

MX104 Universal Routing Platform Hardware Guide

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MX104 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 MX104 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

[MX104 Quick Start Guide](#)

[Junos OS for MX Series 5G Universal Routing Platforms](#)

1

CHAPTER

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MX104 Universal Routing Platform Overview

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- Benefits of MX104 Router | 2
- System Overview | 3

The Juniper Networks MX104 Universal Routing Platform is optimized for aggregating mobile, enterprise WAN, business, and residential access services. The MX104 router is designed for high-density access and pre-aggregation and is environmentally hardened to allow outside deployments in cabinets and remote terminals. The router is a high-performance router functioning as a universal aggregation platform for mobile broadband and metro Ethernet applications. It also acts as a universal edge platform supporting all types of private WAN, data center interconnect, Internet edge, business edge, and residential edge services.

The router is powered by the Junos Trio chipset and runs the Junos® operating system (Junos OS) for high-performance routing and switching. For a list of related Junos OS documentation, see <https://www.juniper.net/documentation/software/junos/>.

Benefits of MX104 Router

- **System Capacity**—MX104 provides 80 Gbps of throughput. MX104 has four Modular Interface Card (MIC) slots and supports redundant fixed 10-Gigabit Ethernet interfaces for flexible network connectivity.
- **The 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.
- **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.
- **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.

System Overview

The chassis is a rigid sheet metal structure that houses all the other router components (see [Figure 1 on page 4](#) and [Figure 2 on page 4](#)). The hardware system provides resiliency and redundancy, including power supplies and Routing Engines. The chassis also has four built-in 10-Gigabit Ethernet SFP+ ports and four slots that accept Modular Interface Cards (MICs). For a list of the supported MICs, see the [MX Series Interface Module Reference](#).

The router is environmentally hardened and is 3.5 rack units (U; that is, 6.125 in., or 15.55 cm) tall. Several routers can be stacked in a single floor-to-ceiling rack, for increased port density per unit of floor

space. The chassis is installed in standard 11.81 in. (30 cm)-deep (or larger) enclosed cabinets, 19-in. equipment racks, or telco open-frame racks.

Figure 1: Front Panel of the MX104 Router

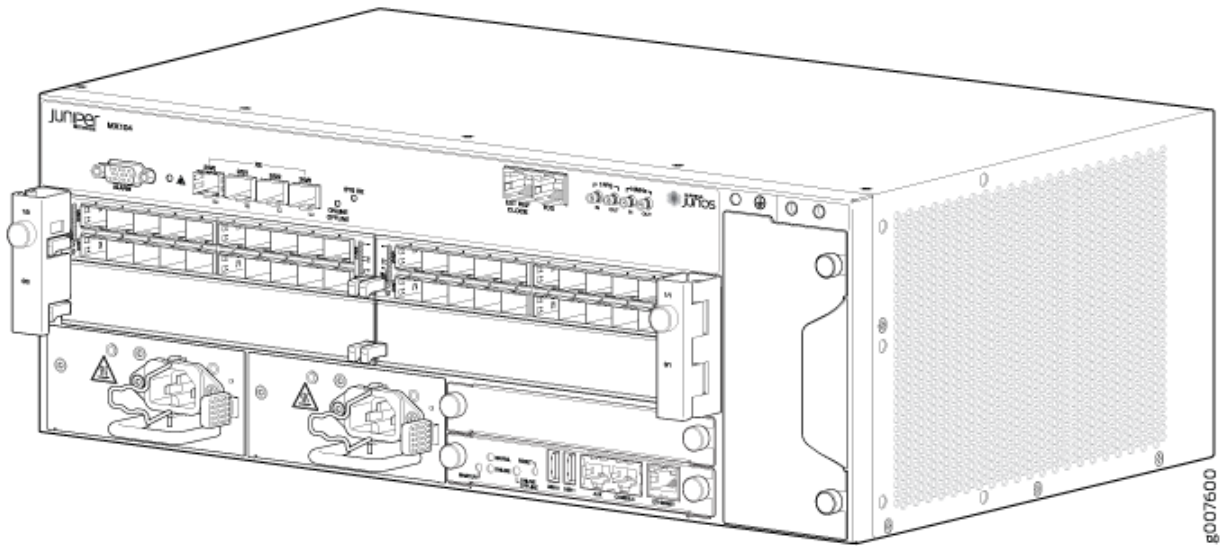


Figure 2: Rear View of the MX104 Router



RELATED DOCUMENTATION

| [MX104 Port and Interface Numbering](#) | 34

MX104 Chassis

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MX104 Chassis Overview

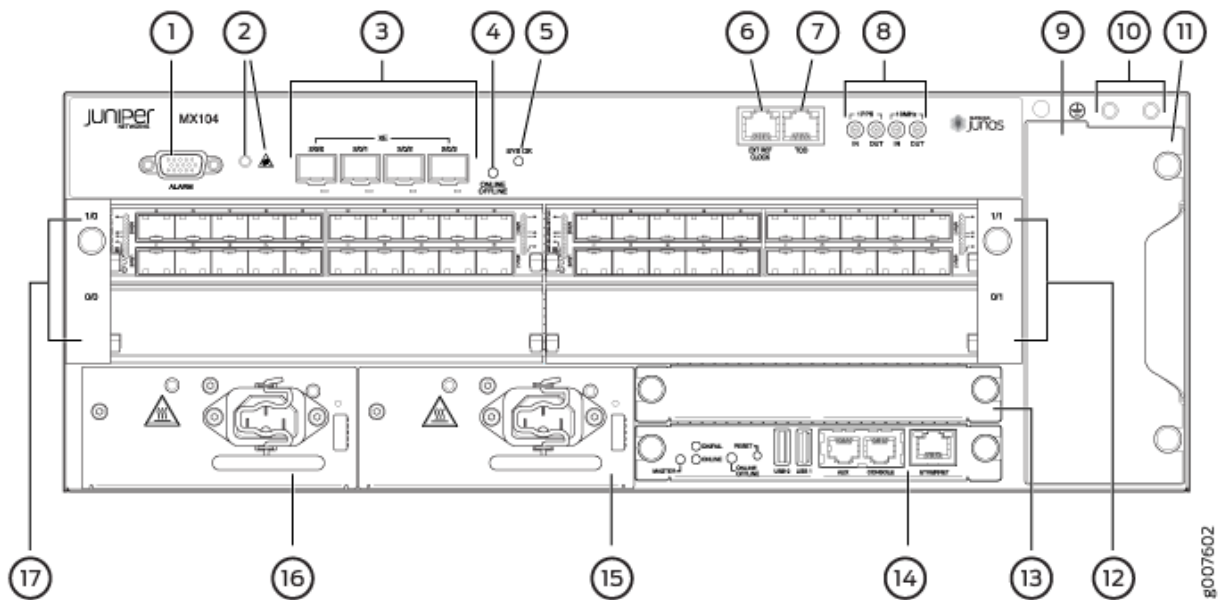
The MX104 router contains a front panel with slots in which you can install field-replaceable units (FRUs). From the front of the chassis, you can see the following components (see [Figure 3 on page 6](#)):

- Alarm console port labeled **ALARM**, which accepts a DE-15 alarm cable.
- Alarm LEDs that indicate major or minor alarms.
- Built-in 10-Gigabit Ethernet MIC with four ports that accept 10-Gigabit Ethernet SFP+ transceivers.
- **ONLINE/OFFLINE** button.
- Chassis status LED labeled **SYS OK**
- External building integrated timing system (BITS) port labeled **EXT REF CLOCK**
- Time-of-day (**TOD**) port
- External clocking ports supporting 1-PPS and 10-MHz input and output
- ESD point
- Fan tray, which contains five fans and an air filter
- Four slots for installing MICs

NOTE: For a detailed description of the MX104 port and interface numbering see "[MX104 Port and Interface Numbering](#)" on page 34.

- Two slots for installing either AC or DC power supplies, labeled **PS 0** and **PS 1**
- Two slots for installing Routing Engines, labeled **RE 0** and **RE 1**

Figure 3: Front View of the MX104 Router



1– Alarm input and output contacts	10– Grounding terminals
2– Alarm LEDs	11– Fan tray
3– 10-Gigabit Ethernet SFP+ ports	12– MIC slots 0/1 and 1/1
4– Online/offline button	13– Routing Engine slot 1
5– System status LED	14– Routing Engine slot 0
6– External reference clocking port	15– Power supply slot 1
7– Time-of-day (ToD) port	16– Power supply slot 0
8– 1-PPS and 10-MHz GPS input and output ports	17– MIC slots 0/0 and 1/0
9– ESD point	

MX104 Hardware and CLI Terminology Mapping

The MX104 router supports the components in [Table 1 on page 7](#), listed in alphabetic order.

Table 1: MX104 Routers Hardware Components and CLI Terminology

Component	Hardware Model Number	CLI Name	Description
Chassis	N/A	MX104	"MX104 Universal Routing Platform Overview" on page 2
Cooling system, including fan trays and air filters			"MX104 Cooling System and Airflow Overview" on page 14
Air filter kit	FLTR-KIT-MX104	N/A	
Fan tray	FANTRAY-MX104	Fan Tray	
Power system components			"MX104 Power Overview" on page 16
Power blank cover	PWR-BLANK-MX104	N/A	
Power supply	<ul style="list-style-type: none"> AC: PWR-MX104-AC DC: PWR-MX104-DC 	PEM	

Table 1: MX104 Routers Hardware Components and CLI Terminology (Continued)

Component	Hardware Model Number	CLI Name	Description
MIC	N/A (built-in)	4x 10GE(LAN) SFP+	"MX104 Modular Interface Card (MIC) Overview" on page 32
	See MX Series Interface Module Reference .		"MX104 Modular Interface Card (MIC) Overview" on page 32
MPC	N/A (built-in)	FPC	"MX104 Modular Interface Card (MIC) Overview" on page 32
Routing Engine	RE-S-MX104	Routing Engine	"MX104 Routing Engine Overview" on page 26
Transceiver	See MX Series Interface Module Reference .	xcvr	"MX104 Modular Interface Card (MIC) Overview" on page 32

SEE ALSO

| [MX104 Port and Interface Numbering](#) | 34

MX104 Component Redundancy

The MX104 chassis provides redundancy and resiliency. The hardware system is fully redundant, including power supplies, Routing Engines, and cooling system.

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:

- **Power supplies**—In a redundant configuration, the router contains either two AC or DC power supplies that install into the front of the chassis. The slots are labeled **PS 0** and **PS 1** (left to right). Each power supply provides power to all components in the router. When two power supplies are present, they share power almost equally within a fully populated system. If one power supply in a redundant configuration fails or is removed, the remaining power supplies assume the entire electrical load without interruption. Two power supplies provide the maximum configuration with full power for as long as the router is operational.
- **Routing Engine**—If two Routing Engines are installed, one functions as the primary and the other functions as the backup. If the primary Routing Engine fails, the backup can take over as the primary.
- **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.

MX104 Alarm Contact Port Overview

The MX104 router has four external alarm contacts (also known as potential free contacts) for connecting the router to external alarm devices. The port labeled **ALARM** uses a 15-pin D-type connector. The external alarm contact has 15 pins that accept a single core wire from external alarm devices. A DE-15 alarm cable is required to connect the MX104 router to external alarm devices. Use the gauge wire appropriate for the external device that you are connecting.

Whenever a system condition triggers an alarm, the alarm relay contacts are activated, which in turn activates the external alarm devices. The alarm setting is open or closed.

You can connect and configure two output alarms and four input alarms. Two additional output alarms are reserved and are used to indicate major and minor system alarms. Each output and input alarm has two contacts for connecting the router to external alarm devices. Contact 1 of each alarm can be configured as Normally Open [NO] or Normally Closed [NC] through the CLI. Contact 2 of each alarm functions as a reference [REF] or negative potential terminal for Contact 1 of the corresponding alarm and provides a current path for external alarm devices. [Table 2 on page 9](#) describes the functions of the alarm contacts.

Table 2: Alarm Relay Contact Functions

Contact Name	Contact Name	Function
Contact 1	Normally Open [NO]	Current is not flowing through Contact 1 and Contact 2 [REF] when operating normally. When the current flows, the closed alarm is generated.

Table 2: Alarm Relay Contact Functions (Continued)

Contact Name	Contact Name	Function
	Normally Closed [NC]	Current is flowing through Contact 1 and Contact 2 [REF] when operating normally. When the current stops flowing, the open alarm is generated.
Contact 2	Reference [REF]	Provides the current path for the external alarm-reporting device and functions as a reference or negative potential terminal for Contact 1.

Figure 4 on page 10 shows an example of a wiring diagram for a simple output alarm-reporting device. In this case, the device is a light bulb that illuminates when the device encounters a condition that activates the red alarm LED and relay contacts. The alarm relay contacts can also be used to activate other devices such as bells or buzzers.

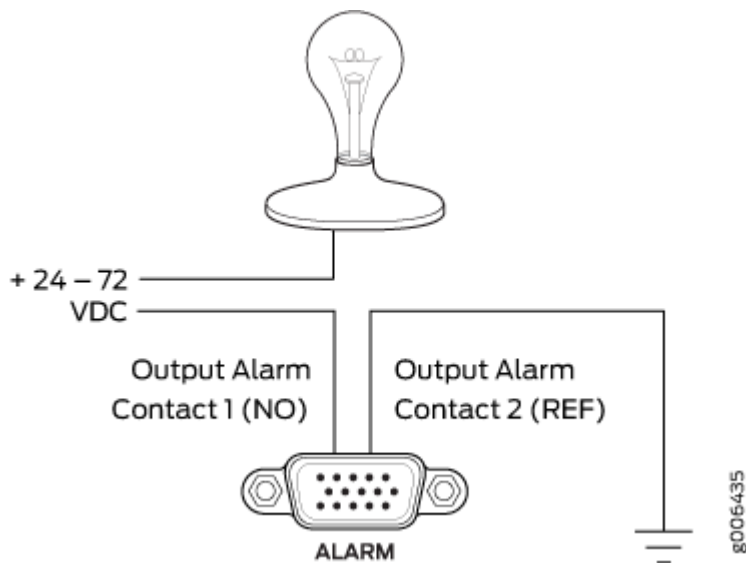
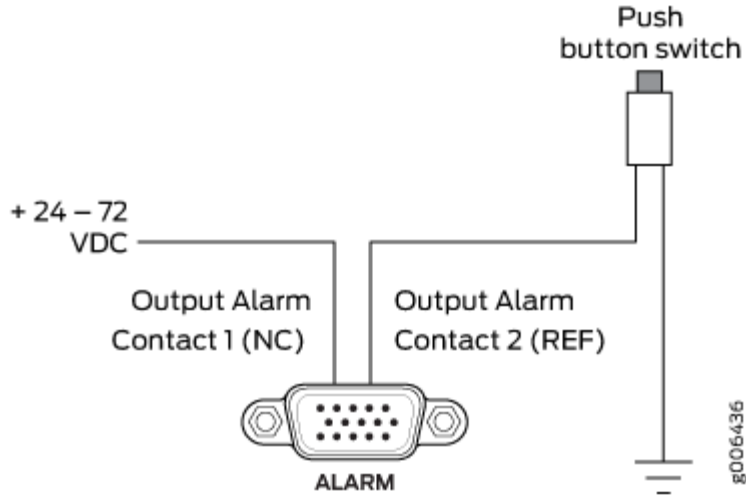
Figure 4: Sample Output Alarm-Reporting Device

Figure 5 on page 11 shows an example of a wiring diagram for a simple input alarm-reporting device. In this case, the push button switch is an alarm sensor that triggers an input alarm when a door-open condition occurs.

Figure 5: Sample Input Alarm-Reporting Device



SEE ALSO

| [MX104 Alarm Contact Port Specifications](#) | 67

MX104 LEDs Overview

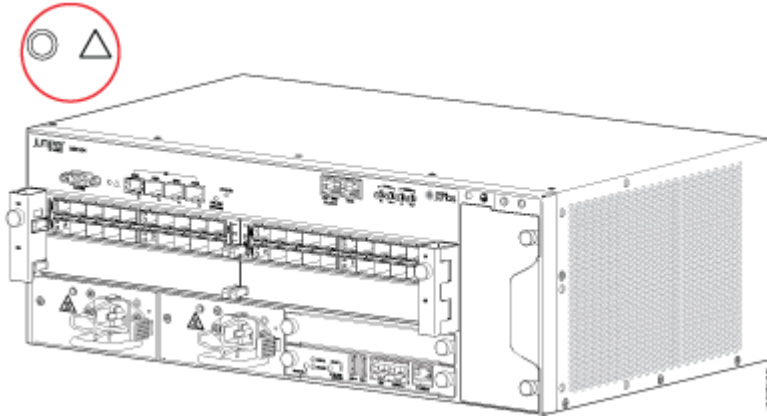
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Alarm LEDs on the Front Panel



Two LEDs, located to the right of the alarm contact port indicates major and minor alarms for the router (see [Figure 6 on page 12](#)).

Figure 6: Alarm LEDs on the MX104 Router



[Table 3 on page 12](#) describes the alarm LED in more detail.

Table 3: Alarm LEDs on the Front Panel

Shape	Color	State	LED Control Name	Description
	Red	On steadily	Critical alarm	Indicates a critical condition that can cause the router to stop functioning. Possible causes include component removal, failure, or overheating.
	Yellow	On steadily	Warning alarm	Indicates a serious but nonfatal error condition, such as a maintenance alert or a significant increase in component temperature.

System LED on the Front Panel

One bicolor LED labeled **SYS OK** indicates the status of the router. [Table 4 on page 13](#) describes the system LED in more detail.

Table 4: System LED on the Front Panel

Label	Color	State	Description
SYS OK	Green	Blinking	Router has no primary Routing Engine.
		On steadily	Router is functioning normally.
	Yellow	On steadily	Router has reported a minor alarm.
	Red	On steadily	Router has failed.

MIC LEDs

Each hot-removable and hot-insertable 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](#).

For information about the built-in MIC LEDs, see "[MX104 Modular Interface Card \(MIC\) Overview](#)" on [page 32](#).

Power Supply LED

One LED labeled **PS STATUS** indicates the status of the power supply. For more information, see "[MX104 Power Overview](#)" on [page 16](#).

Routing Engine LEDs

Three LEDs indicate the status of the Routing Engine. For more information, see "[MX104 Routing Engine Overview](#)" on [page 26](#).

SEE ALSO

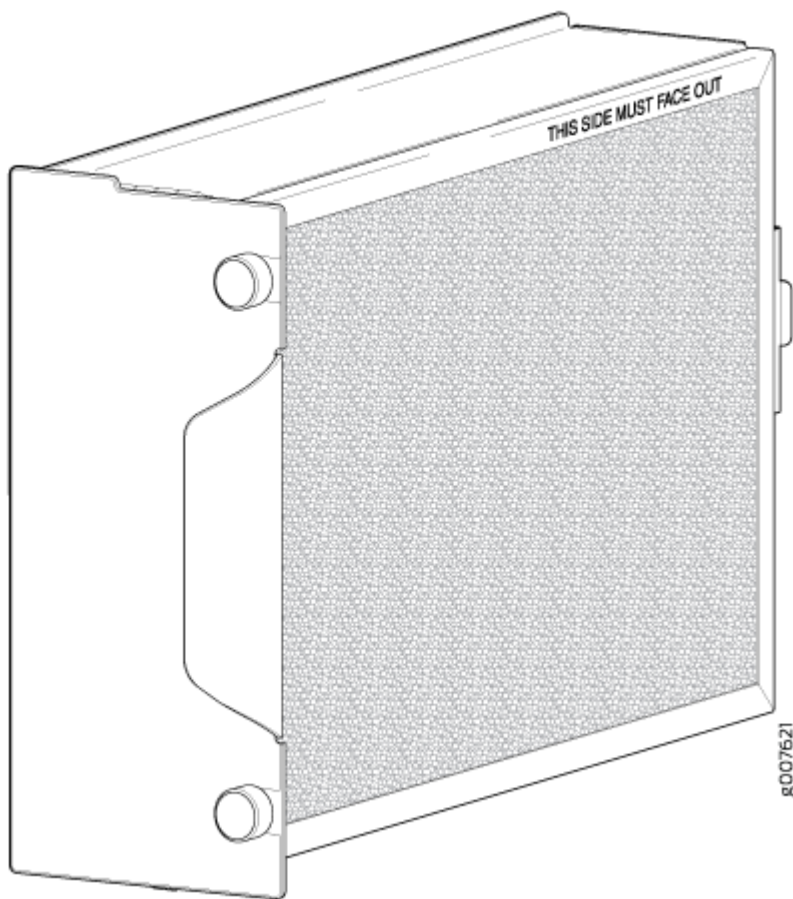
| [Troubleshooting Resources for MX104 Routers](#) | 159

MX104 Cooling System and Airflow Overview

The cooling system in an MX104 router consists of the following components (see [Figure 7 on page 14](#)):

- Fan tray
- Air filter

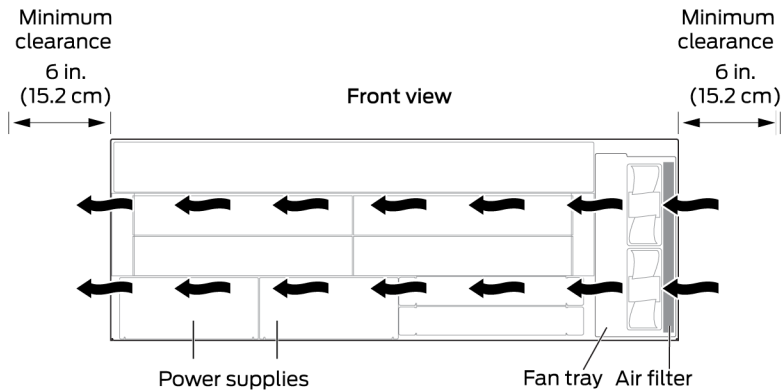
Figure 7: MX104 Fan Tray and Air Filter



The router has one hot-swappable fan tray that contains five fans. The air filter installs into the side of the fan tray. The air intake to cool the chassis is located on the right side of the chassis next to the air filter. Air is pulled through the air filter toward the fan tray, where it is exhausted out the left side of the

system (see [Figure 8 on page 15](#)). The exhaust for the power supplies is located on the left side of the chassis.

Figure 8: Cooling System and Airflow in an MX104 Router



The cooling system components work together to keep all router components within the acceptable temperature range. The chassis 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.

RELATED DOCUMENTATION

[Preparing the Site for the MX104 Router Overview | 43](#)

[Maintaining the MX104 Air Filter | 121](#)

[Rack Requirements for MX104 Routers | 52](#)

[Cabinet Requirements for MX104 Routers | 53](#)

[Clearance Requirements for Airflow and Hardware Maintenance on MX104 Routers | 56](#)

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MX104 Power System

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MX104 Power Overview

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- [Power Supply LEDs | 18](#)

The MX104 router uses either AC or DC power supplies (see [Figure 9 on page 17](#) and [Figure 10 on page 18](#)). The power supplies are located in the front of the chassis and offer 1+1 redundancy. Each power supply has a handle, an ejection tab, and a status LED.



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

When two power supplies are present, they share power almost equally within a fully populated system. If one power supply in a redundant configuration fails or is removed, the remaining power supply assumes the entire electrical load without interruption. A single power supply provides the maximum configuration with full power for as long as the router is operational. A second power supply can be installed for redundancy. Each power supply is cooled by its own internal cooling system.

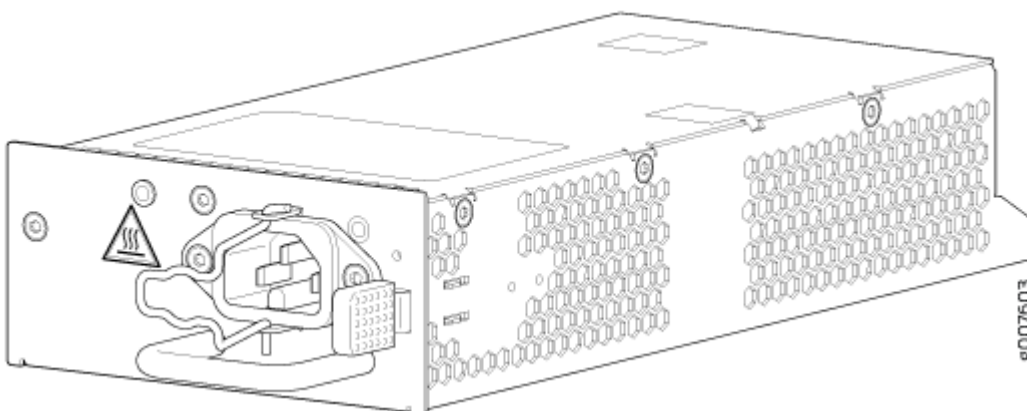
Redundant power supplies are hot-removable and hot-insertable. When you remove a power supply from a router that uses only one power supply, the router might shut down depending on your configuration.

AC Power Supplies

Each AC power supply weighs approximately 2.5 lb (1.13 kg) and consists of a handle, a power cord retainer clip, an ejection latch, an AC appliance inlet, a fan, and an LED to monitor the status of the power supply. [Figure 9 on page 17](#) shows the power supply.

Each inlet requires a dedicated AC power feed and a dedicated customer site circuit breaker. We recommend that you use a dedicated customer site circuit breaker rated for 10 A (100 VAC), or as required by local code.

Figure 9: AC Power Supply



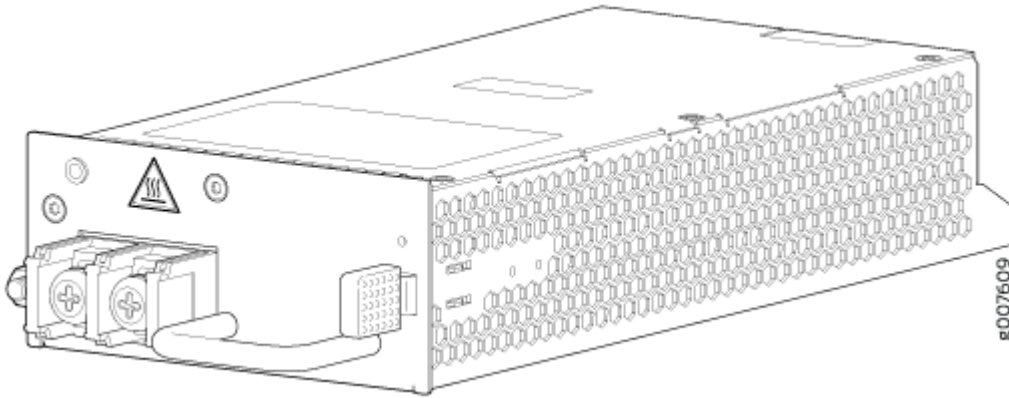
WARNING: The router is pluggable type A equipment installed in a restricted-access location. It has a separate protective earthing terminal (sized for SAE 10-32 ground screws) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earthing terminal must be permanently connected to earth.

DC Power Supplies

Each DC power supply weighs approximately 3 lb (1.36 kg) and consists of a handle, an ejection latch, a status LED, a grounding point, and a terminal block that provides a single DC input (24, -48, or -60 VDC).

and return) that requires a dedicated customer site circuit breaker. We recommend that you provide at least 40 A @ 24 VDC and use a facility circuit breaker. [Figure 10 on page 18](#) shows the power supply.

Figure 10: DC Power Supply



Power Supply LEDs

One LED labeled **PS STATUS** indicates the status of the power supply. [Table 5 on page 18](#) describes the system LED in more detail.

Table 5: Power Supply LED

Label	Color	State	Description
PS STATUS	Green	On steadily	Power supply is functioning normally, and input voltage is within allowable operating range.
	Yellow	On steadily	Primary OTP
		Blinking	Secondary OTP
	Red	On steadily	Power supply is receiving input voltage below the allowable operating range, but the redundant power supply is functioning normally.
	—	Off	Power supply is receiving input voltage below the allowable operating range and is not part of a redundant configuration.

SEE ALSO

[Connecting AC Power Cords to the MX104 Router | 86](#)

[Connecting DC Power Cables to the MX104 Router | 88](#)

MX104 Power Consumption

The MX104 router supports installation of up to two AC or DC power supplies in slots labeled on the front of the router.

[Table 6 on page 19](#) lists the power consumed by the MX104 router.

NOTE: The power consumption values are measured from the power source and are based on systems that contain redundant power supplies, redundant Routing Engines, a fan tray, and are fully loaded with MICs.

Table 6: Power Consumed by MX104 Routers

Description	Value
Power consumed by the AC router (typical)	600 W
Power consumed by the DC router (typical)	625 W
Power consumed by the AC router without MICs (typical)	325 W
Power consumed by the DC router without MICs (typical)	350 W

SEE ALSO

[Connecting DC Power Cables to the MX104 Router | 88](#)

[MX104 DC Power Electrical Safety Guidelines | 207](#)

MX104 AC Power Specifications

Table 7 on page 20 lists the AC power electrical specifications.

Table 7: AC Power Electrical Specifications

Item	Specification
Power Supplies	
AC input voltage	Operating range: 100 to 240 VAC
AC input line frequency	50 to 60 Hz (nominal)
AC input current rating	10 A maximum per inlet at 100 VAC
Efficiency	91% @ 800 W@ 230 V
Maximum AC power supply output power	800 W
System	
Maximum output power	800 W

NOTE: We recommend that you use a facility circuit breaker rated for 10 A maximum per inlet at 100 VAC to 240 VAC. Doing so enables you to operate the router in any configuration without upgrading the power infrastructure, and allows the router to function at full capacity using multiple power supplies.

SEE ALSO

[Connecting AC Power Cords to the MX104 Router | 86](#)

[Replacing an MX104 AC Power Supply | 145](#)

[MX104 AC Power Electrical Safety Guidelines and Warnings | 206](#)

MX104 AC Power Cord Specifications

Each AC power supply has a single AC appliance inlet 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 C15 appliance coupler at the socket end of the cord, as described by International Electrotechnical Commission (IEC) standard 60320, inserts into the AC appliance inlet coupler. The plug end of the power cord fits into the power source receptacle that is standard for your geographic location.

[Table 8 on page 21](#) provides specifications on the AC power cord provided for each country or region.

Table 8: AC Power Cord Specifications

Country	Model Number	Electrical Specification	Plug Type	Design Standard
Argentina	CBL-PWR-C15M-HITEMP-AR	250 VAC, 10 A, 50 Hz	RA/3	IRAM 2073
Australia	CBL-PWR-C15M-HITEMP-AU	250 VAC, 10 A, 50 Hz	SAA/3	AS/NZS 3112-2000
Brazil	CBL-PWR-C15M-HITEMP-BR	250 VAC, 10 A, 50 Hz	BR/3	NBR 14136
China	CBL-PWR-C15M-HITEMP-CH	250 VAC, 10 A, 50 Hz	PRC/3	GB2099, GB1002
Europe (except Italy, Switzerland, and United Kingdom)	CBL-PWR-C15M-HITEMP-EU	250 VAC, 10 A, 50 Hz	VIIG	CEE (7) VII
India	CBL-PWR-C15M-HITEMP-IN	250 VAC, 10 A, 50 Hz	ZA/3	SABS 164/1:1992

Table 8: AC Power Cord Specifications (Continued)

Country	Model Number	Electrical Specification	Plug Type	Design Standard
Israel	CBL-PWR-C15M-HITEMP-IL	250 VAC, 10 A, 50 Hz	IL/3G	SI 32
Italy	CBL-PWR-C15M-HITEMP-IT	250 VAC, 10 A, 50 Hz	I/3G	CEI 23-16
Japan	CBL-PWR-C15M-HITEMP-JP	125 VAC, 15 A, 50 Hz or 60 Hz	498GJ	JIS 8303
Korea	CBL-PWR-C15M-HITEMP-KR	250 VAC, 10 A, 50 Hz	VIIG	CEE (7) VII
South Africa	CBL-PWR-C15M-HITEMP-SA	250 VAC, 10 A, 50 Hz	ZA/3	SABS 164/1:1992
Switzerland	CBL-PWR-C15M-HITEMP-SZ	250 VAC, 10 A, 50 Hz	12G	SEV 1011 / 6534-2
North America	CBL-PWR-C15M-HITEMP-US	125 VAC, 13 A, 60 Hz	498G	NEMA 5-15
United Kingdom	CBL-PWR-C15M-HITEMP-UK	250 VAC, 10 A, 50 Hz	BS89/13	BS 1363/A



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

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。

NOTE: In North America, AC power cords must not exceed approximately 14.75 ft (4.5 m) 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.



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

NOTE:

- Use power cords rated up to 149° F (65° C) for ambient temperatures up to 140° F (60° C).
- The supported power cord temperature ranges from -20°C to +90°C (for Japan), and from -20°C to +65°C (for China).

SEE ALSO

[Connecting AC Power Cords to the MX104 Router | 86](#)

[Replacing an MX104 AC Power Supply | 145](#)

[MX104 AC Power Electrical Safety Guidelines and Warnings | 206](#)

MX104 DC Power Specifications

The MX104 power supply contains DC power terminals to connect power to the router and supports the specifications shown in [Table 9 on page 23](#).

Table 9: DC Power Electrical Specifications

Item	Specification
------	---------------

Power Supplies

Table 9: DC Power Electrical Specifications (Continued)

Item	Specification
DC input voltages	<ul style="list-style-type: none"> • 18 to 30 VDC; nominal 24 VDC • -39 to -56 VDC; nominal 48 VDC • -39 to -72 VDC; nominal 60 VDC
DC input currents	<ul style="list-style-type: none"> • 40 A @ 24 VDC • 20 A @ -48 VDC • 15 A @ -60 VDC
Maximum power supply output	800 W
System	
Maximum output power	800 W

Each DC power supply has a single DC input (24, -48, or -60 VDC and return) that requires a dedicated circuit breaker. We recommend that you use a facility circuit breaker rated for 40 A @ 24 VDC. Doing so enables you to operate the router in any configuration without upgrading the power infrastructure, and allows the router to function at full capacity using multiple power supplies.

