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MX104 Universal Routing Platform Hardware Guide

Modified: 2018-12-02

MX104 Universal Routing Platform Hardware Guide

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

YEAR 2000 NOTICE

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

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About the Documentation

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

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Documentation Conventions

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

Table 1: Notice Icons

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

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

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the **configure** command: user@host> **configure**
`Fixed-width text like this`	Represents output that appears on the terminal screen.	`user@host>` **show chassis alarms** `No alarms currently active`
Italic text like this	• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User Guide* • RFC 1997, *BGP Communities Attribute*
Italic text like this	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# **set system domain-name** *domain-name*

Table 2: Text and Syntax Conventions (continued)

Convention	Description	Examples
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• To configure a stub area, include the **stub** statement at the **[edit protocols ospf area area-id]** hierarchy level. • The console port is labeled **CONSOLE**.
< > (angle brackets)	Encloses optional keywords or variables.	stub <default-metric *metric* >;
| (pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	broadcast | multicast (*string1* | *string2* | *string3*)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	community name members [*community-ids*]

Indention and braces ({ })	Identifies a level in the configuration hierarchy.	[edit]
		routing-options {
		  static {
		    route default {
		      nexthop *address*;
		      retain;
		    }
		  }
		}

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

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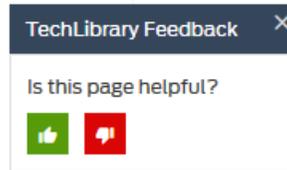
- Click the thumbs-up icon if the information on the page was helpful to you.

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- Product warranties—For product warranty information, visit https://www.juniper.net/support/warranty/.

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- Search for known bugs: https://prsearch.juniper.net/

- Find product documentation: https://www.juniper.net/documentation/

- Find solutions and answer questions using our Knowledge Base: https://kb.juniper.net/

- Download the latest versions of software and review release notes: https://www.juniper.net/customers/csc/software/

- Search technical bulletins for relevant hardware and software notifications: https://kb.juniper.net/InfoCenter/

- Join and participate in the Juniper Networks Community Forum:
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- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

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

CHAPTER 1

Overview

MX104 Universal Routing Platform Overview

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/.

The chassis is a rigid sheet metal structure that houses all the other router components (see Figure 1 on page 20 and Figure 2 on page 20). 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
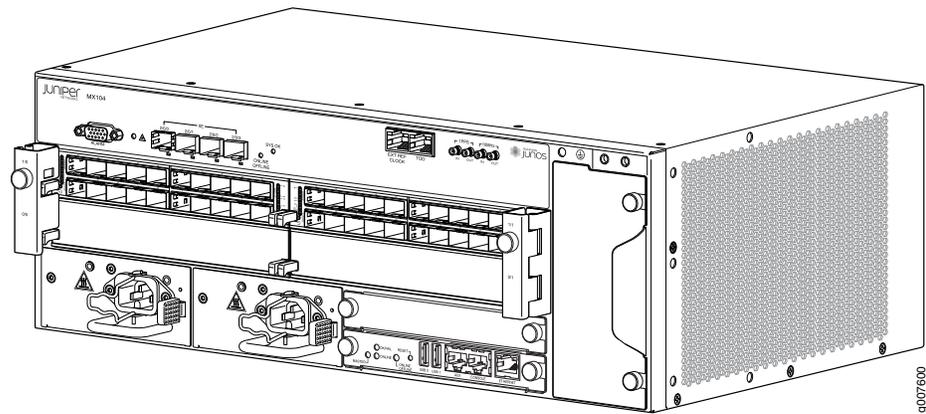
Figure 2: Rear View of the MX104 Router

Related
Documentation

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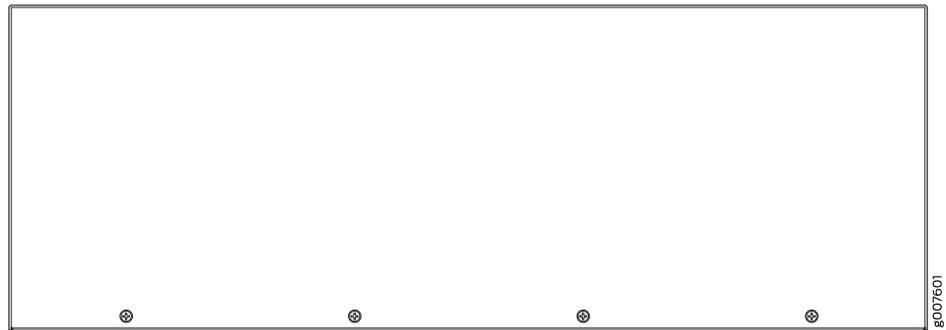
MX104 Chassis

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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 22):

- 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 69.

- 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
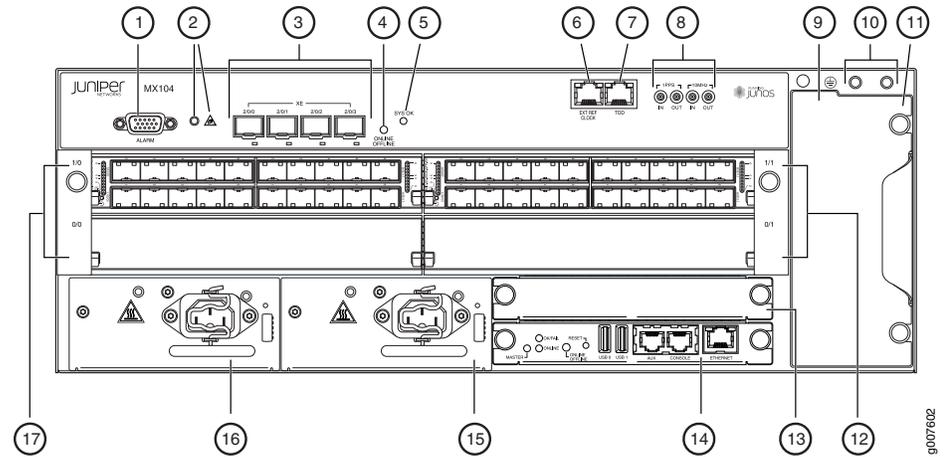
1—Alarm input and output contacts	10—Grounding terminals
2—Alarm LEDs	11—Fan tray
3—10-Gigabit Ethernet SFP+ ports	12—MIC slots 0/1 and 1/1
4—Online/offline button	13—Routing Engine slot 1
5—System status LED	14—Routing Engine slot 0
6—External reference clocking port	15—Power supply slot 1
7—Time-of-day (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 , listed in alphabetic order.

Table 3: 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 19
Cooling system, including fan trays and air filters			"MX104 Cooling System and Airflow Overview" on page 27
Air filter kit	FLTR-KIT-MX104	N/A	
Fan tray	FANTRAY-MX104	**Fan Tray**	

Table 3: MX104 Routers Hardware Components and CLI Terminology (continued)

Component	Hardware Model Number	CLI Name	Description
Power system components			"MX104 Power Overview" on page 29
Power blank cover	PWR-BLANK-MX104	N/A	
Power supply	• AC: PWR-MX104-AC • DC: PWR-MX104-DC	**PEM**	
MIC	N/A (built-in)	4x 10GE(LAN) SFP+	"MX104 Modular Interface Card (MIC) Overview" on page 59
	See *MX Series Interface Module Reference*.		"MX104 Modular Interface Card (MIC) Overview" on page 59
MPC	N/A (built-in)	**FPC**	"MX104 Modular Interface Card (MIC) Overview" on page 59
Routing Engine	RE-S-MX104	**Routing Engine**	"MX104 Routing Engine Overview" on page 36
Transceiver	See *MX Series Interface Module Reference*.	**Xcvr**	"MX104 Modular Interface Card (MIC) Overview" on page 59

See Also • MX104 Port and Interface Numbering on page 69

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 master and the other functions as the backup. If the master Routing Engine fails, the backup can take over as the master.

- 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 4 on page 24 describes the functions of the alarm contacts.

Table 4: 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.
	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 25 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

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
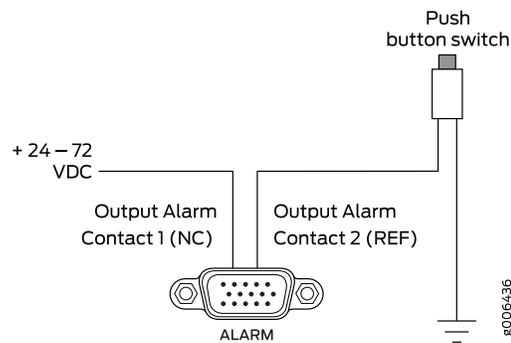
See Also •

MX104 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: Alarm LEDs on the MX104 Router
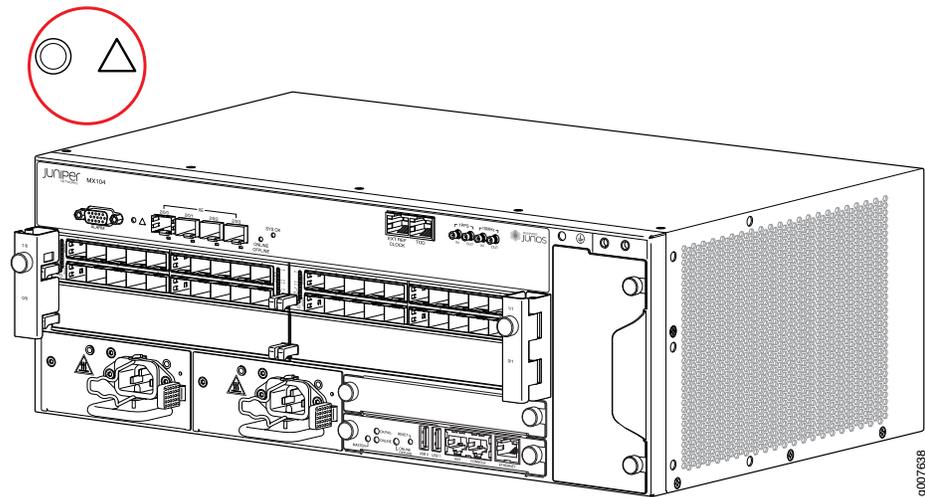
describes the alarm LED in more detail.

Table 5: 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. describes the system LED in more detail.

Table 6: System LED on the Front Panel

Label	Color	State	Description
SYS OK	Green	Blinking	Router has no master 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 59.

Power Supply LED

One LED labeled **PS STATUS** indicates the status of the power supply. For more information, see "MX104 Power Overview" on page 29.

Routing Engine LEDs

Three LEDs indicate the status of the Routing Engine. For more information, see "MX104 Routing Engine Overview" on page 36.

See Also   • Troubleshooting Resources for MX104 Routers on page 157

MX104 Cooling System and Airflow Overview

The cooling system in an MX104 router consists of the following components (see Figure 7 on page 27):

• Fan tray

• Air filter

Figure 7: MX104 Fan Tray and Air Filter
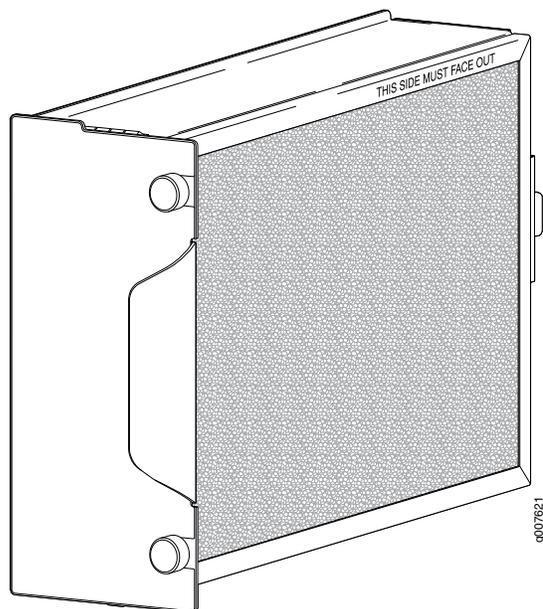
The router has one hot-swappable fan tray that contains five fans. The air filter installs into the side of the fan tray. The air intake to cool the chassis is located on the right side of the chassis next to the air filter. Air is pulled through the air filter toward the fan tray, where it is exhausted out the left side of the system (see Figure 8 on page 28). 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
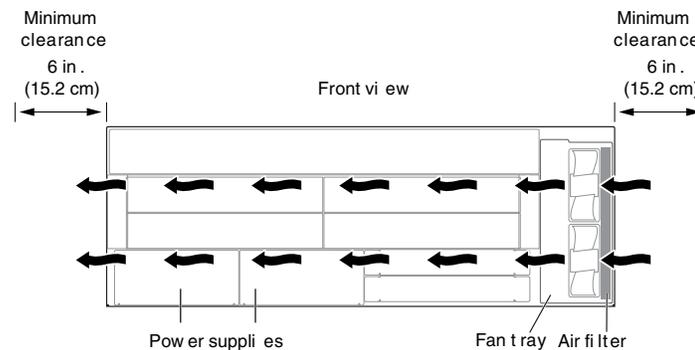
The cooling system components work together to keep all router components within the acceptable temperature range. The chassis monitors the temperature of the router components. When the router is operating normally, the fans function at lower than full speed. If a fan fails or the ambient temperature 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 on page 75

- Maintaining the MX104 Air Filter on page 129

- Rack Requirements for MX104 Routers on page 81

- Cabinet Requirements for MX104 Routers on page 82

- Clearance Requirements for Airflow and Hardware Maintenance on MX104 Routers on page 83

- MX104 Router Environmental Specifications on page 77

MX104 Power System

- MX104 Power Overview on page 29
- MX104 Power Consumption on page 31
- MX104 AC Power Specifications on page 31
- MX104 AC Power Cord Specifications on page 32
- MX104 DC Power Specifications on page 34
- MX104 DC Power Cable and Lug Specifications on page 34

MX104 Power Overview

The MX104 router uses either AC or DC power supplies (see Figure 9 on page 29 and Figure 10 on page 30). 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 on page 29
- DC Power Supplies on page 30
- Power Supply LEDs on page 30

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 29 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
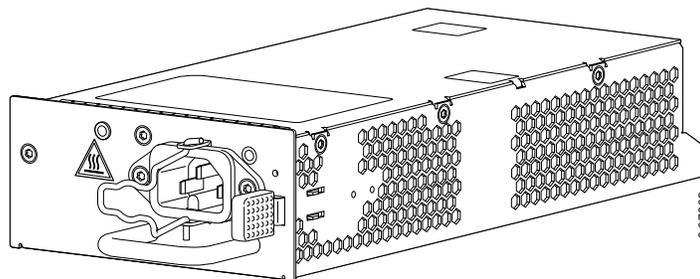
> ⚡ **WARNING:** The router is pluggable type A equipment installed in a restricted-access location. It has a separate protective earthing terminal

(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 30 shows the power supply.

