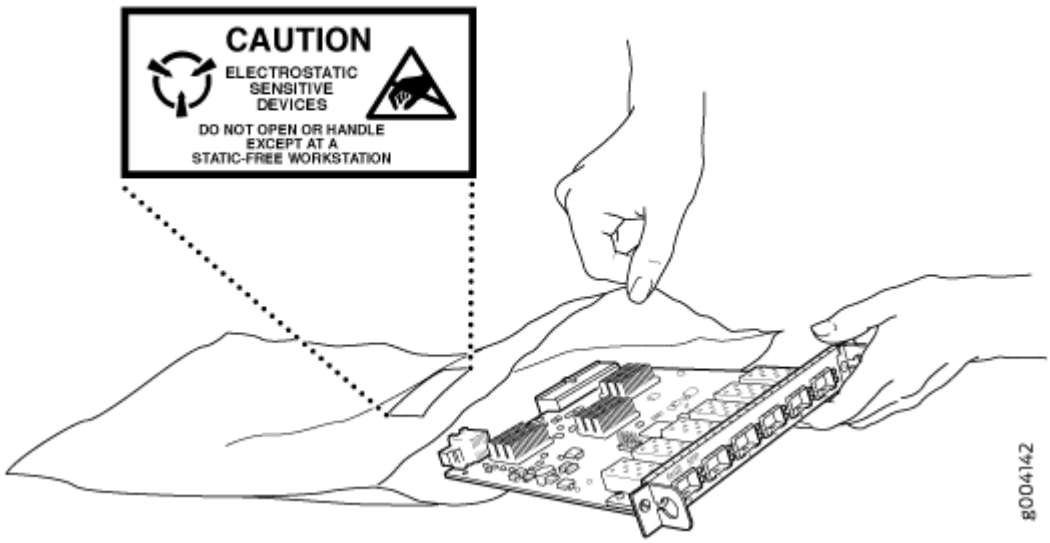
- When handling any component that is subject to ESD damage and that is removed from the device, make sure the equipment end of your ESD wrist strap is attached to the ESD point on the chassis.

  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 174 on page 528). If you are returning a component, place it in an antistatic bag before packing it.

Figure 174: 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。

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, and then call for help.

MX480 Agency Approvals and Compliance Statements

IN THIS SECTION

- Agency Approvals for MX480 Routers | **539**
- Compliance Statements for EMC Requirements | **540**
- Compliance Statements for Environmental Requirements | **542**
- Compliance Statements for Data Center | **542**
- Compliance Statements for Acoustic Noise for the MX480 Router | **542**

Agency Approvals for MX480 Routers

IN THIS SECTION

- Compliance Statement for Argentina | 540

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

Compliance Statement for Argentina

EQUIPO DE USO IDÓNEO.

Compliance Statements for EMC Requirements

IN THIS SECTION

- Canada | **540**
- European Community | **540**
- Israel | **541**
- Japan | **541**
- United States | **541**

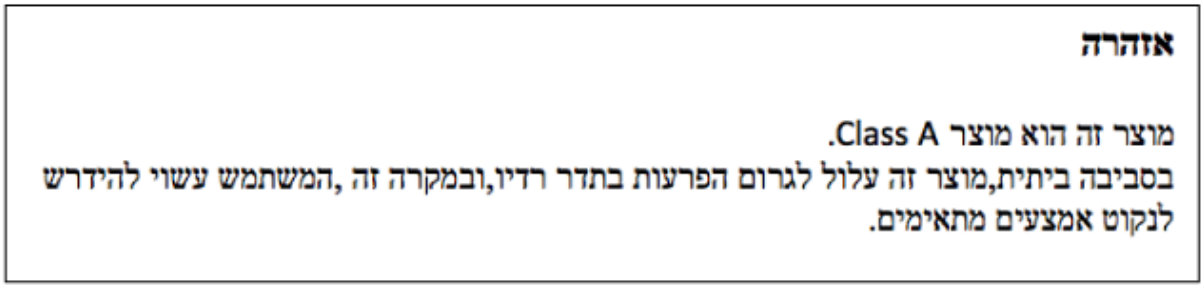
Canada

CAN ICES-3 (A)/NMB-3(A)

European Community

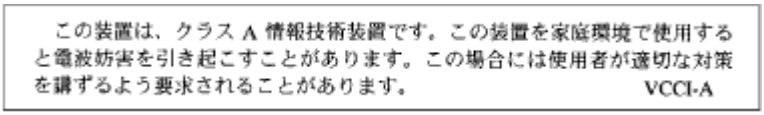
This is a Class A product. In a domestic environment, this product might cause radio interference in which case the user might be required to take adequate measures.

Israel



Translation from Hebrew—Warning: This product is Class A. In residential environments, the product might cause radio interference, and in such a situation, the user might be required to take adequate measures.

Japan



The preceding translates as follows:

This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this product is used near a radio or television receiver in a domestic environment, it might cause radio interference. Install and use the equipment according to the instruction manual. VCCI-A.

United States

The hardware equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Compliance Statements for Environmental Requirements

Batteries in this product are not based on mercury, lead, or cadmium substances. The batteries used in this product are in compliance with EU Directives 91/157/EEC, 93/86/EEC, and 98/101/EEC. The product documentation includes instructional information about the proper method of reclamation and recycling.

Compliance Statements for Data Center

- 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.

Compliance Statements for Acoustic Noise for the MX480 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

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
    1. EX4400-24T
    2. EX4400-24P
    3. EX4400-24MP
    4.
    5. EX4400-48T

6. EX4400-48P
7. EX4400-48MP
8. 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
- MX304
- MX240, MX480, and MX960
- MX10003
- RE-A-2000 Route Engine
- RE-S-X6-64G Routing Engine

NFX Series:

- NFX250

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

- SRX380
- 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