SEE ALSO

[Connecting DC Power Cables to the MX104 Router | 88](#)

[Replacing an MX104 DC Power Supply | 149](#)

[MX104 DC Power Electrical Safety Guidelines | 207](#)

[DC Power Electrical Safety Warnings for Juniper Networks Devices | 208](#)

MX104 DC Power Cable and Lug Specifications

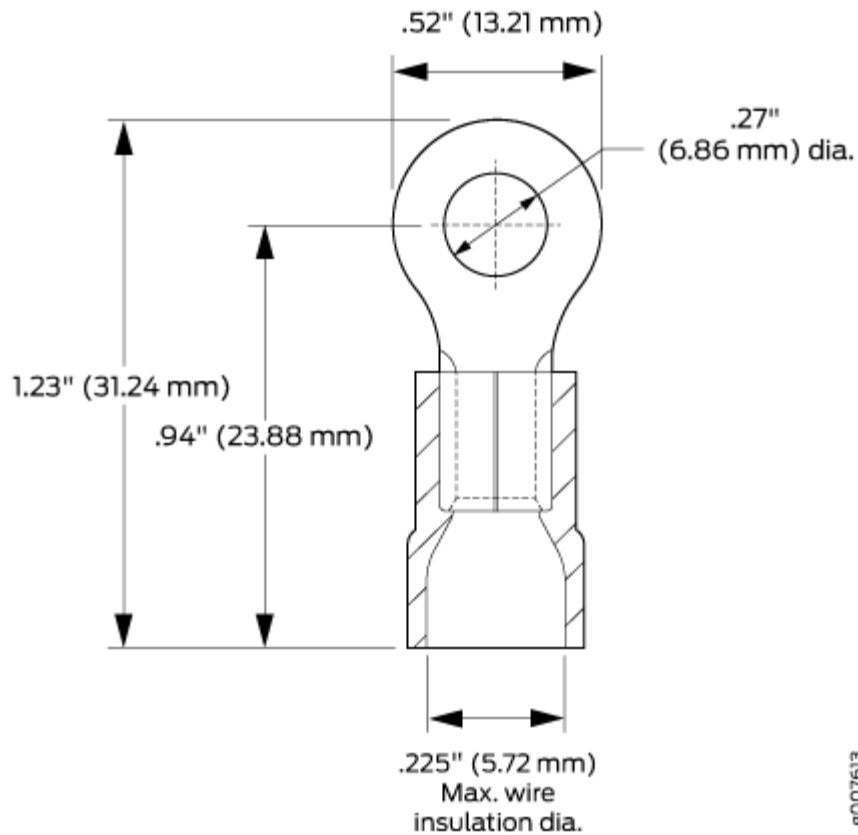
IN THIS SECTION

- DC Power Cable Lug Specifications | 25
- DC Power Cable Specifications | 26

DC Power Cable Lug Specifications

Use cable lugs with the specifications shown in [Figure 11 on page 25](#) to attach each DC power cable to the DC power supply.

Figure 11: 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.

DC Power Cable Specifications

You must supply two DC power cables for each DC power supply that meet the following specifications: 14-AWG (2.08 mm²), minimum 90° C wire, or as required by the local code.

SEE ALSO

[Connecting DC Power Cables to the MX104 Router | 88](#)

[Replacing an MX104 DC Power Supply | 149](#)

[MX104 DC Power Electrical Safety Guidelines | 207](#)

[DC Power Electrical Safety Warnings for Juniper Networks Devices | 208](#)

MX104 Host Subsystem

IN THIS SECTION

- [MX104 Routing Engine Overview | 26](#)

MX104 Routing Engine Overview

IN THIS SECTION

- [MX104 Routing Engine Components | 27](#)
- [MX104 Routing Engine Buttons | 28](#)

- MX104 Routing Engine LEDs | 29
- MX104 Boot Sequence | 30
- MX104 Routing Engine and its Specifications | 30

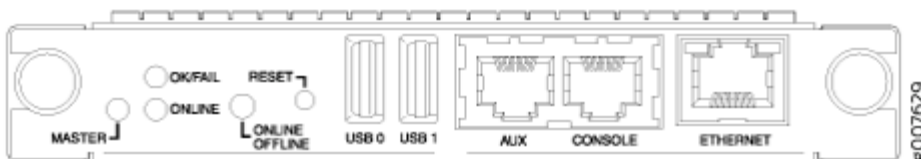
The Routing Engine is a Freescale-based PC platform that runs Junos OS. Software processes that run on the Routing Engine maintain the routing tables, manage the routing protocols used on the router, control the router interfaces, control some chassis components, and provide the interface for system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

You can install one or two Routing Engines in the router. The Routing Engine installs into the front of the chassis. Two USB ports on the Routing Engine accept a USB memory card that allows you to load Junos OS.

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 backup Routing Engine is hot-insertable and hot-removable.

The MX104 router supports the Routing Engine with model number RE-MX104.

Figure 12: MX104 Routing Engine



MX104 Routing Engine Components

Five 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 Routing Engine consists of the following components:

- 1.8-GHz CPU—Runs Junos OS to maintain the router's routing tables and routing protocols.
- 4-GB DDR3 RAM (mini DIMM)—Provides storage for the routing and forwarding tables and for other Routing Engine processes.

- 8-GB on-board NAND Flash—Provides primary storage for software images, configuration files, and microcode. The NAND flash is fixed and is inaccessible from outside the router.
- Interface ports—Provides access to management devices.
 - **AUX**—Not supported.
 - **CONSOLE**—Connects the Routing Engine to a system console through a serial cable with an RJ-45 connector.
 - **ETHERNET**—Connects the Routing Engine through an Ethernet connection to a management LAN (or any other device that plugs into an Ethernet connection). The port uses an autosensing RJ-45 connector to support 10-Mbps, 100-Mbps, or 1000-Mbps connections. Two small LEDs on the right of the port indicate the connection in use: see ["MX104 Routing Engine LEDs" on page 29](#).
- Two USB ports—Provide a removable media interface through which you can install the Junos OS manually. Junos OS supports USB version 1.0.
- Online/Offline button—Takes the Routing Engine online or offline when pressed (see ["MX104 Routing Engine Buttons" on page 28](#)).
- Reset button—Reboots the Routing Engine when pressed (see ["MX104 Routing Engine Buttons" on page 28](#)).
- LEDs—Indicates the status of the Routing Engine and its ports (see ["MX104 Routing Engine LEDs" on page 29](#)).

MX104 Routing Engine Buttons

Each Routing Engine has two push-button controls. The buttons, labeled **ONLINE OFFLINE**, and **RESET**, are located directly on the faceplate of the Routing Engine. [Table 10 on page 28](#) describes the functions of the buttons.

Table 10: MX104 Routing Engine Buttons

Label	Action	Description	Indicator
ONLINE OFFLINE	Press for 2 seconds.	Routing Engine transitions online when pressed.	Green ONLINE LED is on steadily.
	Press for 4 seconds.	Routing Engine transitions offline when pressed.	All LEDs are off.

Table 10: MX104 Routing Engine Buttons (Continued)

Label	Action	Description	Indicator
RESET	Press for 3 seconds.	Routing Engine reboots when pressed.	Green ONLINE LED is on steadily.

MX104 Routing Engine LEDs

Each Routing Engine has three LEDs that indicate its status. The LEDs, labeled **MASTER**, **ONLINE**, and **OK/FAIL**, are located directly on the faceplate of the Routing Engine. [Table 11 on page 29](#) describes the functions of the Routing Engine LEDs.

Table 11: MX104 Routing Engine LEDs

Label	Color	State	Description
MASTER	Blue	On steadily	Routing Engine is the primary.
ONLINE	Green	On steadily	Routing Engine is online.
		Blinking	Routing Engine is booting.
OK/FAIL	Green	On steadily	Routing Engine is functioning normally.
	Red	On steadily	Routing Engine has failed.

The management port labeled **ETHERNET** has a pair of LEDs that display the speed and status of the port.

NOTE: The port labeled **AUX** is not supported.

[Table 12 on page 30](#) describes the LEDs in more detail.

Table 12: Management LEDs

Name	Location	Color	State	Description
Link	Left	Green	On	1000-Mbps link is online.
		Yellow	On	100-Mbps link is online.
		-	Off	10-Mbps link is online.
Activity	Right	Yellow	Blinking	The port is receiving data.
		-	Off	The port is not receiving data.

MX104 Boot Sequence

The MX104 router ships with Junos OS preinstalled and ready to be configured when the router is powered on. One eight-GB internal NAND Flash memory (da0) acts as the hard drive. Two USB ports on the front panel accept USB storage devices (usb0 and usb1) that can also function as alternative boot devices.

When the router boots, it first attempts to start the image on the USB 0 flash memory device, if present, then attempts to start the image on the USB 1 flash memory device, if present. If a USB flash memory device is not inserted into either of the two slots on the Routing Engine, or the attempt otherwise fails, the router next tries the active partition on the NAND Flash device.

MX104 Routing Engine and its Specifications

[Table 13 on page 31](#) provides the details of the Routing Engine supported by the MX104 router.

Table 13: MX104 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
RE-S-MX104	Routing Engine	13.2	-	fxp0	em0 em1

The specifications of the MX104 Routing Engine are as follows:

- Processor—1.8-GHz
- Memory—4 GB
- Connection to PFEs—Gigabit Ethernet
- Media—8 GB NAND Flash

SEE ALSO

[Maintaining the MX104 Routing Engines | 125](#)

[Replacing an MX104 Routing Engine | 127](#)

MX104 Routing Engines

Routing Engine Specifications

MX104 Interface Modules

IN THIS SECTION

- [MX104 Modular Interface Card \(MIC\) Overview | 32](#)
- [MX104 Port and Interface Numbering | 34](#)

MX104 Modular Interface Card (MIC) Overview

IN THIS SECTION

- [Front-Pluggable MICs | 32](#)
- [Built-in 10-Gigabit Ethernet MIC | 32](#)
- [MIC LEDs | 34](#)

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 Packet Forwarding Engine encapsulates the packets received.

The MX104 routers support the following types of MICs:

Front-Pluggable MICs

Modular Interface Cards (MICs) install into four slots in the front of the MX104 router and provide the physical connections to various network media types. MICs are hot-removable and hot-insertable. The slots are labeled **0/0**, **0/1**, **1/0**, and **1/1**. You can install MICs of different media types on the same router as long as the router supports those MICs. For complete specifications, see [MICs Supported by MX80 and MX104 Routers](#) in the *MX Series Interface Module Reference*.

Built-in 10-Gigabit Ethernet MIC

The built-in 10-Gigabit Ethernet MIC is fixed on the MX104 router. The MIC is labeled **XE** and is located on the front panel.

NOTE: If you ordered a license for the built-in 10-Gigabit Ethernet ports on the MX104 and you do not receive a paper license with your shipment, open a case with customer support. See ["Contact Customer Support" on page 165](#) for more information.

The built-in 10-Gigabit Ethernet MIC has the following components:

Hardware features:

- Four 10-Gigabit Ethernet ports labeled **2/0/0** through **2/0/3**, left to right

- High-performance throughput on each port at speeds up to 10 Gbps
- Line-rate on all four 10-Gigabit Ethernet ports
- LAN-PHY mode at 10.3125 Gbps
- Maximum transmission units (MTUs) of up to 9192 bytes
- One green Link LED per port

Software features:

- Configurable LAN-PHY mode options
- Synchronous Ethernet support
- Optical diagnostics and related alarms
- Virtual Router Redundancy Protocol (VRRP) support
- IEEE 802.1Q virtual LANs (VLANs) support
- Remote monitoring (RMON) EtherStats
- Source MAC learning
- MAC accounting and policing—Dynamic local address learning of source MAC addresses
- Flexible Ethernet encapsulation
- Multiple Tag Protocol Identifiers (TPID)

Cables and connectors:

- Duplex LC/PC connector (Rx and Tx)
- Fiber-optic 10-gigabit small form-factor pluggable (SFP+) transceivers:
 - Connector: Duplex LC/PC (Rx and Tx)
 - 10GBASE-SR (model numbers EX-SFP-10GE-SR, EX-SFP-10GE-USR, and SFPP-10GE-SR)
 - 10GBASE-LR (model numbers EX-SFP-10GE-LR and SFPP-10GE-LR)
 - 10GBASE-LRM (model number SFPP-10GE-LRM)

Optical interface specifications—see the Hardware Compatibility Tool at <https://apps.juniper.net/hct>

MIC LEDs

Each front-pluggable 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](#).

The built-in 10-Gigabit Ethernet MIC labeled **XE** accepts 10-Gigabit Ethernet SFP+. Each transceiver has one pair of port LEDs. [Table 14 on page 34](#) describes the LEDs in more detail.

Table 14: SFP+ Port LEDs

Name	Color	State	Description
Link	Green	Steady	The data cable has been connected to the port, and the xe- interface has been enabled.
	-	Off	The data cable has been disconnected from the port.
	Red	Steady	The interface has been disabled, or the 10GbE port does not have the required license.

SEE ALSO

[Replacing an MX104 MIC | 136](#)

[Maintaining the MX104 MICs and Network Ports | 135](#)

MX104 Port and Interface Numbering

IN THIS SECTION

- [Identifying Interface Numbers on the Hardware | 35](#)
- [Identifying Interface Numbers in the CLI | 37](#)

Identifying Interface Numbers on the Hardware

Each MX104 router has three built-in MPCs, which are represented in the CLI as FPC 0 through FPC 2. The numbering of the MPCs is from bottom to top (see [Figure 13 on page 36](#)).

NOTE: The port numbers on MICs correspond to the port numbers on the interface. The port numbering on the MIC-3D-20GE-SFP-EH MIC depicted in [Figure 13 on page 36](#) is only one example of the port numbering for MICs.

Each MIC might number ports differently—horizontally or vertically, for example—and it is important to review the port numbering for your particular MIC in the [MX Series Interface Module Reference](#).

MPC 0 and MPC 1 have two slots each that accept MICs. The MICs are represented as MIC 0 and MIC 1 in the CLI and are logically divided into PICs depending on their type. A MIC installed in the left-most MIC slot (**0/0** or **1/0**) is represented in the CLI as PIC 0 and PIC 1. A MIC installed in the right-most MIC slot (**0/1** or **1/1**) is represented as PIC 2 and PIC 3.

MPC 2 houses a 4-port 10-Gigabit Ethernet MIC. Both the MPC and the MIC are considered fixed and are built into the front panel of the chassis. The MPC is represented as FPC 2 in the CLI. The MIC is represented as MIC 0 in the CLI and is logically divided into a single PIC, which is represented as PIC 0.

Figure 13: MX104 Interface Port Mapping Example

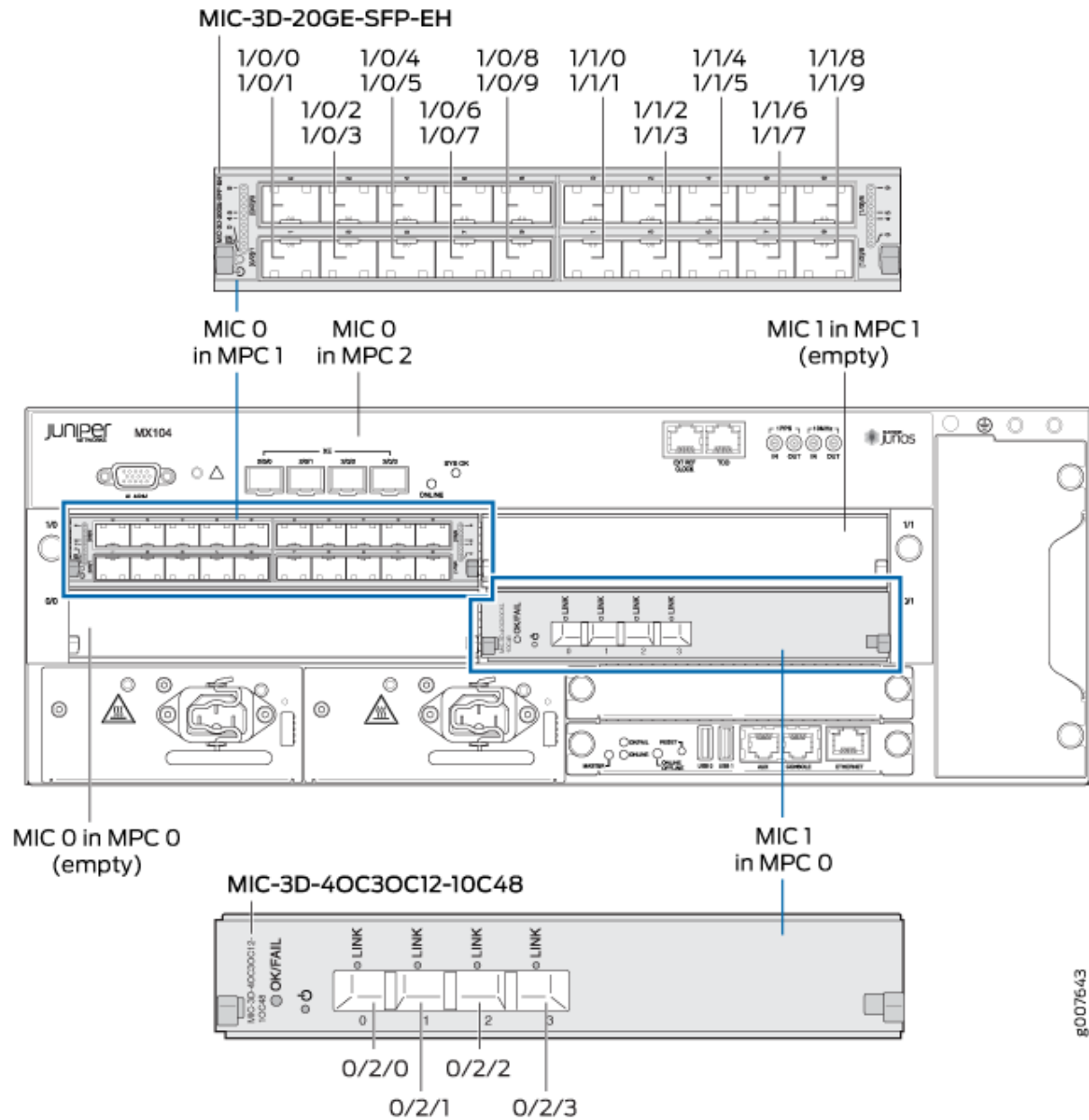


Table 15 on page 37 summarizes the relationship between the components and the interface names.

Table 15: MX104 MIC Interface Names

Component	Component Name in the CLI	Interface Names
Built-in 4-port 10-Gigabit Ethernet MIC	4x 10GE SFP+	xe-2/0/0 through xe-2/0/3
MIC 0 (left) installed in MPC 0 (labeled 0/0)	See MX Series Interface Module Reference .	<i>type-0/0/port</i>
		<i>type-0/1/port</i>
MIC 1 (right) installed in MPC 0 (labeled 0/1)		<i>type-0/2/port</i>
		<i>type-0/3/port</i>
MIC installed in MIC slot 1/0		<i>type-1/0/port</i>
	<i>type-1/1/port</i>	
MIC installed in MIC slot 1/1	<i>type-1/2/port</i>	
	<i>type-1/3/port</i>	

Identifying Interface Numbers in the CLI

In the physical part of the interface name, a hyphen (-) separates the media type from the *MPC* number (represented as an *FPC* in the CLI), and a slash (/) separates the logical *PIC* and port numbers:

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 MX104 router, the three *MPCs* are built into the chassis and are represented in the CLI as *FPC 0*, *FPC 1*, or *FPC 2*.
- *pic*—Logical *PIC* on the *MIC*. The number of logical *PICs* varies depending on the type of *MIC*.

- *port*—Port number.

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

The following sample CLI output displays the three built-in MPCs and five MICs.

```

user@host> show chassis hardware
Hardware inventory:
Item            Version  Part number  Serial number  Description
Chassis                REV 28  750-044219  G3498          MX104
Midplane              REV 03  750-044219  CAAX5767       MX104
PEM 0                 REV 03  740-045932  1H073050110   DC Power Entry Module
PEM 1                 REV 03  740-045932  1H073050017   DC Power Entry Module
Routing Engine 0     REV 03  750-053342  CABP2893       RE-MX-104
Routing Engine 1     REV 03  750-053342  CABP2978       RE-MX-104
AFEB 0
FPC 0
  MIC 0              REV 02  750-046905  CAAV2145       3D 20x 1GE(LAN)-EH,SFP
  PIC 0
  PIC 1
  MIC 1              REV 02  750-047733  CAAN7024       16x CHE1T1 -H, RJ48
  PIC 2
FPC 1
  MIC 0              REV 05  750-046905  CAAY0325       3D 20x 1GE(LAN)-EH,SFP
  PIC 0
  PIC 1
  MIC 1              REV 05  750-046905  CAAY0325       1x COC12/4x COC3 CH-CE -H, SFP
  PIC 2
FPC 2
  MIC 0
  PIC 0
Fan Tray 0           REV 02  711-049570  CAAX6564       Fan Tray

```

The `show interfaces terse` command displays the four built-in 10-Gigabit Ethernet interfaces as `xe-2/0/0` through `xe-2/0/3`.

```

user@host> show interfaces terse
Interface            Admin Link Proto  Local          Remote
...
xe-2/0/0             up    up

```

```

xe-2/0/0.0      up   up   inet
xe-2/0/1       up   up
xe-2/0/1.0     up   up   inet
xe-2/0/2       up   up
xe-2/0/2.0     up   up   inet
xe-2/0/3       up   up
xe-2/0/3.0     up   up   inet
...

```

The `show interfaces terse` command displays the Gigabit Ethernet interfaces for the 20-port Gigabit Ethernet MIC installed in MIC slot **1/0**. The media type of the 20-port Gigabit Ethernet MIC dictates that the MIC be logically divided into two PICs, each with 10 ports. The interfaces are numbered `ge-1/0/0` through `ge-1/0/9` and `ge-1/1/0` through `ge-1/1/9`.

```

user@host> show interfaces terse
Interface           Admin Link Proto  Local           Remote
...
ge-1/0/0            up   up
ge-1/0/0.0         up   up   inet    10.0.0.10/24
                  multiservice
ge-1/0/1            up   up
ge-1/0/1.0         up   up   inet    10.0.1.10/24
                  multiservice
ge-1/0/2            up   up
ge-1/0/2.0         up   up   inet    10.0.2.10/24
                  multiservice
ge-1/0/3            up   up
ge-1/0/3.0         up   up   inet    10.0.3.10/24
                  multiservice
ge-1/0/4            up   up
ge-1/0/4.0         up   up   inet    10.0.4.10/24
                  multiservice
ge-1/0/5            up   up
ge-1/0/5.0         up   up   inet    10.0.5.10/24
                  multiservice
ge-1/0/6            up   up
ge-1/0/6.0         up   up   inet    10.0.6.10/24
                  multiservice
ge-1/0/7            up   up
ge-1/0/7.0         up   up   inet    10.0.7.10/24
                  multiservice
ge-1/0/8            up   up

```



```

ge-1/0/8.0      up   up   inet    10.0.8.10/24
                multiservice
ge-1/0/9        up   up
ge-1/0/9.0     up   up   inet    10.0.9.10/24
                multiservice
ge-1/1/0        up   up
ge-1/1/0.0     up   up   inet    10.1.0.11/24
                multiservice
ge-1/1/1        up   up
ge-1/1/1.0     up   up   inet    10.1.1.11/24
                multiservice
ge-1/1/2        up   up
ge-1/1/2.0     up   up   inet    10.1.2.11/24
                multiservice
ge-1/1/3        up   up
ge-1/1/3.0     up   up   inet    10.1.3.11/24
                multiservice
ge-1/1/4        up   up
ge-1/1/4.0     up   up   inet    10.1.4.11/24
                multiservice
ge-1/1/5        up   up
ge-1/1/5.0     up   up   inet    10.1.5.11/24
                multiservice
ge-1/1/6        up   up
ge-1/1/6.0     up   up   inet    10.1.6.11/24
                multiservice
ge-1/1/7        up   up
ge-1/1/7.0     up   up   inet    10.1.7.11/24
                multiservice
ge-1/1/8        up   up
ge-1/1/8.0     up   up   inet    10.1.8.11/24
                multiservice
ge-1/1/9        up   up
ge-1/1/9.0     up   up   inet    10.1.9.11/24
                multiservice
...

```

The `show interfaces terse` command displays the four SONET/SDH interfaces for the MIC installed in MIC slot **0/1** as `coc3-0/2/0` through `co3-2/0/3`.

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

Interface	Admin	Link	Proto	Local	Remote
-----------	-------	------	-------	-------	--------

```
...
coc3-0/2/0          up   up
coc1-0/2/0:1       up   up
coc3-0/2/1          up   up
coc1-0/2/1:1       up   up
coc3-0/2/2          up   up
coc1-0/2/2:1       up   up
coc3-0/2/3          up   up
coc1-0/2/3:1       up   up
...
```

SEE ALSO

[MX104 Universal Routing Platform Overview | 2](#)

[MX104 Hardware and CLI Terminology Mapping | 7](#)

[MX104 Chassis Overview | 5](#)

RELATED DOCUMENTATION

[MICs Supported by MX Series Routers](#)

2

CHAPTER

Site Planning, Preparation, and Specifications

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MX104 Site Guidelines and Requirements | 44

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MX104 Management and Console Port Specifications and Pinouts | 61

Preparing the Site for the MX104 Router Overview

To prepare a site for router installation:

1. Verify that environmental factors such as temperature and humidity do not exceed router tolerances. See ["MX104 Router Environmental Specifications" on page 45](#).
2. Verify that the site and installation plan meets all safety guidelines and requirements. See ["General Safety Guidelines for Juniper Networks Devices" on page 178](#).
3. Measure distance between external power sources and the router installation site. See:
 - ["MX104 AC Power Cord Specifications" on page 21](#)
 - ["MX104 DC Power Cable and Lug Specifications" on page 25](#)
4. Locate sites for connection of system grounding. See ["MX104 Chassis Grounding Cable and Lug Specifications" on page 47](#).
5. Calculate the power consumption and requirements. See:
 - ["MX104 Power Consumption" on page 19](#)
 - ["MX104 AC Power Specifications" on page 20](#)
 - ["MX104 DC Power Specifications" on page 23](#)
6. Verify that the plan for power installation meets all electrical safety guidelines. See:
 - ["General Electrical Safety Guidelines and Electrical Codes for Juniper Networks Devices" on page 205](#)
 - ["MX104 AC Power Electrical Safety Guidelines and Warnings" on page 206](#)
 - ["MX104 DC Power Electrical Safety Guidelines" on page 207](#)
7. Verify that your rack or cabinet meets the minimum requirements for the installation of the router. See:
 - ["Rack Requirements for MX104 Routers" on page 52](#)
 - ["Cabinet Requirements for MX104 Routers" on page 53](#)
8. Plan the location of the rack, including required space for airflow and maintenance. See ["Clearance Requirements for Airflow and Hardware Maintenance on MX104 Routers" on page 56](#).
9. Plan to secure the rack to the floor and building structure. See ["Rack Requirements for MX104 Routers" on page 52](#).
10. Acquire cables and connectors:
 - Determine the number of cables needed based on your planned configuration.

- Review the maximum distance allowed for each cable. Choose the length of cable based on the distance between the hardware components being connected.

See the [MX Series Interface Module Reference](#).

11. Plan the cable routing and management. See "[Maintaining Cables That Connect to MX104 Network Ports](#)" on page 143.

RELATED DOCUMENTATION

| [MX104 Installation Overview](#) | 77

MX104 Site Guidelines and Requirements

IN THIS SECTION

- [MX104 Router Physical Specifications](#) | 44
- [MX104 Router Environmental Specifications](#) | 45
- [MX104 Chassis Grounding Cable and Lug Specifications](#) | 47
- [Rack Requirements for MX104 Routers](#) | 52
- [Cabinet Requirements for MX104 Routers](#) | 53
- [Clearance Requirements for Airflow and Hardware Maintenance on MX104 Routers](#) | 56

MX104 Router Physical Specifications

The MX104 router is a rigid sheet-metal structure that houses the hardware components. [Table 16 on page 45](#) summarizes the physical specifications of the MX104 router and its components.

Table 16: Physical Specifications of the MX104 Router Chassis

Component	Weight	Width	Height	Depth
Chassis	<ul style="list-style-type: none"> Chassis without power supplies, fan tray, or MICs: 19.56 lb (9 kg) Chassis with power supplies, fan tray, and MICs: 32 lb (14.5 kg) 	17.22 in. (43.7 cm) 19.2 in. (48.7 cm) with mounting brackets attached	6.09 in. (15.47 cm)	9.461 in. (24 cm)
Fan tray	1 lb (0.45 kg)	1.48 in. (3.8 cm)	5.39 in. (13.7 cm)	8.58 in. (21.8 cm)
MIC	Maximum up to 1.2 lb (0.54 kg)	6.25 in. (15.9 cm)	1.9 in. (3.28 cm)	7.38 in. (18.74 cm)
AC power supply	2.5 lb (1.13 kg)	4 in. (10.16 cm)	1.75 in. (4.45 cm)	8.88 in. (22.55 cm)
DC power supply	3 lb (1.36 kg)	4 in. (10.16 cm)	1.75 in. (4.45 cm)	8.88 in. (22.55 cm)
Routing Engine	8.9 oz (0.3 kg)	4.59 in. (11.66 cm)	0.87 in. (2.2 cm)	7.25 in. (18.42 cm)

MX104 Router Environmental Specifications

The router must be installed in a rack or cabinet housed in a dry, clean, well-ventilated, and temperature-controlled environment.

Ensure that these environmental guidelines are followed:

- The site must be as dust-free as possible, because dust can clog air intake vents and filters, reducing the efficiency of the router cooling system.

- Maintain ambient airflow for normal router operation. If the airflow is blocked or restricted, or if the intake air is too warm, the router might overheat, leading to the router temperature monitor shutting down the router to protect the hardware components.

NOTE: Depending on the ambient temperature, it may take up to 5 minutes for the router to heat up to the operating temperature.

Table 17 on page 46 provides the required environmental conditions for normal router operation.

Table 17: MX104 Environmental Specifications

Description	Value
Altitude	No performance degradation to 6,000 ft (1,900 m)
Relative humidity	Normal operation ensured in relative humidity range of 5% to 85%, noncondensing
Temperature	<ul style="list-style-type: none"> • Harsh environment: -40° F (-40° C) to 149° F (65° C), de-rate 1° C for every 1000 ft. • Central office environment: 23° F (-5° C) to 131° F (55° C)
Commercial grade SFP/SFP+ temperature	<ul style="list-style-type: none"> • Harsh environment: -40° F (-40° C) to 122° F (50° C) • Central office environment: -40° F (-40° C) to 104° F (40° C)
Seismic	Designed to meet Telcordia Technologies Zone 4 earthquake requirements

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.

NOTE: The MX104 complies with GR3108 as Class-2 equipment.

MX104 Chassis Grounding Cable and Lug Specifications

IN THIS SECTION

- [Grounding Points Specifications | 47](#)
- [Grounding Cable Lug Specifications | 49](#)
- [Grounding Cable Specifications | 51](#)

Grounding Points Specifications

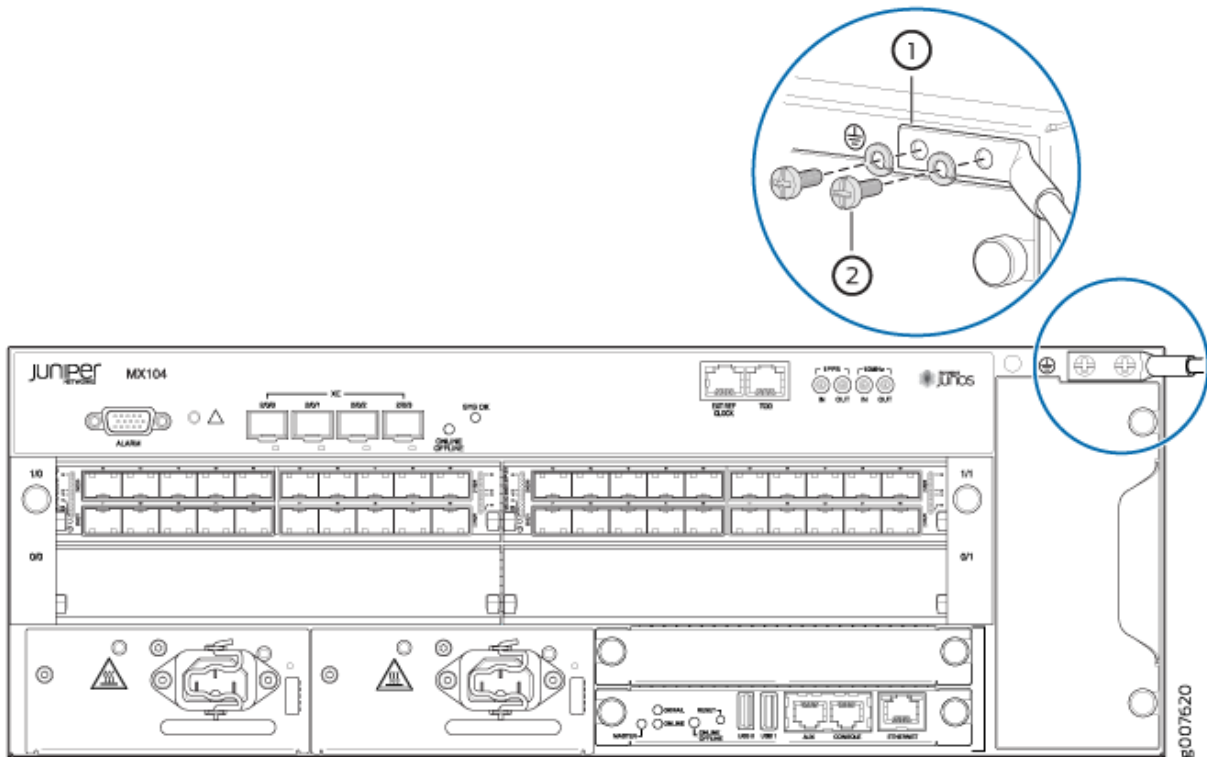
To meet safety and electromagnetic interference (EMI) requirements and to ensure proper operation, the router must be adequately grounded before power is connected. To ground AC-powered and DC-powered routers, you must connect a grounding cable to earth ground and then attach it to the chassis grounding points using two washers and two screws (see [Figure 14 on page 48](#)).

Two threaded holes are provided on the front the router chassis for connecting the router to earth ground. The grounding points fit SAE 10-32 screws (American). The grounding points are spaced at 0.625-in. (15.86-mm) centers.

You must install the MX104 router in a restricted-access location and ensure that the chassis is always properly grounded. The MX104 router has a two-hole protective grounding terminal provided on the chassis. See [Figure 14 on page 48](#). 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 14: Grounding Points on the MX104 Routers



NOTE: All bare grounding connection points to the router must be cleaned and coated with an antioxidant solution before grounding the router.

NOTE: All surfaces on the router that are unplated must be brought to a bright finish and treated with an antioxidant solution before connecting the router.