Figure 10: DC Power Supply
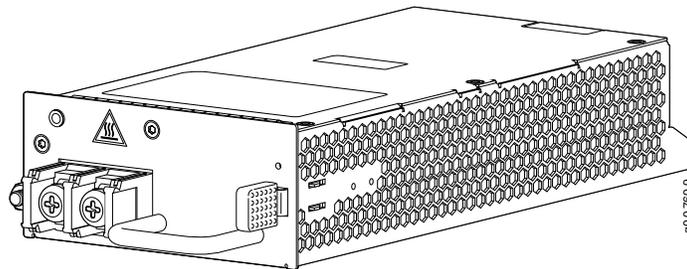
Power Supply LEDs

One LED labeled **PS STATUS** indicates the status of the power supply. Table 7 on page 30 describes the system LED in more detail.

Table 7: 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 on page 104
- Connecting DC Power Cables to the MX104 Router on page 106

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 8 on page 31 lists the power consumed by the MX104 router.

> *i* 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 8: 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 on page 106
- MX104 DC Power Electrical Safety Guidelines on page 194

MX104 AC Power Specifications

Table 9 on page 31 lists the AC power electrical specifications.

Table 9: 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	

Table 9: AC Power Electrical Specifications (continued)

Item	Specification
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 on page 104
- Replacing an MX104 AC Power Supply on page 147
- MX104 AC Power Electrical Safety Guidelines and Warnings on page 193

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

Table 10 on page 32 provides specifications on the AC power cord provided for each country or region.

Table 10: 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/NZZS 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

Table 10: AC Power Cord Specifications (continued)

Country	Model Number	Electrical Specification	Plug Type	Design Standard
India	CBL-PWR-C15M-HITEMP-IN	250 VAC, 10 A, 50 Hz	ZA/3	SABS 164/1:1992
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。

g017253

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 149º F (65º C) for ambient temperatures up to 140º F (60º C).

See Also
- Connecting AC Power Cords to the MX104 Router on page 104
- Replacing an MX104 AC Power Supply on page 147
- MX104 AC Power Electrical Safety Guidelines and Warnings on page 193

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 11 on page 34.

Table 11: DC Power Electrical Specifications

Item	Specification
Power Supplies	
DC input voltages	18 to 30 VDC; nominal 24 VDC −39 to −56 VDC; nominal 48 VDC −39 to −72 VDC; nominal 60 VDC
DC input currents	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 on page 106
- Replacing an MX104 DC Power Supply on page 149
- MX104 DC Power Electrical Safety Guidelines on page 194
- DC Power Electrical Safety Warnings for Juniper Networks Devices on page 195

MX104 DC Power Cable and Lug Specifications

- DC Power Cable Lug Specifications on page 35
- DC Power Cable Specifications on page 35

DC Power Cable Lug Specifications

Use cable lugs with the specifications shown in to attach each DC power cable to the DC power supply.

Figure 11: DC Power Cable Lug
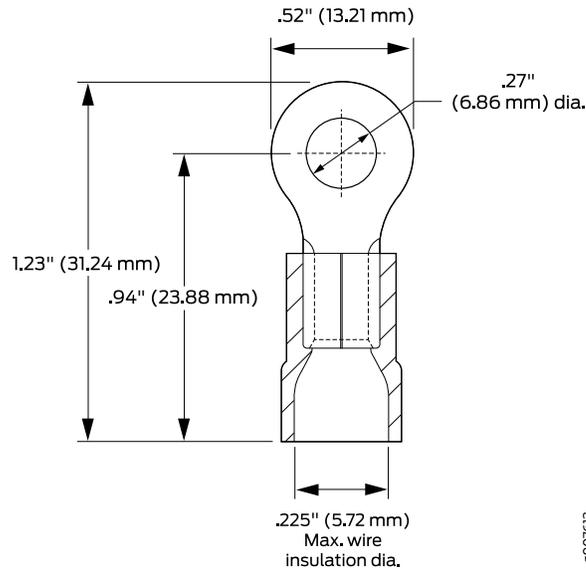
> ⚠ **CAUTION:** Before router installation begins, a licensed electrician must attach a cable lug to the grounding and power cables that you supply. A cable with an incorrectly attached lug can damage the router.

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 mm^2), minimum 90º C wire, or as required by the local code.

See Also
-
-
-
-

MX104 Host Subsystem

-
-
-

MX104 Routing Engine Overview

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 master and the other acts as the backup. If the master Routing Engine fails or is removed and the backup is configured appropriately, the backup takes over as the master. The backup Routing Engine is hot-insertable and hot-removable.

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

Figure 12: MX104 Routing Engine
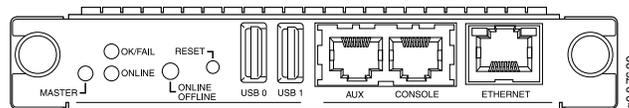
- MX104 Routing Engine Components on page 36
- MX104 Routing Engine Buttons on page 37
- MX104 Routing Engine LEDs on page 37
- MX104 Boot Sequence on page 38

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 37.

- 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 37).

- Reset button—Reboots the Routing Engine when pressed (see "MX104 Routing Engine Buttons" on page 37).

- LEDs—Indicates the status of the Routing Engine and its ports (see "MX104 Routing Engine LEDs" on page 37)

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 12 on page 37 describes the functions of the buttons.

Table 12: 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.
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 13 on page 37 describes the functions of the Routing Engine LEDs.

Table 13: MX104 Routing Engine LEDs

Label	Color	State	Description
MASTER	Blue	On steadily	Routing Engine is the master.

Table 13: MX104 Routing Engine LEDs (continued)

Label	Color	State	Description
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 14 on page 38 describes the LEDs in more detail.

Table 14: 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.

See Also
- Maintaining the MX104 Routing Engines on page 131
- Replacing an MX104 Routing Engine on page 133

Routing Engine Specifications

Table 15 on page 39 lists the current specifications for Routing Engines supported on M Series, MX Series, and T Series routers. Table 16 on page 42 lists the specifications for end-of-life Routing Engines.

> (i) NOTE: For a list of the routing engines that are supported on the M Series, MX Series, T Series, and PTX routers, see "Supported Routing Engines by Router" on page 43.

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

Table 15: Routing Engine Specifications

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

Table 15: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-C1800	1.8-GHz	8 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	T1600 router in a routing matrix: 9.6R2 Standalone T640 or T1600 router:11.2	CB-T for a standalone router. CB-LCC for a router in a routing matrix.
	1.8 Ghz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	32-bit Junos OS on a standalone T1600 router: 11.4R2 32-bit Junos OS on a T1600 router in a routing matrix: 11.4R2 64-bit Junos OS on a standalone T1600 router: 11.4R2 64-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	CB-T for a standalone router. CB-LCC for a router in a routing matrix.
RE-C2600	2.6-GHz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	TX Matrix Plus router: 9.6R2	–
RE-A-1800x2	1800-MHz	8 GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	–
RE-S-1800x2	1800-MHz	8 GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	SCB, SCBE
RE-S-1800x4	1800-MHz	8GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	SCB, SCBE, SCBE2
RE-S-MX104	1.8-GHz	4 GB	Gigabit Ethernet	–	8 GB NAND Flash	13.2	–
RE-B-1800x1-4G	1.73-GHz	4 GB	Gigabit Ethernet	64 GB SSD	4 GB CompactFlash card	12.1R2, 11.4R4, and 12.2R1	–

Table 15: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-MX2000-1800x4	1.8- GHz	16 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	12.3R2	SCB, SCBE
RE-S-1800X4-32GS	1.8- Ghz	32 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	• 12.3R4 • 13.2R1	SCB, SCBE SCBE2
RE-MX2K-1800-32GS	1.8- Ghz	32 GB	Gigabit Ethernet	32 GB SSD	4GB Fixed Internal CompactFlash card	• 12.3R4 • 13.2R1	–
RE-S-X6-64G	2 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	-	15.1F4, 16.1	SCBE2
RE-MX2K-X8-64G	2.3 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	15.1F5-S1, 16.1R2, and 16.2R1	–
RE-MX2K-X8-64G-LT	2.3 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	17.2R1	–
RE-MX2008-X8-64G	2.3 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	–	15.1F7	–
RE-S-1600x8	1.6 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	–	17.3R1	–
RE-MX2008-X8-64G-LT	2.1 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	17.2R1	-
RE-MX2008-X8-128G	2.3 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	18.2R1	-
RE-S-X6-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 100-GB SSDs	-	18.1R1	-
RE-MX2K-X8-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 100-GB SSDs	-	18.1R1	-
JNP10003-RE1	1.6-GHz	64 GB	Gigabit Ethernet	Two 100 GB SSDs	-	17.3R1	-

Table 15: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
JNP10003-RE-LT	1.6-GHz	64 GB	Gigabit Ethernet	Two 100 GB SSDs	-	18.1R1	-
JNP10K-RE0	2.5 GhZ	32 GB	Gigabit Ethernet	Two 50 GB SSDs	-	17.2R1	-
JNP10K-RE1	2.3 GhZ	64 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.2R1	-
JNP10K-RE1-LT	2.3 GhZ	64 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.3R1	-
JNP10K-RE1-128	2.3 GhZ	128 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.3R1	-

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

Table 16: End-of-Life Routing Engine Specifications

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

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

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	EOL Details
RE-M40-333-768	333-MHz Pentium II	768 MB	Fast Ethernet	10 GB hard disk	80 MB CompactFlash card	4.2	PSN-2003-01-063
RE-M40-600-2048	600-MHz Pentium III	2048 MB	Fast Ethernet	30 GB hard disk	128 MB CompactFlash card	5.4	PSN-2004-11-020
RE-1600-2048	1.6-GHz Pentium M	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	6.2	PSN-2008-02-019

> ⓘ NOTE: The memory in Table 15 on page 39 indicates the amount of total memory. To determine the amount of available memory, issue the **show chassis routing-engine** CLI command.

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

Supported Routing Engines by Router

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

M7i Routing Engines

Table 17 on page 44 lists the Routing Engines supported by the M7i router. The M7i router supports 32-bit Junos OS only.

Table 17: M7i Routing Engines

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

M10i Routing Engines

Table 18 on page 44 lists the Routing Engines supported by the M10i router. The M10i router supports 32-bit Junos OS only.

Table 18: M10i Routing Engines

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

Table 18: M10i Routing Engines (continued)

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

M40e Routing Engines

Table 19 on page 45 lists the Routing Engines supported by the M40e router.

Table 19: M40e Routing Engines

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

M120 Routing Engines

Table 20 on page 45 lists the Routing Engines supported by the M120 router.

Table 20: M120 Routing Engines

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

Table 20: M120 Routing Engines (continued)

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

M320 Routing Engines

Table 21 on page 46 lists the Routing Engines supported by the M320 router.

Table 21: M320 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-1600-2048 (EOL details: TSB14374)	**RE-4.0**	6.2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	**RE-A-2000**	8.1	–	fxp0	em0 bcm0
RE-A-1800X2-8G	**RE-A-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 bcm0
RE-A-1800X2-16G	**RE-A-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 bcm0
RE-A-1800X4-8G	**RE-A-1800X4**	• 11.4R5 • 12.1R3 • 12.2	10.4	fxp0	em0 em1

MX5, MX10, MX40, and MX80 Routing Engine

Table 22 on page 47 lists the Routing Engines supported by the MX5, MX10, MX40, and MX80 routers.

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

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

MX104 Routing Engines

lists the Routing Engines supported by MX104 routers.

Table 23: MX104 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-MX104	**Routing Engine**	13.2	–	fxp0	fxp1 fxp2

MX240 Routing Engines

lists the Routing Engines supported by MX240 routers.

Table 24: MX240 Supported Routing Engines

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

Table 24: MX240 Supported Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X4-8G	**RE-S-1800X4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-16G	**RE-S-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	**RE-S-1800X4**	• 12.3R4 • 13.2R1	• 12.3R4 • 13.2R1	fxp0	em0, em1
RE-S-X6-64G	**RE-S-2X00x6**	–	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	**RE-S-2X00x6 -LT**	–	17.2R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	**RE-S-2X00x6-128**	–	18.1R1	fxp0	ixlv0, igb0 em0

MX480 Routing Engines

lists the Routing Engines supported by MX480 routers.

Table 25: MX480 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1300-2048 (EOL details: TSB16556	**RE-S-1300**	8.4	–	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: TSB16735	**RE-S-2000**	8.4	–	fxp0	fxp1 fxp2
RE-S-1800X2-8G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X2-16G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1

Table 25: MX480 Supported Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X4-8G	**RE-S-1800X4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-16G	**RE-S-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	**RE-S-1800X4**	• 12.3R4 • 13.2R1	• 12.3R4 • 13.2R1	fxp0	em0 em1
RE-S-X6-64G	**RE-S-2X00x6**	–	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	**RE-S-2X00x6 -LT**	–	17.2R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	**RE-S-2X00x6-128**	–	18.1R1	fxp0	ixlv0, igb0 em0

MX960 Routing Engines

lists the Routing Engines supported by MX960 routers.

Table 26: MX960 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1300-2048 (EOL details: TSB16556	**RE-S-1300**	8.2	–	fxp0	fxp1 fxp2
RE-S-2000-4096 (EOL details: TSB16735	**RE-S-2000**	8.2	–	fxp0	fxp1 fxp2
RE-S-1800X2-8G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X2-16G (EOL details: TSB16556	**RE-S-1800x2**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1

Table 26: MX960 Supported Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-S-1800X4-8G	**RE-S-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-16G	**RE-S-1800x4**	• 11.4R5 • 12.1R3	10.4	fxp0	em0 em1
RE-S-1800X4-32G-S	**RE-S-1800x4**	• 12.3R4 • 13.2R1	• 12.3R4 • 13.2R1	fxp0	em0 em1
RE-S-X6-64G	**RE-S-2X00x6**	–	15.1F4 16.1R1	fxp0	ixlv0, igb0
RE-S-X6-64G (For MX960-VC)	**RE-S-2X00x6**	–	17.1R2	fxp0	ixlv0, igb0
RE-S-X6-64G-LT	**RE-S-2X00x6 -LT**	–	17.2R1	fxp0	ixlv0, igb0 em0
RE-S-X6-128G	**RE-S-2X00x6-128**	–	18.1R1	fxp0	ixlv0, igb0 em0

MX2008 Routing Engines

lists the Routing Engines supported by MX2008 routers.

Table 27: MX2008 Supported Routing Engines

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

MX2010 Routing Engines

Table 28 on page 51 lists the Routing Engines supported by MX2010 routers.