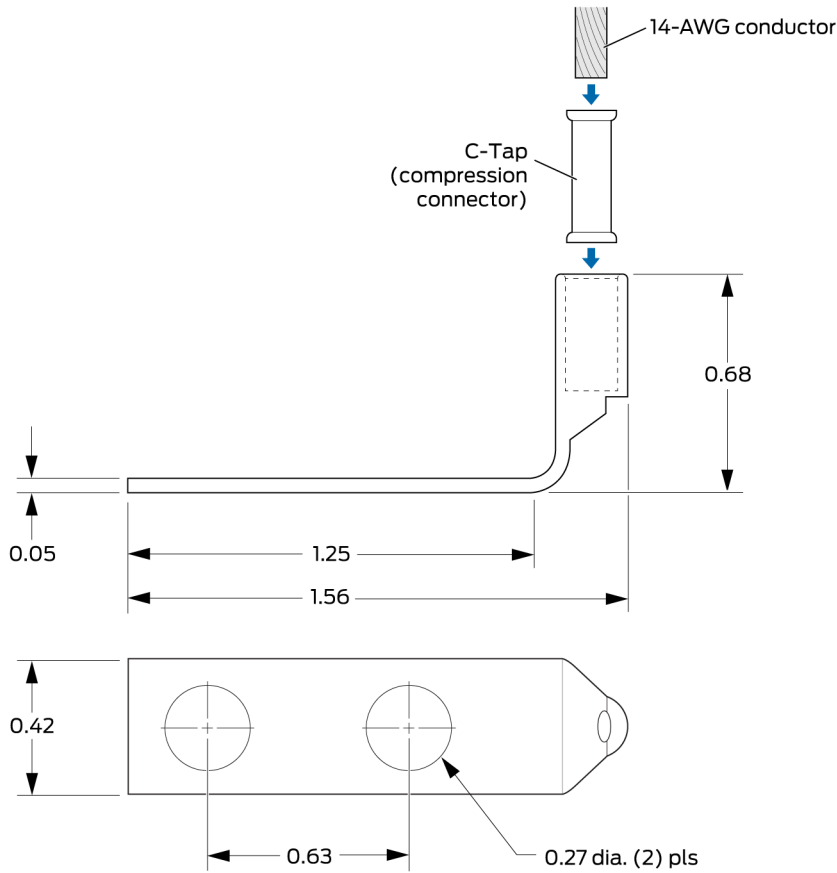
NOTE: All nonconductive surfaces on the router must be removed from all threads and connection points to ensure electrical continuity.

Grounding Cable Lug Specifications

The grounding cable lug is used to secure the grounding cable to the grounding points on the chassis. The grounding cable lug attaches to the grounding cable and is secured to the router by two SAE 10-32 screws. We recommend using washers between the grounding lug and the screws. The grounding cable

lug, screws, and washers are supplied with the router. See [Figure 15 on page 50](#) for AC systems and [Figure 16 on page 51](#) for 24 VDC systems.

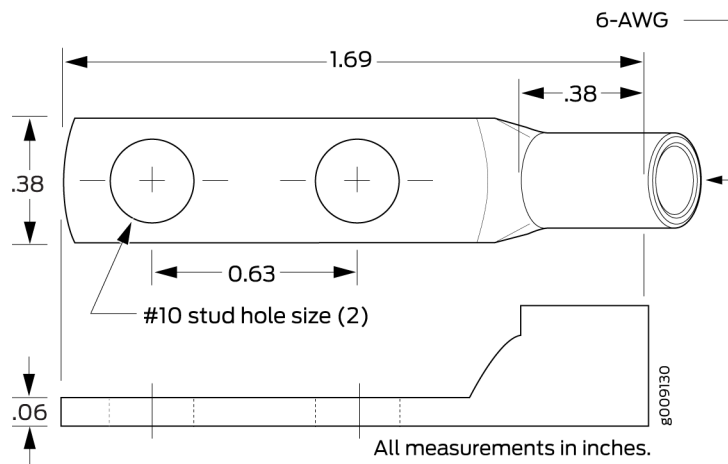
Figure 15: Grounding Cable Lug for MX104 AC Systems



All measurements in inches.

g0009127

Figure 16: Grounding Cable Lug for MX104 24 VDC Systems



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.



CAUTION: The maximum torque rating of the grounding screws on the router is 4.34 lb-in. (0.49 Nm). The grounding screws may be damaged if excessive torque is applied. Use only a torque-controlled driver to tighten screws. Use an appropriately sized driver, with a maximum torque capacity of 5 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 Cable Specifications

You must provide one grounding cable that meets the following specifications:

- For AC systems, use 14-AWG (2.08 mm²) 90° C wire. See, [Figure 15 on page 50](#)
- For 24 VDC systems, use 6-AWG (13.3 mm²) 60° C wire, or as required by the local code. See [Figure 16 on page 51](#)

SEE ALSO

[Connecting the MX104 Router to Earth Ground | 84](#)

[Preventing Electrostatic Discharge Damage to an MX104 Router | 182](#)

Rack Requirements for MX104 Routers

You can mount the router on two-post racks or four-post racks.

Rack requirements consist of:

- Rack type
- Mounting bracket hole spacing
- Rack size and strength
- Rack connection to the building structure

Table 18 on page 52 provides the rack requirements and specifications for the router.

Table 18: Rack Requirements and Specifications for the Router

Rack Requirement	Guidelines
Rack type	<p>Use a two-post rack or a four-post rack. You can mount the router on any two-post or four-post rack that provides bracket holes or hole patterns spaced at 1 U (1.75 in., or 4.45 cm) increments and that meets the size and strength requirements to support the weight.</p> <p>A U is the standard rack unit defined in <i>Cabinets, Racks, Panels, and Associated Equipment</i> (document number EIA-310-D) published by the Electronics Components Industry Association (http://www.ecianow.org/).</p> <p>The rack must meet the strength requirements to support the weight of the chassis.</p>
Mounting bracket hole spacing	<p>The holes in the mounting brackets are spaced at 1 U (1.75 in., or 4.45 cm) so that the router can be mounted in any rack that provides holes spaced at that distance.</p>

Table 18: Rack Requirements and Specifications for the Router (Continued)

Rack Requirement	Guidelines
Rack size and strength	<ul style="list-style-type: none"> • Ensure that the rack complies with this standard: <ul style="list-style-type: none"> • A 19-in. (48.3 cm) rack as defined in <i>Cabinets, Racks, Panels, and Associated Equipment</i> (document number EIA-310-D) published by the Electronics Industry Association (http://www.eia.org). • Ensure that the rack rails are spaced widely enough to accommodate the external dimensions of the router chassis. The outer edges of the front-mounting brackets extend the width of the chassis to 19.2 in. (48.7 cm). • The rack must be strong enough to support the weight of the router. • Ensure that the spacing of rails and adjacent racks allows for the proper clearance around the router and rack.
Rack connection to building structure	<ul style="list-style-type: none"> • Secure the rack to the building structure. • If earthquakes are a possibility in your geographical area, secure the rack to the floor. • Secure the rack to the ceiling brackets as well as to the wall or floor brackets for maximum stability.

One pair of mounting brackets for mounting the router on two posts of a rack is supplied with each router. For mounting the router on four posts of a rack or cabinet, you can order a four-post rack-mount kit separately.

SEE ALSO

[MX104 Installation Overview | 77](#)

Cabinet Requirements for MX104 Routers

You can mount the router in a cabinet that contains a 19-in. (48.3 cm) rack.

Cabinet requirements consist of:

- Cabinet size

- Clearance requirements
- Cabinet airflow requirements

Table 19 on page 54 provides the cabinet requirements and specifications for the router.

Table 19: Cabinet Requirements and Specifications for the MX104 Router

Cabinet Requirement	Guidelines
Cabinet size	<ul style="list-style-type: none"> • You can mount the router in a cabinet that contains a 19-in. (48.3 cm) rack as defined in <i>Cabinets, Racks, Panels, and Associated Equipment</i> (document number EIA-310-D) published by the Electronic Components Industry Association (ECIA) (http://www.ecianow.org). <p>NOTE: The rack must meet the strength requirements to support the weight of the router.</p> <ul style="list-style-type: none"> • The minimum cabinet size must be able to accommodate the maximum external dimensions of the router.
Cabinet clearance	<ul style="list-style-type: none"> • The outer edges of the mounting brackets extend the width of the chassis to 19 in. (48.3 cm). • The minimum total clearance inside the cabinet is 30 in. (76.2 cm) between the inside of the front door and the inside of the rear door.

Table 19: Cabinet Requirements and Specifications for the MX104 Router (Continued)

Cabinet Requirement	Guidelines
Cabinet airflow requirements	<p>When you mount the router in a cabinet, ensure that ventilation through the cabinet is sufficient to prevent overheating.</p> <ul style="list-style-type: none"> • Ensure an adequate cool air supply to dissipate the thermal output of the router or routers. • Ensure that the cabinet allows the hot exhaust air from the chassis to exit 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. • Install the router in the cabinet in a way that maximizes the open space on the side of the chassis that has the hot air exhaust. This space maximizes the clearance for critical airflow. • Route and dress all cables to minimize the blockage of airflow to and from the chassis. • Ensure that the spacing of rails and adjacent cabinets allows for proper clearance around the router and cabinet. • A cabinet larger than the minimum required provides better airflow and reduces the chance of overheating.

SEE ALSO

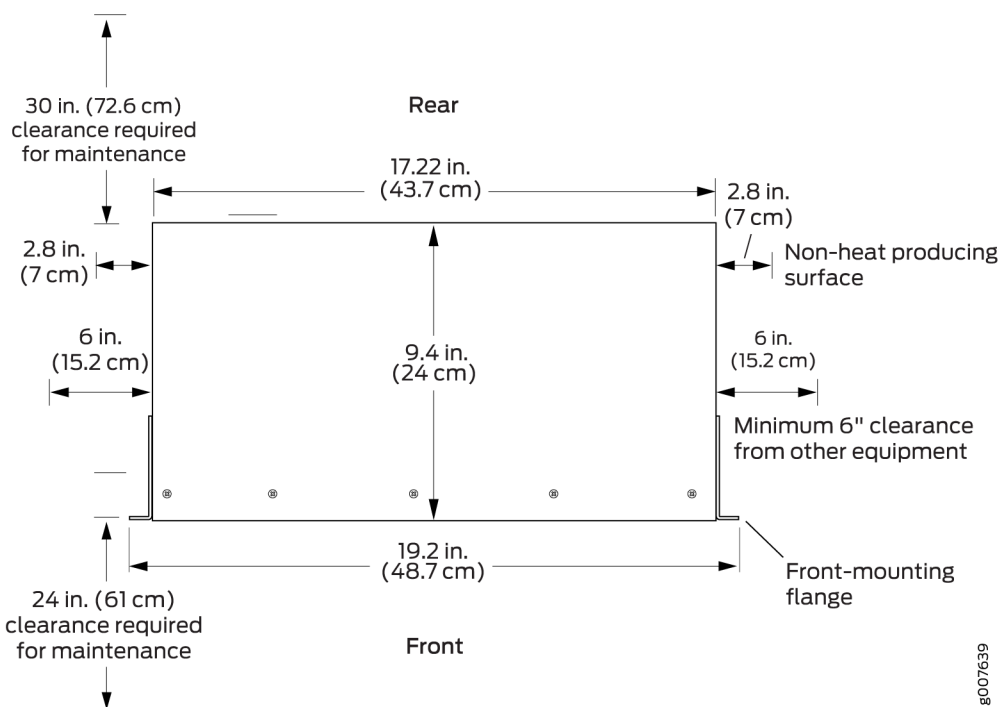
| [MX104 Installation Overview](#) | 77

Clearance Requirements for Airflow and Hardware Maintenance on MX104 Routers

When planning the installation site, allow sufficient clearance around the rack (see [Figure 17 on page 56](#)):

- For the cooling system to function properly, the airflow around the chassis must be unrestricted. Allow at least 6 in. (15.2 cm) of clearance between side-cooled routers. Allow 2.8 in. (7 cm) between the side of the chassis and any non-heat-producing surface such as a wall.
- For service personnel to remove and install hardware components, there must be adequate space at the front and back of the router. At least 24 in. (61 cm) is required both in front of and behind the router. NEBS GR-63 recommends that you allow at least 30 in. (72.6 cm) in front of the rack and 24 in. (61.0 cm) behind the router.

Figure 17: MX104 Chassis Dimensions and Clearance Requirements



SEE ALSO

[MX104 Installation Overview](#) | 77

MX104 Network Cable and Transceiver Planning

IN THIS SECTION

- [Calculating Power Budget and Power Margin for Fiber-Optic Cables | 57](#)
- [Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion | 60](#)

Calculating Power Budget and Power Margin for Fiber-Optic Cables

IN THIS SECTION

- [How to Calculate Power Budget for Fiber-Optic Cables | 57](#)
- [How to Calculate Power Margin for Fiber-Optic Cables | 58](#)

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 20 on page 58](#) 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 20: Estimated Values for Factors Causing Link Loss

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

Table 20: Estimated Values for Factors Causing Link Loss (Continued)

Link-Loss Factor	Estimated Link-Loss Value
Fiber attenuation	Single mode—0.5 dB/km
	Multimode—1 dB/km

The following sample calculation for a 2-km-long multimode link with a power budget (P_B) of 13 dB uses the estimated values from [Table 20 on page 58](#). 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:

$$P_M = P_B - LL$$

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

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

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

The following sample calculation for an 8-km-long single-mode link with a power budget (P_B) of 13 dB uses the estimated values from [Table 20 on page 58](#). 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:

$$P_M = P_B - LL$$

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

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

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

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

Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion

IN THIS SECTION

- [Signal Loss in Multimode and Single-Mode Fiber-Optic Cable | 60](#)
- [Attenuation and Dispersion in Fiber-Optic Cable | 60](#)

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

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

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

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

Attenuation and Dispersion in Fiber-Optic Cable

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

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

- Chromatic dispersion—Spreading of the signal over time, resulting from the different speeds of light rays.

- Modal dispersion—Spreading of the signal over time, resulting from the different propagation modes in the fiber.

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

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

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

MX104 Management and Console Port Specifications and Pinouts

IN THIS SECTION

- [MX104 Clocking and Timing Ports Overview | 62](#)
- [MX104 Routing Engine Ethernet Port Specifications | 62](#)
- [MX104 Routing Engine Auxiliary and Console Ports Specifications | 64](#)
- [MX104 Routing Engine USB Port Specifications | 66](#)
- [MX104 Alarm Contact Port Specifications | 67](#)
- [MX104 BITS Port Specifications | 70](#)
- [MX104 1-PPS and 10-MHz GPS Port Specifications | 72](#)
- [MX104 Time of Day Port Specifications | 73](#)

MX104 Clocking and Timing Ports Overview

Four Subminiature B (SMB) connectors (for 10-MHz and 1-PPS), one RJ-48 port (for BITS), and one RS-232 port (for TOD) on the front panel of the router connect to external clock signal sources. The clocking ports provide the synchronized output clocks from any one of the reference clock inputs based on the clock's priority.

The reference clock inputs can be Ethernet-recovered clocks, T1 or E1 line clocks, IEEE 1588v2-recovered clocks, BITS timing, 10-MHz timing, and 1-PPS timing. The T1 or E1 line clock also supports loop timing. These clocking ports distribute a synchronized clock signal throughout the chassis by locking onto the selected clock source. In the absence of these configured ports, the local oscillator present in the system provides the chassis synchronization.

Clock sources within the MX104 router include:

- External clock timing port
- 10-MHz timing connectors (one input and one output)
- 1-pulse-per-second (PPS) connectors (one input and one output)
- Time-of-day (TOD) RS-232 port
- Synchronous Ethernet support on SFP ports as timing input or output
- Packet (IEEE 1588-2008) v2 timing includes:
 - Timing input when configured as Ordinary Clock (OC) or Boundary Clock (BC)
 - Timing output when configured as BC

SEE ALSO

[Connecting the MX104 Router to External Clocking and Timing Devices | 96](#)

MX104 Routing Engine Ethernet Port Specifications

IN THIS SECTION

[Cable Specifications | 63](#)

Cable Specifications

Table 21 on page 63 lists the specifications for the cables that connect to the **ETHERNET** port.

Table 21: MX104 Routing Engine Ethernet Port Cable Specifications

Specification	Value
Cable specification	Category 5 cable or equivalent suitable for 1000Base-T operation
Cable/wire supplied	One 15-ft (4.57-m) length with RJ-45/RJ-45 connectors
Maximum length	328 ft (100 m)
Router receptacle	RJ-45 autosensing

Pinouts

The port on the front panel labeled **ETHERNET** is an autosensing 10/100/1000-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 22 on page 63 describes the RJ-45 connector pinout.

Table 22: Ethernet Port Pinouts

Pin	Signal	Description
1	TX+_D1	Transmit data+
2	TX-_D1	Transmit data-
3	RX+_D2	Receive data+

Table 22: Ethernet Port Pinouts (Continued)

Pin	Signal	Description
4	BI+_D3	Bidirectional+
5	BI-_D3	Bidirectional-
6	RX-_D2	Receive data-
7	BI+_D4	Bidirectional+
8	BI-_D4	Bidirectional-

SEE ALSO

[MX104 Routing Engine Overview | 26](#)

[Maintaining the MX104 Routing Engines | 125](#)

MX104 Routing Engine Auxiliary and Console Ports Specifications

IN THIS SECTION

- [Cable Specifications | 65](#)
- [Pinouts | 65](#)

The Routing Engine contains two ports labeled **AUX** and **CONSOLE**.

NOTE: The AUX port is not supported.

The ports are asynchronous serial interfaces that accept an RJ-45 connector. The ports connect the Routing Engine to an auxiliary or console management device. [Table 24 on page 65](#) describes the RJ-45 connector pinout.

Cable Specifications

[Table 23 on page 65](#) lists the specifications for the cables that connect to console port.

Table 23: MX104 Routing Engine Console Port Cable Specifications

Specification	Value
Cable specification	RS-232 (EIA-232) serial cable
Cable/wire supplied	One 6-ft (1.83-m) length with RJ-45/DB-9 connectors
Maximum length	6 ft (1.83 m)
Router receptacle	RJ-45 socket

Pinouts

[Table 24 on page 65](#) describes the RJ-45 connector pinout.

Table 24: Console Port Pinouts

Pin	Signal	Description
1	RTS	Request to Send
2	DTR	Data Terminal Ready
3	TXD	Transmit Data
4	Ground	Signal Ground

Table 24: Console Port Pinouts (*Continued*)

Pin	Signal	Description
5	Ground	Signal Ground
6	RXD	Receive Data
7	DSR/DCD	Data Set Ready
8	CTS	Clear to Send

SEE ALSO

[MX104 Routing Engine Overview | 26](#)

[Maintaining the MX104 Routing Engines | 125](#)

MX104 Routing Engine USB Port Specifications

The following Juniper Networks USB Flash drives have been tested and are officially supported for the USB port on all MX Series routers:

- RE-USB-1G-S
- RE-USB-2G-S
- RE-USB-4G-S



CAUTION: Any USB memory product not listed as supported for MX Series routers has not been tested by Juniper Networks. The use of any unsupported USB memory product could expose your MX Series router to unpredictable behavior. Juniper Networks Technical Assistance Center (JTAC) can provide only limited support for issues related to unsupported hardware. We strongly recommend that you use only supported USB Flash drives.

All USB Flash drives used on MX Series routers must have the following features:

- USB 2.0 or later.
- Formatted with a FAT or MS-DOS file system.

SEE ALSO

[MX104 Routing Engine Overview | 26](#)

[Initially Configuring the MX104 Router | 99](#)

MX104 Alarm Contact Port Specifications

IN THIS SECTION

[Cable Specifications | 67](#)

[Port Pinouts | 68](#)

Cable Specifications

[Table 25 on page 67](#) lists the specifications for the cables that connect to the **ALARM** port.

Table 25: MX104 Alarm Contact Port Cable Specifications

Specification	Value
Cable	DE-15 alarm cable
Wire gauge	Between 20 AWG (0.52 mm ²) and 14 AWG (2.08 mm ²)
Router receptacle	15-pin D-type

Port Pinouts

You can independently configure alarm input ports (0 to 3) to operate in Normally Open or Normally Closed mode, and to trigger a red alarm condition or a yellow alarm condition, or to ignore alarm conditions.

You can independently configure alarm output ports (0 and 1) to relay alarm information when the system condition goes to a red or yellow alarm condition and when the alarm output port is configured to trigger based on alarm input condition. Alarm output ports (2 and 3) are used to indicate major and minor system alarms and are normally in open mode.

[Table 26 on page 68](#) shows the alarm contact connector pinouts.

Table 26: Alarm Contact Connector Pinouts

Pin Number	Signal Definition	Direction	CLI Port Mapping	Function
1	ALARM_IN0_NO/NC	Input	Input Alarm Port 0	External alarm input 0 (if voltage on this pin is between 24V to 72V with reference to Pin 6, alarm input 0 is in closed condition)
2	ALARM_IN1_REF	Input	Input Alarm Port 1	External alarm input 1 (Reference for Pin 7)
3	ALARM_IN2_NO/NC	Input	Input Alarm Port 2	External alarm input 2 (if voltage on this pin is between 24V to 72V with reference to Pin 8, alarm input 2 is in closed condition)
4	ALARM_IN3_NO/NC	Input	Input Alarm Port 3	External alarm input 3 (if voltage on this pin is between 24V to 72V with reference to Pin 8, alarm input 3 is in closed condition)
5	ALARM_OUT3_REF	Output	Reserved for Major alarm	External alarm output 3 (this pin is connected to Pin 10 in closed condition)

Table 26: Alarm Contact Connector Pinouts (Continued)

Pin Number	Signal Definition	Direction	CLI Port Mapping	Function
6	ALARM_IN0_REF	Input	Input Alarm Port 0	External alarm input 0 (Reference for Pin 1)
7	ALARM_IN1_NO/NC	Input	Input Alarm Port 1	External alarm input 1 (if voltage on this pin is between 24V to 72V with reference to Pin 2, alarm input 1 is closed)
8	ALARM_IN2_IN3_REF	Input	Input Alarm Port 2 and Input Alarm Port 3	Common contact for external alarm input 2 and 3 (Reference for Pin 3 and Pin 4)
9	ALARM_OUT2_REF	Output	Reserved for Minor alarm	External alarm output 2 (this pin is connected to Pin 15 in closed condition)
10	ALARM_OUT3_NO/NC	Output	Reserved for Major alarm	External alarm output 3 (this pin is connected to Pin 5 in closed condition)
11	ALARM_OUT0_NO/NC	Output	Output Alarm Port 0	External alarm output 0 (this pin is connected to Pin 12 in closed condition)
12	ALARM_OUT0_REF	Output	Output Alarm Port 0	External alarm output 0 (this pin is connected to Pin 11 in closed condition)
13	ALARM_OUT1_NO/NC	Output	Output Alarm Port 1	External alarm output 1 (this pin is connected to Pin 14 in closed condition)
14	ALARM_OUT1_REF	Output	Output Alarm Port 1	External alarm output 1 (this pin is connected to Pin 13 in closed condition)

Table 26: Alarm Contact Connector Pinouts (Continued)

Pin Number	Signal Definition	Direction	CLI Port Mapping	Function
15	ALARM_OUT2_NO/NC	Output	Reserved for Minor alarm	External alarm output 2 (this pin is connected to Pin 9 in closed condition)

SEE ALSO

[MX104 Universal Routing Platform Overview | 2](#)

[MX104 Chassis Overview | 5](#)

[MX104 LEDs Overview | 11](#)

[MX104 Alarm Contact Port Overview | 9](#)

[Replacing an MX104 Alarm Cable | 114](#)

MX104 BITS Port Specifications

IN THIS SECTION

- [Cable Specifications | 70](#)
- [Port Pinouts | 71](#)

The external Building-Integrated Timing Supply (BITS) clock interface port labeled **EXT REF CLK IN** on the front panel of the router allows you to connect external clock signal sources.

Two LEDs indicate link status on the port and function in the same way as the T1/E1 ports. The clocking information is extracted from the input, but the data is discarded.

Cable Specifications

[Table 27 on page 71](#) lists the specifications for the cables that connect to the **EXT REF CLK IN** port.

NOTE: The plastic connector at the end of the RJ-48 cable is physically identical to an RJ-45 connector (see [Figure 18 on page 71](#)). You must ensure that the cable pinouts match the pinouts described in [Table 28 on page 71](#).

Figure 18: RJ-48 Connector for MX104 BITS Ports

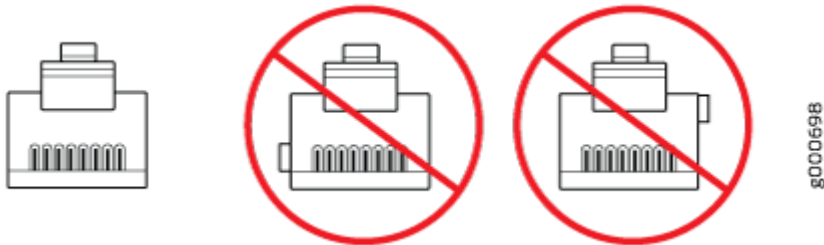


Table 27: MX104 BITS Port Cable Specifications

Specification	Value
Cable	RJ-48 shielded cable
Router receptacle	Autosensing RJ-48 connector

Port Pinouts

[Table 28 on page 71](#) provides the pinout information for the RJ-48 connector for the external clocking input port.

Table 28: BITS Port Pinouts

Pin	Description	Direction
1	EXT_CLKA_RRING_LINE	Input
2	EXT_CLKA_RTIP_LINE	Input

Table 28: BITS Port Pinouts (Continued)

Pin	Description	Direction
3	Reserved	-
4	EXT_CLKA_TRING_LINE	Output
5	EXT_CLKA_TTIP_LINE	Output
6	Reserved	-
7	Reserved	-
8	Reserved	-

MX104 1-PPS and 10-MHz GPS Port Specifications

The router contains four ports that support 1-pulse-per-second (PPS) and 10-MHz GPS signals. These signals are internally isolated and have surge protection.

[Table 29 on page 72](#) lists the specifications for the cables that connect to the **1PPS** and **10MHZ** input and output ports.

Table 29: 1-PPS and 10-MHz GPS Port Specifications

Specification	Value
Cable specification	Coaxial
Router receptacle	Four SMB input and output connectors
Connector specification	Molex 50-ohm SMB (or equivalent)

Table 29: 1-PPS and 10-MHz GPS Port Specifications (Continued)

Specification	Value
Signal support	10-MHz GPS and 1-pulse-per-second (PPS)

MX104 Time of Day Port Specifications

IN THIS SECTION

- [Cable Specifications | 73](#)
- [Port Pinouts | 74](#)

A time-of-day (ToD) port on the front panel of the router allows you to connect external timing signal sources. The external timing input port is labeled **TOD**.

Cable Specifications

[Table 30 on page 73](#) lists the specifications for the cable that connects to the **TOD** port.

NOTE: The output signals are not supported

Table 30: TOD Cable Specifications

Specification	Value
Cable specification	RS-232 (EIA-232) serial cable
Cable/wire	One 6-ft (1.83-m) length with RJ-45 connectors
Maximum length	6 ft (1.83 m)

Table 30: TOD Cable Specifications (Continued)

Specification	Value
Connector	RJ-45 socket

Port Pinouts

[Table 31 on page 74](#) provides the pinout information for the RS-232 connector for the ToD port.

Table 31: ToD Port Connector Pinouts

Pin	Description	Direction
1	Reserved	-
2	Reserved	-
3	Transmit Data	Output
4	Signal Ground	-
5	Signal Ground	-
6	Receive Data	Input
7	Reserved	-
8	Reserved	-

SEE ALSO

[MX104 Universal Routing Platform Overview | 2](#)

[MX104 Chassis Overview | 5](#)

[MX104 LEDs Overview | 11](#)

3

CHAPTER

Initial Installation and Configuration

[MX104 Installation Overview | 77](#)

[Unpacking the MX104 | 78](#)

[Installing the MX104 | 81](#)

[Connecting the MX104 to Power | 84](#)

[Connecting the MX104 to the Network | 94](#)

[Initially Configuring the MX104 Router | 99](#)

MX104 Installation Overview

To install and connect an MX104 router:

1. Review all safety guidelines and warnings for the router. See:
 - ["General Safety Warnings for Juniper Networks Devices" on page 179](#)
 - ["General Safety Guidelines for Juniper Networks Devices" on page 178](#)
2. Prepare the installation site for the router. See ["Preparing the Site for the MX104 Router Overview" on page 43](#).
3. Unpack the router and verify the parts received. See ["Unpacking an MX104 Router" on page 78](#).
4. Install the router in a rack. See ["Installing the MX104" on page 81](#).
5. Ground the router. See ["Connecting the MX104 Router to Earth Ground" on page 84](#).
6. Connect the router to external devices. See:
 - ["Connecting the MX104 Router to Management Devices" on page 94](#)
 - ["Connecting the MX104 Router to External Clocking and Timing Devices" on page 96](#)
 - ["Replacing an MX104 Alarm Cable" on page 114](#)
7. Connect power to the router:
 - AC-powered models—See ["Connecting AC Power Cords to the MX104 Router" on page 86](#).
 - DC-powered models—See ["Connecting DC Power Cables to the MX104 Router" on page 88](#).
8. Perform initial configuration of the router by following instructions in ["Initially Configuring the MX104 Router" on page 99](#).

RELATED DOCUMENTATION

| [MX104 Universal Routing Platform Overview](#) | 2

Unpacking the MX104

IN THIS SECTION

- [Unpacking an MX104 Router | 78](#)
- [Parts Inventory \(Packing List\) for an MX104 Router | 79](#)

Unpacking an MX104 Router

The MX104 routers are shipped in a cardboard carton, secured with foam packing material. The carton also contains an accessory box.



CAUTION: MX104 routers are maximally protected inside the shipping carton. Do not unpack the routers until you are ready to begin installation.

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

- Blank panels to cover any slots not occupied by a component

To unpack the router:

1. Move the shipping carton to a staging area as close to the installation site as possible, but where you have enough room to remove the system components.
2. Position the carton so that the arrows are pointing up.
3. Open the top flaps on the shipping carton.
4. Remove the accessory box and verify the contents in it against the parts inventory on the label attached to the carton.
5. Pull out the packing material holding the router in place.
6. Verify the chassis components received against the packing list included with the router. An inventory of parts provided with the router is provided in "[Parts Inventory \(Packing List\) for an MX104 Router](#)" on page 79.
7. Save the shipping carton and packing materials in case you need to move or ship the router later.

SEE ALSO

[MX104 Universal Routing Platform Overview | 2](#)

[Preparing the Site for the MX104 Router Overview | 43](#)

Parts Inventory (Packing List) for an MX104 Router

The MX104 routers are shipped in a cardboard carton, secured with foam packing material. The carton also contains an accessory box.

The router shipment includes a packing list. Check the parts you receive in the router shipping carton against the items on the packing list. The packing list specifies the part number and description of each part in your order. The parts shipped depend on the configuration you order.

If any part on the packing list is missing, contact your customer service representative or contact Juniper Customer Care from within the U.S. or Canada by telephone at 1-888-314-5822. For international-dial or direct-dial options in countries without toll-free numbers, see <http://www.juniper.net/support/>.

NOTE: If you ordered a license for the built-in 10-Gigabit Ethernet ports on the MX104 and you do not receive a paper license with your shipment, open a case with customer support. See ["Contact Customer Support" on page 165](#) for more information.

[Table 32 on page 79](#) lists the parts and their quantities in the packing list. [Table 33 on page 80](#) lists the contents provided in the accessory box.

Table 32: Parts List for a Fully Configured MX104 Router

Component	Quantity
Chassis with mounting brackets, attached	1
MICs	Up to 4
Routing Engines	1 or 2
Power supplies (AC or DC)	1 or 2

Table 32: Parts List for a Fully Configured MX104 Router (Continued)

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

Table 33: Accessory Box Parts List for an MX104 Router

Component	Quantity
USB media kit	1
Phillips screws, 10-32 x 1/2, with square cone sems washers	2
Phillips screws, M3 x 10 mm, with square cone sems washers	2
Ground terminal lug, two hole, sized for #10 screws, 14 AWG	1
Philips screws, 6-32 x 1/4 in.	4
DC power ring terminal 6-14 AWG	6
RJ-45 cable with RJ-45 Jack to socket DB-9	1
ESD wrist strap with cable	1
Read Me	1

Table 33: Accessory Box Parts List for an MX104 Router (*Continued*)

Component	Quantity
Affidavit for T1 connection	1
Documentation card	1
Quick Start installation instructions	1
Juniper Networks Product Warranty	1
End User License Agreement	1

NOTE: AC power cords are not included in the accessory box. You must purchase them separately. For information on AC power cord, see "[MX104 AC Power Cord Specifications](#)" on [page 21](#).

NOTE: You must provide additional mounting screws if needed that are appropriate for your rack or cabinet to mount the chassis on a rack or a cabinet.

SEE ALSO

| [MX104 Universal Routing Platform Overview | 2](#)

Installing the MX104

NOTE: The router can be installed horizontally in a rack or cabinet.

To install the router in the rack (see [Figure 19 on page 83](#)):



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.

NOTE: One person must be available to lift the router while another secures it to the rack.



CAUTION: If you are mounting multiple units on a rack, mount the heaviest unit at the bottom of the rack and mount the other units from the bottom of the rack to the top in decreasing order of the weight of the units.

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.
3. Hold onto the bottom of the chassis and carefully lift it so that the mounting brackets contact the rack rails.

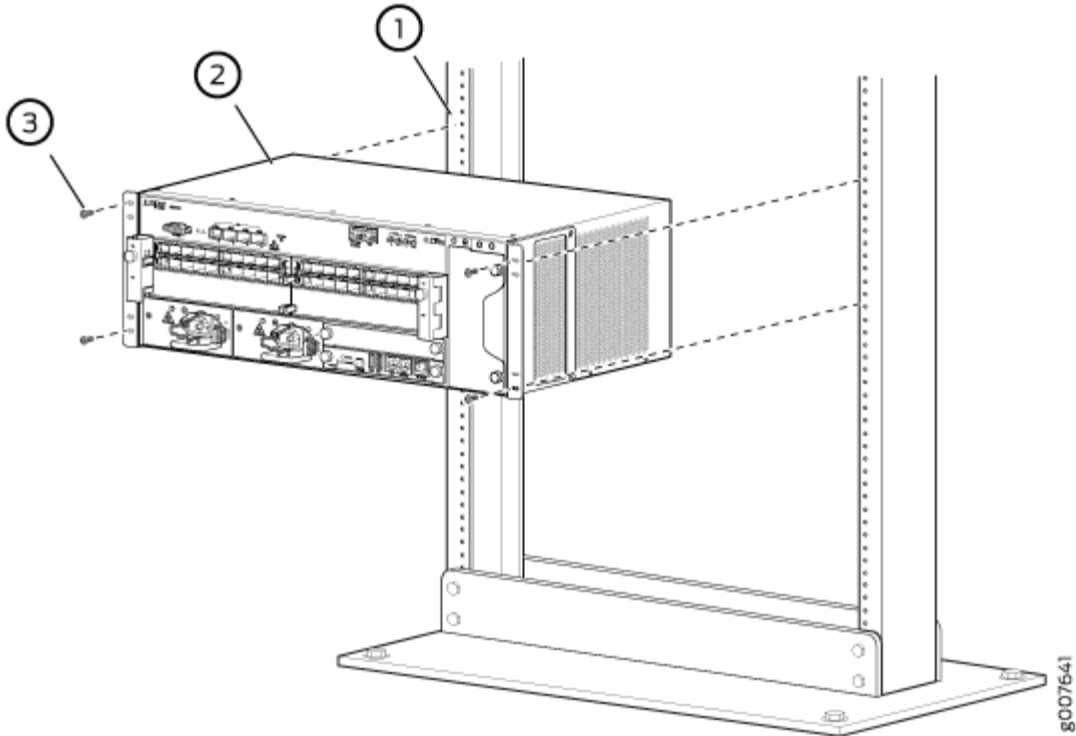


WARNING: To prevent injury, keep your back straight and lift with your legs, not your back. Avoid twisting your body as you lift. Balance the load evenly and be sure that your footing is solid.