Table 28: MX2010 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-MX2000-1800X4	**RE-S-1800x4**	12.3R2	fxp0	em0 em1
REMX2K-1800-32G-S	**RE-S-1800x4**	• 12.3R4 • 13.2R1	fxp0	em0 em1
REMX2K-X8-64G	**RE-S-2X00x8**	• 15.1F5-S1 • 16.1R2 • 16.2R1	fxp0	ixlv0 ixlv1 em0
REMX2K-X8-64G-LT	**RE-S-2X00x8**	17.2R1	fxp0	ixlv0 ixlv1 em0
REMX2K-X8-128G	**RE-MX200X8-128G**	18.1R1	fxp0	ixlv0 ixlv1

MX2020 Supported Routing Engines

Table 29 on page 51 lists the Routing Engines supported by MX2020 routers.

Table 29: MX2020 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-MX2000-1800X4	**RE-S-1800x4**	12.3R2	fxp0	em0 em1
REMX2K-1800-32G-S	**RE-S-1800x4**	• 12.3R4 • 13.2R1	fxp0	em0 em1

Table 29: MX2020 Supported Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
REMX2K-X8-64G	**RE-S-2X00x8**	• 15.1F5-S1 • 16.1R2 • 16.2R1	fxp0	ixlv0 ixlv1 em0
REMX2K-X8-64G-LT	**RE-S-2X00x8**	17.2R1	fxp0	ixlv0 ixlv1 em0
REMX2K-X8-128G	**RE-MX200X8-128G**	18.1R1	fxp0	ixlv0 ixlv1 em0

MX10003 Routing Engines

lists the Routing Engines supported by MX10003 routers.

Table 30: MX10003 Supported Routing Engines

Model Number	Name in CLI Output	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
JNP10003-RE1	**RE-S-2X00x6**	17.3R1	fxp0	em3 em4
JNP10003-RE1-LT	RE-S-1600x8	18.1R1	fxp0	em3 em4

MX10008 Routing Engines

lists the Routing Engines supported on the MX10008 router.

Table 31: MX10008 Routing Engines

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

PTX1000 Routing Engines

Table 32 on page 53 lists the Routing Engine supported on the PTX1000.

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

Table 32: PTX1000 Routing Engines

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

PTX3000 Routing Engines

Table 33 on page 53 lists the Routing Engines supported on the PTX3000.

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

Table 33: PTX3000 Routing Engines

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

PTX5000 Routing Engines

Table 34 on page 54 lists the Routing Engines supported on the PTX5000.

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

Table 34: PTX5000 Routing Engines

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

PTX10008 and PTX10016 Routing Engines

lists the Routing Engines supported on the PTX10008 and PTX10016 routers.

Table 35: PTX10008 and PTX10016 Routing Engines

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

Table 35: PTX10008 and PTX10016 Routing Engines (continued)

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

T320 Routing Engines

lists the Routing Engines supported by the T320 router.

Table 36: T320 Routing Engines

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

The T320 router supports the CB-T control board.

T640 Routing Engines

lists the Routing Engines supported by the T640 router.

Table 37: T640 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: TSB14373)	**RE-3.0** or **RE-3.0 (RE-600)**	5.3	–	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: TSB14374	**RE-4.0**	6.2	–	fxp0	fxp1 fxp2
RE-A-2000-4096	**RE-A-2000**	8.1	–	fxp0	em0 bcm0

Table 37: T640 Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-DUO-C1800-8G	**RE-DUO-1800**	32-bit Junos OS on a standalone T640 router: 11.2 32-bit Junos OS on a T640 router in a routing matrix: 11.4R9	64-bit Junos OS on a standalone T640 router: 11.3 64-bit Junos OS on a T640 router in a routing matrix: 11.4R9	em0	bcm0 em1
RE-DUO-C1800-16G	**RE-DUO-1800**	32-bit Junos OS on a standalone T640 router: 11.4R2 32-bit Junos OS on a T640 router in a routing matrix: 11.4R9	64-bit Junos OS on a standalone T640 router: 11.4R2 64-bit Junos OS on a T640 router in a routing matrix: 11.4R9	em0	bcm0 em1

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

T1600 Routing Engines

Table 38 on page 56 lists the Routing Engines supported by the T1600 router.

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

Table 38: T1600 Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: TSB14373)	**RE-3.0** or **RE-3.0 (RE-600)**	8.5	–	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: TSB14374	**RE-4.0 (RE-1600)**	8.5	–	fxp0	fxp1 fxp2
RE-A-2000-4096	**RE-A-2000**	8.5	–	fxp0	em0 bcm0

Table 38: T1600 Routing Engines (continued)

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-DUO-C1800-8G	**RE-TXP-LCC** or **RE-DUO-1800**	32-bit Junos OS on a T1600 router in a routing matrix: 9.6 NOTE: Junos OS Releases 9.6 through 10.4 support RE-DUO-C1800-8G only during upgrade to a line-card chassis (LCC) in a routing matrix. 32-bit Junos OS on a standalone T1600 router: 11.1	64-bit Junos OS on a T1600 router in a routing matrix: 9.6 64-bit Junos OS on a standalone T1600 router: 11.1	em0	bcm0 em1
RE-DUO-C1800-16G	**RE-DUO-1800**	32-bit Junos OS on a standalone T1600 router: 11.4R2 32-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	64-bit Junos OS on a standalone T1600 router: 11.4R2 64-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	em0	bcm0 em1

T4000 Routing Engines

Table 39 on page 57 lists the Routing Engines supported by the T4000 router.

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

Table 39: T4000 Routing Engines

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

The T4000 router supports the CB-LCC control board.

TX Matrix Routing Engines

Table 40 on page 58 lists the Routing Engines supported by the TX Matrix router.

Table 40: TX Matrix Routing Engines

Model Number	Name in CLI Output	First Supported 32-bit Junos OS Release	First Supported 64-bit Junos OS Release	Management Ethernet Interface	Internal Ethernet Interface
RE-600-2048 (EOL details: TSB14373)	**RE-3.0 or RE-3.0 (RE-600)**	7.0	–	fxp0	fxp1 fxp2
RE-1600-2048 (EOL details: TSB14374	**RE-4.0 (RE-1600)**	7.0	–	fxp0	fxp1 fxp2
RE-A-2000-4096	**RE-A-2000**	8.5	–	fxp0	em0 bcm0
RE-DUO-C1800-8G	**RE-DUO-1800**	11.4R9	11.4R9	em0	bcm0 em1
RE-DUO-C1800-16G	**RE-DUO-1800**	11.4R9	11.4R9	em0	bcm0 em1

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

TX Matrix Plus Routing Engines

Table 41 on page 58 lists the Routing Engines supported by the TX Matrix Plus router.

Table 41: TX Matrix Plus Routing Engines

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

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

TX Matrix Plus (with 3D SIBs) Routing Engines

Table 42 on page 59 lists the Routing Engines supported by the TX Matrix Plus router with 3D SIBs.

Table 42: Routing Engines on TX Matrix Plus with 3D SIBs

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

See Also
- *Understanding Internal Ethernet Interfaces*
- *Understanding Management Ethernet Interfaces*

MX104 Interface Modules

- MX104 Modular Interface Card (MIC) Overview on page 59
- MICs Supported by MX Series Routers on page 61
- MX104 Port and Interface Numbering on page 69

MX104 Modular Interface Card (MIC) Overview

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 on page 59
- Built-in 10-Gigabit Ethernet MIC on page 59
- MIC LEDs on page 61

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 MX Series Routers" on page 61 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 "Contacting Customer Support" on page 161 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 43 on page 61 describes the LEDs in more
detail.

Table 43: SFP+ Port LEDs

Name	Location	Color	State	Description
Activity	Left	Green	Blinking	The port is receiving data.
		–	Off	The port is not receiving data.
Link	Right	Yellow	On	Link is online.
		–	Off	No link.

See Also
- Replacing an MX104 MIC on page 139
- Maintaining the MX104 MICs and Network Ports on page 139

MICs Supported by MX Series Routers

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

- Table 44 on page 62 lists the first supported Junos OS release for MICs on MX240,
  MX480, MX960, and MX2008 routers.

- Table 45 on page 64 lists the first supported Junos OS release for MICs on MX2010
  and MX2020 routers.

- Table 46 on page 66 list the first supported Junos OS release for MICs on MX5, MX10,
  and MX40 routers.

- Table 47 on page 67 lists the first supported Junos OS release for MICs on MX80 and
  MX104 routers.

- Table 48 on page 69 lists the first supported Junos OS release for MICs on MX10003
  router.

Table 44: MICs Supported by MX240, MX480, MX960 and MX2008 Routers

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
ATM				
ATM MIC with SFP	MIC-3D-8OC3-2OC12-ATM	8	12.1	15.1F7
DS3/E3				
DS3/E3 MIC	MIC-3D-8DS3-E3,	8	11.4	15.1F7
	MIC-3D-8CHDS3-E3-B			
Circuit Emulation				
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	16	12.3	15.1F7
Gigabit Ethernet				
Gigabit Ethernet MIC with SFP	MIC-3D-20GE-SFP	20	10.1	15.1F7
Gigabit Ethernet MIC with SFP (E)	MIC-3D-20GE-SFP-E	20	13.3	15.1F7
10-Gigabit Ethernet				
10-Gigabit Ethernet MICs with XFP	MIC-3D-2XGE-XFP	2	10.2	15.1F7
10-Gigabit Ethernet MICs with XFP	MIC-3D-4XGE-XFP	4	10.1	15.1F7
10-Gigabit Ethernet MIC with SFP+ (10 Ports)	MIC3-3D-10XGE-SFPP	10	12.3	15.1F7
10-Gigabit Ethernet MIC with SFP+ (24 Ports)	MIC6-10G	24	-	15.1F7
10-Gigabit Ethernet OTN MIC with SFP+ (24 Ports)	MIC6-10G-OTN	24	-	15.1F7
40-Gigabit Ethernet				
40-Gigabit Ethernet MIC with QSFP+	MIC3-3D-2X40GE-QSFPP	2	12.2	15.1F7
100-Gigabit Ethernet				
100-Gigabit Ethernet MIC with CFP	MIC3-3D-1X100GE-CFP	1	12.1	15.1F7
100-Gigabit Ethernet MIC with CXP	MIC3-3D-1X100GE-CXP	1	12.2	15.1F7

Table 44: MICs Supported by MX240, MX480, MX960 and MX2008 Routers (continued)

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
100-Gigabit Ethernet MIC with CXP (4 Ports)	MIC6-100G-CXP	4	-	15.1F7
100-Gigabit Ethernet MIC with CFP2	MIC6-100G-CFP2	2	-	15.1F7
100-Gigabit DWDM OTN				
100-Gigabit DWDM OTN MIC with CFP2-ACO	MIC3-100G-DWDM	1	15.1F5 15.1F6 17.1R1	15.1F7
Multi-Rate				
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4OC3OC12-1OC48	4	11.2	15.1F7
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8OC3OC12-4OC48	8	11.2	15.1F7
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4CHOC3-2CHOC12	4	11.4	15.1F7
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4CHOC12	8	11.4	15.1F7
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	4	12.2	15.1F7
MIC MRATE (12-Port Multi-Rate MIC with QSFP+)	MIC-MRATE	12	-	15.1F7
Multi-Rate Ethernet MIC (12-Port Multi-Rate MACsec MIC with QSFP+)	MIC-MACSEC-MRATE	12		17.4
Tri-Rate				
Tri-Rate MIC	MIC-3D-40GE-TX	40	10.2	15.1F7
Services				
Multiservices MIC	MS-MIC-16G	0	13.2	15.1F7
SONET/SDH				
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	1	12.2	15.1F7

Table 45: MICs Supported by MX2010 and MX2020 Routers

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
ATM				
ATM MIC with SFP	MIC-3D-8OC3-2OC12-ATM	8	12.3	12.3
DS3/E3				
DS3/E3 MIC	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	12.3	12.3
Circuit Emulation				
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	16	–	–
Gigabit Ethernet				
Gigabit Ethernet MIC with SFP	MIC-3D-20GE-SFP	20	12.3	12.3
Gigabit Ethernet MIC with SFP (E)	MIC-3D-20GE-SFP-E	20	13.3	13.3
10-Gigabit Ethernet				
10-Gigabit Ethernet MICs with XFP	MIC-3D-2XGE-XFP	2	12.3	12.3
10-Gigabit Ethernet MICs with XFP	MIC-3D-4XGE-XFP	4	12.3	12.3
10-Gigabit Ethernet MIC with SFP+ (10 Ports)	MIC3-3D-10XGE-SFPP	10	12.3	12.3
10-Gigabit Ethernet MIC with SFP+ (24 Ports)	MIC6-10G	24	13.3R2	13.3R2
10-Gigabit Ethernet OTN MIC with SFP+ (24 Ports)	MIC6-10G-OTN	24	13.3R3	13.3R3
40-Gigabit Ethernet				
40-Gigabit Ethernet MIC with QSFP+	MIC3-3D-2X40GE-QSFPP	2	12.3	12.3
100-Gigabit Ethernet				
100-Gigabit Ethernet MIC with CFP	MIC3-3D-1X100GE-CFP	1	12.3	12.3
100-Gigabit Ethernet MIC with CXP	MIC3-3D-1X100GE-CXP	1	12.3	12.3
100-Gigabit Ethernet MIC with CXP (4 Ports)	MIC6-100G-CXP	4	13.3R2	13.3R2

Table 45: MICs Supported by MX2010 and MX2020 Routers (continued)

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
100-Gigabit Ethernet MIC with CFP2	MIC6-100G-CFP2	2	13.3R3	13.3R3
100-Gigabit DWDM OTN				
100-Gigabit DWDM OTN MIC with CFP2-ACO	MIC3-100G-DWDM	1	15.1F5 15.1F6 17.1R1	15.1F5 15.1F6 17.1R1
Multi-Rate				
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4OC3OC12-1OC48	4	12.3	12.3
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8OC3OC12-4OC48	8	12.3	12.3
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4CHOC3-2CHOC12	4	12.3	12.3
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4CHOC12	8	12.3	12.3
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	4	12.3	12.3
MIC MRATE (12-Port Multi-Rate MIC with QSFP+)	MIC-MRATE	12	• 15.1F5 with Junos Continuity • 16.1R1 and later	• 15.1F5 with Junos Continuity • 16.1R1 and later
Multi-Rate Ethernet MIC (12-Port Multi-Rate MACsec MIC with QSFP+)	MIC-MACSEC-MRATE	12	17.4	17.4
Tri-Rate				
Tri-Rate MIC	MIC-3D-40GE-TX	40	12.3	12.3
Services				
Multiservices MIC	MS-MIC-16G	0	13.2	13.2
SONET/SDH				
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	1	12.3	12.3

Table 46: MICs Supported by MX5, MX10, and MX40 Routers

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
ATM					
ATM MIC with SFP	MIC-3D-8OC3-2OC12-ATM	8	12.1	12.1	12.1
DS3/E3					
DS3/E3 MIC	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	11.4	11.4	11.4
Circuit Emulation					
Channelized E1/T1 Circuit Emulation MIC	MIC-3D-16CHE1-T1-CE	16	13.2R2	13.2R2	13.2R2
Channelized E1/T1 Circuit Emulation MIC (H)	MIC-3D-16CHE1-T1-CE-H	16	–	–	–
Gigabit Ethernet					
Gigabit Ethernet MIC with SFP	MIC-3D-20GE-SFP	20	11.2R4	11.2R4	11.2R4
Gigabit Ethernet MIC with SFP (E)	MIC-3D-20GE-SFP-E	20	13.2R2	13.2R2	13.2R2
Gigabit Ethernet MIC with SFP (EH)	MIC-3D-20GE-SFP-EH	20	–	–	–
10-Gigabit Ethernet					
10-Gigabit Ethernet MICs with XFP	MIC-3D-2XGE-XFP	2	11.2R4	11.2R4	11.2R4
Multi-Rate					
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4OC3OC12-1OC48	4	11.2R4	11.2R4	11.2R4
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8OC3OC12-4OC48	8	11.2R4	11.2R4	11.2R4
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4CHOC3-2CHOC12	4	11.4	11.4	11.4
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4CHOC12	8	11.4	11.4	11.4
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	4	12.2	12.2	12.2

Table 46: MICs Supported by MX5, MX10, and MX40 Routers (continued)

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (H)	MIC-4COC3-1COC12-CE-H	-	-	-	-
Tri-Rate					
Tri-Rate MIC	MIC-3D-40GE-TX	40	–	11.2R4	11.2R4
Services					
Multiservices MIC	MS-MIC-16G	0	13.2 Rear slot only.	13.2 Rear slot only.	13.2 Rear slot only.
SONET/SDH					
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	1	12.2	12.2	12.2

Table 47: MICs Supported by MX80 and MX104 Routers

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

Table 47: MICs Supported by MX80 and MX104 Routers (continued)

MIC Name	MIC Model Number	Ports	MX80	MX104
10-Gigabit Ethernet MICs with XFP	MIC-3D-2XGE-XFP	2	10.2	13.2R2
Multi-Rate				
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4OC3OC12-1OC48	4	11.2	13.3
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8OC3OC12-4OC48	8	11.2	13.3
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-4CHOC3-2CHOC12	4	11.4	13.3
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	MIC-3D-8CHOC3-4CHOC12	8	11.4	13.3
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	MIC-3D-4COC3-1COC12-CE	4	12.2	13.2R2
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (H)	MIC-4COC3-1COC12-CE-H	-	-	13.2R2
Tri-Rate				
Tri-Rate MIC	MIC-3D-40GE-TX	40	10.2	13.2R2
Services				
Multiservices MIC	MS-MIC-16G	0	13.2 Rear slot only. Supported on the modular MX80 and fixed MX80-48T	13.3R2 NOTE: Starting From Junos OS 13.3R3, 14.1R2, and 14.2R1, MX104 supports only two Multiservices MICs.
SONET/SDH				
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	1	12.2	13.3

Table 48: MICs Supported by MX10003 Router

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

See Also
- *MX Series MIC Overview*
- *MIC/MPC Compatibility*

MX104 Port and Interface Numbering

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 70).

> 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 70 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
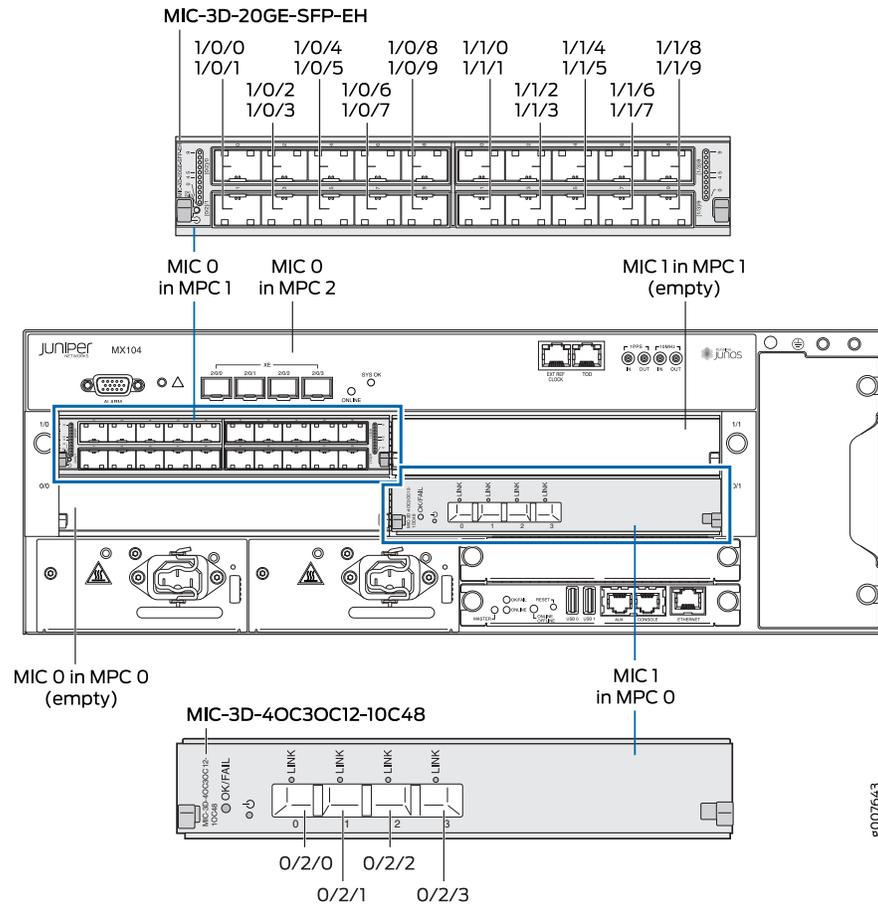
Table 49 on page 70 summarizes the relationship between the components and the interface names.

Table 49: 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**

Table 49: MX104 MIC Interface Names (continued)

Component	Component Name in the CLI	Interface Names
MIC 0 (left) installed in MPC 0 (labeled **0/0**)	See *MX Series Interface Module Reference*.	*type*-0/0/*port*
		type-0/1/*port*
MIC 1 (right) installed in MPC 0 (labeled **0/1**)		*type*-0/2/*port*
		type-0/3/*port*
MIC installed in MIC slot 1/0		*type*-1/0/*port*
		type-1/1/*port*
MIC installed in MIC slot 1/1		*type*-1/2/*port*
		type-1/3/*port*

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.