4. Align the mounting brackets 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 19: Install the Front-Mounted Router in the Rack



1– Rack

2– MX104 router

3– Mounting screws

RELATED DOCUMENTATION

[Preparing the Site for the MX104 Router Overview | 43](#)

Connecting the MX104 to Power

IN THIS SECTION

- [Connecting the MX104 Router to Earth Ground | 84](#)
- [Connecting AC Power Cords to the MX104 Router | 86](#)
- [Connecting DC Power Cables to the MX104 Router | 88](#)

Connecting the MX104 Router to Earth Ground

To ground the router, you need the following tools:

- Phillips (+) screwdriver, number 2
- ESD grounding wrist strap
- Two SAE 10-32 screws and flat washers
- Grounding lug, Panduit LCD10-10-L
- Grounding cable that meets the following specifications:
 - For AC systems—Use a 14-AWG (2.08 mm²) 90° C wire
 - For 24 V systems—Use 6-AWG (13.3 mm²) 60° C wire (not provided)

You ground the router by connecting a grounding cable to earth ground and then attaching it to the chassis grounding points on the front of 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 front of the chassis (see [Figure 20 on page 86](#)).
8. Secure the grounding cable lug with the washers and screws. The holes are sized for SAE 10-32 screws. Apply 4.34 lb-in. (0.49 Nm) of torque to each screw. Do not overtighten the screw. (Use a number 2 Phillips screwdriver.)



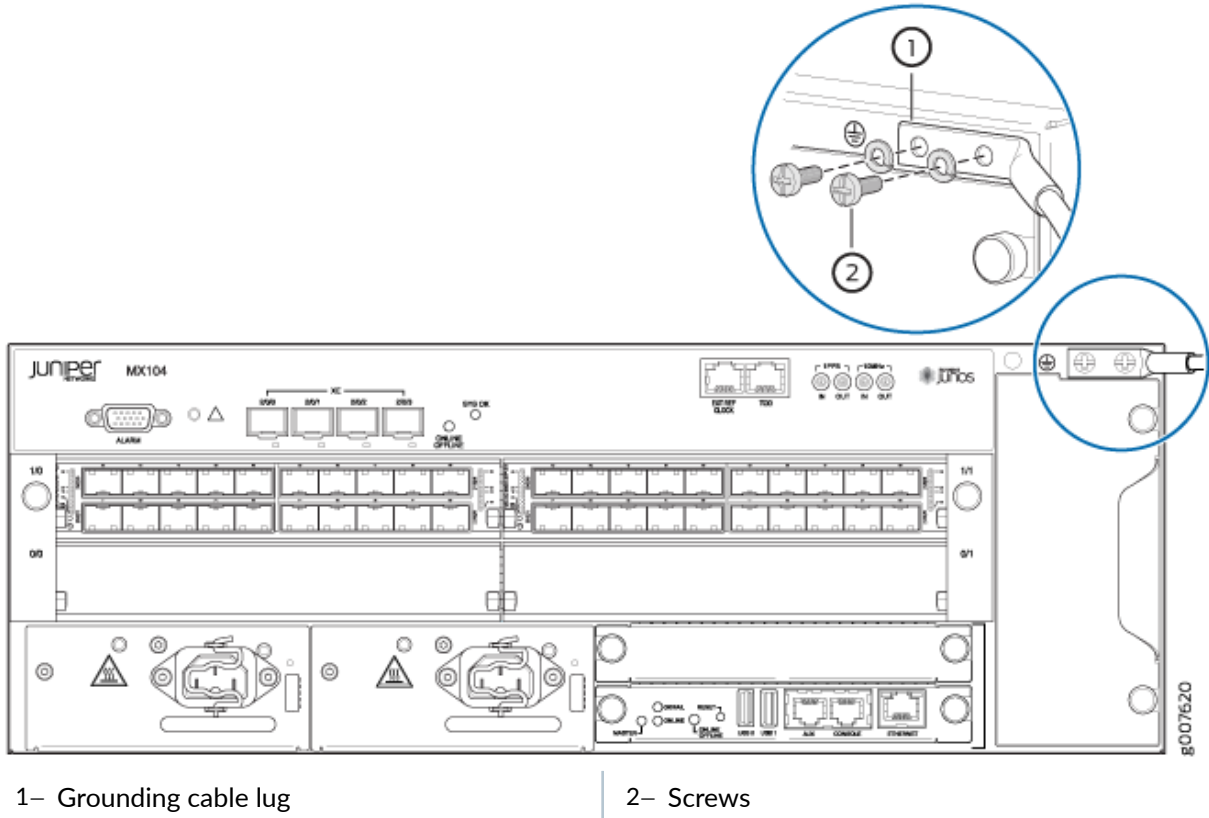
CAUTION: Ensure that each grounding cable lug seats flush against the surface of the grounding points as you are tightening the screws. Ensure that each screw is properly threaded into the grounding points. Applying installation torque to the screw when it is improperly threaded may damage the terminal.



CAUTION: The maximum torque rating of the grounding screws on the router is 4.34 lb-in. (0.49 Nm). The grounding screws may be damaged if excessive torque is applied. Use only a torque-controlled driver to tighten screws. Use an appropriately sized driver, with a maximum torque capacity of 5 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.

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.

Figure 20: Grounding Points on the MX104 Router



SEE ALSO

[MX104 Installation Overview | 77](#)

[Connecting AC Power Cords to the MX104 Router | 86](#)

[Connecting DC Power Cables to the MX104 Router | 88](#)

[Preventing Electrostatic Discharge Damage to an MX104 Router | 182](#)

Connecting AC Power Cords to the MX104 Router

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

- ESD grounding wrist strap
- AC power cords



WARNING: You must ground the router before connecting the router to power.

To connect AC power to the router:

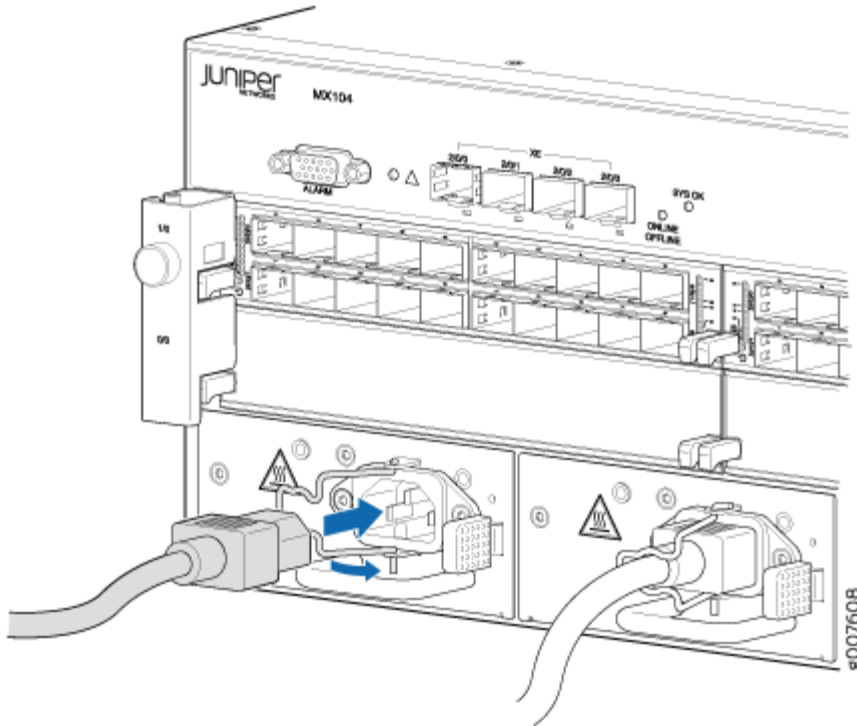
1. Locate the power cords, which should have a plug appropriate for your geographical location. See the ["MX104 AC Power Cord Specifications" on page 21](#).
2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
3. Insert the appliance coupler end of the power cord into the appliance inlet on the power supply.
4. Insert the power cord plug into an external AC power source receptacle.

NOTE: Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker. We recommend that you use a dedicated customer site circuit breaker rated for 10 A (100 VAC), or as required by local code.

5. Secure the power cord with the power cord retainer clip.
6. Dress the power cord appropriately. Verify that the power cord does not block the air exhaust and access to router components, or drape where people could trip on it.
7. Repeat Step 1 through Step 6 for the remaining power supply.
8. Observe the LED on the power supply. The LED blinks green as it transitions online. If the power supply is functioning normally, the LED lights green steadily.

If the LED is red or not lit, the power supply is not functioning normally. Repeat the cabling procedures.

Figure 21: Connecting AC Power to the Router



SEE ALSO

[MX104 Power Overview | 16](#)

[MX104 AC Power Electrical Safety Guidelines and Warnings | 206](#)

[MX104 AC Power Specifications | 20](#)

Connecting DC Power Cables to the MX104 Router

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

- Phillips (+) screwdriver, number 2
- ESD grounding wrist strap

- Grounding ring lug with hole sized for an M5 screw
- M5 nut and washer (one per DC power supply, attached)
- DC power source cables, minimum 14 AWG or as required by local code (not provided)
- DC power ring lugs, Panduit PV12-14HDRB-2k (two per DC power supply)
- M6 screws and washers (two per DC power supply, attached)
- Grounding cable, minimum 14 AWG or as required by local code (not provided)

The DC power supply has one grounding point and two terminals on each power supply, covered by a clear plastic cover.



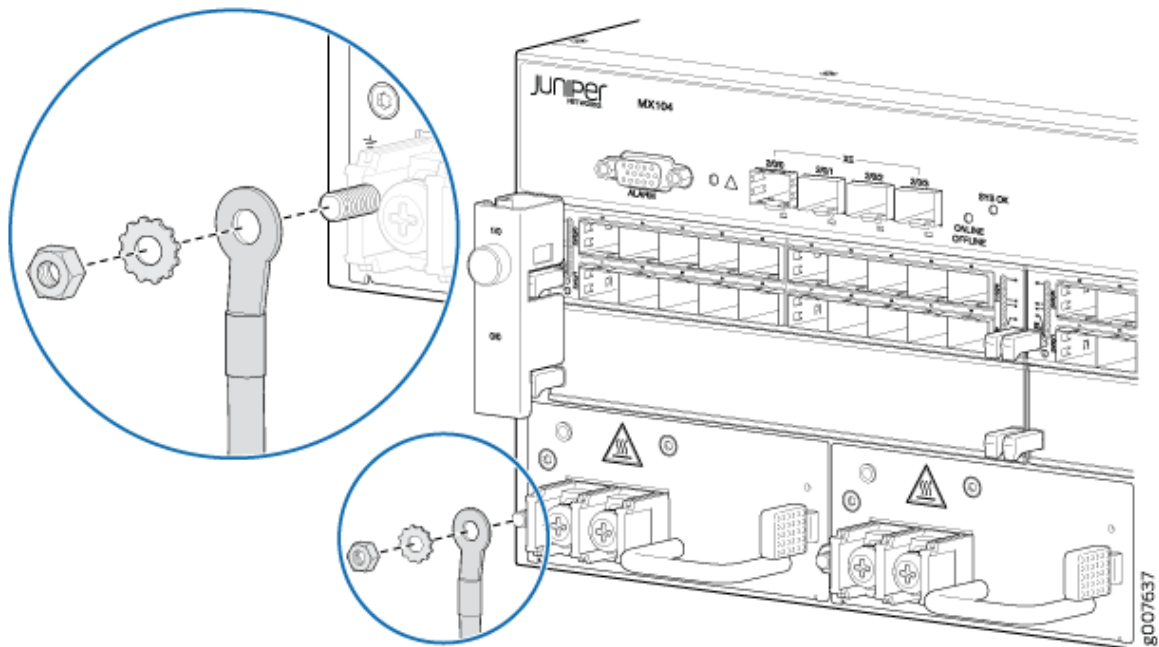
WARNING: You must ground the router before connecting the DC power cables.

To connect the power cables:

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. Ground the DC power supply (see [Figure 22 on page 90](#)):
 - a. Remove the nut and washer from the grounding point on the power supply.

- b. Secure each grounding cable lug to the grounding point with the washer and nut.

Figure 22: Connecting the Ground Cable to the MX104 DC Power Supply



3. Remove the plastic cover protecting the terminal on the faceplate.
4. Verify that the DC power cables are correctly labeled before making connections to the power supply. In a typical power distribution scheme where the return is connected to chassis ground at the battery plant, you can use a multimeter to verify the resistance of the -48V and return DC cables to chassis ground:

For -48V and -60V :

 - a. The cable with very high resistance (indicating an open circuit) to chassis ground is the DC input cable (-).
 - b. The cable with very low resistance (indicating a closed circuit) to chassis ground is the return cable (+).

For $+24\text{V}$:

 - a. The cable with very low resistance (indicating a closed circuit) to chassis ground is the DC input cable (-).
 - b. The cable with very high resistance (indicating an open circuit) to chassis ground is the return cable (+).
5. Install heat-shrink tubing insulation around the power cables.

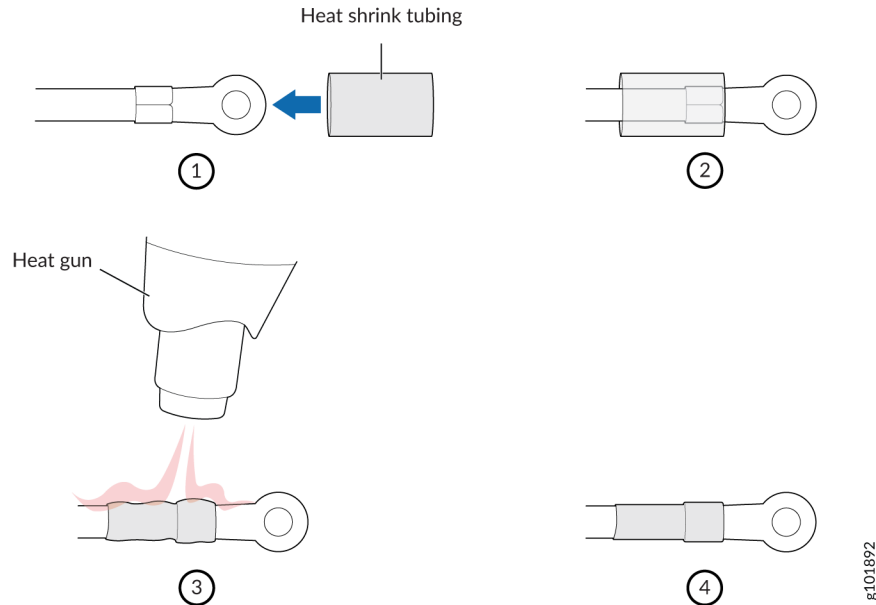
To install heat-shrink tubing:

- 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 23 on page 91 shows the steps to install heat-shrink tubing.

NOTE: Do not overheat the tubing.

Figure 23: How to Install Heat-Shrink Tubing



6. Remove the cover protecting the terminal studs on the faceplate.
7. Remove the screws and washers from the terminals.
8. Secure each power cable lug to the terminal with the washers and screw (see [Figure 24 on page 93](#)). Apply 27.4 lb-in. (3.1 Nm) of torque to each screw. Do not overtighten the screw. (Use a number 2 Phillips screwdriver.)
 - a. Secure the positive DC source power cable lug to the return (+) terminal.
 - b. Secure the negative DC source power cable lug to the input (-) terminal.



CAUTION: Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the screws. Ensure that each screw is properly threaded into the terminal. Applying installation torque to the screw when it is improperly threaded may damage the terminal.



CAUTION: The maximum torque rating of the terminal screws on the DC power supply is 27.4 lb-in. (3.1 Nm). The terminal screws may be damaged if excessive torque is applied. Use only a torque-controlled driver to tighten screws on the DC power supply terminals. Use an appropriately-sized driver, with a maximum torque capacity of 27.4 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.

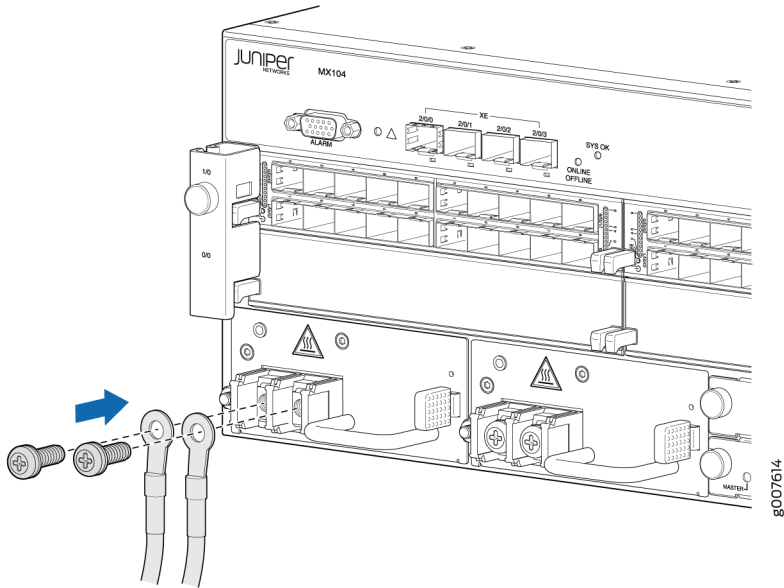
9. Replace the plastic cover over the terminals on the faceplate.
10. Connect each DC power cable to the appropriate external DC power source.

NOTE: For information about connecting to external DC power sources, see the instructions for your site.

11. Switch on the external circuit breakers to provide voltage to the DC power source cable leads.
12. Repeat Step 2 through Step 11 for the remaining power supply.
13. Observe the LED on the power supply. The LED blinks green as it transitions online. If the power supply is functioning normally, the LED lights green steadily.

If the LED is red or not lit, the power supply is not functioning normally. Repeat the cabling procedures.

Figure 24: Connecting DC Power to the Router



SEE ALSO

[MX104 Power Overview | 16](#)

[MX104 Installation Overview | 77](#)

[Connecting the MX104 Router to Earth Ground | 84](#)

[MX104 DC Power Electrical Safety Guidelines | 207](#)

[MX104 DC Power Specifications | 23](#)

[MX104 DC Power Cable and Lug Specifications | 25](#)

Connecting the MX104 to the Network

IN THIS SECTION

- [Connecting the MX104 Router to Management Devices | 94](#)
- [Connecting the MX104 Router to External Clocking and Timing Devices | 96](#)
- [Connecting Interface Cables to MX104 Routers | 98](#)

Connecting the MX104 Router to Management Devices

IN THIS SECTION

- [Connecting the Router to a Network for Out-of-Band Management | 94](#)
- [Connecting the Router to a Management Console Device | 95](#)

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

- RJ-45 Ethernet cable and RJ-45 to DB-9 serial port adapter (provided)
- Management host, such as a PC, with an Ethernet port (not provided)

The following topics provide instructions for connecting the router to management devices:

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

To connect to the **ETHERNET** port on the MX104 Routing Engine:

1. Turn off the power to the management device.
2. Plug one end of the Ethernet cable into the **MGMT** port on the Routing Engine. (Figure 1 shows the connector. Figure 2 shows the port.)

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

Figure 25: Ethernet Cable Connector

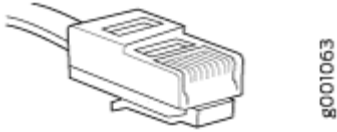
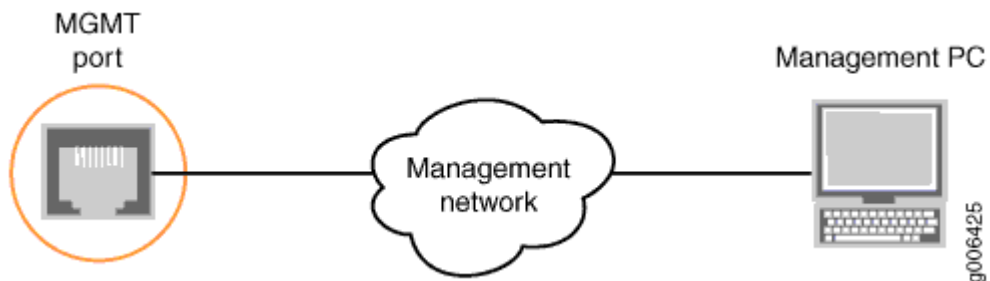


Figure 26: Ethernet Port



Connecting the Router to a Management Console Device

You can connect a console, laptop, modem, or other auxiliary device by connecting a serial cable to the port on the front panel labeled **CONSOLE**. This port accepts a serial cable with an RJ-45 connector that is provided with the router.

NOTE: The **AUX** port is not supported.

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 into the **CONSOLE** port on the Routing Engine (Figure 27 on page 96 shows the connector. Figure 28 on page 96 shows the ports.)
3. Plug the socket DB-9 end into the serial port of the device.

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 27: Routing Engine Console Cable Connector

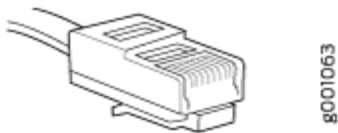
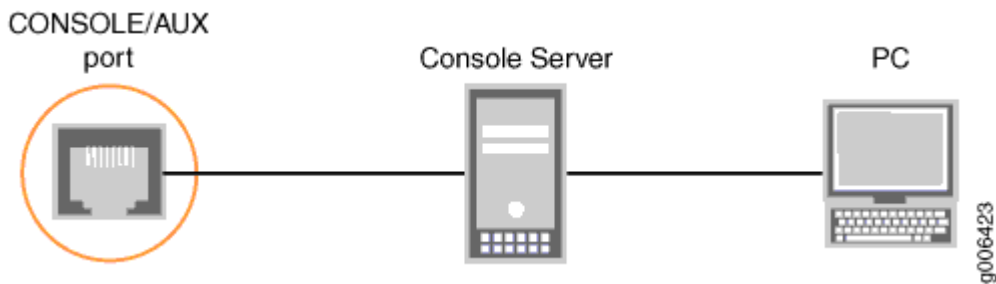


Figure 28: Console Connections



Connecting the MX104 Router to External Clocking and Timing Devices

IN THIS SECTION

- [Connecting 1-PPS and 10-MHz Timing Devices to the MX104 Router | 97](#)
- [Connecting a T1 or E1 External Clocking Device to the MX104 Router | 97](#)
- [Connecting a Time-of-Day Device to the MX104 Router | 97](#)

The MX104 router supports external clock synchronization for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs.

Connecting 1-PPS and 10-MHz Timing Devices to the MX104 Router

The MX104 router has four SMB connectors that support 1-PPS and 10-MHz timing devices.

NOTE: Ensure a cable of 3 m or less in length is used for the 10-MHz and 1-PPS connectors.

To connect the SMB coaxial cable to the external clocking input port:

1. Connect one end of the SMB coaxial cable to either the 1-PPS SMB connector or the 10-MHz SMB connector on the router.
2. Connect the other end of the SMB coaxial cable to the 10-MHz or 1-PPS source network equipment.

NOTE: Ensure that the 10-MHz or 1-PPS source network equipment contains a complementary metal oxide semiconductor (LVCMOS) of a low voltage of 50 ohms or is compatible with low-voltage transistor-transistor logic (LVTTTL) (3.3v).

Connecting a T1 or E1 External Clocking Device to the MX104 Router

The MX104 router contains an external building-integrated timing supply (BITS) port labeled **EXT REF CLOCK** on the front panel of the router.

To connect the router to a BITS T1 or E1 external clocking device:

1. Attach an electrostatic discharge (ESD) grounding trap on your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Plug one end of the RJ-45 cable into the internal clock port on the craft interface.
3. Plug the other end of the RJ-45 cable into the T1 or E1 external clocking device.
4. Verify that the LEDs for the external clock input are lit steadily green.
5. Configure the port. See *Configuring Clock Synchronization Interface on MX Series Routers*.

Connecting a Time-of-Day Device to the MX104 Router

A time-of-day port labeled **TOD** on the front panel of the router allows you to connect external timing devices such as the TCA6500 timing client.

To connect the router to a TOD external timing device:

1. Attach an electrostatic discharge (ESD) grounding trap on your bare wrist, and connect the strap to one of the ESD points on the chassis.

2. Plug one end of the RJ-45 cable into the TOD port on the front panel.
3. Plug the other end of the RJ-45 cable into the TOD timing device.
4. Verify that the LEDs for the TOD port on the router are lit steadily green.
5. Configure the port. See *Configuring Clock Synchronization Interface on MX Series Routers*.

RELATED DOCUMENTATION

[MX104 Clocking and Timing Ports Overview | 62](#)

[MX104 Time of Day Port Specifications | 73](#)

Connecting Interface Cables to MX104 Routers

To connect the physical interfaces to the network (see [Figure 29 on page 99](#)):

1. Have ready a length of the type of cable used by the component. For MIC 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.

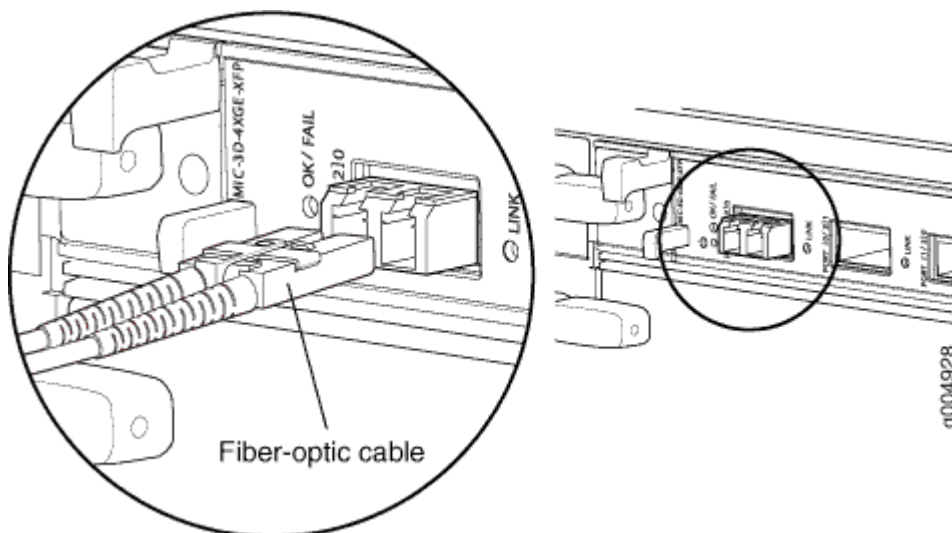
NOTE: The XFP cages and optics on the components are industry standard parts that have limited tactile feedback for insertion of optics and fiber. You need to insert the optics and fiber firmly until the latch is securely in place.

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 29: Attaching a Cable to a MIC



Initially Configuring the MX104 Router

The MX104 router ships with Junos OS preinstalled and ready to be configured when the router is powered on. One 8-GB internal NAND Flash memory (da0) acts as the hard drive. Two USB ports on the front panel accept USB storage devices (usb0 and usb1) that can also function as alternative boot devices.

When the router boots, it first attempts to start the image on the USB 0 flash memory device, if present, then attempts to start the image on the USB 1 flash memory device, if present. If a USB flash memory device is not inserted into either of the two slots on the Routing Engine, or the attempt otherwise fails, the router next tries the active partition on the NAND Flash device.

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 front panel, or over a telnet connection to a network connected to the Routing Engine **ETHERNET** port on the front panel.

NOTE: For the initial configuration, use a device attached to the **CONSOLE** port.

Gather the following information before configuring the router:

- Name that the router will use on the network
- Domain name that the router will use
- IP address and prefix length information for the Ethernet interface
- IP address of a default router
- IP address of a DNS server
- Password for the root user

This procedure connects the router to the network but does not enable it to forward traffic. For complete information about enabling the router to forward traffic, including examples, see the Junos 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 double quotation marks (" ").

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

6. Create a user account for the management console.

```
[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>
```

RELATED DOCUMENTATION

| [MX104 Hardware and CLI Terminology Mapping](#) | 7

4

CHAPTER

Maintaining Components

Maintaining MX104 Components | 106

Maintaining MX104 Cooling System Components | 117

Maintaining MX104 Host Subsystem Components | 125

Maintaining MX104 Interface Modules | 134

Maintaining MX104 Power System Components | 145

Maintaining MX104 Components

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- [Tools and Parts Required to Maintain the MX104 Components | 106](#)
- [MX104 Field-Replaceable Units \(FRUs\) | 106](#)
- [Routine Maintenance Procedures for Your Site | 107](#)
- [Routine Maintenance Procedures for the MX104 Router | 108](#)
- [Replacing an MX104 Console or Auxiliary Cable | 109](#)
- [Replacing an MX104 Management Ethernet Cable | 111](#)
- [Replacing an MX104 Fiber-Optic Cable | 112](#)
- [Replacing an MX104 Alarm Cable | 114](#)
- [MX104 Routine Maintenance Checklist | 116](#)

Tools and Parts Required to Maintain the MX104 Components

The following tools and parts are required to maintain the hardware components of an MX104 device.

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

MX104 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 34 on page 107 lists the FRUs for the MX104 router. Before you replace a Routing Engine, you must take the Routing Engine offline.

Table 34: Field-Replaceable Units

Hot-Removable and Hot-Insertable FRUs	Hot-Pluggable FRUs
<ul style="list-style-type: none"> • Air filter • Backup Routing Engine (if redundant) • Primary Routing Engine (if <i>nonstop active routing</i> is configured) • Modular Interface Cards (MICs) • AC and DC power supplies (if redundant) • Fan tray • Transceivers 	<ul style="list-style-type: none"> • Primary Routing Engine (if nonstop active routing is not configured) • Routing Engine (nonredundant)

SEE ALSO

[MX104 Universal Routing Platform Overview | 2](#)

Routine Maintenance Procedures for Your Site

Routine maintenance of a site generally includes maintenance of the equipment, floors, sub-floors, raised floors, rack surface, among others. Keeping your site clean, free of dust and debris is critical in ensuring that the equipment continues to run safely and efficiently.

Routine preventive maintenance of your site involves the following steps:

- Cleaning the site regularly. Ensure that floors, underfloor, raised floor, and other surfaces are cleaned regularly by qualified cleaning staff.

- Checking the equipment regularly for dust, debris, and other contamination particulates. Keep the area around the chassis clean and free of dust.

Juniper recommends that you use only approved site cleaning tools or chemicals that include:

- Vacuum cleaners equipped with high efficiency particulate air (HEPA) filters or S-Class filters that support triple filtration.
- Cleaning chemicals that are pH neutral and static dissipative.
- Lint-free mops with non-metal handles and sewn ends, to prevent snagging.
- Low-speed floor scrubbing machines. Avoid high-speed buffers.
- Electrical cords that are in good condition and, if appropriate for local power configurations, have a three-pin plug.

Routine Maintenance Procedures for the MX104 Router

IN THIS SECTION

- [Purpose | 108](#)
- [Action | 108](#)

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.
- Inspect the air filter on the side of the fan tray, and replace it every six months. Do not run the router for more than a few minutes without the air filter in place.
- Check the status-reporting devices on the front panel: the system alarms and LEDs.
- Ensure that all the empty slots on the chassis have blank fillers inserted.

Routine maintenance of the site, chassis, and the FRUs keeps the equipment in good health. However, the equipment in some sites may require more frequent maintenance than the equipment in other sites.

The following topics cover the maintenance procedures for the MX104 components.

- [Replacing an MX104 Console or Auxiliary Cable](#)
- [Replacing an MX104 Management Ethernet Cable](#)
- [Replacing an MX104 Fiber-Optic Cable](#)
- [Replacing an MX104 Alarm Cable](#)
- [Maintaining MX104 Cooling System Components](#)
- [Maintaining MX104 Host Subsystem Components](#)
- [Maintaining MX104 Interface Modules](#)
- [Maintaining MX104 Power System Components](#)

Replacing an MX104 Console or Auxiliary Cable

IN THIS SECTION

- [Removing an MX104 Console or Auxiliary Cable | 109](#)
- [Installing an MX104 Console or Auxiliary Cable | 110](#)

NOTE: The **AUX** port is not supported.

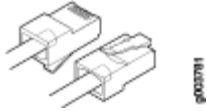
Removing an MX104 Console or Auxiliary Cable

To remove a serial cable connected to a 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 **AUX** or **CONSOLE** port. Figure 1 shows the connector.

3. Disconnect the cable from the console or auxiliary device.

Figure 30: Ethernet Cable Connectors



SEE ALSO

[MX104 Routing Engine Auxiliary and Console Ports Specifications | 64](#)

Installing an MX104 Console or Auxiliary Cable

The **CONSOLE** port on the front panel of the router accepts an RS-232 (EIA-232) serial cable with RJ-45 connectors.

NOTE: The **AUX** port is not supported.

To connect a cable between the router and the 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. Connect one end of the replacement cable into the **CONSOLE/AUX** port.
3. Plug the other end of the cable into the device's serial port.

SEE ALSO

[MX104 Routing Engine Auxiliary and Console Ports Specifications | 64](#)

Replacing an MX104 Management Ethernet Cable

IN THIS SECTION

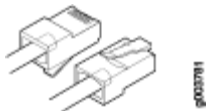
- [Removing an MX104 Management Ethernet Cable | 111](#)
- [Installing an MX104 Management Ethernet Cable | 111](#)

Removing an MX104 Management Ethernet Cable

To remove a serial cable connected to a management 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 **ETHERNET** port. Figure 2 shows the connector.
3. Disconnect the cable from the network device.

Figure 31: Ethernet Cable Connectors



SEE ALSO

[MX104 Routing Engine Ethernet Port Specifications | 62](#)

Installing an MX104 Management Ethernet Cable

To install a serial cable connected to a management 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. Plug one end of the replacement cable into the appropriate **ETHERNET** port.
3. Plug the other end of the cable into the network device.

Replacing an MX104 Fiber-Optic Cable

IN THIS SECTION

- [Disconnecting an MX104 Fiber-Optic Cable | 112](#)
- [Connecting an MX104 Fiber-Optic Cable | 113](#)

Disconnecting an MX104 Fiber-Optic Cable

The MX104 router has field-replaceable unit (FRU) optical transceivers to which you can connect fiber-optic cables.

Before you begin disconnecting a fiber-optic cable from an optical transceiver installed in an MX104 router, ensure that you have taken the necessary precautions for safe handling of lasers (see "[Laser Safety Warnings for Juniper Networks Devices](#)" on page 191).