> (i) 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                                    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
```

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 on page 19
- MX104 Hardware and CLI Terminology Mapping on page 22
- MX104 Chassis Overview on page 20

CHAPTER 2

Site Planning, Preparation, and Specifications

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 77.

2. Verify that the site and installation plan meets all safety guidelines and requirements. See "General Safety Guidelines for Juniper Networks Devices" on page 171.

3. Measure distance between external power sources and the router installation site. See:

   - MX104 AC Power Cord Specifications on page 32

   - MX104 DC Power Cable and Lug Specifications on page 34

4. Locate sites for connection of system grounding. See "MX104 Chassis Grounding Cable and Lug Specifications" on page 78.

5. Calculate the power consumption and requirements. See:

   - MX104 Power Consumption on page 31

   - MX104 AC Power Specifications on page 31

   - MX104 DC Power Specifications on page 34

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 193

- MX104 AC Power Electrical Safety Guidelines and Warnings on page 193

- MX104 DC Power Electrical Safety Guidelines on page 194

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 81

   - Cabinet Requirements for MX104 Routers on page 82

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 83.

9. Plan to secure the rack to the floor and building structure. See "Rack Requirements for MX104 Routers" on page 81.

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 145.

Related Documentation
- MX104 Installation Overview on page 97

MX104 Site Guidelines and Requirements

- MX104 Router Physical Specifications on page 76
- MX104 Router Environmental Specifications on page 77
- MX104 Chassis Grounding Cable and Lug Specifications on page 78
- Rack Requirements for MX104 Routers on page 81
- Cabinet Requirements for MX104 Routers on page 82
- Clearance Requirements for Airflow and Hardware Maintenance on MX104 Routers on page 83

MX104 Router Physical Specifications

The MX104 router is a rigid sheet-metal structure that houses the hardware components. Table 50 on page 77 summarizes the physical specifications of the MX104 router and its components.

Table 50: Physical Specifications of the MX104 Router Chassis

Component	Weight	Width	Height	Depth
Chassis	• 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 51 on page 77 provides the required environmental conditions for normal router operation.

Table 51: 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

Table 51: MX104 Environmental Specifications (continued)

Description	Value
Temperature	• Harsh environment: −40º F (−40º C) to 149º F (65º C), de-rate 1º C for every 1000 ft. • Central office environment: 23º F (−5º C) to 131º F (55º C)
Commercial grade SFP/SFP+ temperature	• Harsh environment: −40º F (−40º C) to 122º F (50º C) • Central office environment: −40º F (−40º C) to 104º F (40º 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

- Grounding Points Specifications on page 78
- Grounding Cable Lug Specifications on page 79
- Grounding Cable Specifications on page 81

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 79).

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.

Figure 14: Grounding Points on the MX104 Routers
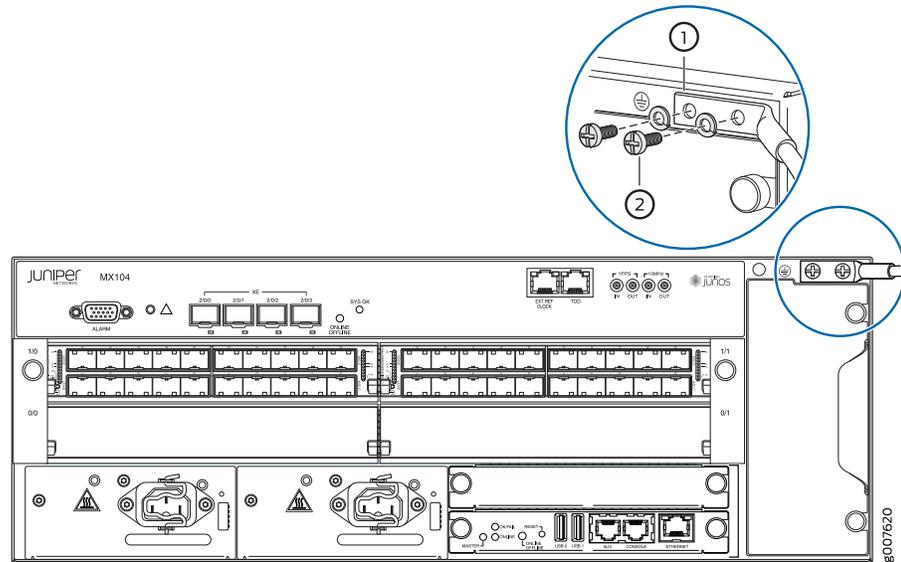
NOTE: All bare grounding connection points to the router must be cleaned and coated with an antioxidant solution before grounding the router.

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 80 for AC systems and Figure 16 on page 80 for 24 VDC systems.

Figure 15: Grounding Cable Lug for MX104 AC Systems

14-AWG conductor

C-Tap
(compression
connector)

0.68

0.05

1.25

1.56

0.42

0.63

0.27 dia. (2) pls

g009127

All measurements in inches.
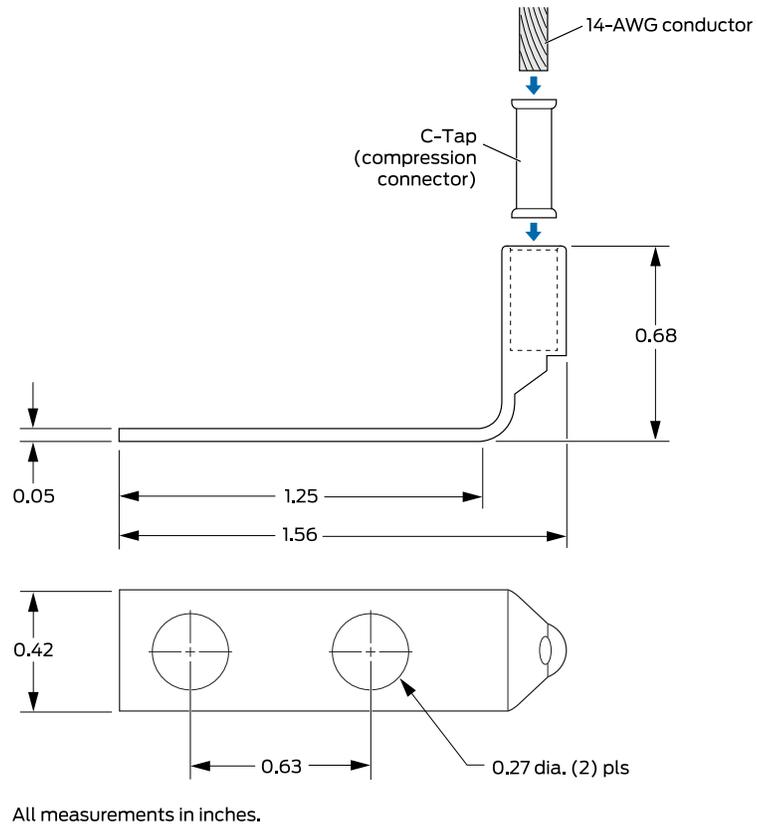
Figure 16: Grounding Cable Lug for MX104 24 VDC Systems
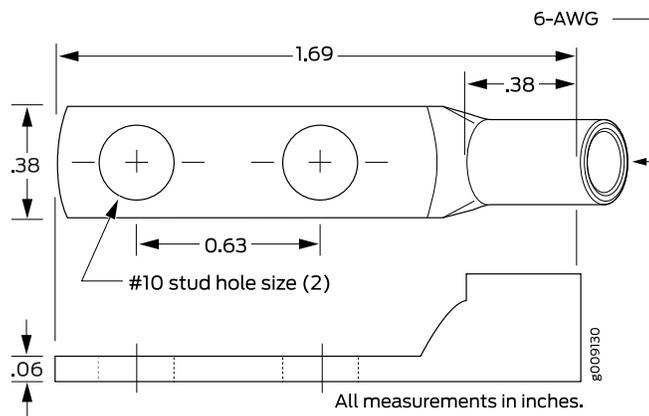
6-AWG

1.69

.38

.38

0.63

#10 stud hole size (2)

.06

g009130

All measurements in inches.

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

⚠️ **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 mm^2) 90° C wire. See, Figure 15 on page 80

- For 24 VDC systems, use 6-AWG (13.3 mm^2) 60° C wire, or as required by the local code. See Figure 16 on page 80

See Also
- Connecting the MX104 Router to Earth Ground on page 102

- Preventing Electrostatic Discharge Damage to an MX104 Router on page 174

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 52 on page 81 provides the rack requirements and specifications for the router.

Table 52: Rack Requirements and Specifications for the Router

Rack Requirement	Guidelines
Rack type	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.
	A U is the standard rack unit defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310–D) published by the Electronics Components Industry Association (http://www.ecianow.org/).
	The rack must meet the strength requirements to support the weight of the chassis.
Mounting bracket hole spacing	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.

Table 52: Rack Requirements and Specifications for the Router (continued)

Rack Requirement	Guidelines
Rack size and strength	• Ensure that the rack complies with this standard: • A 19-in. (48.3 cm) rack as defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310-D) published by the Electronics Industry Association (http://www.eia.org). • 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	• 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 on page 97

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 53 on page 82 provides the cabinet requirements and specifications for the router.

Table 53: Cabinet Requirements and Specifications for the MX104 Router

Cabinet Requirement	Guidelines
Cabinet size	• You can mount the router in a cabinet that contains a 19-in. (48.3 cm) rack as defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310-D) published by the Electronic Components Industry Association (ECIA) (http://www.ecianow.org). NOTE: The rack must meet the strength requirements to support the weight of the router. • The minimum cabinet size must be able to accommodate the maximum external dimensions of the router.

Table 53: Cabinet Requirements and Specifications for the MX104 Router (continued)

Cabinet Requirement	Guidelines
Cabinet clearance	• 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.
Cabinet airflow requirements	When you mount the router in a cabinet, ensure that ventilation through the cabinet is sufficient to prevent overheating. • 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 on page 97

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 84):

- 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
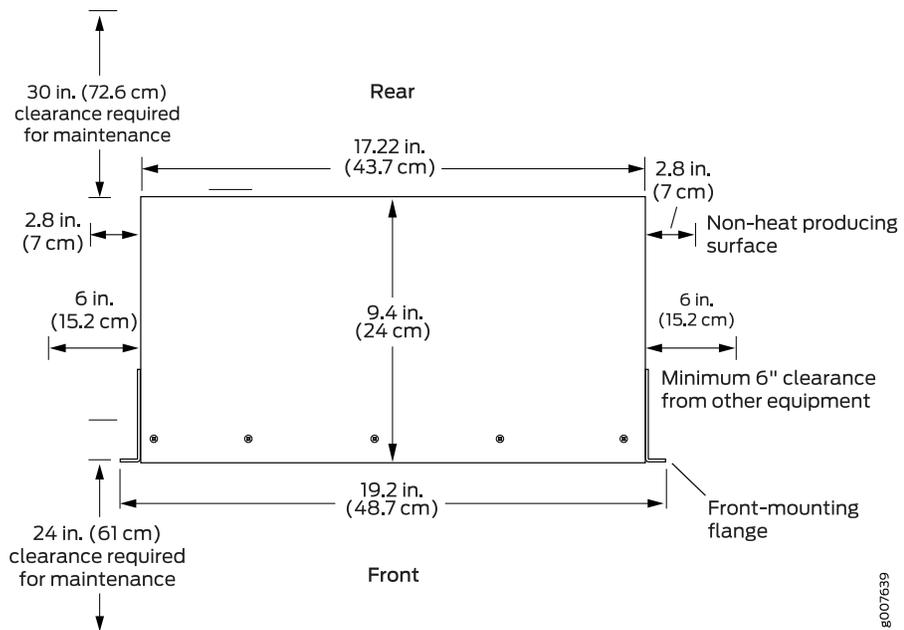
MX104 Network Cable and Transceiver Planning

Calculating Power Budget and Power Margin for Fiber-Optic Cables

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

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

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

Calculating Power Budget for Fiber-Optic Cable

To ensure that fiber-optic connections have sufficient power for correct operation, you need to calculate the link's power budget, which is the maximum amount of power it can transmit. When you calculate the power budget, you use a worst-case analysis to provide a margin of error, even though all the parts of an actual system do not operate

at the worst-case levels. To calculate the worst-case estimate of power budget (P_B), you assume minimum transmitter power (P_T) and minimum receiver sensitivity (P_R):

$$P_B = P_T - P_R$$

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

$$P_B = P_T - P_R$$

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

$$P_B = 13 \text{ dB}$$

Calculating Power Margin for Fiber-Optic Cable

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

$$P_M = P_B - LL$$

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

Factors that can cause link loss include higher-order mode losses, modal and chromatic dispersion, connectors, splices, and fiber attenuation. Table 54 on page 85 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 54: Estimated Values for Factors Causing Link Loss

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

The following sample calculation for a 2-km-long multimode link with a power budget (P_B) of 13 dB uses the estimated values from Table 54 on page 85 to calculate link loss

(LL) as the sum of fiber attenuation (2 km @ 1 dB/km, or 2 dB) and loss for five connectors (0.5 dB per connector, or 2.5 dB) and two splices (0.5 dB per splice, or 1 dB) as well as higher-order mode losses (0.5 dB). The power margin (P_M) is calculated as follows:

$P_M = P_B - LL$

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

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

P_M = 7 dB

The following sample calculation for an 8-km-long single-mode link with a power budget (P_B) of 13 dB uses the estimated values from to calculate link loss (LL) as the sum of fiber attenuation (8 km @ 0.5 dB/km, or 4 dB) and loss for seven connectors (0.5 dB per connector, or 3.5 dB). The power margin (P_M) is calculated as follows:

$P_M = P_B - LL$

P_M = 13 dB − 8 km (0.5 dB/km) − 7(0.5 dB)

P_M = 13 dB − 4 dB − 3.5 dB

P_M = 5.5 dB

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

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

This topic describes signal loss, attenuation, and dispersion in fiber-optic cable.

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

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 on page 111

MX104 Routing Engine Ethernet Port Specifications

- Cable Specifications on page 88
- Pinouts on page 89

Cable Specifications

Table 55 on page 88 lists the specifications for the cables that connect to the **ETHERNET** port.

Table 55: MX104 Routing Engine Ethernet Port Cable Specifications

Specification	Value
Cable specification	Category 5 cable or equivalent suitable for 1000Base-T operation

Table 55: MX104 Routing Engine Ethernet Port Cable Specifications (continued)

Specification	Value
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 56 on page 89 describes the RJ-45 connector pinout.

Table 56: Ethernet Port Pinouts

Pin	Signal	Description
1	TX+_D1	Transmit data+
2	TX−_D1	Transmit data−
3	RX+_D2	Receive data+
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 on page 36
- Maintaining the MX104 Routing Engines on page 131

MX104 Routing Engine Auxiliary and Console Ports Specifications

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

> *i* 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 58 on page 90 describes the RJ-45 connector pinout.

- Cable Specifications on page 90
- Pinouts on page 90

Cable Specifications

Table 57 on page 90 lists the specifications for the cables that connect to console port.

Table 57: 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 female

Pinouts

Table 58 on page 90 describes the RJ-45 connector pinout.

Table 58: Console Port Pinouts

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

See Also
- MX104 Routing Engine Overview on page 36
- Maintaining the MX104 Routing Engines on page 131

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 on page 36

- Initially Configuring the MX104 Router on page 114

MX104 Alarm Contact Port Specifications

Cable Specifications

Table 59 on page 91 lists the specifications for the cables that connect to the **ALARM** port.

Table 59: 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 60 on page 92 shows the alarm contact connector pinouts.

Table 60: 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 Minor alarm	External alarm output 3 (this pin is connected to Pin 10 in closed condition)
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 Major alarm	External alarm output 2 (this pin is connected to Pin 15 in closed condition)
10	ALARM_OUT3_NO/NC	Output	Reserved for Minor 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)

Table 60: Alarm Contact Connector Pinouts (continued)

Pin Number	Signal Definition	Direction	CLI Port Mapping	Function
14	ALARM_OUT1_REF	Output	Output Alarm Port 1	External alarm output 1 (this pin is connected to Pin 13 in closed condition)
15	ALARM_OUT2_NO/NC	Output	Reserved for Major alarm	External alarm output 2 (this pin is connected to Pin 9 in closed condition)

See Also
- MX104 Universal Routing Platform Overview on page 19
- MX104 Chassis Overview on page 20
- MX104 LEDs Overview on page 25
- MX104 Alarm Contact Port Overview on page 24
- Connecting the MX104 Router to an External Alarm-Reporting Device on page 125

MX104 BITS Port Specifications

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 on page 93
- Port Pinouts on page 94

Cable Specifications

Table 61 on page 94 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 93). You must ensure that the cable pinouts match the pinouts described in Table 62 on page 94.

Figure 18: RJ-48 Connector for MX104 BITS Ports
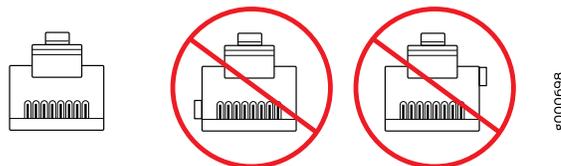
Table 61: MX104 BITS Port Cable Specifications

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

Port Pinouts

Table 62 on page 94 provides the pinout information for the RJ-48 connector for the external clocking input port.

Table 62: BITS Port Pinouts

Pin	Description	Direction
1	EXT_CLKA_RRING_LINE	Input
2	EXT_CLKA_RTIP_LINE	Input
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 63 on page 94 lists the specifications for the cables that connect to the **1PPS** and **10MHZ** input and output ports.

Table 63: 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)
Signal support	10-MHz GPS and 1-pulse-per-second (PPS)

MX104 Time of Day Port Specifications

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 on page 95
- Port Pinouts on page 95

Cable Specifications

Table 64 on page 95 lists the specifications for the cable that connects to the **TOD** port.

> *i*   NOTE: **The output signals are not supported**

Table 64: 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)
Connector	RJ-45 female

Port Pinouts

Table 65 on page 95 provides the pinout information for the RS-232 connector for the ToD port.

Table 65: 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 on page 19
- MX104 Chassis Overview on page 20
- MX104 LEDs Overview on page 25
- MX104 Clocking and Timing Ports Overview on page 88

Initial Installation and Configuration

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 172
   - General Safety Guidelines for Juniper Networks Devices on page 171

2. Prepare the installation site for the router. See "Preparing the Site for the MX104 Router Overview" on page 75.

3. Unpack the router and verify the parts received. See "Unpacking an MX104 Router" on page 98.

4. Install the router in a rack. See "Installing the MX104" on page 101.

5. Ground the router. See "Connecting the MX104 Router to Earth Ground" on page 102.

6. Connect the router to external devices. See:

   - Connecting the MX104 Router to Management Devices on page 109
   - Connecting the MX104 Router to External Clocking and Timing Devices on page 111
   - Connecting the MX104 Router to an External Alarm-Reporting Device on page 125

7. Connect power to the router:

- AC-powered models—See "Connecting AC Power Cords to the MX104 Router" on page 104.

- DC-powered models—See "Connecting DC Power Cables to the MX104 Router" on page 106.

8. Perform initial configuration of the router by following instructions in "Initially Configuring the MX104 Router" on page 114.

Related Documentation
- MX104 Universal Routing Platform Overview on page 19

Unpacking the MX104

- Unpacking an MX104 Router on page 98
- Parts Inventory (Packing List) for an MX104 Router on page 99

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 .

7. Save the shipping carton and packing materials in case you need to move or ship the router later.

See Also
-
-

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 for more information.

lists the parts and their quantities in the packing list. lists the contents provided in the accessory box.

Table 66: 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
Fan tray	1
Air filter	1

Table 66: Parts List for a Fully Configured MX104 Router (continued)

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

Table 67: 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 female DB-9	1
ESD wrist strap with cable	1
Read Me	1
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 32.

> ⓘ **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 on page 19

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 102):

> ⚠ **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
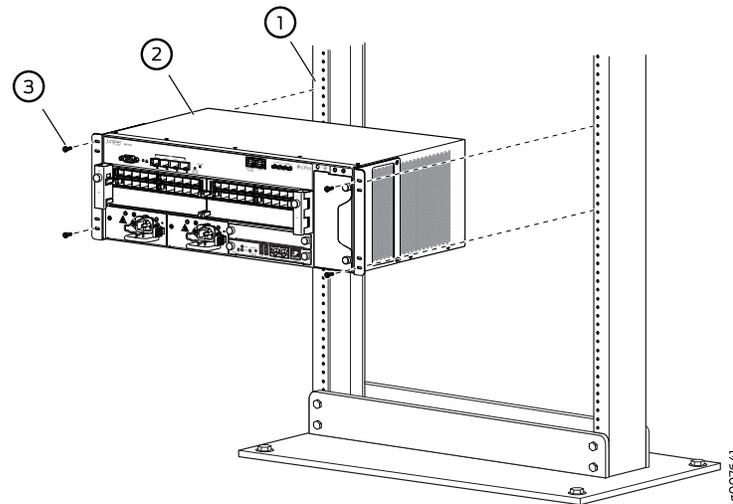
1—Rack	3—Mounting screws
2—MX104 router	

Related Documentation
- Preparing the Site for the MX104 Router Overview on page 75

Connecting the MX104 to Power

- Connecting the MX104 Router to Earth Ground on page 102
- Connecting AC Power Cords to the MX104 Router on page 104
- Connecting DC Power Cables to the MX104 Router on page 106

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 mm^2) 90° C wire

- For 24 V systems—Use 6-AWG (13.3 mm^2) 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 electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.

3. Ensure that all grounding surfaces are clean and brought to a bright finish before grounding connections are made.

4. Connect the grounding cable to a proper earth ground.

5. Detach the ESD grounding strap from the site ESD grounding point.

6. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

7. Place the grounding cable lug over the grounding points on the front of the chassis (see Figure 20 on page 104).

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

| 1—Grounding cable lug | 2—Screws |
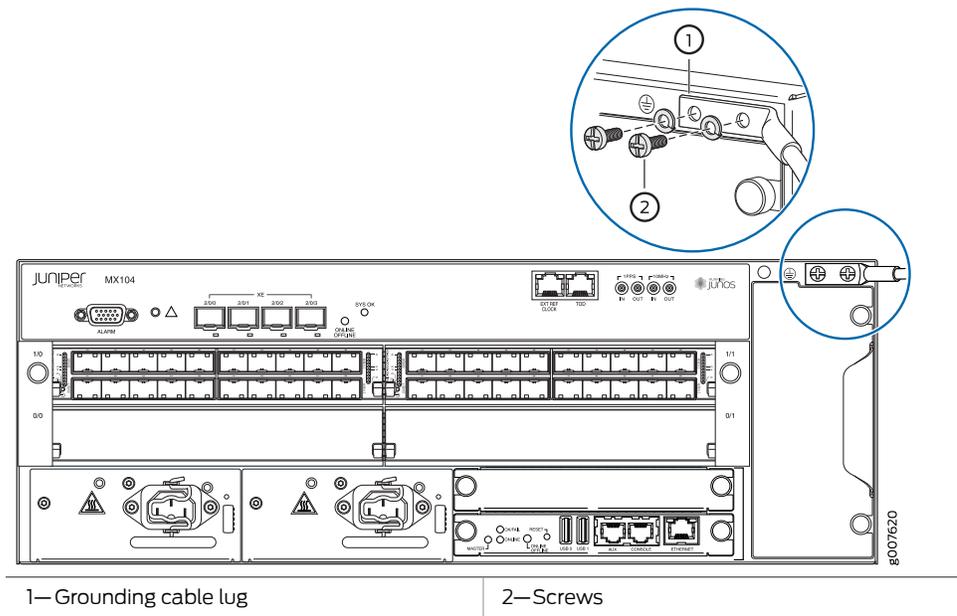
See Also
- MX104 Installation Overview on page 97
- Connecting AC Power Cords to the MX104 Router on page 104
- Connecting DC Power Cables to the MX104 Router on page 106
- Preventing Electrostatic Discharge Damage to an MX104 Router on page 174

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 32.

2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

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.

> *i* 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
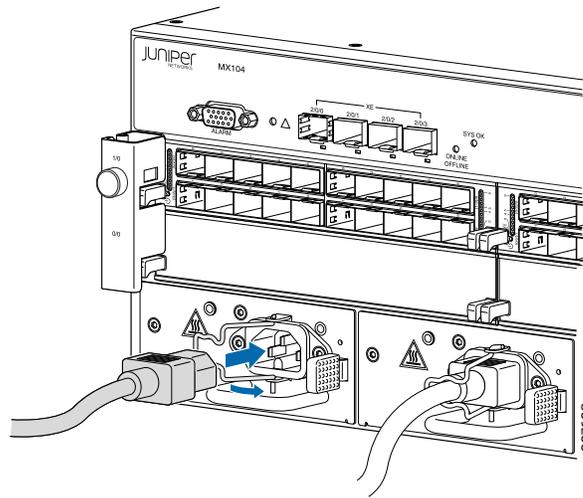
Connecting DC Power Cables to the MX104 Router

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 107):

   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
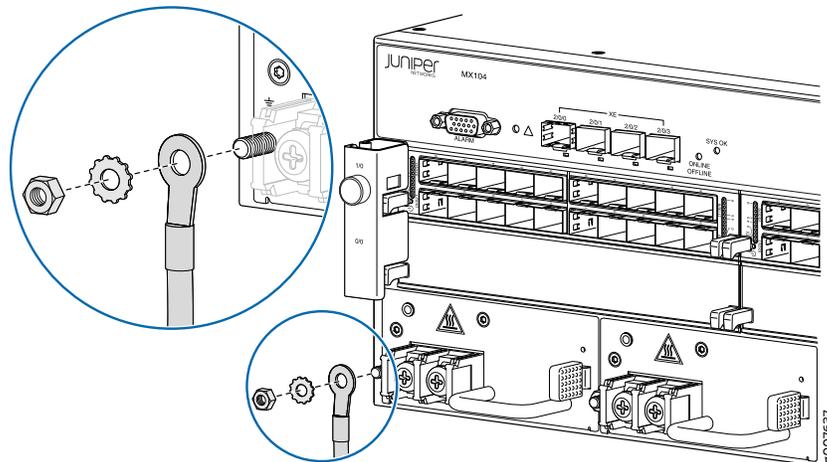
3. Remove the plastic cover protecting the terminal on the faceplate.

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 +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 (**+**).

5. Remove the screws and washers from the terminals.

6. Secure each power cable lug to the terminal with the washers and screw (see Figure 23 on page 109). 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.

7. Replace the plastic cover over the terminals on the faceplate.

8. 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.

9. Switch on the external circuit breakers to provide voltage to the DC power source cable leads.

10. Repeat Step 2 through Step 9 for the remaining power supply.

11. 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 23: Connecting DC Power to the Router
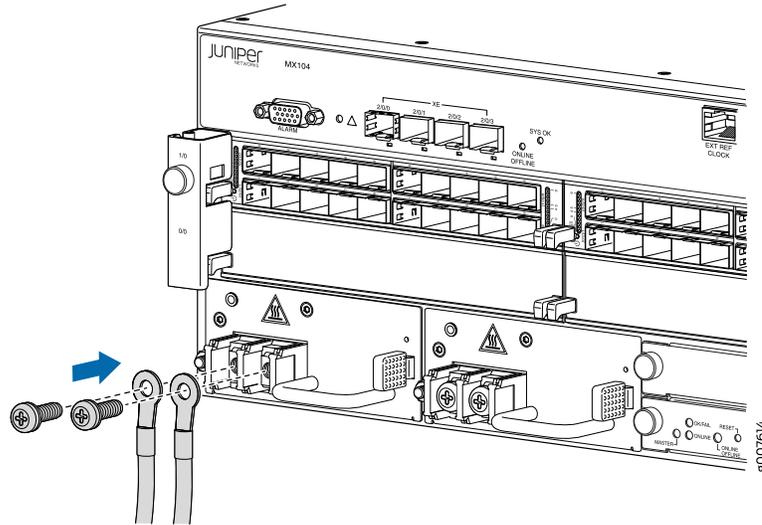
See Also
- MX104 Power Overview on page 29
- MX104 Installation Overview on page 97
- Connecting the MX104 Router to Earth Ground on page 102
- MX104 DC Power Electrical Safety Guidelines on page 194
- MX104 DC Power Specifications on page 34
- MX104 DC Power Cable and Lug Specifications on page 34

Connecting the MX104 to the Network

- Connecting the MX104 Router to Management Devices on page 109
- Connecting the MX104 Router to External Clocking and Timing Devices on page 111
- Connecting Interface Cables to MX104 Routers on page 113

Connecting the MX104 Router to Management Devices

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 24 on page 110 shows the connector. Figure 25 on page 110 shows the port.)

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

Figure 24: Ethernet Cable Connector
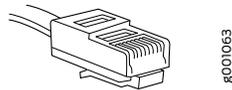
Figure 25: Ethernet Port
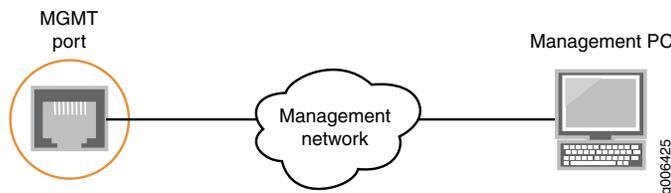
Connecting the Router to a Management Console Device

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.

> (i) 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 26 on page 111 shows the connector. Figure 27 on page 111 shows the ports.)

3. Plug the female DB-9 end into the serial port of the device.

> ℹ️ **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 26: Routing Engine Console Cable Connector
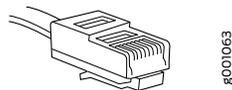
Figure 27: Console Connections
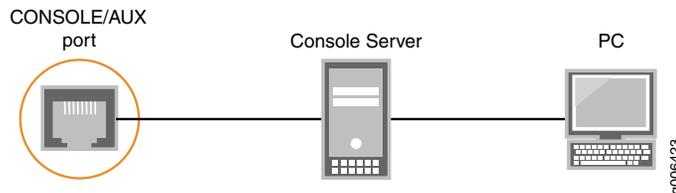
Connecting the MX104 Router to External Clocking and Timing Devices

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 on page 111
- Connecting a T1 or E1 External Clocking Device to the MX104 Router on page 112
- Connecting a Time-of-Day Device to the MX104 Router on page 112

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.

> ℹ️ **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 (LVTTL) (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*.

See Also
-

- MX104 Time of Day Port Specifications on page 95

Connecting Interface Cables to MX104 Routers

To connect the physical interfaces to the network (see Figure 28 on page 114):

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.

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

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

3. Insert the cable connector into the cable connector port on the 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 fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

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

Figure 28: Attaching a Cable to a MIC
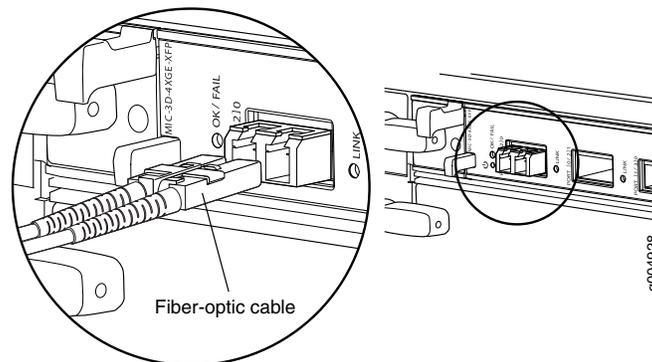
Fiber-optic cable

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.

> *i* 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*.