Ensure that you have the following parts and tools available:

- A rubber safety cap to cover the transceiver
- A rubber safety cap to cover the fiber-optic cable connector

To disconnect a fiber-optic cable from an optical transceiver installed in the router:

1. Disable the port in which the transceiver is installed by issuing the following command:

```
[edit interfaces]
user@router# set interface-name disable
```



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 transceivers emit laser light that can damage your eyes.

2. Carefully unplug the fiber-optic cable connector from the transceiver.
3. Cover the transceiver with a rubber safety cap.



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

4. Cover the fiber-optic cable connector with the rubber safety cap.

Connecting an MX104 Fiber-Optic Cable

Before you begin connecting a fiber-optic cable to an optical transceiver installed in a router, ensure that you have taken the necessary precautions for safe handling of lasers (see "[General Laser Safety Guidelines for Juniper Networks Devices](#)" on page 190).

MX104 routers have field-replaceable unit (FRU) optical transceivers to which you can connect fiber-optic cables.

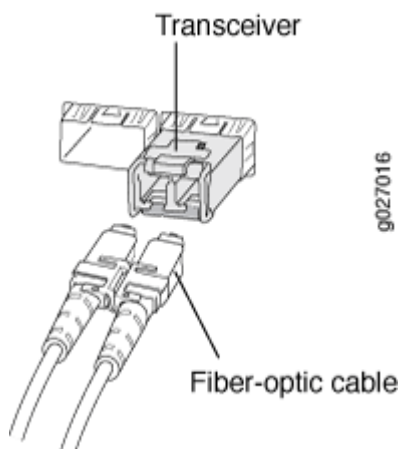
To connect a fiber-optic cable to an optical transceiver installed in a router:



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 transceivers emit laser light that can damage your eyes.

1. If the fiber-optic cable connector is covered by a rubber safety cap, remove the cap. Save the cap.
2. Remove the rubber safety cap from the optical transceiver. Save the cap.
3. Insert the cable connector into the optical transceiver (see [Figure 32 on page 113](#)).

Figure 32: Connecting a Fiber-Optic Cable to an Optical Transceiver Installed in a Router



4. Secure the cables so that they are not supporting their own weight. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on a loop helps cables maintain their shape.



CAUTION: Do not bend fiber-optic cables beyond their minimum bend radius. An arc smaller than a few inches in diameter can damage the cables and cause problems that are difficult to diagnose.

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

SEE ALSO

[Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion | 60](#)

[Calculating Power Budget and Power Margin for Fiber-Optic Cables | 57](#)

Replacing an MX104 Alarm Cable

IN THIS SECTION

- [Disconnecting the Router from an External Alarm-Reporting Device | 114](#)
- [Connecting the MX104 Router to an External Alarm-Reporting Device | 115](#)

Disconnecting the Router from an External Alarm-Reporting Device

Ensure that you have the following parts and tools available:

- Electrostatic discharge (ESD) grounding strap
- 2.5-mm flat-blade (-) screwdriver

To connect an external device to an alarm relay contact:

1. Remove the other end of the wires to 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. Loosen the small screws on the face of the terminal block using a screwdriver and remove the block from the relay contact.

4. Loosen the small screws on the side of the terminal block using a screwdriver. Remove existing wires from the slots in the front of the block.

Connecting the MX104 Router to an External Alarm-Reporting Device

Ensure that you have the following parts and tools available:

- Electrostatic discharge (ESD) grounding strap
- 2.5-mm flat-blade (-) screwdriver

To connect the router to external alarm-reporting devices, attach wires to the **ALARM** relay contacts on the front panel of the router. A system condition that triggers the red or yellow alarm on the router 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 20 AWG (0.52 mm²) and 14 AWG (2.08 mm²), which is not provided. Use the gauge of wire appropriate for the external device you are connecting.

To connect an external device to an alarm relay contact:

1. Prepare the required length of wire with gauge between 20 AWG (0.52 mm²) and 14 AWG (2.08 mm²).
2. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
3. While the terminal block is not plugged into the relay contact, use a screwdriver to loosen the small screws on its side. With the small screws on its side facing left, insert wires into the slots in the front of the block based on the wiring for the external device. Tighten the screws to secure the wire.
4. Orient the terminal block according to the labels to the left of the appropriate relay contact (**NC** means “normally closed, **C** means “common,” and **NO** means “normally open”).
5. Plug the terminal block into the relay contact and use a screwdriver to tighten the screws on the face of the block.
6. Attach the other end of the wires to the external device.

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

SEE ALSO

[MX104 Alarm Contact Port Overview | 9](#)

[MX104 Alarm Contact Port Specifications | 67](#)

MX104 Routine Maintenance Checklist

You can refer to the following checklist during your visit to the site to perform preventive maintenance.

Item	Ensure that the following criteria is met
Site	The site is dry, clean, well-ventilated, temperature-controlled and dust-free.
Rack	<ul style="list-style-type: none"> • The rack is dry, clean, well-ventilated, temperature-controlled and dust-free. • Intake air is cold.
Air flow	<ul style="list-style-type: none"> • The rack has sufficient clearance around it. • The inlet and exhaust areas of the router free of any object or obstruction. • The airflow around the chassis is unrestricted.
Blank fillers	All the empty slots are filled with blank fillers.
Air filters	Air filter is in good state and is clean.
Fan tray	Fan tray is in good state and is clean.
Routing Engine	<ul style="list-style-type: none"> • The chassis has two Routing Engines installed. • The Online LEDs on both the Routing Engines are green. • The OK/Fail LEDs on both the Routing Engines are green.
Other modules	<ul style="list-style-type: none"> • The states of other modules are ok. • The Online LED is green. • No alarms are reported on the craft interface.

Maintaining MX104 Cooling System Components

IN THIS SECTION

- Maintaining the MX104 Cooling System | 117
- Replacing an MX104 Fan Tray | 119
- Maintaining the MX104 Air Filter | 121
- Replacing an MX104 Air Filter | 122

Maintaining the MX104 Cooling System

IN THIS SECTION

- Purpose | 117
- Action | 117
- Meaning | 118

Purpose

For optimum cooling, verify the condition of the fans.

Action

The router has a single fan tray that installs into the front of the chassis, as shown in ["MX104 Universal Routing Platform Overview"](#) on page 2.

To check the status of the fans in the fan tray, issue the `show chassis environment` command. The output includes an entry for each fan in the fan tray:

```
user@host> show chassis environment
Class Item                               Status Measurement
```

Temp	PEM 0	OK	27 degrees C / 80 degrees F
	PEM 1	OK	18 degrees C / 64 degrees F
	ABB 0 Intake	OK	29 degrees C / 84 degrees F
	ABB 0 Exhaust A	OK	34 degrees C / 93 degrees F
	ABB 0 Exhaust B	OK	36 degrees C / 96 degrees F
	ABB 1 Intake	OK	29 degrees C / 84 degrees F
	ABB 1 Exhaust A	OK	34 degrees C / 93 degrees F
	ABB 1 Exhaust B	OK	36 degrees C / 96 degrees F
	Routing Engine 0	OK	31 degrees C / 87 degrees F
	Routing Engine 0 CPU	OK	39 degrees C / 102 degrees F
	Routing Engine 1	Present	
	Routing Engine 1 CPU	Present	
	AFEB 0 AFEB Processor	OK	28 degrees C / 82 degrees F
	AFEB 0 LU Temp	OK	40 degrees C / 104 degrees F
	AFEB 0 MQ Temp	OK	38 degrees C / 100 degrees F
	AFEB 0 QX Temp	OK	40 degrees C / 104 degrees F
Pic	PIC 0/0 Channel 0	OK	40 degrees C / 104 degrees F
	PIC 0/0 Channel 1	OK	40 degrees C / 104 degrees F
	PIC 0/0 Channel 2	OK	39 degrees C / 102 degrees F
	PIC 0/0 Channel 3	OK	39 degrees C / 102 degrees F
	PIC 0/0 Channel 4	OK	39 degrees C / 102 degrees F
	PIC 0/0 Channel 5	OK	28 degrees C / 82 degrees F
	PIC 0/0 Channel 6	OK	29 degrees C / 84 degrees F
	PIC 0/0 Channel 7	OK	28 degrees C / 82 degrees F
	PIC 0/0 Channel 8	OK	44 degrees C / 111 degrees F
	PIC 1/0 Channel 0	OK	45 degrees C / 113 degrees F
	PIC 1/0 Channel 1	OK	30 degrees C / 86 degrees F
	PIC 1/0 Channel 2	OK	31 degrees C / 87 degrees F
	PIC 1/2 Channel 0	OK	42 degrees C / 107 degrees F
	PIC 1/2 Channel 1	OK	29 degrees C / 84 degrees F
	PIC 1/2 Channel 2	OK	30 degrees C / 86 degrees F
Fans	Fan 1	Check	
	Fan 2	OK	Spinning at high speed
	Fan 3	OK	Spinning at high speed
	Fan 4	OK	Spinning at high speed
	Fan 5	OK	Spinning at high speed

Meaning

Check is displayed in the Status column if a fan that is not functioning. OK is displayed in the Status column if the fan is functioning normally.

For further description of the output from the command, see the *show chassis environment* command summary in the [CLI Explorer](#).

SEE ALSO

[Replacing an MX104 Fan Tray | 119](#)

Replacing an MX104 Fan Tray

IN THIS SECTION

- [Removing an MX104 Fan Tray | 119](#)
- [Installing an MX104 Fan Tray | 120](#)

Removing an MX104 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 1):

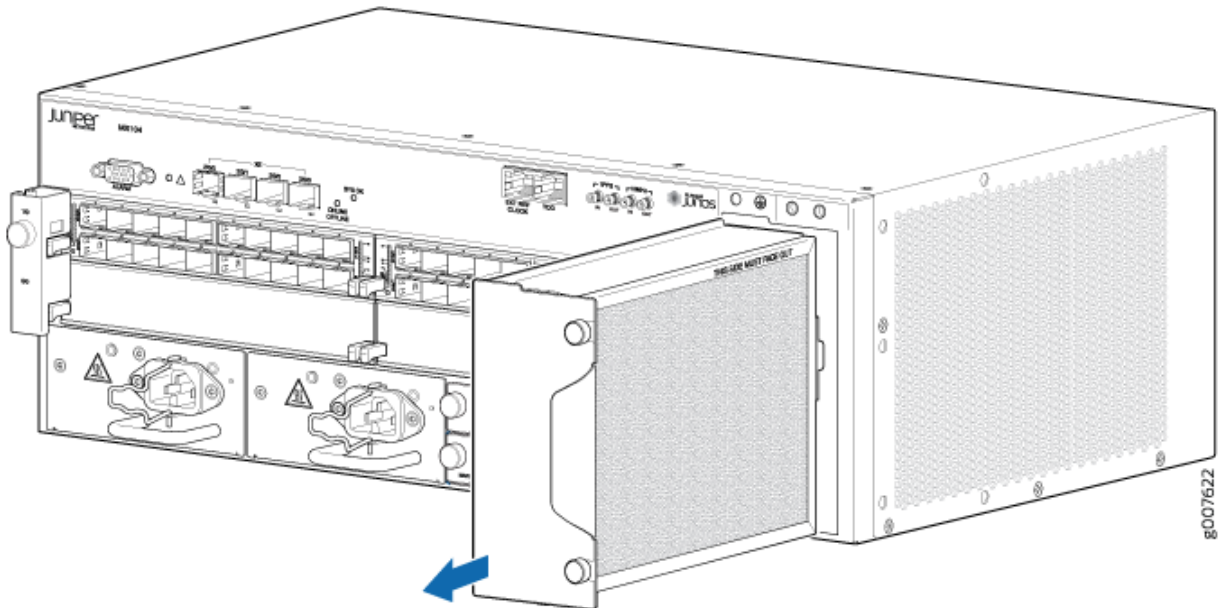
1. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
2. Loosen the captive screws on the corners of the fan tray faceplate.
3. Grasp the fan tray handle, and begin to pull the fan tray from the chassis.



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

Figure 33: Removing the Fan Tray



SEE ALSO

[MX104 Cooling System and Airflow Overview](#) | 14

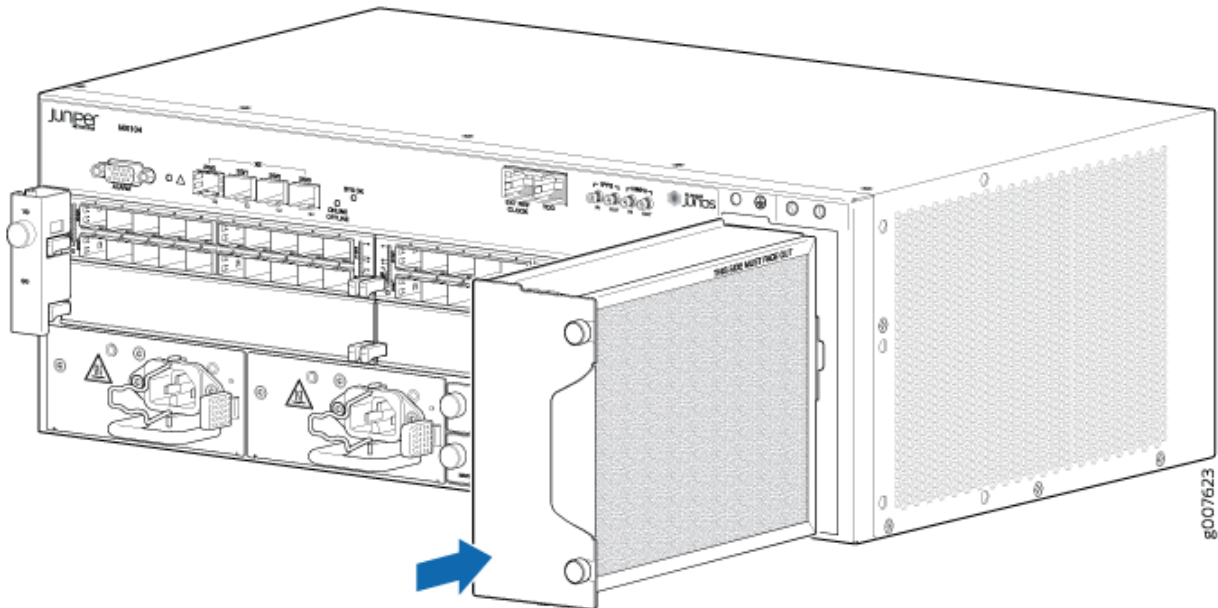
Installing an MX104 Fan Tray

To install the fan tray (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. Orient the fan tray in the slot so that the arrow is pointing up, and slide the fan tray straight into the chassis.
3. Verify that the front of the fan tray is firmly seated in the chassis.

4. Tighten the captive screws on the fan tray faceplate to secure it in the chassis.

Figure 34: Installing the Fan Tray



SEE ALSO

| [MX104 Cooling System and Airflow Overview](#) | 14

Maintaining the MX104 Air Filter

IN THIS SECTION

- Purpose | 122
- Action | 122

Purpose

For optimum cooling, verify the condition of the air filter.

Action

- Regularly inspect the air filter. A dirty air filter restricts airflow in the unit, producing a negative effect on the ventilation of the chassis. The filter degrades over time. You must replace the filter every 6 months.



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

- 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 an MX104 Air Filter

IN THIS SECTION

- [Removing an MX104 Air Filter | 122](#)
- [Installing an MX104 Air Filter | 124](#)

Removing an MX104 Air Filter



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

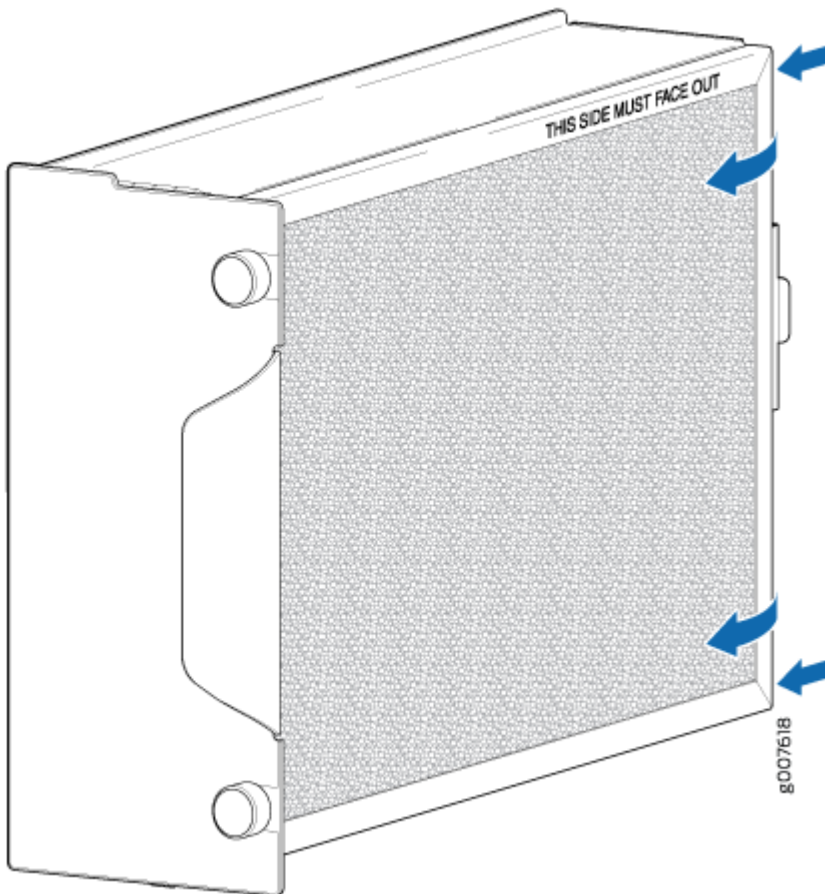


CAUTION: Always keep the air filter in place while the device is operating, except during replacement. The fans are very powerful and can pull small bits of wire or other materials into the device if the air filter isn't in place. These materials can damage device components.

The air filter must be installed on the right side of the fan tray. To remove the air filter (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. Remove the fan tray as described in ["Replacing an MX104 Fan Tray" on page 119](#).
3. Press the release tab on the rear of the fan tray to release the air filter.
4. Grasp the sides of the air filter, and slide it away from the fan tray faceplate.

Figure 35: Removing the MX104 Air Filter

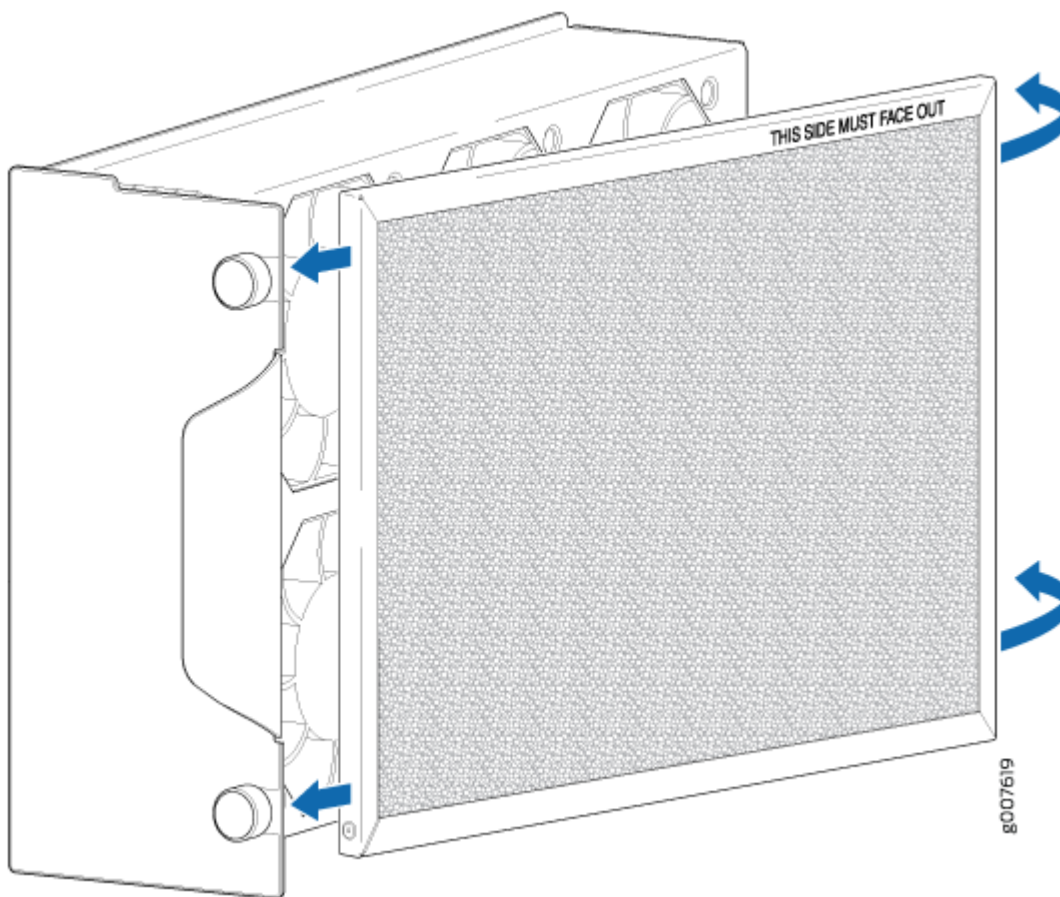


Installing an MX104 Air Filter

The air filter installs on the right side of the fan tray. To install the air filter (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. Locate the THIS SIDE MUST FACE OUT label and ensure that the air filter is right side up.
3. Insert the air filter into the groove located toward the front of the fan tray.
4. Press the tab on the rear of the fan tray to allow the air filter to slide into place.

Figure 36: Installing the Air Filter



RELATED DOCUMENTATION

| [MX104 Cooling System and Airflow Overview](#) | 14

Maintaining MX104 Host Subsystem Components

IN THIS SECTION

- Maintaining the MX104 Routing Engines | 125
- Replacing an MX104 Routing Engine | 127

Maintaining the MX104 Routing Engines

IN THIS SECTION

- Purpose | 125
- Action | 125
- Meaning | 127

Purpose

For optimum router performance, verify the condition of the Routing Engines.

Action

On a regular basis:

- Check the Routing Engine LEDs. For more information about the LEDs and the display, see "[MX104 Routing Engine Overview](#)" on page 26.
- Issue the `show chassis routing-engine` command to check the status of the Routing Engines. 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            34 degrees C / 93 degrees F
CPU temperature        43 degrees C / 109 degrees F
DRAM                  3840 MB (3840 MB installed)
Memory utilization     34 percent
CPU utilization:
  User                 0 percent
  Background           0 percent
  Kernel               3 percent
  Interrupt            3 percent
  Idle                 94 percent
Model                 RE-S-MX104
Serial ID              CAAR5925
Start time             2013-05-24 16:33:54 IST
Uptime                 2 days, 20 hours, 11 minutes, 15 seconds
Last reboot reason    0x200:normal shutdown
Load averages:        1 minute   5 minute  15 minute
                      0.13      0.04     0.01

```

Routing Engine status:

Slot 1:

```

Current state           Backup
Election priority      Backup (default)
Temperature            36 degrees C / 96 degrees F
CPU temperature        42 degrees C / 107 degrees F
DRAM                  3840 MB (3840 MB installed)
Memory utilization     23 percent
CPU utilization:
  User                 0 percent
  Background           0 percent
  Kernel               1 percent
  Interrupt            2 percent
  Idle                 97 percent
Model                 RE-S-MX104
Serial ID              CAAM6369
Start time             2013-05-24 16:34:14 IST
Uptime                 2 days, 20 hours, 10 minutes, 47 seconds
Last reboot reason    0x200:normal shutdown
Load averages:        1 minute   5 minute  15 minute
                      0.00      0.00     0.00

```

Meaning

The command output displays the Routing Engine slot number, current state (Master, Backup, or Disabled), election priority (Master or Backup), and airflow temperature. The command output also displays the total DRAM available to the Routing Engine processor, the CPU utilization percentage, and the Routing Engine serial number for the slot. Additionally, the command output displays when the Routing Engine started running, how long the Routing Engine has been running, and the time, uptime, and load averages for the last 1, 5, and 15 minutes.

Check the `Uptime` to ensure that the Routing Engine has not rebooted since it started running.

To check the Routing Engine environmental status information, such as the operating state, function, and operating temperature, use the `show chassis environment routing-engine` command:

```
user@host> show chassis environment routing-engine
Routing Engine 0 status:
  State           Online Master
  Temperature     37 degrees C / 98 degrees F
  CPU Temperature 47 degrees C / 116 degrees F
Routing Engine 1 status:
  State           Present
```

For further description of the output from the command, see the `show chassis routing-engine` command summary in the [CLI Explorer](#).

Replacing an MX104 Routing Engine

IN THIS SECTION

- [Effect of Taking the MX104 Routing Engine Offline | 128](#)
- [Taking an MX104 Routing Engine Offline | 130](#)
- [Removing an MX104 Routing Engine | 131](#)
- [Installing an MX104 Routing Engine | 133](#)

Effect of Taking the MX104 Routing Engine Offline

Before you replace a Routing Engine, you must take the Routing Engine offline. The Routing Engine is hot-pluggable.

Normally, if two Routing Engines are installed in the router, **RE 0** functions as the primary and **RE 1** functions as the backup. You can remove the backup Routing Engine (or either of its components) without interrupting the functioning of the router. If you take the primary Routing Engine offline, the backup Routing Engine becomes the primary (the router might reboot, depending on your configuration). If the router has only one Routing Engine, taking the Routing Engine offline causes the router to shut down. The effect of taking the primary Routing Engine offline varies depending on your configuration of high availability features.

Table 1 explains the effect of taking the Routing Engine offline.

Table 35: Effect of Taking the Routing Engine Offline

Type of Routing Engine	Effect of Taking the Routing Engine Offline
Nonredundant Routing Engine	The router shuts down.
Backup Routing Engine	The functioning of the router is not interrupted. The backup Routing Engine is hot-removable and hot-insertable.

Table 35: Effect of Taking the Routing Engine Offline (*Continued*)

Type of Routing Engine	Effect of Taking the Routing Engine Offline
Primary Routing Engine	<p>The backup Routing Engine becomes the primary. The backup Routing Engine assumes Routing Engine functions. The primary Routing Engine is hot-pluggable. Removal or failure of the primary Routing Engine affects forwarding and routing based on the high availability configuration:</p> <ul style="list-style-type: none"> • Dual Routing Engines without any high availability features enabled—Traffic is interrupted while the Packet Forwarding Engine is reinitialized. All kernel and forwarding processes are restarted. When the switchover to the new primary Routing Engine is complete, routing convergence takes place and traffic is resumed. • <i>Graceful Routing Engine switchover</i> (GRES) is enabled—Graceful Routing Engine switchover preserves interface and kernel information. Traffic is not interrupted. However, graceful Routing Engine switchover does not preserve the control plane. Neighboring routers detect that the router has restarted and react to the event in a manner prescribed by individual routing protocol specifications. To preserve routing without interruption during a switchover, graceful Routing Engine switchover must be combined with <i>nonstop active routing</i>. • Nonstop active routing is enabled (graceful Routing Engine switchover must be configured for nonstop active routing to be enabled)—Nonstop active routing supports Routing Engine switchover without alerting peer nodes that a change has occurred. Nonstop active routing uses the same infrastructure as graceful Routing Engine switchover to preserve interface and kernel information. However, nonstop active routing also preserves routing information and protocol sessions by running the routing protocol process (rpd) on both Routing Engines. In addition, nonstop active routing preserves TCP connections maintained in the kernel. • Graceful restart is configured—Graceful restart provides extensions to routing protocols so that neighboring helper routers restore routing information to a restarting router. These extensions signal neighboring routers about the graceful restart and prevent the neighbors from reacting to the router restart and from propagating the change in state to the network during the graceful restart period. Neighbors provide the routing information that enables the restarting router to stop and restart routing protocols without causing network reconvergence. Neighbors are required to support graceful restart. The routing protocol process (rpd) restarts. A graceful restart interval is required. For certain protocols, a significant change in the network can cause graceful restart to stop.

NOTE: Router performance might change if the backup Routing Engine's configuration differs from the former primary's configuration. For the most predictable performance, configure the two Routing Engines identically, except for parameters unique to each Routing Engine.

To configure Routing Engine-specific parameters and still use the same configuration on both Routing Engines, include the appropriate configuration statements under the `re0` and `re1` statements at the `[edit groups]` hierarchy level and use the `apply-groups` statement. For instructions, see the [Junos OS Administration Library for Routing Devices](#).

To configure Routing Engine-specific parameters and still use the same configuration on both Routing Engines, include the appropriate configuration statements under the `re0` and `re1` statements at the `[edit groups]` hierarchy level and use the `apply-groups` statement. For instructions, see the [Junos OS Administration Library for Routing Devices](#).

NOTE: For information about configuring graceful Routing Engine switchover, graceful restart, and nonstop active routing, see the [Junos OS High Availability User Guide](#).

NOTE: Graceful restart software requirements depend on the routing protocols configured on the router. For the minimum software requirements for graceful restart, see the [Junos OS High Availability User Guide](#).

SEE ALSO

[MX104 Routing Engine Overview | 26](#)

[MX104 LEDs Overview | 11](#)

Taking an MX104 Routing Engine Offline

Before you take a Routing Engine offline, see "[Replacing an MX104 Routing Engine](#)" on page 127.

To take the Routing Engine offline:

1. Determine whether the Routing Engine is functioning as the primary or as the backup, using one of the two following methods:
 - If the **MASTER** LED on the Routing Engine is lit, that Routing Engine is functioning as the primary.

- Issue the `show chassis routing-engine` command.

```
user@host> show chassis routing-engine
Routing Engine status:
Slot 0:
  Current state           Master
  Election priority      Master (default)
```

The primary Routing Engine is designated Master in the current state field.

2. If the Routing Engine is functioning as the primary, switch it to backup using the `request chassis routing-engine master switch` command:

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

3. On the console or other management device connected to the Routing Engine you are removing, enter CLI operational mode and issue the `request system halt` command. The command shuts down the Routing Engine cleanly, so its state information is preserved:

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

Wait until a message appears on the console confirming that the operating system has halted.

For more information about the command, see the [CLI Explorer](#).

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

SEE ALSO

[MX104 LEDs Overview | 11](#)

[MX104 Routing Engine Overview | 26](#)

Removing an MX104 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 Routing Engine offline. If there is only one Routing Engine, taking the Routing Engine offline shuts down the router.



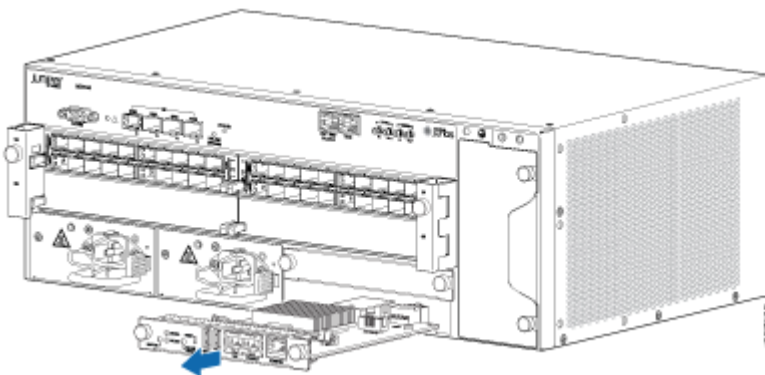
CAUTION: If the Routing Engine to be replaced is currently functioning as the primary Routing engine, switch it to be the backup before removing it.

To remove a Routing Engine from (see [Figure 37 on page 132](#)):

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 both sides of the Routing Engine.
6. Grasp the Routing Engine by the captive screws, 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.

NOTE: To maintain proper airflow through the chassis, do not leave 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 37: Removing an MX104 Routing Engine



Installing an MX104 Routing Engine

To install a Routing Engine (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. Place one hand underneath the Routing Engine to support it.
3. Carefully align the sides of the Routing Engine with the guides inside the opening on the chassis.
4. Slide the Routing Engine into the chassis until you feel resistance.
5. Tighten the captive screws on both sides of the Routing Engine.
6. Connect the management device cables to the Routing Engine.

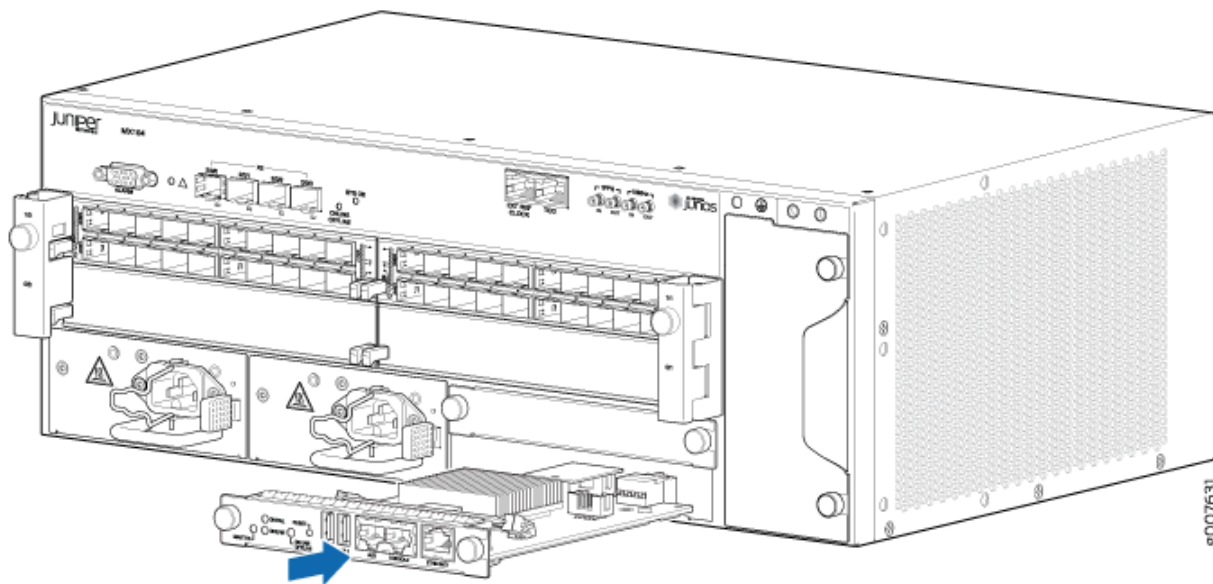
NOTE: The Routing Engine might require several minutes to boot.

7. After the Routing Engine boots, verify that it is installed correctly:
 - Check the LEDs on the Routing Engine. If the router is operational and the Routing Engine is functioning properly, the green **ONLINE** LED lights steadily. If the red **OK/FAIL** LED lights steadily instead, remove and install the Routing Engine again. If the red **OK/FAIL** LED still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.
 - Check the status of the Routing Engine, using the **show chassis environment routing-engine** CLI command:

```
user@ host > show chassis environment routing-engine
Routing Engine 0 status:
  State           Online Master
  Temperature     34 degrees C / 93 degrees F
  CPU Temperature 43 degrees C / 109 degrees F
Routing Engine 1 status:
  State           Online Standby
  Temperature     33 degrees C / 91 degrees F
  CPU Temperature 39 degrees C / 102 degrees F
```

If the router is operational and the Routing Engine is functioning properly, the state shows `Online Master` or `Online Standby`. For more information about using the `show chassis routing-engine` CLI command, see *show chassis environment routing-engine*.

Figure 38: Installing a Routing Engine



SEE ALSO

| [MX104 Routing Engine Overview](#) | 26

Maintaining MX104 Interface Modules

IN THIS SECTION

- [Maintaining the MX104 MICs and Network Ports](#) | 135
- [Replacing an MX104 MIC](#) | 136
- [Replacing an MX104 Transceiver](#) | 140
- [Maintaining Cables That Connect to MX104 Network Ports](#) | 143

Maintaining the MX104 MICs and Network Ports

IN THIS SECTION

- Purpose | 135
- Action | 135
- Meaning | 136

Purpose

For optimum performance, verify the condition of the network ports.

Action

On a regular basis:

- Check the port LEDs. The meaning of the LED states differs for various uplink ports. For more information, see "[MX104 LEDs Overview](#)" on page 11. If the router detects a port failure, the router generates an alarm message to be sent to the Routing Engine.

A green status LED indicates that the port is functioning normally.

- From the CLI, issue the `show chassis fpc pic-status` command.

```
user@host> show chassis fpc pic-status
Slot 0  Online
  PIC 0  Online      10x 1GE(LAN) SFP
  PIC 1  Online      10x 1GE(LAN) SFP
  PIC 2  Online      1xCOC12/4xCOC3 CH-CE
Slot 1  Online
  PIC 0  Online      10x 1GE(LAN) SFP
  PIC 1  Online      10x 1GE(LAN) SFP
Slot 2  Online
  PIC 0  Online      4x 10GE(LAN) SFP+
```


Meaning

Online is displayed in the second column if a MIC is functioning normally.

For further description of the output from the command, see the *show chassis fpc* command summary in the [CLI Explorer](#).

SEE ALSO

| [MX104 Hardware and CLI Terminology Mapping](#) | 7

Replacing an MX104 MIC

IN THIS SECTION

- [Removing an MX104 MIC](#) | 136
- [Installing an MX104 MIC](#) | 138

Removing an MX104 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.

In the MX104 router, the MICs can be installed in four slots in the front of the router. A MIC weighs less than 2 lb (0.9 kg).

To remove a MIC (see Figure 1):

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 five seconds).

- Issue the following CLI command:

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

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 a 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.

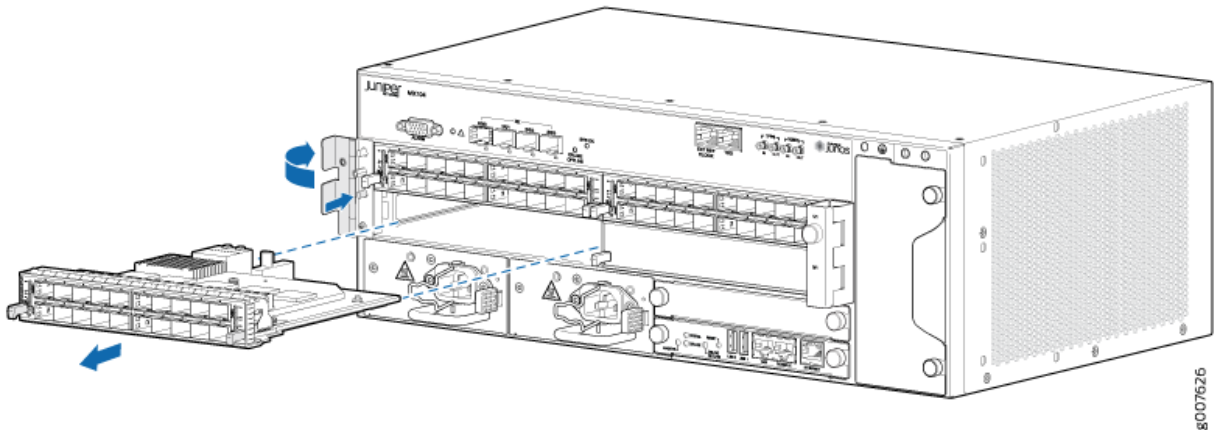


CAUTION: Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

7. Loosen the captive screw on the cover that is adjacent to the MIC that you are removing. Swing the cover away from the MIC to expose the handles.
8. Grasp the handles on either side of the MIC faceplate, and slide the MIC out of the chassis. Place the MIC 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 chassis card cage.

Figure 39: Removing a MIC



Installing an MX104 MIC

To install a MIC (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. 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.
3. Loosen the captive screw on the cover that is adjacent to the MIC slot. Swing the cover away from the MIC slot.
4. Align the rear of the MIC with the guides located at the corners of the MIC slot.
5. 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.

6. Swing the cover into place so that it sits over the MIC handle on one side.
7. Tighten the captive screw on the cover.
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.



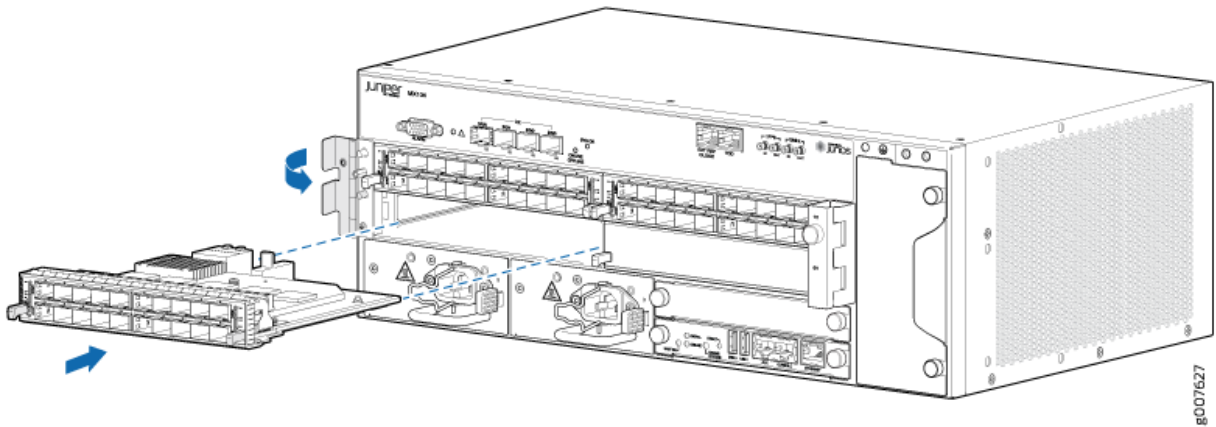
CAUTION: Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

11. Bring the MIC online by issuing the following CLI command:

```
user@host> request chassis mic fpc-slot slot-number mic-slot slot-number 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 the MX104 MICs and Network Ports](#)" on page 135.

Figure 40: Installing a MIC



SEE ALSO

| [MX104 Modular Interface Card \(MIC\) Overview](#) | 32

Replacing an MX104 Transceiver

IN THIS SECTION

- [Removing an MX104 Transceiver](#) | 141
- [Installing an MX104 Transceiver](#) | 142

Small form-factor pluggable transceivers (SFPs) are optical transceivers that are installed in the front panel of the MX104 router. Transceivers are hot-insertable and hot-removable.

Removing an MX104 Transceiver

Removing a transceiver does not interrupt router functioning, but the removed transceiver no longer receives or transmits data.

To remove a transceiver (see Figure 3):

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.



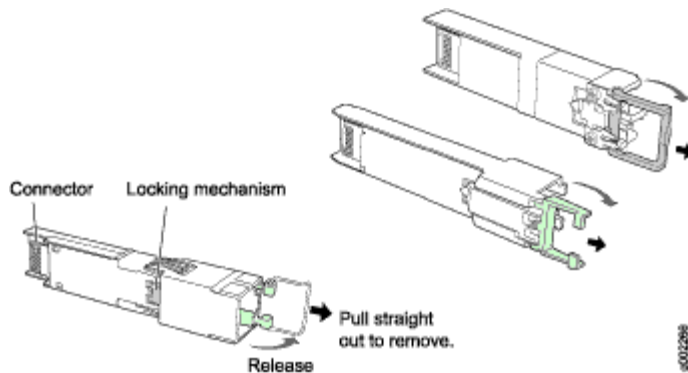
CAUTION: Make sure that you open the ejector handle completely until you hear it click. This action prevents damage to the transceiver.

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 router.

- Using your fingers, grasp the body of the transceiver, and pull it the rest of the way out of the router.

Figure 41: Removing Transceivers



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



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

SEE ALSO

[MX104 Chassis Overview | 5](#)

[MX104 Modular Interface Card \(MIC\) Overview | 32](#)

Installing an MX104 Transceiver

To install a transceiver:

- Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
- Take each transceiver to be installed out of its electrostatic bag, and identify the slot on the component where it will be installed.
- Verify that each transceiver is covered by a rubber safety cap. If it is not, cover the transceiver with a safety cap.
- Carefully align the transceiver with the slots in the component. The connectors should face the component.
- 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 front panel indicate that the transceiver is functioning correctly. For more information about the component LEDs, see the "[MX104 LEDs Overview](#)" on page 11.

SEE ALSO

[MX104 Chassis Overview | 5](#)

[MX104 Modular Interface Card \(MIC\) Overview | 32](#)

Maintaining Cables That Connect to MX104 Network Ports

IN THIS SECTION

- [Purpose | 143](#)
- [Action | 143](#)

Purpose

For optimum router performance, verify the condition of the cables that connect to the network ports.

Action

On a regular basis:

- Use the cable management bracket to support cables and prevent cables from dislodging or developing stress points.

- Place excess cable out of the way in the cable management bracket. Do not allow fastened loops of cable to dangle from the connector or cable management bracket, 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

[Routine Maintenance Procedures for the MX104 Router | 108](#)

[Troubleshooting Resources for MX104 Routers | 159](#)

Maintaining MX104 Power System Components

IN THIS SECTION

- [Replacing an MX104 AC Power Supply | 145](#)
- [Replacing an MX104 DC Power Supply | 149](#)

Replacing an MX104 AC Power Supply

IN THIS SECTION

- [Removing an MX104 AC Power Supply | 145](#)
- [Installing an MX104 AC Power Supply | 148](#)

Removing an MX104 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 2):

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. Swing the power cord retention clip out of the way of the power cord.
4. Remove the power cord from the power supply.
5. Press the release latch on the right side of the power supply to disconnect the power supply from the chassis.

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

Figure 42: Removing an AC Power Cord

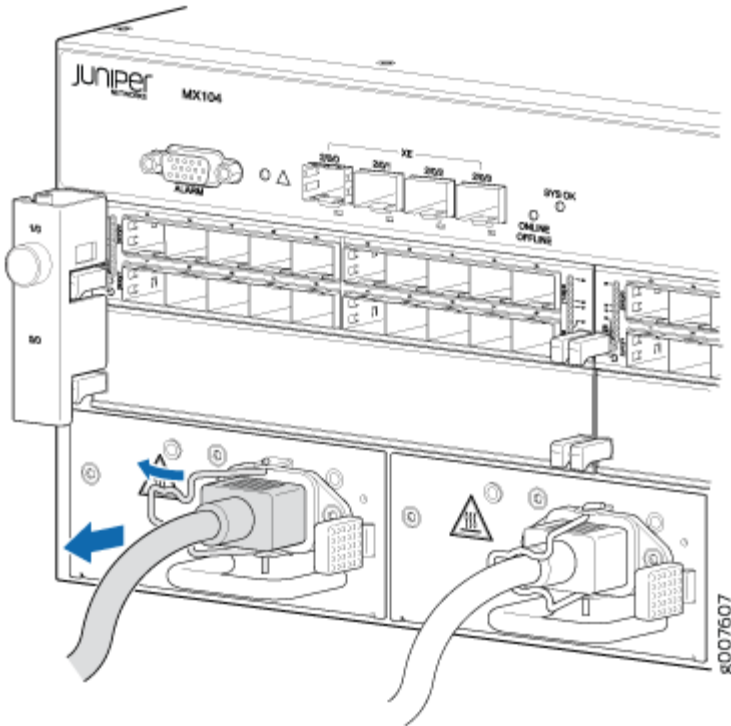
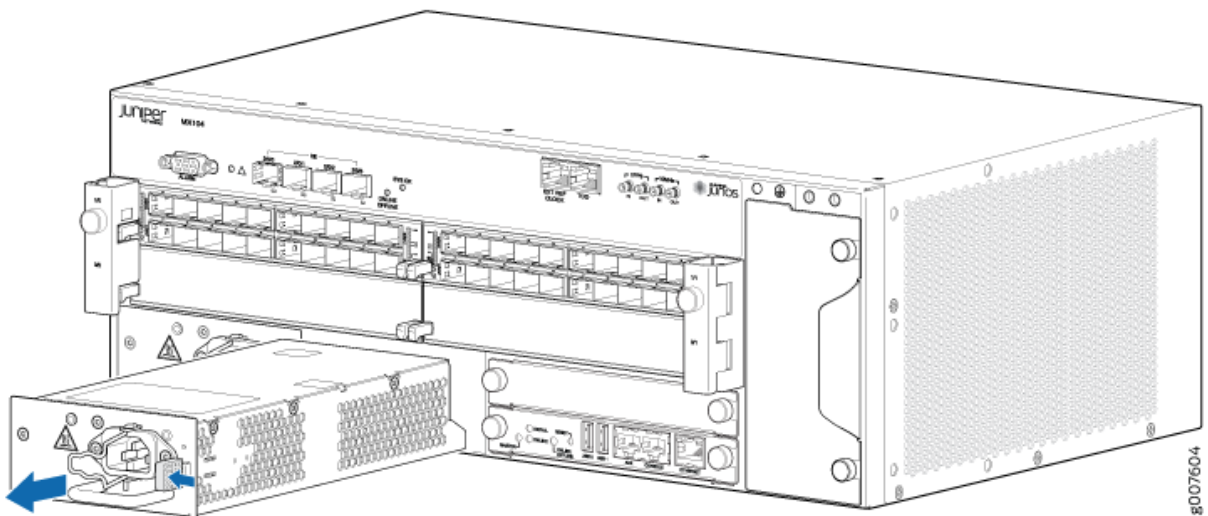


Figure 43: Removing an AC Power Supply



SEE ALSO

[Connecting AC Power Cords to the MX104 Router | 86](#)

[MX104 AC Power Specifications | 20](#)

[MX104 AC Power Cord Specifications | 21](#)

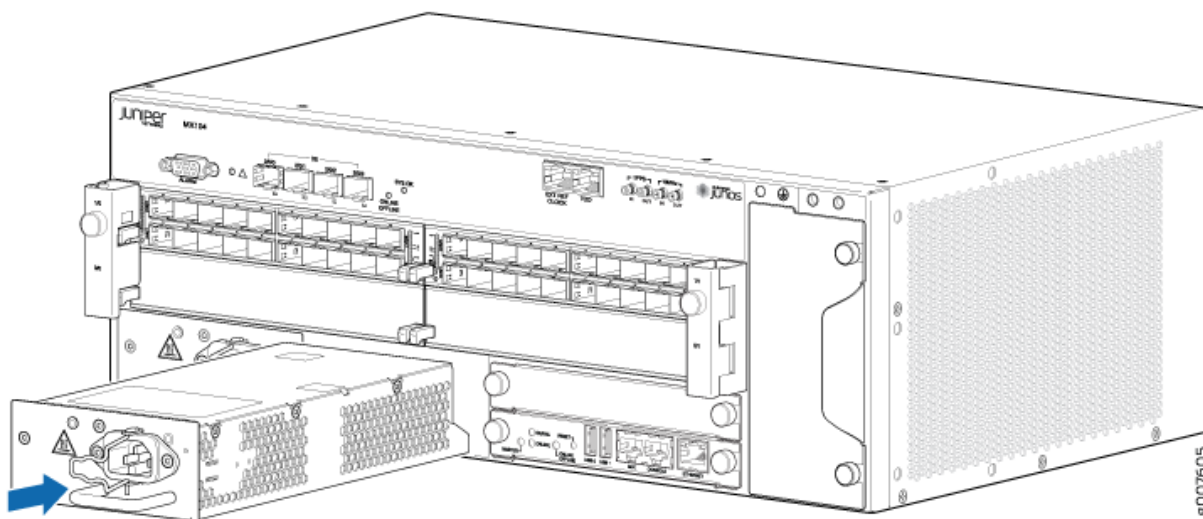
Installing an MX104 AC Power Supply

To install an AC 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 ESD grounding point.
2. 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.
3. Attach the power cord to the power supply.
4. Secure the power cord with the power cord retainer clip.
5. Attach the power cord to the AC power source, and switch on the dedicated customer site circuit breaker. Follow the instructions for your site.

Observe the status LED on the power supply faceplate. If the power supply is correctly installed and functioning normally, the status LED lights green steadily.

Figure 44: Installing an AC Power Supply



8007605

SEE ALSO

[Connecting AC Power Cords to the MX104 Router | 86](#)

[MX104 AC Power Specifications | 20](#)

[MX104 AC Power Cord Specifications | 21](#)

Replacing an MX104 DC Power Supply

IN THIS SECTION

- [Removing an MX104 DC Power Supply | 149](#)
- [Installing an MX104 DC Power Supply | 153](#)

Removing an MX104 DC Power Supply

To remove a DC power supply from the router, you need the following tools:

- Phillips (+) screwdriver, number 2
- ESD grounding wrist strap

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 6):

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 status LED on the power supply is not lit.
4. Attach an ESD grounding strap to your bare wrist, and connect the other end of the strap to an ESD grounding point.
5. Remove the clear plastic cover protecting the terminal studs on the faceplate (see Figure 4).
6. Remove the screw and washer from each of the terminals. (Use a number 2 Phillips screwdriver.)
7. Remove the cable lugs from the terminals.
8. Carefully move the power cables out of the way.
9. Remove the nut and washer from the DC power supply grounding point (see Figure 5).
10. Remove the cable lug from the grounding point.
11. Move the grounding cable out of the way.
12. Press the release latch on the right side of the power supply to disconnect the power supply from the chassis.

13. Grasp the handle on the power supply and pull the power supply straight out of the chassis.

Figure 45: Disconnecting the DC Power Cables

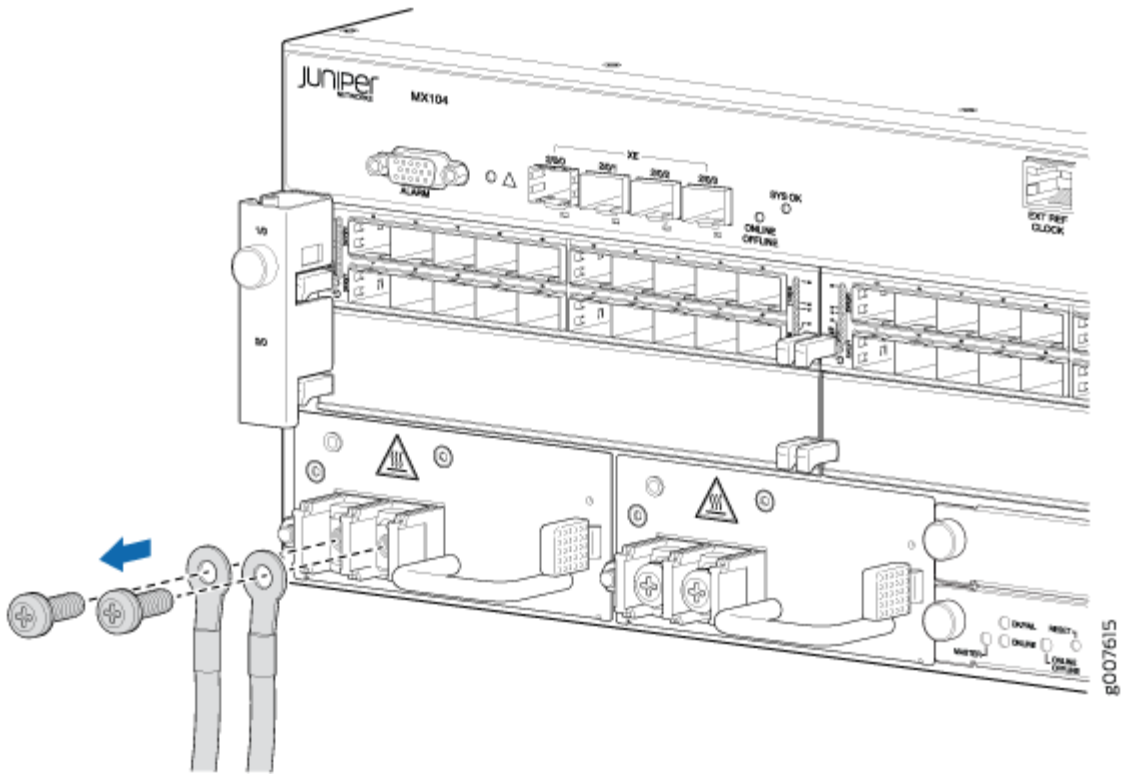


Figure 46: Disconnecting the Grounding Cable

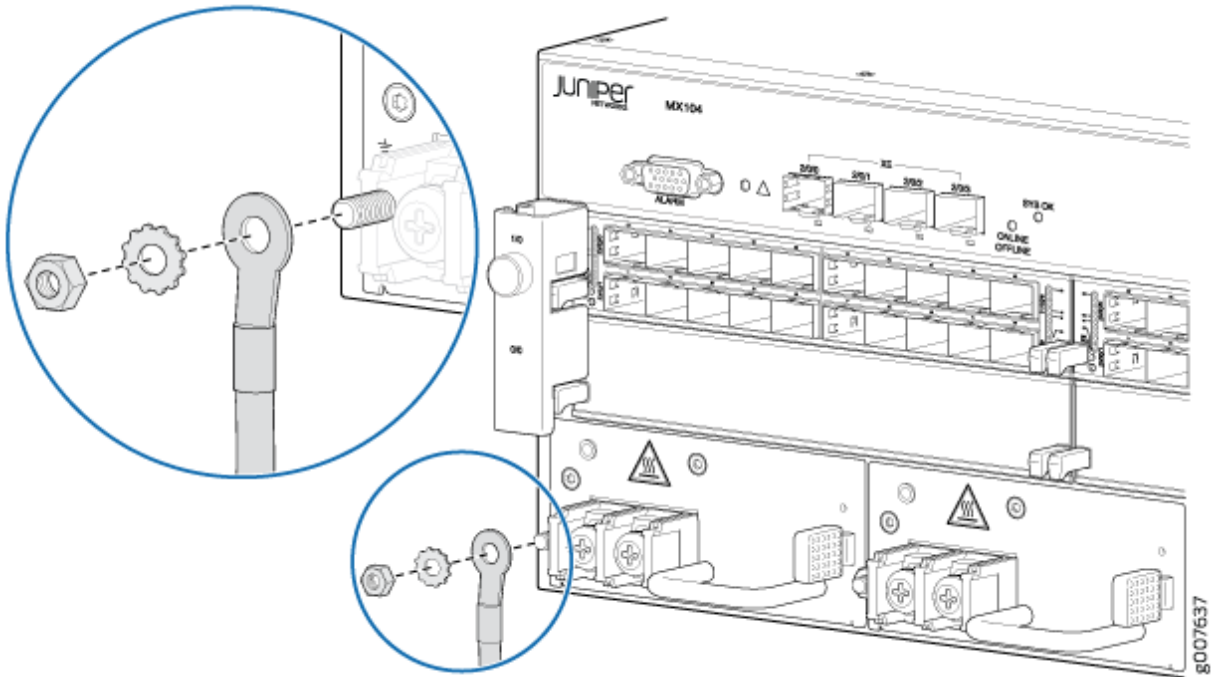
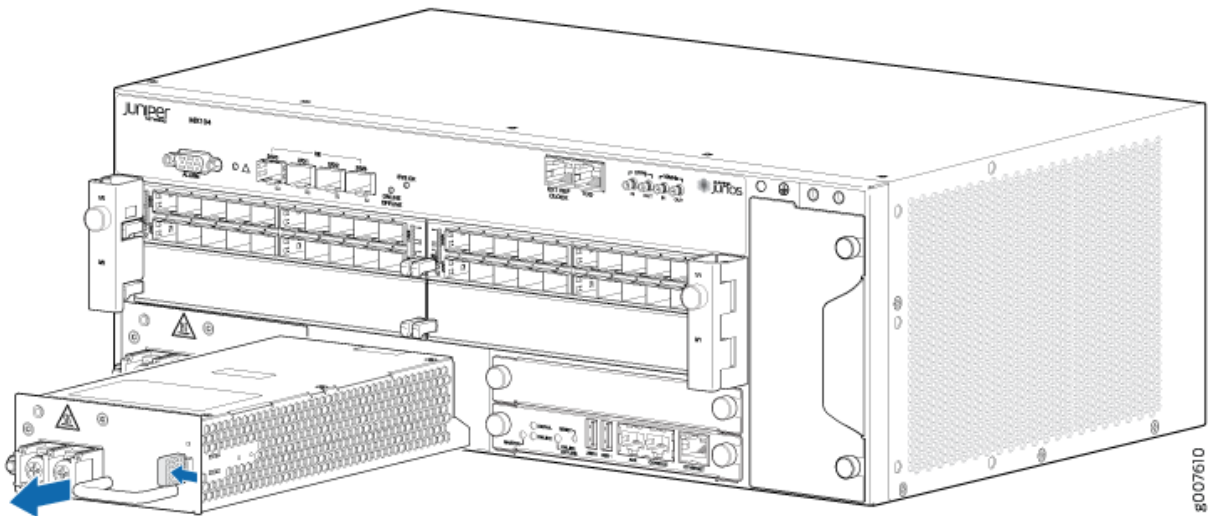


Figure 47: Removing a DC Power Supply



SEE ALSO

[Connecting the MX104 Router to Earth Ground](#) | 84

[MX104 Chassis Grounding Cable and Lug Specifications | 47](#)

[MX104 DC Power Electrical Safety Guidelines | 207](#)

[DC Power Electrical Safety Warnings for Juniper Networks Devices | 208](#)

[MX104 DC Power Specifications | 23](#)

[MX104 DC Power Cable and Lug Specifications | 25](#)

Installing an MX104 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 in the router, you need the following tools:

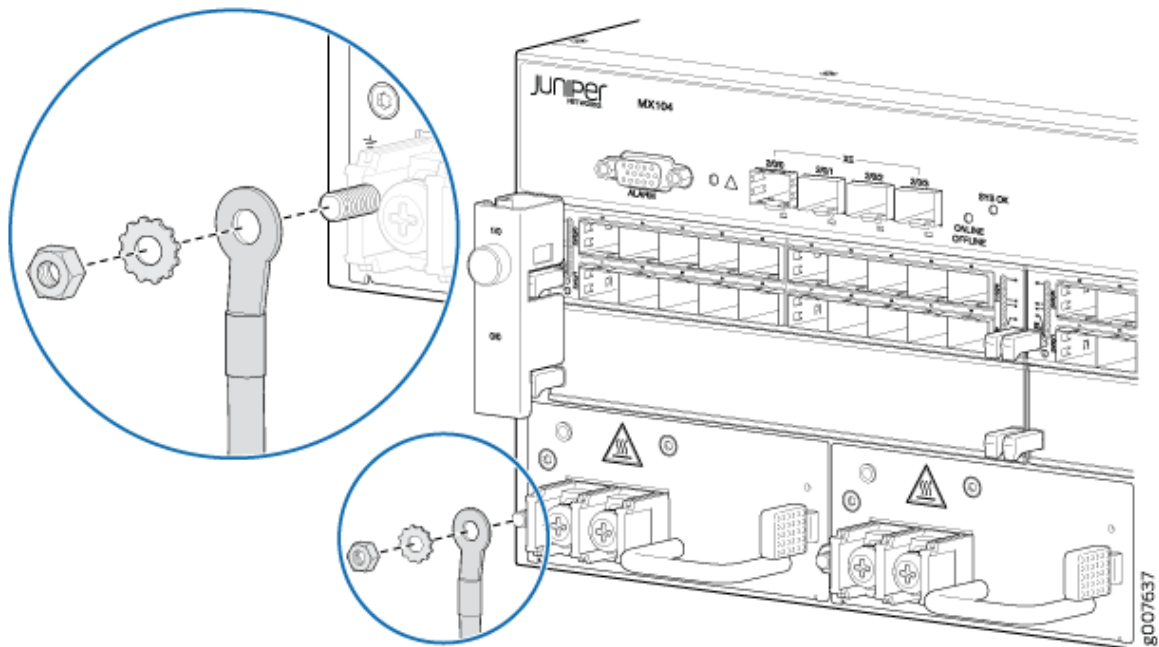
- Phillips (+) screwdriver, number 2
- ESD grounding wrist strap
- Grounding ring lug with hole sized for an M5 screw
- M5 nut and washer (one per DC power supply, attached)
- DC power source cables, minimum 14 AWG or as required by local code (not provided)
- DC power ring lugs, Panduit PV12-14HDRB-2k
- M6 screws and washers (two per DC power supply, attached)
- Grounding cable, minimum 14 AWG or as required by local code (not provided)

To install a DC power supply (see Figure 8):

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. 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. Remove the clear plastic cover protecting the terminal on the faceplate.
5. Ground the DC power supply (see Figure 7):
 - Remove the nut and washer from the grounding point on the power supply.

- Secure each grounding cable lug to the grounding point with the washer and nut.

Figure 48: Connecting a DC Power Supply Grounding Cable



6. Remove the screws and washers from the DC terminals.
7. 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 DC cables to chassis ground:

For -48V and -60V:

 - a. The cable with very high resistance (indicating an open circuit) to chassis ground is the DC input cable (-).
 - b. The cable with very low resistance (indicating a closed circuit) to chassis ground is the return cable (+).

For +24V:

 - a. The cable with very low resistance (indicating a closed circuit) to chassis ground is the DC input cable (-).
 - b. The cable with very high resistance (indicating an open circuit) to chassis ground is the return cable (+).

8. Secure each power cable lug to the terminal with the flat washers and screw (see Figure 9). Apply up to 27.4 lb-in. (3.1 Nm) of torque to each screw. Do not overtighten the screw. (Use a number 2 Phillips screwdriver.)
 - a. Secure the positive DC source power cable lug to the return (+) terminal.
 - b. Secure the negative DC source power cable lug to the input (-) terminal.



CAUTION: Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the screws. Ensure that each screw is properly threaded into the terminal. Applying installation torque to the screw when improperly threaded may result in damage to the terminal.



CAUTION: The maximum torque rating of the terminal screws on the DC power supply is 27.4 lb-in. (3.1 Nm). The terminal screws may be damaged if excessive torque is applied. Use only a torque-controlled driver to tighten screws on the DC power supply terminals. Use an appropriately sized driver, with a maximum torque capacity of 27.4 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.

9. Replace the clear plastic cover over the terminals on the faceplate.
10. Connect each DC power cable to the appropriate external DC power source.

NOTE: For information about connecting to external DC power sources, see the instructions for your site.

11. Switch on the external circuit breakers to provide voltage to the DC power source cable leads. Observe the system LED on the front of the router. If the DC power cable is correctly installed and

functioning normally, the system LED lights green steadily. If the status LED indicates that the power supply is not functioning normally, repeat the installation and cabling procedures.

Figure 49: Installing a DC Power Supply

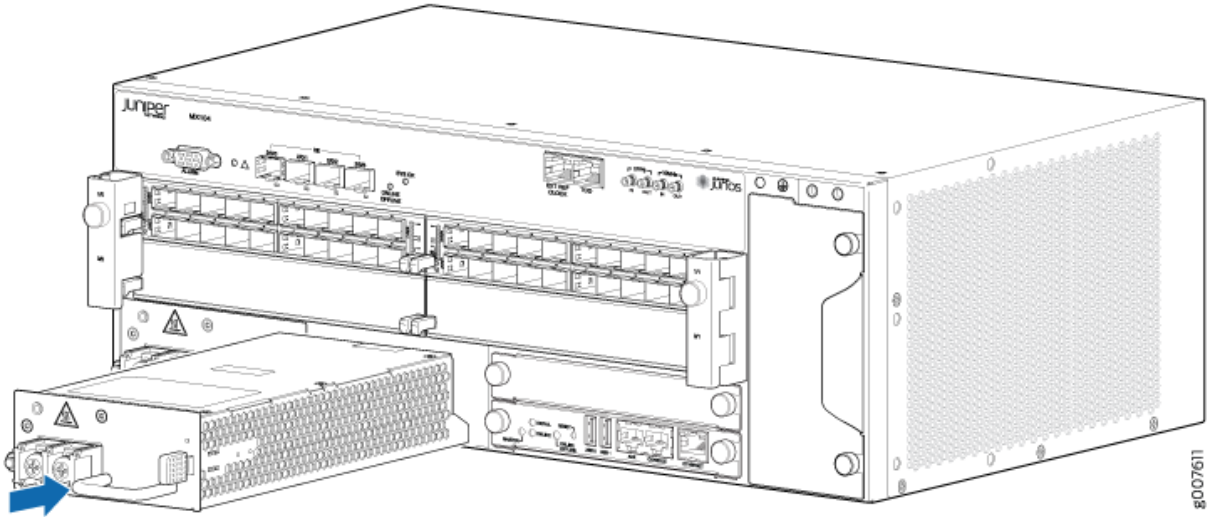
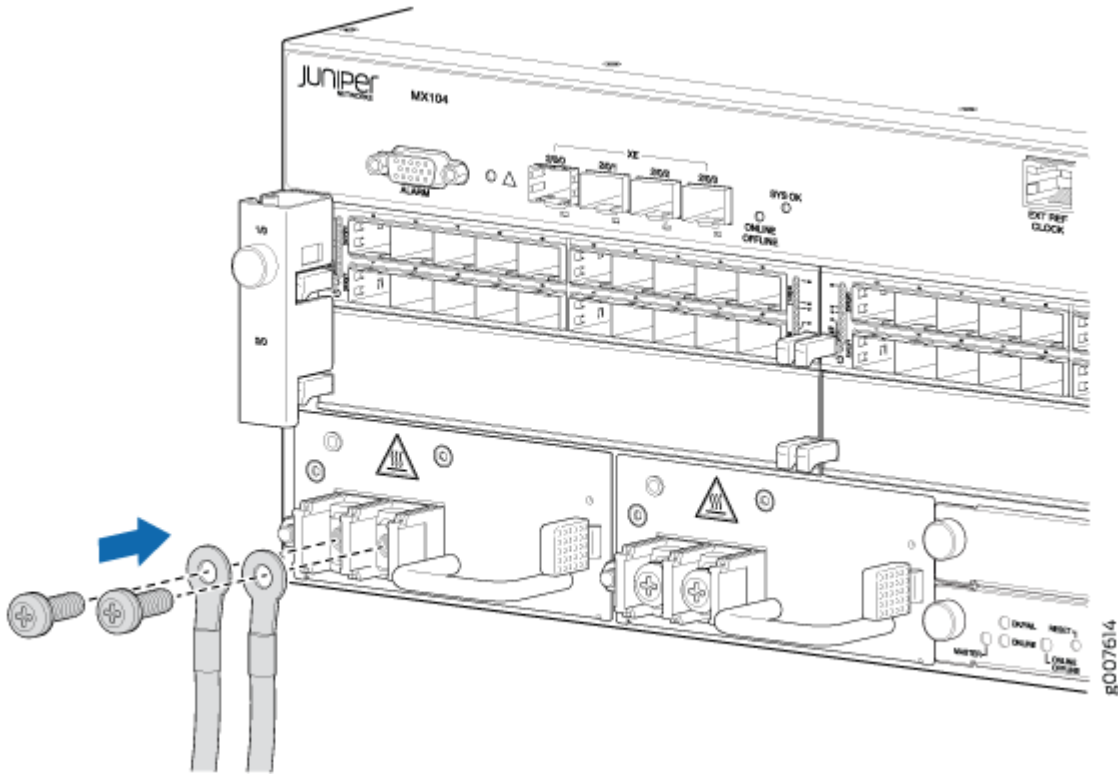


Figure 50: Connecting the DC Power Cables



SEE ALSO

[Connecting the MX104 Router to Earth Ground | 84](#)

[MX104 Chassis Grounding Cable and Lug Specifications | 47](#)

[MX104 DC Power Electrical Safety Guidelines | 207](#)

[DC Power Electrical Safety Warnings for Juniper Networks Devices | 208](#)

[MX104 DC Power Specifications | 23](#)

[MX104 DC Power Cable and Lug Specifications | 25](#)

5

CHAPTER

Troubleshooting Hardware

[Troubleshooting the MX104 | 159](#)

Troubleshooting the MX104

IN THIS SECTION

- [Troubleshooting Resources for MX104 Routers | 159](#)
- [Understanding Alarm Types and Severity Classes on MX104 Routers | 160](#)
- [Verifying Active Alarms on MX104 Routers | 162](#)
- [Monitoring System Log Messages on MX104 Routers | 163](#)

Troubleshooting Resources for MX104 Routers

IN THIS SECTION

- [Command-Line Interface | 159](#)
- [Front Panel LEDs | 160](#)
- [Alarm Devices and Messages | 160](#)

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 front panel.