```
[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 on page 22

CHAPTER 4

Maintaining Components

Maintaining MX104 Components

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 68 on page 120 lists the FRUs for the MX104 router. Before you replace a Routing Engine, you must take the Routing Engine offline.

Table 68: Field-Replaceable Units

Hot-Removable and Hot-Insertable FRUs	Hot-Pluggable FRUs
• Air filter • Backup Routing Engine (if redundant) • Master Routing Engine (if nonstop active routing is configured) • Modular Interface Cards (MICs) • AC and DC power supplies (if redundant) • Fan tray • Transceivers	• Master Routing Engine (if nonstop active routing is not configured) • Routing Engine (nonredundant)

See Also • MX104 Universal Routing Platform Overview on page 19

Routine Maintenance Procedures for the MX104 Router

Purpose   For optimum router performance, perform preventive maintenance procedures.

Action   • Inspect the installation site for moisture, loose wires or cables, and excessive dust. Make sure that airflow is unobstructed around the router and into the air intake vents.

• Inspect the air filter on the side of the fan tray, replacing them 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: system alarms and LEDs.

Replacing an MX104 Console or Auxiliary Cable

ⓘ   NOTE: The AUX port is not supported.

1. Removing an MX104 Console or Auxiliary Cable on page 120
2. Installing an MX104 Console or Auxiliary Cable on page 121

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 strap to one of the ESD points on the chassis.

2. Press the tab on the connector, and pull the connector straight out of the **AUX** or **CONSOLE** port. Figure 29 on page 121 shows the connector.

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

Figure 29: Ethernet Cable Connectors
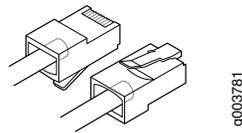
Installing an MX104 Console or Auxiliary Cable

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

> (i) 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 strap to one of the ESD points on the chassis.

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.

Replacing an MX104 Management Ethernet Cable

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 strap to one of the ESD points on the chassis.

2. Press the tab on the connector, and pull the connector straight out of the **ETHERNET** port. Figure 30 on page 122 shows the connector.

3. Disconnect the cable from the network device.

Figure 30: Ethernet Cable Connectors
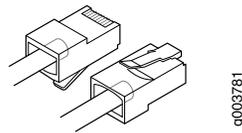
• MX104 Routing Engine Ethernet Port Specifications on page 88

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 strap to one of the ESD points on the chassis.

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

1. Disconnecting an MX104 Fiber-Optic Cable on page 122
2. Connecting an MX104 Fiber-Optic Cable on page 123

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 181).

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
   ```

   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.

   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

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

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 180).

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

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 31 on page 124).

Figure 31: Connecting a Fiber-Optic Cable to an Optical Transceiver Installed in a Router
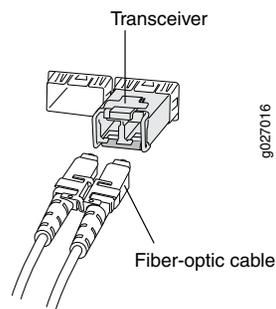
4. Secure the cables so that they are not supporting their own weight. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on a loop helps cables maintain their shape.

⚠️ 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
- Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion on page 86
- Calculating Power Budget and Power Margin for Fiber-Optic Cables on page 84

Replacing an MX104 Alarm Cable

- Disconnecting the Router from an External Alarm-Reporting Device on page 124
- Connecting the MX104 Router to an External Alarm-Reporting Device on page 125

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 strap to one of the ESD points on the chassis.

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 mm^2) and 14 AWG (2.08 mm^2), which is not provided. Use the gauge of wire appropriate for the external device you are connecting.

To connect an external device to an alarm relay contact:

1. Prepare the required length of wire with gauge between 20 AWG (0.52 mm^2) and 14 AWG (2.08 mm^2).

2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

3. While the terminal block is not plugged into the relay contact, use a 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 on page 24

Maintaining MX104 Cooling System Components

Maintaining the MX104 Cooling System

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 19.

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 on page 127

Replacing an MX104 Fan Tray

1. Removing an MX104 Fan Tray on page 127
2. Installing an MX104 Fan Tray on page 128

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 32 on page 128):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

2. Loosen the captive screws 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 avoid injury, keep tools and your fingers away from the fans as you slide the fan module out of the chassis. 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 32: Removing the Fan Tray
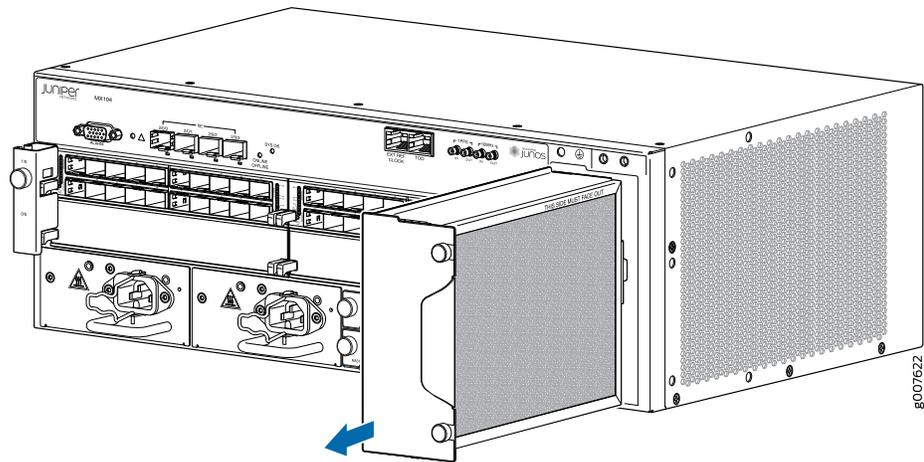
See Also
- MX104 Cooling System and Airflow Overview on page 27

Installing an MX104 Fan Tray

To install the fan tray (see Figure 33 on page 129):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

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 33: Installing the Fan Tray
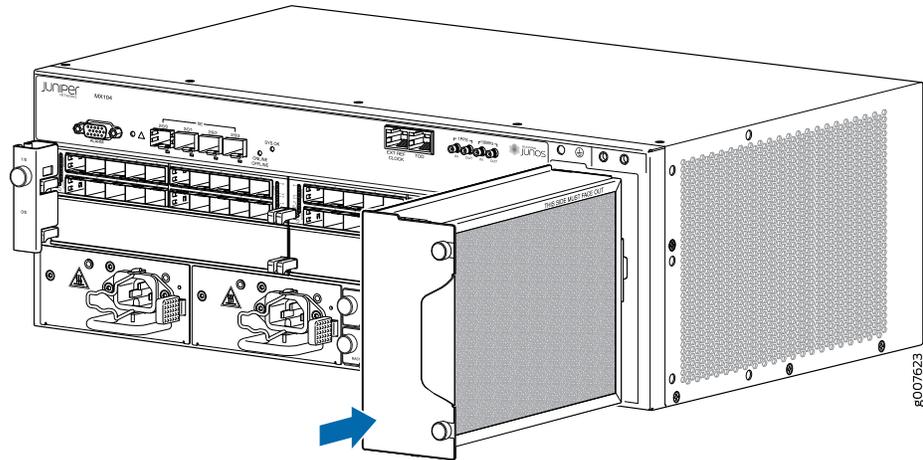
Maintaining the MX104 Air Filter

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 40ºF (4º C) to 90ºF (32º C). Note that if the material flakes, or becomes brittle when rubbed or deformed, it is no longer usable.

Replacing an MX104 Air Filter

Removing an MX104 Air Filter

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

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

The air filter must be installed on the right side of the fan tray. To remove the air filter (see Figure 34 on page 130):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

2. Remove the fan tray as described in "Removing an MX104 Fan Tray" on page 127.

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 34: Removing the MX104 Air Filter
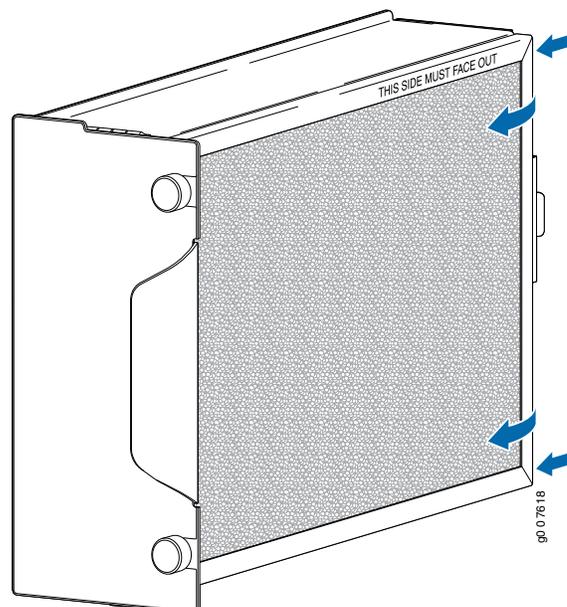
Installing an MX104 Air Filter

The air filter installs on the right side of the fan tray. To install the air filter (see Figure 35 on page 131):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

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 35: Installing the Air Filter
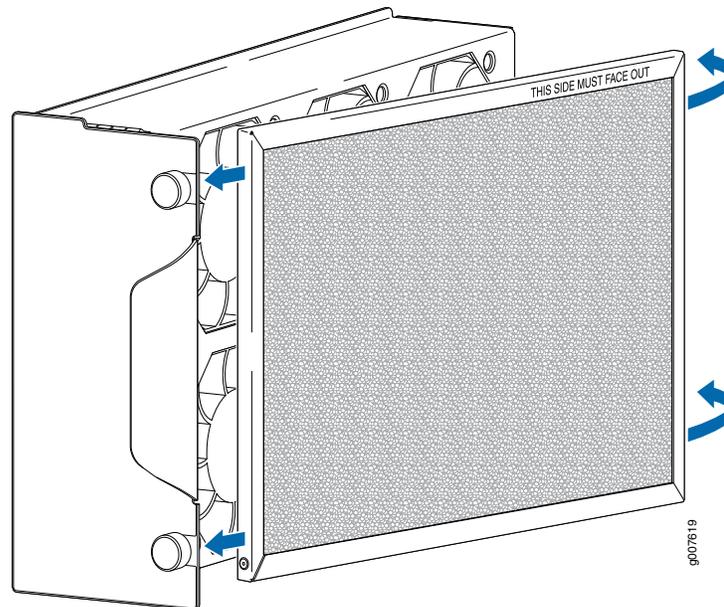
See Also
- MX104 Cooling System and Airflow Overview on page 27

Maintaining MX104 Host Subsystem Components

- Maintaining the MX104 Routing Engines on page 131
- Replacing an MX104 Routing Engine on page 133

Maintaining the MX104 Routing Engines

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 36.

- 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

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 master 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 master Routing Engine offline, the backup Routing Engine becomes the master (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 master Routing Engine offline varies depending on your configuration of high availability features.

Table 69 on page 133 explains the effect of taking the Routing Engine offline.

Table 69: 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.

Table 69: Effect of Taking the Routing Engine Offline (continued)

Type of Routing Engine	Effect of Taking the Routing Engine Offline
Backup Routing Engine	The functioning of the router is not interrupted. The backup Routing Engine is hot-removable and hot-insertable.
Master Routing Engine	The backup Routing Engine becomes the master. The backup Routing Engine assumes Routing Engine functions. The master Routing Engine is hot-pluggable. Removal or failure of the master Routing Engine affects forwarding and routing based on the high availability configuration: • Dual Routing Engines without any high availability features enabled—Traffic is interrupted while the Packet Forwarding Engine is reinitialized. All kernel and forwarding processes are restarted. When the switchover to the new master Routing Engine is complete, routing convergence takes place and traffic is resumed. • Graceful Routing Engine switchover (GRES) is enabled—Graceful Routing Engine switchover preserves interface and kernel information. Traffic is not interrupted. However, graceful Routing Engine switchover does not preserve the control plane. Neighboring routers detect that the router has restarted and react to the event in a manner prescribed by individual routing protocol specifications. To preserve routing without interruption during a switchover, graceful Routing Engine switchover must be combined with nonstop active routing. • 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.

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

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*.

(i) NOTE: For information about configuring graceful Routing Engine switchover, graceful restart, and nonstop active routing, see the *High Availability Feature Guide*.

(i) NOTE: Graceful restart software requirements depend on the routing protocols configured on the router. For the minimum software requirements for graceful restart, see the *High Availability Feature Guide*.

See Also
- MX104 Routing Engine Overview on page 36
- MX104 LEDs Overview on page 25

Taking an MX104 Routing Engine Offline

Before you take a Routing Engine offline, see "Effect of Taking the MX104 Routing Engine Offline" on page 133.

To take the Routing Engine offline:

1. Determine whether the Routing Engine is functioning as the master 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 master.

   - 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 master Routing Engine is designated **Master** in the current state field.

2. If the Routing Engine is functioning as the master, 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 on page 25
- MX104 Routing Engine Overview on page 36

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 master Routing engine, switch it to be the backup before removing it.

To remove a Routing Engine from (see Figure 36 on page 137):

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 strap to one of the ESD points on the chassis.

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 36: Removing an MX104 Routing Engine
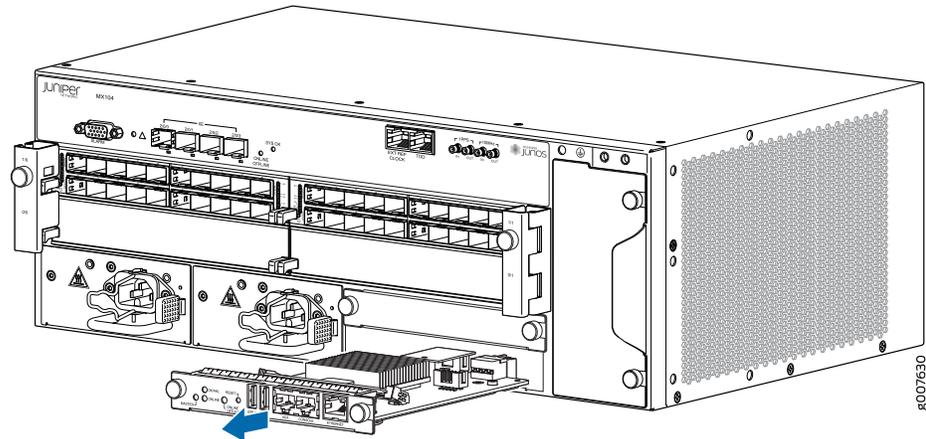
Installing an MX104 Routing Engine

To install a Routing Engine (see Figure 37 on page 138):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

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 37: Installing a Routing Engine
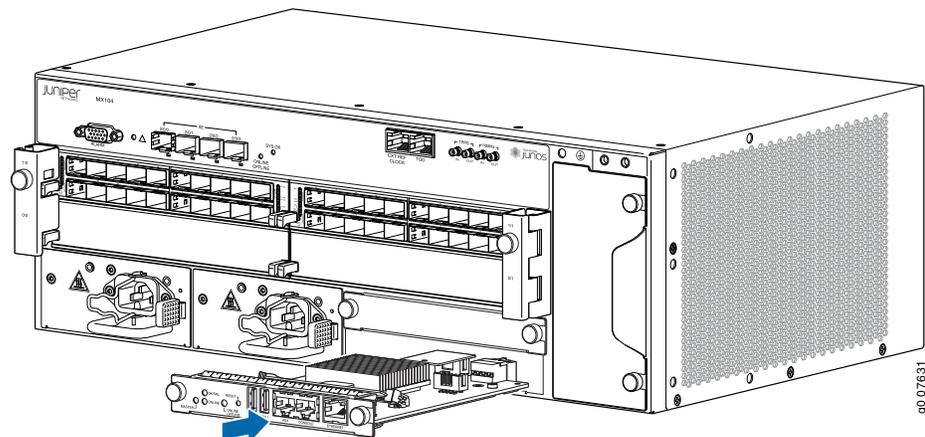
Maintaining MX104 Interface Modules

Maintaining the MX104 MICs and Network Ports

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 25. 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        1xC0C12/4xC0C3 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 on page 22

Replacing an MX104 MIC

1. Removing an MX104 MIC on page 140
2. Installing an MX104 MIC on page 141

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 38 on page 141):