For information about using the CLI to troubleshoot the Junos OS, see the appropriate Junos OS configuration guide.

Front Panel LEDs

The front panel on the router contains LEDs that allow you to troubleshoot the router.

LEDs on the front panel include the following:

- System LED—One LED labeled **SYS OK** on the front panel indicates the status of the router.
- Alarm LEDs—One yellow and one red LED on the front panel indicate major and minor alarms.

For more information about component and front panel LEDs, see "[MX104 LEDs Overview](#)" on page 11.

Alarm Devices and Messages

When a major or minor alarm occurs, it logs the cause of the alarm. If the alarm relay contact is connected to alarm devices, the router also trips the corresponding alarm relay contact.

To view a detailed description of the alarm cause, issue the `show chassis alarms` command:

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

Understanding Alarm Types and Severity Classes on MX104 Routers

IN THIS SECTION

- [Alarm Severity Classes](#) | 161

Before monitoring alarms on the router, become familiar with the terms defined in [Table 36 on page 160](#).

Table 36: Alarm Terms

Term	Definition
alarm	Signal alerting you to conditions that might prevent normal operation. On a router, the alarm signal is the red system LED lit on the front of the chassis.

Table 36: Alarm Terms (Continued)

Term	Definition
alarm condition	Failure event that triggers an alarm.
alarm severity	Seriousness of the alarm. The level of severity can be either major (steady red) or minor (blinking red).
chassis alarm	Predefined alarm triggered by a physical condition on the router or one of the router components. Alarms may be triggered by events such as a power failure, excessive component temperature, or media failure. Chassis alarms are preset and cannot be modified.
system alarm	Predefined alarm triggered by a missing rescue configuration or failure to install a license for a licensed software feature. System alarms are preset and cannot be modified, although you can configure them to appear automatically in the J-Web interface display or CLI display.
interface alarm	Predefined alarm triggered by a problem with a specific network interface.

Alarm Severity Classes

Alarms on the MX104 routers have two severity classes:

- Major (steady red)—Indicates a critical situation on the router that has resulted from one of the following conditions. A red alarm condition requires immediate action.
 - One or more hardware components have failed.
 - One or more hardware components have exceeded temperature thresholds.
 - An alarm condition configured on an interface has triggered a critical warning.
- Minor (steady yellow)—Indicates a noncritical condition on the router that, if left unchecked, might cause an interruption in service or degradation in performance. A minor alarm condition requires monitoring or maintenance.

A missing rescue configuration generates a minor system alarm.

SEE ALSO

| *Chassis Conditions That Trigger Alarms*

Verifying Active Alarms on MX104 Routers

IN THIS SECTION

- Purpose | 162
- Action | 162
- Meaning | 162

Purpose

Use the monitoring functionality to view alarm information for the MX104 routers, including alarm type, alarm severity, and a brief description for each active alarm on the router.

Action

- Observe the system LED on the front panel of the router. If the router is functioning normally with no alarms, the system LED lights green steadily.
- Issue the CLI `show chassis alarms` command to verify the status of the router. As shown in the sample output, the value `Class` indicates the severity of the alarm.

```
user@host> show chassis alarms
2 alarms currently active
Alarm time           Class  Description
2010-01-01 00:05:24 UTC  Minor  Loss of communication with Backup RE
2010-01-01 00:05:24 UTC  Major  Fan Tray Failure
```

When the router is functioning normally with no active alarms, the CLI displays the output as shown:

```
user@host> show chassis alarms
No alarms currently active
```

Meaning

[Table 37 on page 163](#) lists the alarm output fields.

Table 37: Alarm Output Fields

Field	Values
Alarm time	Date and time when the failure was detected
Class	Alarm severity—either major or minor
Description	Brief synopsis of the alarm

Monitoring System Log Messages on MX104 Routers

IN THIS SECTION

- Purpose | 163
- Action | 163

Purpose

Use the monitoring functionality to view system log messages for MX Series routers.

Action

To view events in the CLI, enter the `show log` command. For more information, see [Displaying a Log File from a Single-Chassis System](#).



CHAPTER

Contacting Customer Support and Returning the Chassis or Components

Contacting Customer Support and Returning the Chassis or Components | 165

Contacting Customer Support and Returning the Chassis or Components

IN THIS SECTION

- [Contact Customer Support | 165](#)
- [How to Return a Hardware Component to Juniper Networks, Inc. | 166](#)
- [Locating the MX104 Components and Serial Numbers | 167](#)
- [MX104 Chassis Serial Number Label | 168](#)
- [MX104 Fan Tray Serial Number Label | 169](#)
- [MX104 MIC Serial Number Label | 170](#)
- [MX104 Power Supply Serial Number Label | 171](#)
- [MX104 Routing Engine Serial Number Label | 172](#)
- [Guidelines for Packing Hardware Components for Shipment | 172](#)
- [Packing the MX104 Router for Shipment | 172](#)

Contact Customer Support

You can contact Juniper Networks Technical Assistance Center (JTAC) 24 hours a day, 7 days a week in one of the following ways:

- On the Web, using the Service Request Manager link at:
<https://support.juniper.net/support/>
- By telephone:
 - From the US and Canada: 1-888-314-JTAC
 - From all other locations: 1-408-745-9500

NOTE: If contacting JTAC by telephone, enter your 12-digit service request number followed by the pound (#) key if this is an existing case, or press the star (*) key to be routed to the next available support engineer.

When requesting support from JTAC by telephone, be prepared to provide the following information:

- Your existing service request number, if you have one
- Details of the failure or problem
- Type of activity being performed on the device when the problem occurred
- Configuration data displayed by one or more `show` commands
- Your name, organization name, telephone number, fax number, and shipping address

The support representative validates your request and issues an RMA number for return of the component.

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.

Locating the MX104 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                G3498      MX104
Midplane             REV 28   750-044219  CAAX5767      MX104
PEM 0                REV 03   740-045932  1H073050110  DC Power Entry Module
PEM 1                REV 03   740-045932  1H073050017  DC Power Entry Module
Routing Engine 0     REV 03   750-053342  CABP2893      RE-MX-104
Routing Engine 1     REV 03   750-053342  CABP2978      RE-MX-104
AFEB 0                          BUILTIN    BUILTIN      Forwarding Engine Processor
FPC 0                          BUILTIN    BUILTIN      MPC BUILTIN
  MIC 0                REV 02   750-046905  CAAV2145      3D 20x 1GE(LAN)-EH,SFP
  PIC 0                          BUILTIN    BUILTIN      10x 1GE(LAN) -EH SFP
  PIC 1                          BUILTIN    BUILTIN      10x 1GE(LAN) -EH SFP
  MIC 1                REV 02   750-047733  CAAN7024      16x CHE1T1 -H, RJ48
  PIC 2                          BUILTIN    BUILTIN      16x CHE1T1 -H, RJ48
FPC 1                          BUILTIN    BUILTIN      MPC BUILTIN
  MIC 0                REV 05   750-046905  CAAY0325      3D 20x 1GE(LAN)-EH,SFP
  PIC 0                          BUILTIN    BUILTIN      10x 1GE(LAN) -EH SFP
  PIC 1                          BUILTIN    BUILTIN      10x 1GE(LAN) -EH SFP
  MIC 1                REV 05   CAAW5365      1x COC12/4x COC3 CH-CE -H, SFP
  PIC 2                          BUILTIN    BUILTIN      1x COC12/4x COC3 CH-CE -H, SFP
```


FPC 2		BUILTIN	BUILTIN	MPC BUILTIN
MIC 0		BUILTIN	BUILTIN	4x 10GE(LAN) SFP+
PIC 0		BUILTIN	BUILTIN	4x 10GE(LAN) SFP+
Fan Tray 0	REV 02	711-049570	CAAX6564	Fan Tray

Most components also have a small rectangular serial number ID label (see [Figure 51 on page 168](#)) attached to the component body.

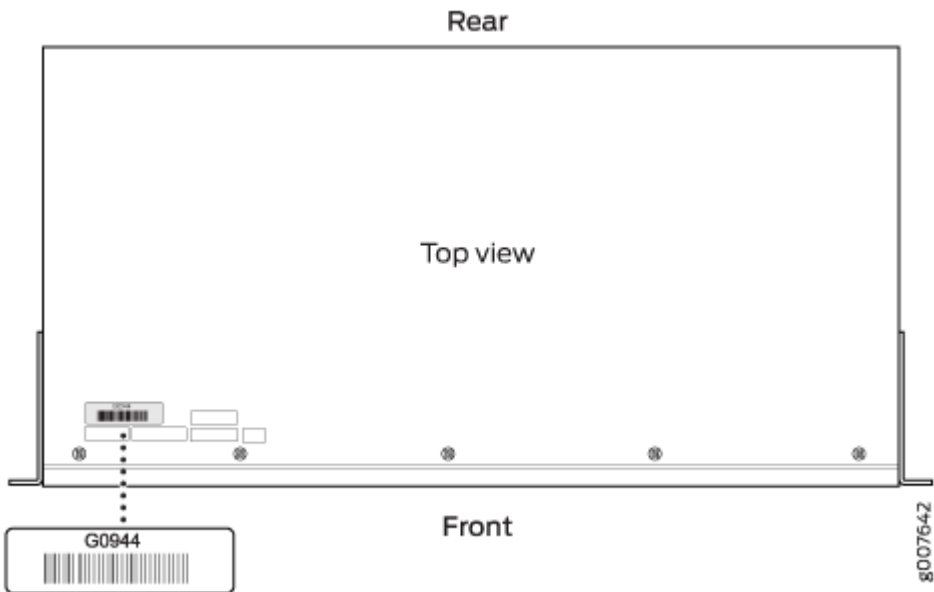
Figure 51: Serial Number ID Label



MX104 Chassis Serial Number Label

The chassis serial number is located on the rear of the chassis (see [Figure 52 on page 168](#)).

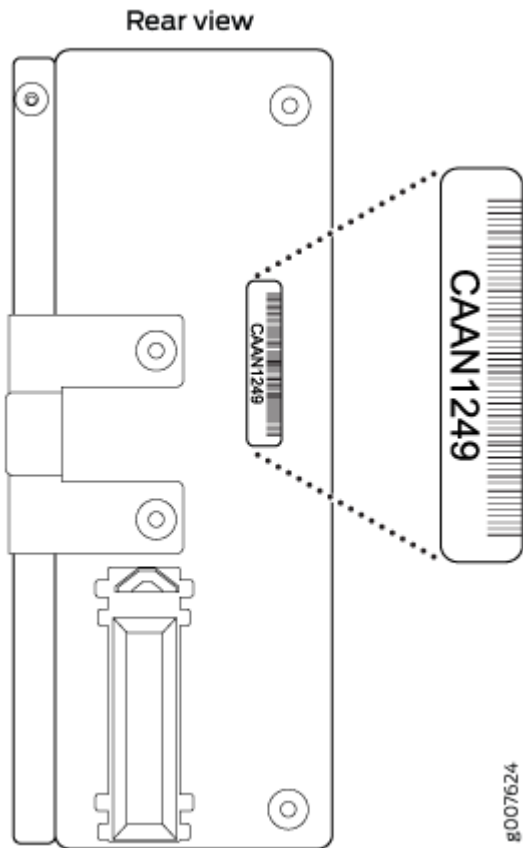
Figure 52: MX104 Chassis Serial Number Label



MX104 Fan Tray Serial Number Label

The fan tray serial number is located on the rear of the fan tray (see [Figure 53 on page 169](#)).

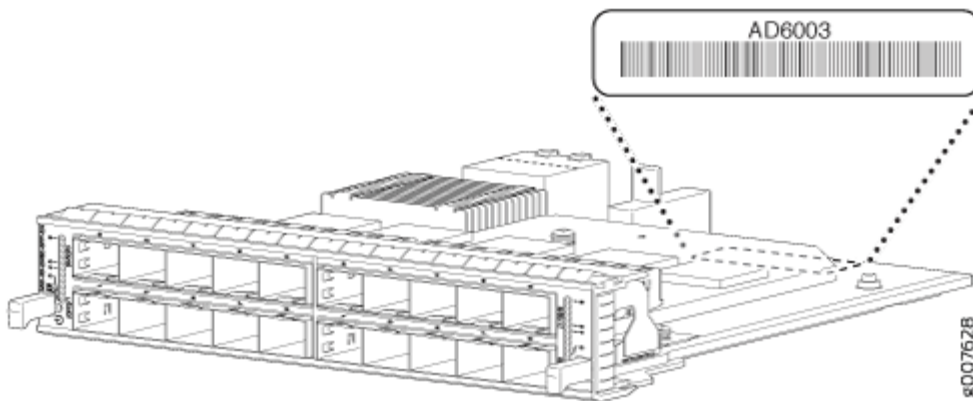
Figure 53: MX104 Fan Tray Serial Number Label



MX104 MIC Serial Number Label

The MIC serial number label is located on the top of the MIC (see [Figure 54 on page 170](#)).

Figure 54: MX104 MIC Serial Number Label

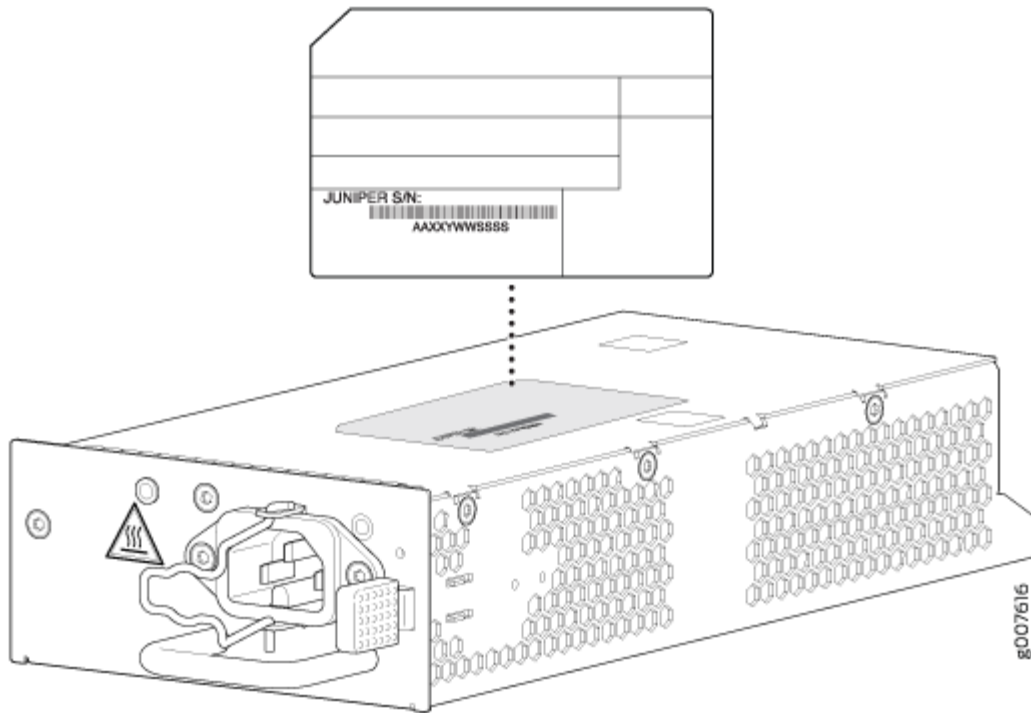


NOTE: The location of the serial number label may vary depending on model. Look for an alphanumeric sticker similar to the one shown in [Figure 54 on page 170](#).

MX104 Power Supply Serial Number Label

The power supply serial number is located on the top of the power supply (see [Figure 55 on page 171](#)).

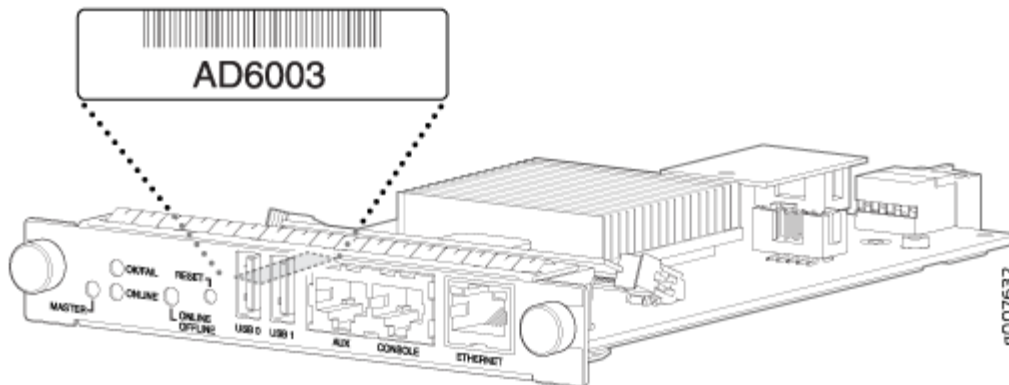
Figure 55: MX104 Power Supply Serial Number Label



MX104 Routing Engine Serial Number Label

The Routing Engine serial number is located on the top of the Routing Engine (see [Figure 56 on page 172](#)).

Figure 56: MX104 Routing Engine Serial Number Label



Guidelines for Packing Hardware Components for Shipment

To pack and ship individual components:

- When you return components, make sure that they are adequately protected with packing materials and packed so that the pieces are prevented from moving around inside the carton.
- Use the original shipping materials if they are available.
- Place individual components in antistatic bags.
- Write the RMA number on the exterior of the box to ensure proper tracking.



CAUTION: Do not stack any of the hardware components.

Packing the MX104 Router for Shipment

To pack the router for shipment:

1. Retrieve the shipping box 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 Routing Engine, enter CLI operational mode and issue the following command to shut down the router software.

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

Wait until a message appears on the console confirming that the operating system has halted.

For more information about the command, see the [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. 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. One person should grasp the router while a second person unscrews and removes the mounting screws from the rack. One lifter can then move the router to the shipping container.
9. Place the router in the shipping container.
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.
13. Write the RMA number on the exterior of the box to ensure proper tracking.

SEE ALSO

| [Contact Customer Support](#) | 165

7

CHAPTER

Safety and Compliance Information

- Definition of Safety Warning Levels | 176
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- Preventing Electrostatic Discharge Damage to an MX104 Router | 182
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Definition of Safety Warning Levels

The documentation uses the following levels of safety warnings:

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



CAUTION: You must observe the specified guidelines to avoid minor injury or discomfort to you, or severe damage to the hardware device.



LASER WARNING: This symbol alerts you to the risk of personal injury from a laser.



WARNING: This symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

Waarschuwing Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen.

Varoitus Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista.

Attention Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents.

Warnung Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt.

Avvertenza Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti.

Advarsel Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du være oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker.

Aviso Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes.

¡Atención! Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes.

Warning! Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador.

RELATED DOCUMENTATION

General Safety Warnings for Juniper Networks Devices

Installation Safety Warnings for Juniper Networks Devices

Maintenance and Operational Safety Warnings for Juniper Networks Devices

General Electrical Safety Warnings for Juniper Networks Devices

DC Power Electrical Safety Warnings for Juniper Networks Devices

General Safety Guidelines for Juniper Networks Devices

The following guidelines help ensure your safety and protect the hardware equipment from damage. The list of guidelines might not address all potentially hazardous situations in your working environment, so be alert and exercise good judgment at all times.

- Perform only the procedures explicitly described in this documentation. Make sure that only authorized service personnel perform other system services.
- Keep the area around the chassis clear and free from dust before, during, and after installation.
- Keep tools away from areas where people could trip over them while walking.
- Do not wear loose clothing or jewelry, such as rings, bracelets, or chains, that could become caught in the chassis.
- Wear safety glasses if you are working under any conditions that could be hazardous to your eyes.
- Do not perform any actions that create a potential hazard to people or make the equipment unsafe.
- Never attempt to lift an object that is too heavy for one person to handle.
- Never install or manipulate wiring during electrical storms.
- Never install electrical jacks in wet locations unless the jacks are specifically designed for wet environments.
- Operate the hardware equipment only when the chassis is properly grounded.
- Do not open or remove chassis covers or sheet metal parts unless instructions are provided in this documentation. Such an action could cause severe electrical shock.
- Do not push or force any objects through any opening in the chassis frame. Such an action could result in electrical shock or fire.
- Avoid spilling liquid onto the chassis or onto any hardware component. Such an action could cause electrical shock or damage the hardware equipment.
- Avoid touching uninsulated electrical wires or terminals that have not been disconnected from their power source. Such an action could cause electrical shock.
- Some parts of the router might become hot. The following label provides the warning of the hot surfaces on the router:



RELATED DOCUMENTATION

| *General Safety Warnings for Juniper Networks Devices*

General Safety Warnings for Juniper Networks Devices

IN THIS SECTION

- [Qualified Personnel Warning | 179](#)
- [Restricted-Access Area Warning | 180](#)

Qualified Personnel Warning



WARNING: Only trained and qualified personnel should install or replace the hardware equipment.

Waarschuwing Installatie en reparaties mogen uitsluitend door getraind en bevoegd personeel uitgevoerd worden.

Varoitus Ainoastaan koulutettu ja pätevä henkilökunta saa asentaa tai vaihtaa tämän laitteen.

Attention Tout installation ou remplacement de l'appareil doit être réalisé par du personnel qualifié et compétent.

Warnung Gerät nur von geschultem, qualifiziertem Personal installieren oder auswechseln lassen.

Avvertenza Solo personale addestrato e qualificato deve essere autorizzato ad installare o sostituire questo apparecchio.

Advarsel Kun kvalifisert personell med riktig opplæring bør montere eller bytte ut dette utstyret.

Aviso Este equipamento deverá ser instalado ou substituído apenas por pessoal devidamente treinado e qualificado.

¡Atención! Estos equipos deben ser instalados y reemplazados exclusivamente por personal técnico adecuadamente preparado y capacitado.

Warning! Denna utrustning ska endast installeras och bytas ut av utbildad och kvalificerad personal.

Restricted-Access Area Warning



WARNING: The hardware equipment is intended for installation in restricted-access areas. A restricted-access area is an area to which access can be gained only by service personnel through the use of a special tool, lock and key, or other means of security, and which is controlled by the authority responsible for the location.

Waarschuwing Dit toestel is bedoeld voor installatie op plaatsen met beperkte toegang. Een plaats met beperkte toegang is een plaats waar toegang slechts door servicepersoneel verkregen kan worden door middel van een speciaal instrument, een slot en sleutel, of een ander veiligheidsmiddel, en welke beheerd wordt door de overheidsinstantie die verantwoordelijk is voor de locatie.

Varoitus Tämä laite on tarkoitettu asennettavaksi paikkaan, johon pääsy on rajoitettua. Paikka, johon pääsy on rajoitettua, tarkoittaa paikkaa, johon vain huoltohenkilöstö pääsee jonkin erikoistyökalun, lukkoon sopivan avaimen tai jonkin muun turvalaitteen avulla ja joka on paikasta vastuussa olevien toimivaltaisten henkilöiden valvoma.

Attention Cet appareil est à installer dans des zones d'accès réservé. Ces dernières sont des zones auxquelles seul le personnel de service peut accéder en utilisant un outil spécial, un mécanisme de verrouillage et une clé, ou tout autre moyen de sécurité.

L'accès aux zones de sécurité est sous le contrôle de l'autorité responsable de l'emplacement.

Warnung Diese Einheit ist zur Installation in Bereichen mit beschränktem Zutritt vorgesehen. Ein Bereich mit beschränktem Zutritt ist ein Bereich, zu dem nur Wartungspersonal mit einem Spezialwerkzeugs, Schloß und Schlüssel oder anderer Sicherheitsvorkehrungen Zugang hat, und der von dem für die Anlage zuständigen Gremium kontrolliert wird.

Avvertenza Questa unità deve essere installata in un'area ad accesso limitato. Un'area ad accesso limitato è un'area accessibile solo a personale di assistenza tramite un'attrezzo speciale, lucchetto, o altri dispositivi di sicurezza, ed è controllata dall'autorità responsabile della zona.

Advarsel Denne enheten er laget for installasjon i områder med begrenset adgang. Et område med begrenset adgang gir kun adgang til servicepersonale som bruker et spesielt verktøy, lås og nøkkel, eller en annen sikkerhetsanordning, og det kontrolleres av den autoriteten som er ansvarlig for området.

Aviso Esta unidade foi concebida para instalação em áreas de acesso restrito. Uma área de acesso restrito é uma área à qual apenas tem acesso o pessoal de serviço autorizado, que possua uma ferramenta, chave e fechadura especial, ou qualquer outra forma de segurança. Esta área é controlada pela autoridade responsável pelo local.

¡Atención! Esta unidad ha sido diseñada para instalarse en áreas de acceso restringido. Área de acceso restringido significa un área a la que solamente tiene acceso el personal de servicio mediante la utilización de una herramienta especial, cerradura con llave, o algún otro medio de seguridad, y que está bajo el control de la autoridad responsable del local.

Varning! Denna enhet är avsedd för installation i områden med begränsat tillträde. Ett område med begränsat tillträde får endast tillträdas av servicepersonal med ett speciellt verktyg, lås och nyckel, eller annan säkerhetsanordning, och kontrolleras av den auktoritet som ansvarar för området.

RELATED DOCUMENTATION

Installation Safety Warnings for Juniper Networks Devices

Maintenance and Operational Safety Warnings for Juniper Networks Devices

General Electrical Safety Warnings for Juniper Networks Devices

DC Power Electrical Safety Warnings for Juniper Networks Devices

Preventing Electrostatic Discharge Damage to an MX104 Router

Many router hardware components are sensitive to damage from static electricity. Some components can be impaired by voltages as low as 30 V. You can easily generate potentially damaging static voltages whenever you handle plastic or foam packing material or if you move components across plastic or carpets. Observe the following guidelines to minimize the potential for electrostatic discharge (ESD) damage, which can cause intermittent or complete component failures:

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



CAUTION: For safety, periodically check the resistance value of the ESD strap. The measurement should be in the range of 1 to 10 Mohms.

- When handling any component that is removed from the chassis, make sure the equipment end of your ESD strap is attached to the electrostatic discharge point on the chassis (see [Figure 57 on page 183](#)).
- 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 58 on page 183](#)). If you are returning a component, place it in an electrostatic bag before packing it.

Figure 57: ESD Point on the MX104 Router Chassis

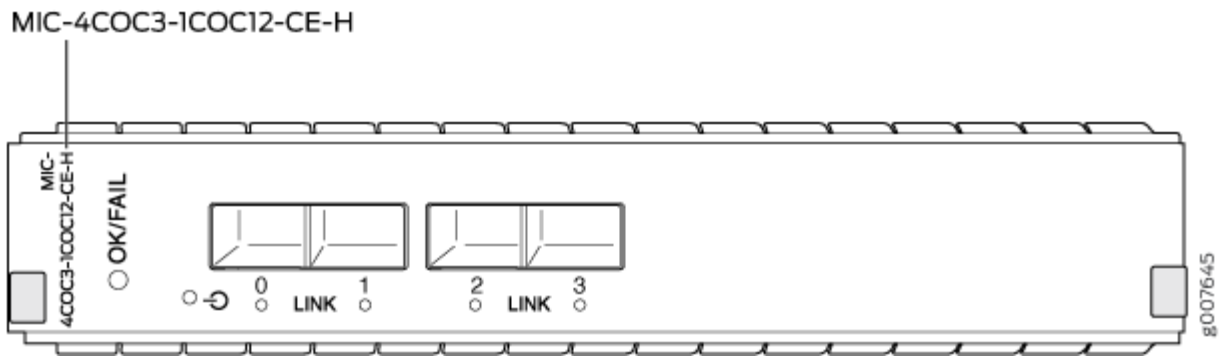
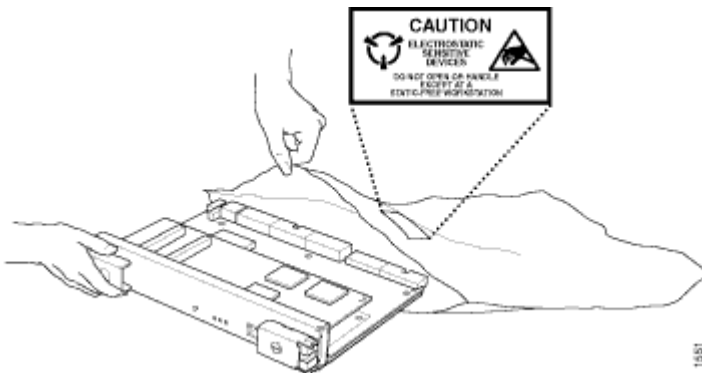


Figure 58: Placing a Component into an Electrostatic Bag



NOTE: [Figure 58 on page 183](#) shows a component that is not supported on MX104 routers.

RELATED DOCUMENTATION

| [Connecting the MX104 Router to Earth Ground](#) | 84

Installation Safety Warnings for Juniper Networks Devices

IN THIS SECTION

- [Intrabuilding Ports Warning | 184](#)
- [Installation Instructions Warning | 184](#)
- [Rack-Mounting Requirements and Warnings | 185](#)
- [Ramp Warning | 189](#)

Observe the following warnings before and during hardware equipment installation:

Intrabuilding Ports Warning



WARNING: The intrabuilding ports of the equipment or subassembly are suitable for connection to intrabuilding or unexposed wiring or cabling only. The intrabuilding ports of the equipment or subassembly **MUST NOT** be metalically connected to interfaces that connect to the Outside Plant (OSP) or its wiring. These interfaces are designed for use as intrabuilding interfaces only (Type 2 or Type 4 ports as described in GR-1089) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metalically to OSP wiring.

Installation Instructions Warning



WARNING: Read the installation instructions before you connect the hardware equipment to a power source.

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

Varoitus Lue asennusohjeet ennen järjestelmän yhdistämistä virtalähteeseen.

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

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

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

Advarsel Les installasjonsinstruksjonene før systemet kobles til strømkilden.

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

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

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

Rack-Mounting Requirements and Warnings

Ensure that the equipment rack into which the chassis is installed is evenly and securely supported, to avoid the hazardous condition that could result from uneven mechanical loading.



WARNING: To prevent bodily injury when mounting or servicing the chassis in a rack, take the following precautions to ensure that the system remains stable. The following directives help maintain your safety:

- The chassis must be installed into a rack that is secured to the building structure.
- The chassis should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting the chassis in a partially-filled rack, load the rack from the bottom to the top, with the heaviest component at the bottom of the rack.

- If the rack is provided with stabilizing devices, install the stabilizers before mounting the chassis in the rack or servicing the hardware equipment.

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

- De router moet in een stelling worden geïnstalleerd die aan een bouwsel is verankerd.
- Dit toestel dient onderaan in het rek gemonteerd te worden als het toestel het enige in het rek is.
- Wanneer u dit toestel in een gedeeltelijk gevuld rek monteert, dient u het rek van onderen naar boven te laden met het zwaarste onderdeel onderaan in het rek.
- Als het rek voorzien is van stabiliseringshulpmiddelen, dient u de stabilisatoren te monteren voordat u het toestel in het rek monteert of het daar een servicebeurt geeft.

Varoitus Kun laite asetetaan telineeseen tai huolletaan sen ollessa telineessä, on noudatettava erityisiä varotoimia järjestelmän vakavuuden säilyttämiseksi, jotta vältetään loukkaantumiselta. Noudata seuraavia turvallisuusohjeita:

- Router on asennettava telineeseen, joka on kiinnitetty rakennukseen.
- Jos telineessä ei ole muita laitteita, aseta laite telineen alaosaan.
- Jos laite asetetaan osaksi täytettyyn telineeseen, aloita kuormittaminen sen alaosasta kaikkein raskaimmalla esineellä ja siirry sitten sen yläosaan.
- Jos telinettä varten on vakaimet, asenna ne ennen laitteen asettamista telineeseen tai sen huoltamista siinä.

Attention Pour éviter toute blessure corporelle pendant les opérations de montage ou de réparation de cette unité en casier, il convient de prendre des précautions spéciales afin de maintenir la stabilité du système. Les directives ci-dessous sont destinées à assurer la protection du personnel:

- Le rack sur lequel est monté le router doit être fixé à la structure du bâtiment.
- Si cette unité constitue la seule unité montée en casier, elle doit être placée dans le bas.

- Si cette unité est montée dans un casier partiellement rempli, charger le casier de bas en haut en plaçant l'élément le plus lourd dans le bas.
- Si le casier est équipé de dispositifs stabilisateurs, installer les stabilisateurs avant de monter ou de réparer l'unité en casier.

Warnung Zur Vermeidung von Körperverletzung beim Anbringen oder Warten dieser Einheit in einem Gestell müssen Sie besondere Vorkehrungen treffen, um sicherzustellen, daß das System stabil bleibt. Die folgenden Richtlinien sollen zur Gewährleistung Ihrer Sicherheit dienen:

- Der router muß in einem Gestell installiert werden, das in der Gebäudestruktur verankert ist.
- Wenn diese Einheit die einzige im Gestell ist, sollte sie unten im Gestell angebracht werden.
- Bei Anbringung dieser Einheit in einem zum Teil gefüllten Gestell ist das Gestell von unten nach oben zu laden, wobei das schwerste Bauteil unten im Gestell anzubringen ist.
- Wird das Gestell mit Stabilisierungszubehör geliefert, sind zuerst die Stabilisatoren zu installieren, bevor Sie die Einheit im Gestell anbringen oder sie warten.

Avvertenza Per evitare infortuni fisici durante il montaggio o la manutenzione di questa unità in un supporto, occorre osservare speciali precauzioni per garantire che il sistema rimanga stabile. Le seguenti direttive vengono fornite per garantire la sicurezza personale:

- Il router deve essere installato in un telaio, il quale deve essere fissato alla struttura dell'edificio.
- Questa unità deve venire montata sul fondo del supporto, se si tratta dell'unica unità da montare nel supporto.
- Quando questa unità viene montata in un supporto parzialmente pieno, caricare il supporto dal basso all'alto, con il componente più pesante sistemato sul fondo del supporto.
- Se il supporto è dotato di dispositivi stabilizzanti, installare tali dispositivi prima di montare o di procedere alla manutenzione dell'unità nel supporto.

Advarsel Unngå fysiske skader under montering eller reparasjonsarbeid på denne enheten når den befinner seg i et kabinett. Vær nøye med at systemet er stabilt. Følgende retningslinjer er gitt for å verne om sikkerheten:

- Router må installeres i et stativ som er forankret til bygningsstrukturen.
- Denne enheten bør monteres nederst i kabinettet hvis dette er den eneste enheten i kabinettet.
- Ved montering av denne enheten i et kabinett som er delvis fylt, skal kabinettet lastes fra bunnen og opp med den tyngste komponenten nederst i kabinettet.
- Hvis kabinettet er utstyrt med stabiliseringsutstyr, skal stabilisatorene installeres før montering eller utføring av reparasjonsarbeid på enheten i kabinettet.

Aviso Para se prevenir contra danos corporais ao montar ou reparar esta unidade numa estante, deverá tomar precauções especiais para se certificar de que o sistema possui um suporte estável. As seguintes directrizes ajudá-lo-ão a efectuar o seu trabalho com segurança:

- O router deverá ser instalado numa prateleira fixa à estrutura do edifício.
- Esta unidade deverá ser montada na parte inferior da estante, caso seja esta a única unidade a ser montada.
- Ao montar esta unidade numa estante parcialmente ocupada, coloque os itens mais pesados na parte inferior da estante, arrumando-os de baixo para cima.
- Se a estante possuir um dispositivo de estabilização, instale-o antes de montar ou reparar a unidade.

¡Atención! Para evitar lesiones durante el montaje de este equipo sobre un bastidor, o posteriormente durante su mantenimiento, se debe poner mucho cuidado en que el sistema quede bien estable. Para garantizar su seguridad, proceda según las siguientes instrucciones:

- El router debe instalarse en un bastidor fijado a la estructura del edificio.
- Colocar el equipo en la parte inferior del bastidor, cuando sea la única unidad en el mismo.
- Cuando este equipo se vaya a instalar en un bastidor parcialmente ocupado, comenzar la instalación desde la parte inferior hacia la superior colocando el equipo más pesado en la parte inferior.

- Si el bastidor dispone de dispositivos estabilizadores, instalar éstos antes de montar o proceder al mantenimiento del equipo instalado en el bastidor.

Warning! För att undvika kroppsskada när du installerar eller utför underhållsarbete på denna enhet på en ställning måste du vidta särskilda försiktighetsåtgärder för att försäkra dig om att systemet står stadigt. Följande riktlinjer ges för att trygga din säkerhet:

- Router måste installeras i en ställning som är förankrad i byggnadens struktur.
- Om denna enhet är den enda enheten på ställningen skall den installeras längst ned på ställningen.
- Om denna enhet installeras på en delvis fylld ställning skall ställningen fyllas nedifrån och upp, med de tyngsta enheterna längst ned på ställningen.
- Om ställningen är försedd med stabiliseringsdon skall dessa monteras fast innan enheten installeras eller underhålls på ställningen.

Ramp Warning



WARNING: When installing the hardware equipment, do not use a ramp inclined at more than 10 degrees.

Waarschuwing Gebruik een oprijplaat niet onder een hoek van meer dan 10 graden.

Varoitus Älä käytä sellaista kaltevaa pintaa, jonka kaltevuus ylittää 10 astetta.

Attention Ne pas utiliser une rampe dont l'inclinaison est supérieure à 10 degrés.

Warnung Keine Rampen mit einer Neigung von mehr als 10 Grad verwenden.

Avvertenza Non usare una rampa con pendenza superiore a 10 gradi.

Advarsel Bruk aldri en rampe som heller mer enn 10 grader.

Aviso Não utilize uma rampa com uma inclinação superior a 10 graus.

¡Atención! No usar una rampa inclinada más de 10 grados

Varning! Använd inte ramp med en lutning på mer än 10 grader.

RELATED DOCUMENTATION

General Safety Guidelines for Juniper Networks Devices

General Safety Warnings for Juniper Networks Devices

Maintenance and Operational Safety Warnings for Juniper Networks Devices

General Laser Safety Guidelines for Juniper Networks Devices

Devices with single-mode optical interfaces are equipped with laser transmitters, which are considered Class 1 Laser product by the U.S. Food and Drug Administration, and are evaluated as a Class 1 Laser Product according to EN 60825-1 +A11 +A2 requirements.

When working around devices with optical interfaces, 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.

RELATED DOCUMENTATION

Laser Safety Warnings for Juniper Networks Devices

General Safety Warnings for Juniper Networks Devices

Laser Safety Warnings for Juniper Networks Devices

IN THIS SECTION

- [Class 1 Laser Product Warning | 191](#)
- [Class 1 LED Product Warning | 191](#)
- [Laser Beam Warning | 192](#)
- [Radiation from Open Port Apertures Warning | 193](#)

Class 1 Laser Product Warning



LASER WARNING: Class 1 laser product.

Waarschuwing Klasse-1 laser produkt.

Varoitus Luokan 1 lasertuote.

Attention Produit laser de classe I.

Warnung Laserprodukt der Klasse 1.

Avvertenza Prodotto laser di Classe 1.

Advarsel Laserprodukt av klasse 1.

Aviso Produto laser de classe 1.

¡Atención! Producto láser Clase I.

Varning! Laserprodukt av klass 1.

Class 1 LED Product Warning



LASER WARNING: Class 1 LED product.

Waarschuwing Klasse 1 LED-product.

Varoitus Luokan 1 valodiodituote.

Attention Alarme de produit LED Class I.

Warnung Class 1 LED-Produktwarnung.

Avvertenza Avvertenza prodotto LED di Classe 1.

Advarsel LED-produkt i klasse 1.

Aviso Produto de classe 1 com LED.

¡Atención! Aviso sobre producto LED de Clase 1.

Varning! Lysdiodprodukt av klass 1.

Laser Beam Warning



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.

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

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

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

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

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

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

Warning! 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-optic cable is connected, avoid exposure to radiation and do not stare into open apertures.

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

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

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

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

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

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

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

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

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

RELATED DOCUMENTATION

General Safety Guidelines for Juniper Networks Devices

General Safety Warnings for Juniper Networks Devices

Installation Safety Warnings for Juniper Networks Devices

Maintenance and Operational Safety Warnings for MX104 Routers

IN THIS SECTION

- [Battery Handling Warning | 195](#)
- [Jewelry Removal Warning | 196](#)
- [Lightning Activity Warning | 197](#)
- [Operating Temperature Warning | 198](#)
- [Product Disposal Warning | 199](#)

As you maintain the hardware equipment, observe the following warnings:

Battery Handling Warning



WARNING: Replacing the battery incorrectly might result in an explosion. Replace the battery only with the same or equivalent type recommended by the manufacturer.

Dispose of used batteries according to the manufacturer's instructions.

Waarschuwing Er is ontploffingsgevaar als de batterij verkeerd vervangen wordt. Vervang de batterij slechts met hetzelfde of een equivalent type dat door de fabrikant aanbevolen is. Gebruikte batterijen dienen overeenkomstig fabrieksvoorschriften weggegooid te worden.

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

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

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

Avvertenza Pericolo di esplosione se la batteria non è installata correttamente. Sostituire solo con una di tipo uguale o equivalente, consigliata dal produttore. Eliminare le batterie usate secondo le istruzioni del produttore.

Advarsel Det kan være fare for eksplosjon hvis batteriet skiftes på feil måte. Skift kun med samme eller tilsvarende type som er anbefalt av produsenten. Kasser brukte batterier i henhold til produsentens instruksjoner.

Aviso Existe perigo de explosão se a bateria for substituída incorrectamente. Substitua a bateria por uma bateria igual ou de um tipo equivalente recomendado pelo fabricante. Destrua as baterias usadas conforme as instruções do fabricante.

¡Atención! Existe peligro de explosión si la batería se reemplaza de manera incorrecta. Reemplazar la batería exclusivamente con el mismo tipo o el equivalente recomendado por el fabricante. Desechar las baterías gastadas según las instrucciones del fabricante.

Varning! Explosionsfara vid felaktigt batteribyte. Ersätt endast batteriet med samma batterityp som rekommenderas av tillverkaren eller motsvarande. Följ tillverkarens anvisningar vid kassering av använda batterier.

Jewelry Removal Warning



WARNING: Before working on equipment that is connected to power lines, remove jewelry, including rings, necklaces, and watches. Metal objects heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.

Waarschuwing Alvorens aan apparatuur te werken die met elektrische leidingen is verbonden, sieraden (inclusief ringen, kettingen en horloges) verwijderen. Metalen voorwerpen worden warm wanneer ze met stroom en aarde zijn verbonden, en kunnen ernstige brandwonden veroorzaken of het metalen voorwerp aan de aansluitklemmen lassen.

Varoitus Ennen kuin työskentelet voimavirtajohtoihin kytkettyjen laitteiden parissa, ota pois kaikki korut (sormukset, kaulakorut ja kellot mukaan lukien). Metalliesineet kuumenevat, kun ne ovat yhteydessä sähkövirran ja maan kanssa, ja ne voivat aiheuttaa vakavia palovammoja tai hitsata metalliesineet kiinni liitännänapoihin.

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

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

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

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

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

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

Varning! Tag av alla smycken (inklusive ringar, halsband och armbandsur) innan du arbetar på utrustning som är kopplad till kraftledningar. Metallobjekt hettas upp när de kopplas ihop med ström och jord och kan förorsaka allvarliga brännskador; metallobjekt kan också sammansvetsas med kontakterna.

Lightning Activity Warning



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

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

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

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

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

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

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

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

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

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

Operating Temperature Warning



WARNING: To prevent the hardware equipment from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature of 149° F (65° C). To prevent airflow restriction, allow at least 6 inches (15.2 cm) of clearance around the ventilation openings.

Waarschuwing Om te voorkomen dat welke router van de router dan ook oververhit raakt, dient u deze niet te bedienen op een plaats waar de maximale aanbevolen omgevingstemperatuur van 65° C wordt overschreden. Om te voorkomen dat de luchtstroom wordt beperkt, dient er minstens 15,2 cm speling rond de ventilatieopeningen te zijn.

Varoitus Ettei router-sarjan reititin ylikuumentuusi, sitä ei saa käyttää tilassa, jonka lämpötila ylittää korkeimman suositellun ympäristölämpötilan 65° C. Ettei ilmanvaihto estyisi, tuuletusaukkojen ympärille on jätettävä ainakin 15,2 cm tilaa.

Attention Pour éviter toute surchauffe des routeurs de la gamme router, ne l'utilisez pas dans une zone où la température ambiante est supérieure à 65° C. Pour permettre un flot d'air constant, dégagez un espace d'au moins 15,2 cm autour des ouvertures de ventilations.

Warnung Um einen router der router vor Überhitzung zu schützen, darf dieser nicht in einer Gegend betrieben werden, in der die Umgebungstemperatur das empfohlene Maximum von 65° C überschreitet. Um Lüftungsverschluß zu verhindern, achten Sie darauf, daß mindestens 15,2 cm lichter Raum um die Lüftungsöffnungen herum frei bleibt.

Avvertenza Per evitare il surriscaldamento dei router, non adoperateli in un locale che ecceda la temperatura ambientale massima di 65° C. Per evitare che la circolazione dell'aria sia impedita, lasciate uno spazio di almeno 15.2 cm di fronte alle aperture delle ventole.

Advarsel Unngå overoppheting av eventuelle rutere i router Disse skal ikke brukes på steder der den anbefalte maksimale omgivelsestemperaturen overstiger 65° C (149° F). Sørg for at klaringen rundt lufteåpningene er minst 15,2 cm (6 tommer) for å forhindre nedsatt luftsirkulasjon.

Aviso Para evitar o sobreaquecimento do encaminhador router, não utilize este equipamento numa área que exceda a temperatura máxima recomendada de 65° C. Para evitar a restrição à circulação de ar, deixe pelo menos um espaço de 15,2 cm à volta das aberturas de ventilação.

¡Atención! Para impedir que un encaminador de la serie router se recaliente, no lo haga funcionar en un área en la que se supere la temperatura ambiente máxima recomendada de 65° C. Para impedir la restricción de la entrada de aire, deje un espacio mínimo de 15,2 cm alrededor de las aperturas para ventilación.

Warning! Förhindra att en router överhettas genom att inte använda den i ett område där den maximalt rekommenderade omgivningstemperaturen på 65° C överskrids. Förhindra att luftcirkulationen inskränks genom att se till att det finns fritt utrymme på minst 15,2 cm omkring ventilationsöppningarna.

Product Disposal Warning



WARNING: Disposal of this product must be handled according to all national laws and regulations.

Waarschuwing Dit produkt dient volgens alle landelijke wetten en voorschriften te worden afgedankt.

Varoitus Tämän tuotteen lopullisesta hävittämisestä tulee huolehtia kaikkia valtakunnallisia lakeja ja säännöksiä noudattaen.

Attention La mise au rebut définitive de ce produit doit être effectuée conformément à toutes les lois et réglementations en vigueur.

Warnung Dieses Produkt muß den geltenden Gesetzen und Vorschriften entsprechend entsorgt werden.

Avvertenza L'eliminazione finale di questo prodotto deve essere eseguita osservando le normative italiane vigenti in materia

Advarsel Endelig disponering av dette produktet må skje i henhold til nasjonale lover og forskrifter.

Aviso A descartagem final deste produto deverá ser efectuada de acordo com os regulamentos e a legislação nacional.

¡Atención! El desecho final de este producto debe realizarse según todas las leyes y regulaciones nacionales

Warning! Slutlig kassering av denna produkt bör skötas i enlighet med landets alla lagar och föreskrifter.

RELATED DOCUMENTATION

[General Safety Guidelines for Juniper Networks Devices | 178](#)

[General Safety Warnings for Juniper Networks Devices | 179](#)

In Case of 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 router.
3. If possible, send another person to get medical aid. Otherwise, assess the condition of the victim, then call for help.

RELATED DOCUMENTATION

[General Safety Guidelines for Juniper Networks Devices](#)

[General Safety Warnings for Juniper Networks Devices](#)

General Electrical Safety Warnings for Juniper Networks Devices

IN THIS SECTION

- [Grounded Equipment Warning | 201](#)
- [Grounding Requirements and Warning | 201](#)
- [Midplane Energy Hazard Warning | 202](#)
- [Multiple Power Supplies Disconnection Warning | 202](#)
- [Power Disconnection Warning | 203](#)

Grounded Equipment Warning



WARNING: The network device is intended to be grounded. Ensure that the network device is connected to earth ground during normal use.

Waarschuwing Deze apparatuur hoort geaard te worden. Zorg dat de host-computer tijdens normaal gebruik met aarde is verbonden.

Varoitus Tämä laitteisto on tarkoitettu maadoitettavaksi. Varmista, että isäntälaitte on yhdistetty maahan normaalikäytön aikana.

Attention Cet équipement doit être relié à la terre. S'assurer que l'appareil hôte est relié à la terre lors de l'utilisation normale.

Warnung Dieses Gerät muß geerdet werden. Stellen Sie sicher, daß das Host-Gerät während des normalen Betriebs an Erde gelegt ist.

Avvertenza Questa apparecchiatura deve essere collegata a massa. Accertarsi che il dispositivo host sia collegato alla massa di terra durante il normale utilizzo.

Advarsel Dette utstyret skal jordes. Forviss deg om vertsterminalen er jordet ved normalt bruk.

Aviso Este equipamento deverá estar ligado à terra. Certifique-se que o host se encontra ligado à terra durante a sua utilização normal.

¡Atención! Este equipo debe conectarse a tierra. Asegurarse de que el equipo principal esté conectado a tierra durante el uso normal.

Warning! Denna utrustning är avsedd att jordas. Se till att värdenheten är jordad vid normal användning.

Grounding Requirements and Warning

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



WARNING: When installing the network device, you must always make the ground connection first and disconnect it last.

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

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

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

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

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

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

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

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

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

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.

Attention Cette unité est équipée de plusieurs raccordements d'alimentation. Pour supprimer tout courant électrique de l'unité, tous les cordons d'alimentation doivent être débranchés.

Warnung Diese Einheit verfügt über mehr als einen Stromanschluß; um Strom gänzlich von der Einheit fernzuhalten, müssen alle Stromzufuhren abgetrennt sein.

Avvertenza Questa unità ha più di una connessione per alimentatore elettrico; tutte le connessioni devono essere completamente rimosse per togliere l'elettricità dall'unità.

Advarsel Denne enheten har mer enn én strømtilkobling. Alle tilkoblinger må kobles helt fra for å eliminere strøm fra enheten.

Aviso Este dispositivo possui mais do que uma conexão de fonte de alimentação de energia; para poder remover a fonte de alimentação de energia, deverão ser desconectadas todas as conexões existentes.

¡Atención! Esta unidad tiene más de una conexión de suministros de alimentación; para eliminar la alimentación por completo, deben desconectarse completamente todas las conexiones.

Warning! Denna enhet har mer än en strömförsörjningsanslutning; alla anslutningar måste vara helt avlägsnade innan strömtillförseln till enheten är fullständigt bruten.

Power Disconnection Warning



WARNING: Before working on the chassis or near power supplies, switch off the power at the DC circuit breaker.

Waarschuwing Voordat u aan een frame of in de nabijheid van voedingen werkt, dient u bij wisselstroom toestellen de stekker van het netsnoer uit het stopcontact te halen; voor gelijkstroom toestellen dient u de stroom uit te schakelen bij de stroomverbreker.

Varoitus Kytke irti vaihtovirtalaitteiden virtajohto ja katkaise tasavirtalaitteiden virta suojakytkimellä, ennen kuin teet mitään asennuspohjalle tai työskentelet virtalähteiden läheisyydessä.

Attention Avant de travailler sur un châssis ou à proximité d'une alimentation électrique, débrancher le cordon d'alimentation des unités en courant alternatif; couper l'alimentation des unités en courant continu au niveau du disjoncteur.

Warnung Bevor Sie an einem Chassis oder in der Nähe von Netzgeräten arbeiten, ziehen Sie bei Wechselstromeinheiten das Netzkabel ab bzw. schalten Sie bei Gleichstromeinheiten den Strom am Unterbrecher ab.

Avvertenza Prima di lavorare su un telaio o intorno ad alimentatori, scollegare il cavo di alimentazione sulle unità CA; scollegare l'alimentazione all'interruttore automatico sulle unità CC.

Advarsel Før det utføres arbeid på kabinettet eller det arbeides i nærheten av strømforsyningsenheter, skal strømleningen trekkes ut p vekselstrømsenheter og strømmen kobles fra ved strømbryteren på likestrømsenheter.

Aviso Antes de trabalhar num chassis, ou antes de trabalhar perto de unidades de fornecimento de energia, desligue o cabo de alimentação nas unidades de corrente alternada; desligue a corrente no disjuntor nas unidades de corrente contínua.

¡Atención! Antes de manipular el chasis de un equipo o trabajar cerca de una fuente de alimentación, desenchufar el cable de alimentación en los equipos de corriente alterna (CA); cortar la alimentación desde el interruptor automático en los equipos de corriente continua (CC).

Warning! Innan du arbetar med ett chassi eller nära strömförsörjningsenheter skall du för växelströmsenheter dra ur nätsladden och för likströmsenheter bryta strömmen vid överspänningsskyddet.

RELATED DOCUMENTATION

| *DC Power Electrical Safety Warnings for Juniper Networks Devices*

General Electrical Safety Guidelines and Electrical Codes for Juniper Networks Devices

- Install the device in compliance with the following local, national, or international electrical codes:
 - United States—National Fire Protection Association (NFPA 70), United States National Electrical Code.
 - Canada—Canadian Electrical Code, Part 1, CSA C22.1.
 - Other countries—International Electrotechnical Commission (IEC) 60364, Part 1 through Part 7.
- Locate the emergency power-off switch for the room in which you are working so that if an electrical accident occurs, you can quickly turn off the power.
- Do not work alone if potentially hazardous conditions exist anywhere in your workspace.
- Never assume that power is disconnected from a circuit. Always check the circuit before starting to work.
- Carefully look for possible hazards in your work area, such as moist floors, ungrounded power extension cords, and missing safety grounds.
- Operate the device within marked electrical ratings and product usage instructions.
- For the device and peripheral equipment to function safely and correctly, use the cables and connectors specified for the attached peripheral equipment, and make certain they are in good condition.

Many device components can be removed and replaced without powering off or disconnecting power to the device. Never install equipment if it appears damaged.

RELATED DOCUMENTATION

| *In Case of an Electrical Accident*

MX104 AC Power Electrical Safety Guidelines and Warnings

The following electrical safety guidelines apply to an AC-powered router:

- You can order three-wire electrical cords with a grounding-type plug that fits only a grounding-type power outlet. Do not circumvent this safety feature. Equipment grounding should comply with local and national electrical codes.
- Each AC power supply has one AC appliance inlet. Each inlet requires a dedicated AC power feed and a dedicated customer-site circuit breaker. For the recommended circuit breaker rating, see ["MX104 AC Power Specifications" on page 20](#).



WARNING: The router is pluggable type A equipment installed in a restricted-access location.

- 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.
- The cores in the main lead are colored in accordance with the following code:
 - Green and yellow—Earth
 - Blue—Neutral
 - Brown—Live
- When a router is equipped with two AC power supplies, you must unplug both power cords (one for each power supply) to completely disconnect power to the router.



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。

RELATED DOCUMENTATION

[MX104 AC Power Specifications | 20](#)

[MX104 AC Power Cord Specifications | 21](#)

[Connecting AC Power Cords to the MX104 Router | 86](#)

MX104 DC Power Electrical Safety Guidelines

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

- A DC-powered router is equipped with a DC terminal block that is rated for the power requirements of a maximally configured router. To supply sufficient power, terminate the DC input wiring on a facility DC source capable of supplying the rating specified in "[MX104 DC Power Specifications](#)" on [page 23](#) per input for each power supply.

Incorporate an easily accessible disconnect device into the facility wiring. In the United States and Canada, the 48-VDC facility should be equipped with a circuit breaker rated a minimum of 125 percent of the power provisioned for the input in accordance with the National Electrical Code in the US and the Canadian Electrical Code in Canada.

- Run two wires from the circuit breaker box to a source of 24, -60, or -48 VDC. Use appropriate gauge wire as specified in "[MX104 DC Power Cable and Lug Specifications](#)" on [page 25](#).
- Be sure to connect the ground wire or conduit to a solid office (earth) ground. We recommend a closed loop ring for terminating the ground conductor at the ground stud.
- A DC-powered router that is equipped with a DC terminal block is intended only for installation in a restricted access location. In the United States, a restricted access area is one in accordance with Articles 110-16, 110-17, and 110-18 of the National Electrical Code ANSI/NFPA 70.

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

- Ensure that the polarity of the DC input wiring is correct. Under certain conditions, connections with reversed polarity might trip the primary circuit breaker or damage the equipment.
- For personal safety, connect the green and yellow wire to safety (earth) ground at both the router and the supply side of the DC wiring.

- The marked input voltage for a DC-powered router is the nominal voltage associated with the battery circuit, and any higher voltages are only to be associated with float voltages for the charging function.
- Because the router is a positive ground system, you must connect the positive lead to the terminal labeled +, the negative lead to the terminal labeled –, and the earth ground to the chassis grounding points.

RELATED DOCUMENTATION

[DC Power Electrical Safety Warnings for Juniper Networks Devices | 208](#)

DC Power Electrical Safety Warnings for Juniper Networks Devices

IN THIS SECTION

- [DC Power Copper Conductors Warning | 208](#)
- [DC Power Disconnection Warning | 209](#)
- [DC Power Wiring Terminations Warning | 210](#)

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

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 procedures on power supplies, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position.

Waarschuwing Voordat u een van de onderstaande procedures uitvoert, dient u te controleren of de stroom naar het gelijkstroom circuit uitgeschakeld is. Om u ervan te verzekeren dat alle stroom UIT is geschakeld, kiest u op het schakelbord de stroomverbreker die het gelijkstroom circuit bedient, draait de stroomverbreker naar de UIT positie en plakt de schakelaarhendel van de stroomverbreker met plakband in de UIT positie vast.

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

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

Warning! Innan du utför någon av följande procedurer måste du kontrollera att strömförsörjningen till likstrømskretsen är bruten. Kontrollera att all strömförsörjning är BRUTEN genom att slå AV det överspänningsskydd som skyddar likstrømskretsen och tejpa fast överspänningsskyddets omkopplare i FRÅN-läget.

DC Power Wiring Terminations Warning



WARNING: When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations must be the appropriate size for the wires and must clamp both the insulation and conductor.

Waarschuwing Wanneer geslagen bedrading vereist is, dient u bedrading te gebruiken die voorzien is van goedgekeurde aansluitpunten, 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 johdinliitääntää, esimerkiksi suljettua silmukkaa tai kourumaista liitääntää, jossa on ylöspäin käännetyt kiinnityskorvat. Tällaisten liitääntöjen tulee olla kooltaan johtimiin sopivia ja niiden tulee puristaa yhteen sekä eristeen että johdinosan.

Attention Quand des fils torsadés sont nécessaires, utiliser des douilles terminales homologuées telles que celles à circuit fermé ou du type à plage ouverte avec cosses rebroussées. Ces douilles terminales doivent être de la taille qui convient aux fils et doivent être refermées sur la gaine isolante et sur le conducteur.

Warnung Wenn Litzenverdrahtung erforderlich ist, sind zugelassene Verdrahtungsabschlüsse, z.B. Ringoesen oder gabelförmige Kabelschuhe mit nach oben gerichteten Enden zu verwenden. Diese Abschlüsse sollten die angemessene Größe für die Drähte haben und sowohl die Isolierung als auch den Leiter festklemmen.

Avvertenza Quando occorre usare trecce, usare connettori omologati, come quelli a occhio o a forcilla con linguette rivolte verso l'alto. I connettori devono avere la misura adatta per il cablaggio e devono serrare sia l'isolante che il conduttore.

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

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 slutet eller öppen typ med uppåtvänd tapp. Storleken på dessa

kontakter måste vara avpassad till ledningarna och måste kunna hålla både isoleringen och ledaren fastklämda.

RELATED DOCUMENTATION

General Safety Warnings for Juniper Networks Devices

General Electrical Safety Warnings for Juniper Networks Devices

Site Electrical Wiring Guidelines for MX104 Routers

IN THIS SECTION

- [Distance Limitations for Signaling | 212](#)
- [Radio Frequency Interference | 212](#)
- [Electromagnetic Compatibility | 213](#)

Distance Limitations for Signaling

Improperly installed wires can emit radio interference. In addition, the potential for damage from lightning strikes increases if wires exceed recommended distances or if wires pass between buildings. The electromagnetic pulse (EMP) caused by lightning can damage unshielded conductors and destroy electronic devices. If your site has previously experienced such problems, you might want to consult experts in electrical surge suppression and shielding.

Radio Frequency Interference

You can reduce or eliminate the emission of radio frequency interference (RFI) from your site wiring by using twisted-pair cable with a good distribution of grounding conductors. If you must exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

Electromagnetic Compatibility

If your site is susceptible to problems with electromagnetic compatibility (EMC), particularly from lightning or radio transmitters, you might want to seek expert advice. Strong sources of electromagnetic interference (EMI) can destroy the signal drivers and receivers in the router and conduct power surges over the lines into the equipment, resulting in an electrical hazard. It is particularly important to provide a properly grounded and shielded environment and to use electrical surge-suppression devices.



WARNING: The intrabuilding port(s) of the equipment or subassembly is suitable for connection to intrabuilding or unexposed wiring or cabling only. The intrabuilding port(s) of the equipment or subassembly **MUST NOT** be metalically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intrabuilding interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE, Issue 4) and require isolation from the exposed OSP cabling. The addition of primary protectors is not sufficient protection to connect these interfaces metalically to OSP wiring.



CAUTION: To comply with intrabuilding lightning and surge requirements, intrabuilding wiring must be shielded, and the shield for the wiring must be grounded at both ends.

RELATED DOCUMENTATION

[General Safety Guidelines for Juniper Networks Devices | 178](#)

[General Safety Warnings for Juniper Networks Devices | 179](#)

Agency Approvals for MX104 Routers

IN THIS SECTION

- [Compliance Statement for Argentina | 215](#)

The MX104 router complies with the following standards:

- Safety:
 - CAN/CSA-22.2 No. 60950-1 (2007), Safety of Information Technology Equipment
 - UL 60950-1 Information Technology Equipment—Safety - Part 1: General Requirements
 - EN 60950-1 European Norm, Safety of Information Technology Equipment
 - IEC 60950-1 Information Technology Equipment—Safety - Part 1: General Requirements (with country deviations)
 - EN 60825-1 Safety of Laser Products—Part 1: Equipment Classification, Requirements and User's Guide
- EMC:
 - EN 300 386 V1.3.3 Telecom Network Equipment - EMC Requirements
- EMI:
 - FCC Part 15 Class A USA Radiated Emissions
 - EN 55022 Class A European Radiated Emissions
 - VCCI Class A Japanese Radiated Emissions
 - BSMI CNS 13438 and NCC C6357 Taiwan Radiated Emissions
- Immunity:
 - EN 55024 Information Technology Equipment Immunity Characteristics
 - EN-61000-3-2 Power Line Harmonics
 - EN-61000-3-3 Power Line Voltage Fluctuations
 - EN-61000-4-2 Electrostatic Discharge
 - EN-61000-4-3 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
- ETSI:

- ETSI EN-300 019: Environmental Conditions & Environmental Tests for Telecommunications Equipment
- ETSI EN 300 019-2-1 (2000) – Storage
- ETSI EN 300 019-2-2 (1999)—Transportation
- ETSI EN 300 019-2-4 (2003)—Stationary Use at Non-Weather-protected Locations
- ETS 300753 (1997)—Acoustic noise emitted by telecommunications equipment
- GR-3108-CORE Issue 2, December 2008—Generic Requirements for Network Equipment in the Outside Plant (OSP)

NEBS Level 3 Compliant:

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

Compliance Statement for Argentina

EQUIPO DE USO IDÓNEO.

RELATED DOCUMENTATION

[Compliance Statements for EMC Requirements for MX104 Routers | 216](#)

[Compliance Statements for NEBS for MX104 Routers | 215](#)

[Compliance Statements for Acoustic Noise for MX104 Routers | 218](#)

[Compliance Statements for Environmental Requirements | 218](#)

Compliance Statements for NEBS for MX104 Routers

- The equipment is suitable for installation as part of the Common Bonding Network (CBN).

- The equipment is suitable for installation in locations where the National Electrical Code (NEC) applies.
- The battery return connection is to be treated as an isolated DC return (i.e. DC-I), as defined in GR-1089-CORE.

RELATED DOCUMENTATION

[Agency Approvals for MX104 Routers | 213](#)

[Compliance Statements for EMC Requirements for MX104 Routers | 216](#)

[Compliance Statements for Acoustic Noise for MX104 Routers | 218](#)

[Compliance Statements for Environmental Requirements | 218](#)

Compliance Statements for EMC Requirements for MX104 Routers

IN THIS SECTION

- [Canada | 216](#)
- [European Community | 217](#)
- [Israel | 217](#)
- [Japan | 217](#)
- [United States | 217](#)

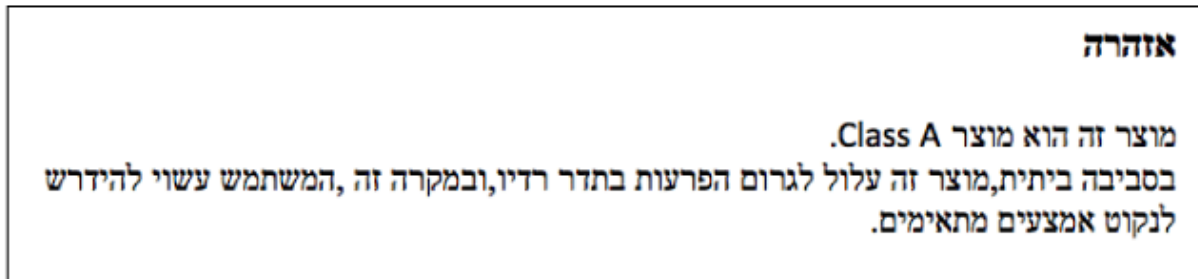
Canada

CAN ICES-3 (A)/NMB-3(A)

European Community

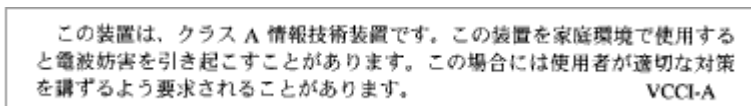
This is a Class A product. In a domestic environment, this product might cause radio interference in which case the user might be required to take adequate measures.

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.

RELATED DOCUMENTATION

[Agency Approvals for MX104 Routers | 213](#)

[Compliance Statements for NEBS for MX104 Routers | 215](#)

[Compliance Statements for Acoustic Noise for MX104 Routers | 218](#)

[Compliance Statements for Environmental Requirements | 218](#)

Compliance Statements for Environmental Requirements

Batteries in this product are not based on mercury, lead, or cadmium substances. The batteries used in this product are in compliance with EU Directives 91/157/EEC, 93/86/EEC, and 98/101/EEC. The product documentation includes instructional information about the proper method of reclamation and recycling.

Compliance Statements for Acoustic Noise for MX104 Routers

The router complies with NEBS Level 3 requirements:

- GR-63-CORE: NEBS, Physical Protection
- GR-1089-CORE: EMC and Electrical Safety for Network Telecommunications Equipment

RELATED DOCUMENTATION

[Compliance Statements for NEBS for MX104 Routers | 215](#)

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