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 strap to one of the ESD points on the chassis.

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.

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

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

6. Arrange the cable to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.

> ⚠️ **CAUTION:** Avoid bending 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 38: Removing a MIC
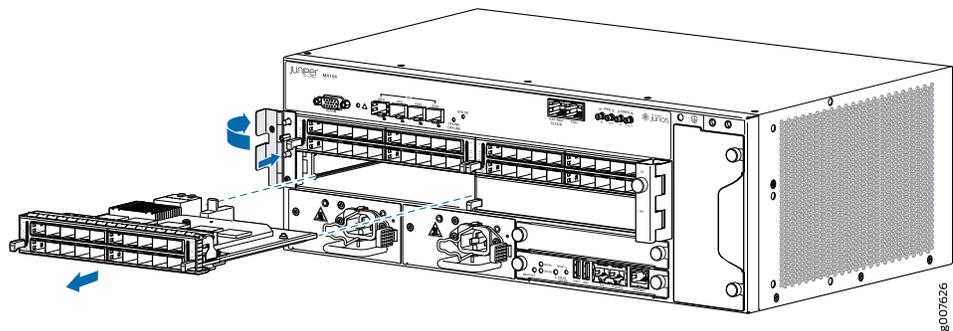
Installing an MX104 MIC

To install a MIC (see):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

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.

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

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

9. Insert the appropriate cables into the cable connectors on the MIC.

10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.

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

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

11. 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 139.

Figure 39: Installing a MIC
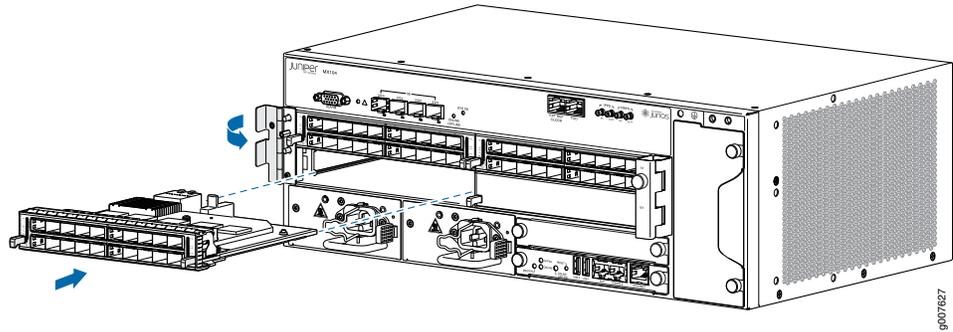
See Also • MX104 Modular Interface Card (MIC) Overview on page 59

Replacing an MX104 Transceiver

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.

1. Removing an MX104 Transceiver on page 143
2. Installing an MX104 Transceiver on page 145

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 40 on page 144):

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 strap to one of the ESD points on the chassis.

3. Label the cables connected to the transceiver so that you can reconnect them correctly later.

   ⚠ WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable 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.

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

Figure 40: Removing Transceivers
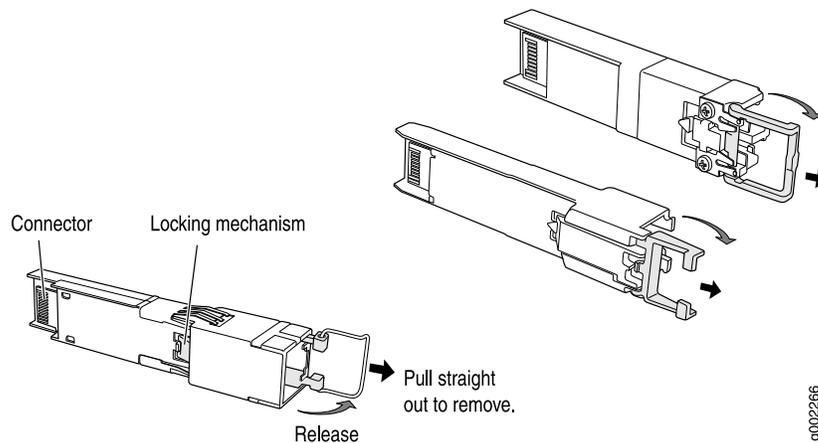
8. Place a rubber safety cap over the transceiver.

9. Place the removed transceiver on an antistatic mat or in an electrostatic bag.

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

See Also
- MX104 Chassis Overview on page 20
- MX104 Modular Interface Card (MIC) Overview on page 59

Installing an MX104 Transceiver

To install a transceiver:

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

2. Take each transceiver to be installed out of its electrostatic bag, and identify the slot on the component where it will be installed.

3. Verify that each transceiver is covered by a rubber safety cap. If it is not, cover the transceiver with a safety cap.

4. Carefully align the transceiver with the slots in the component. The connectors should face the component.

5. Slide the transceiver until the connector is seated in the component slot. If you are unable to fully insert the transceiver, make sure the connector is facing the right way.

6. Close the ejector handle of the transceiver.

7. Remove the rubber safety cap from the transceiver and the end of the cable. Insert the cable into the transceiver.

> ⚠ WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable 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 25.

See Also
- MX104 Chassis Overview on page 20
- MX104 Modular Interface Card (MIC) Overview on page 59

Maintaining Cables That Connect to MX104 Network Ports

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 on page 120
- Troubleshooting Resources for MX104 Routers on page 157

Maintaining MX104 Power System Components

Replacing an MX104 AC Power Supply

Removing an MX104 AC Power Supply

Before you remove a power supply, be aware of the following:

i **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.

i **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 42 on page 148):

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 strap to one of the ESD points on the chassis.

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 41: Removing an AC Power Cord
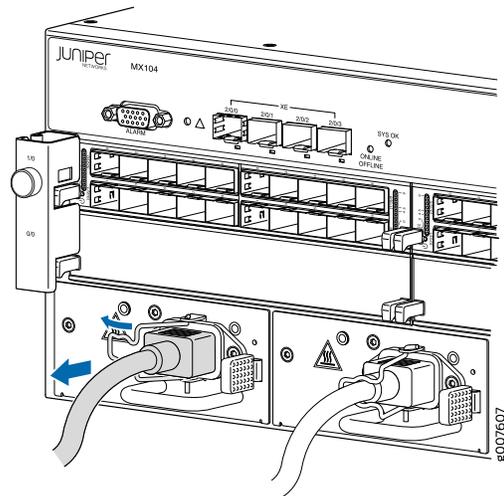
Figure 42: Removing an AC Power Supply
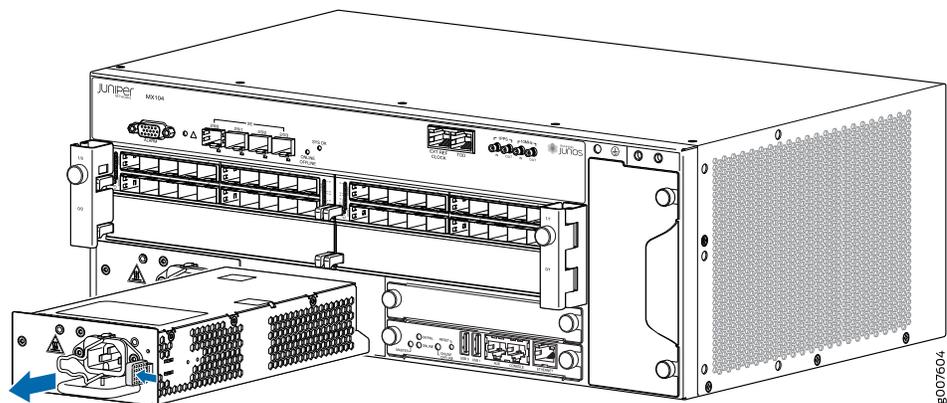
See Also
- Connecting AC Power Cords to the MX104 Router on page 104
- MX104 AC Power Specifications on page 31
- MX104 AC Power Cord Specifications on page 32

Installing an MX104 AC Power Supply

To install an AC power supply (see Figure 43 on page 149):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.

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 43: Installing an AC Power Supply
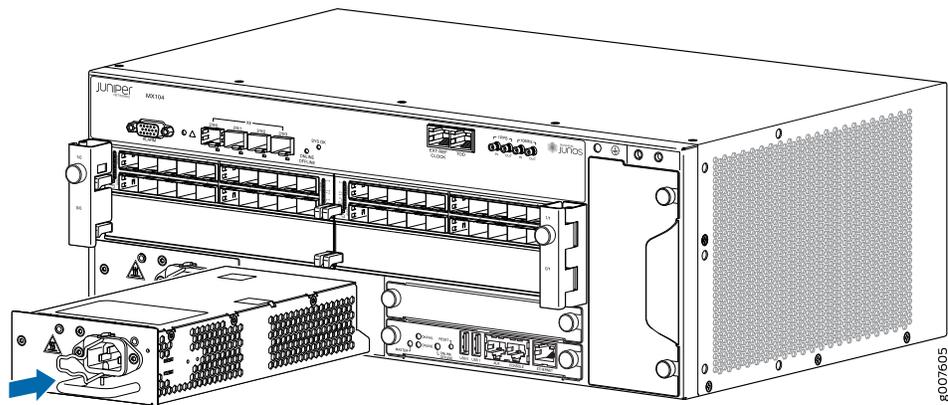
See Also
- Connecting AC Power Cords to the MX104 Router on page 104
- MX104 AC Power Specifications on page 31
- MX104 AC Power Cord Specifications on page 32

Replacing an MX104 DC Power Supply

1. Removing an MX104 DC Power Supply on page 149
2. Installing an MX104 DC Power Supply on page 152

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:

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

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

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

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

To remove a DC power supply (see Figure 46 on page 152):

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 strap to one of the ESD points on the chassis.

5. Remove the clear plastic cover protecting the terminal studs on the faceplate (see Figure 44 on page 151).

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 45 on page 151).

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 44: Disconnecting the DC Power Cables
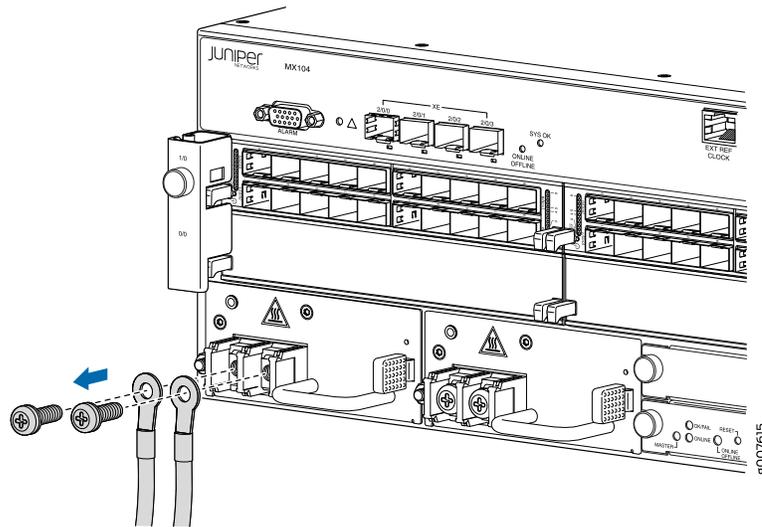
Figure 45: Disconnecting the Grounding Cable
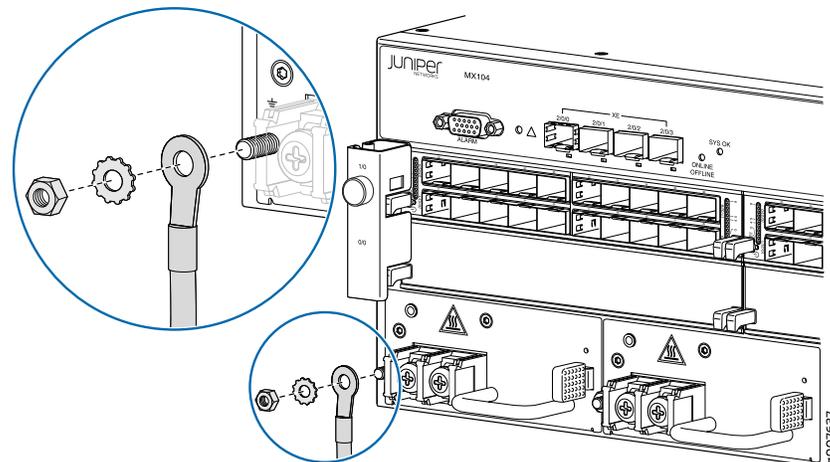
Figure 46: Removing a DC Power Supply
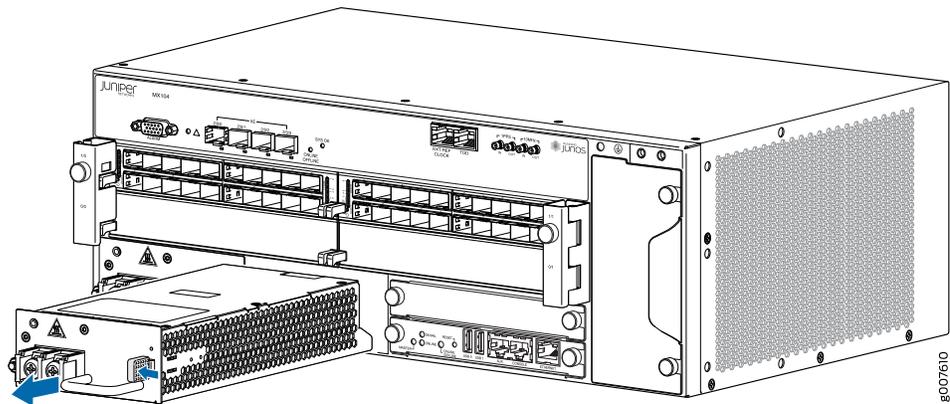
- Connecting the MX104 Router to Earth Ground on page 102
- MX104 Chassis Grounding Cable and Lug Specifications on page 78
- MX104 DC Power Electrical Safety Guidelines on page 194
- DC Power Electrical Safety Warnings for Juniper Networks Devices on page 195
- MX104 DC Power Specifications on page 34
- MX104 DC Power Cable and Lug Specifications on page 34

Installing an MX104 DC Power Supply

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

To install a DC power supply 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 48 on page 155):

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 strap to one of the ESD points on the chassis.

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 47 on page 153):

   • 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 47: Connecting a DC Power Supply Grounding Cable
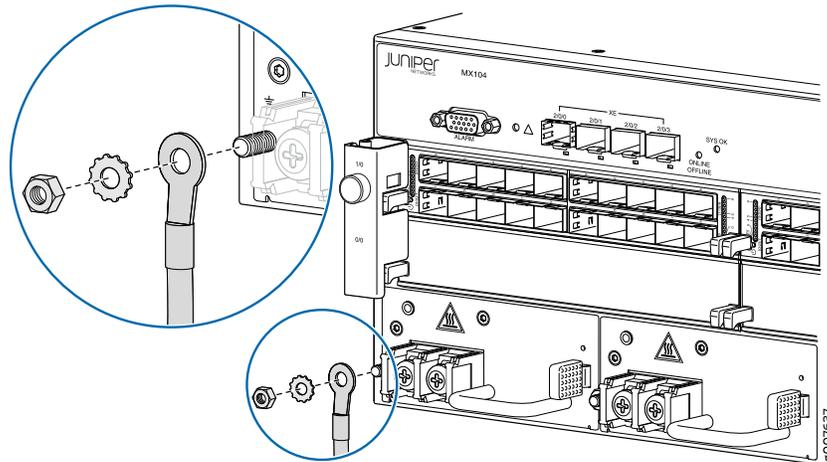
6. Remove the screws and washers from the DC terminals.

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 49 on page 155). 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 48: Installing a DC Power Supply
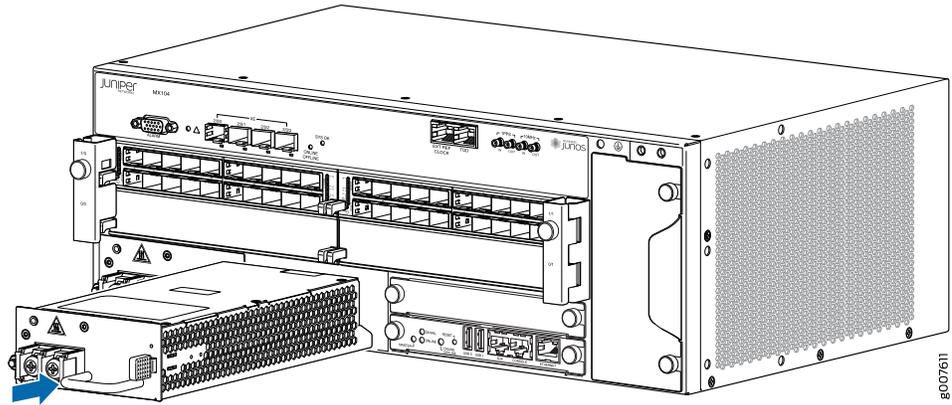
Figure 49: Connecting the DC Power Cables
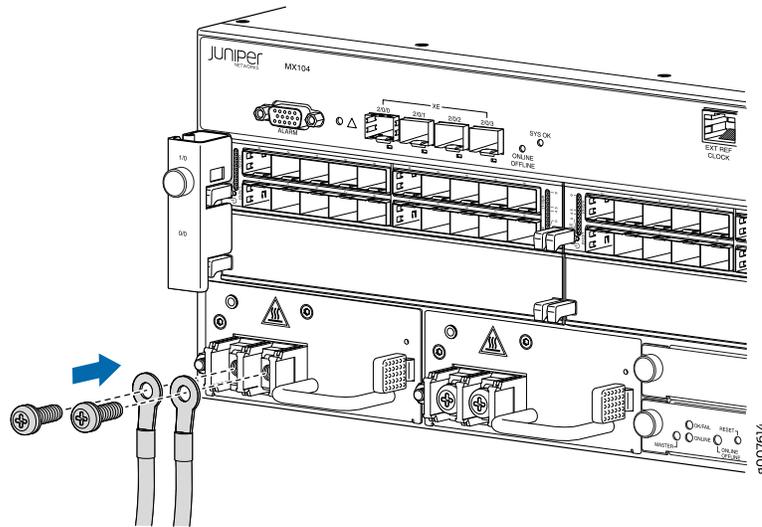
See Also
- Connecting the MX104 Router to Earth Ground on page 102
- MX104 Chassis Grounding Cable and Lug Specifications on page 78
- MX104 DC Power Electrical Safety Guidelines on page 194
- DC Power Electrical Safety Warnings for Juniper Networks Devices on page 195
- MX104 DC Power Specifications on page 34
- MX104 DC Power Cable and Lug Specifications on page 34

Troubleshooting Hardware

Troubleshooting the MX104

Troubleshooting Resources for MX104 Routers

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 25.

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

Before monitoring alarms on the router, become familiar with the terms defined in Table 70 on page 158.

Table 70: 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.
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

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 71 on page 159 lists the alarm output fields.

Table 71: 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

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 6

Contacting Customer Support and Returning the Chassis or Components

Contacting Customer Support and Returning the Chassis or Components

Contacting 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 Case Manager link at:

  https://www.juniper.net/support/

- By telephone:

  From the US and Canada: 1-888-314-JTAC

  From all other locations: 1-408-745-9500

  If contacting JTAC by phone, enter your 12-digit case number followed by the # key if this is an existing case, or press the * key to be routed to the next available support engineer.

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

- Your existing case number, if you have one

- Details of the failure or problem

- Type of activity being performed on the platform when the problem occurred

- Configuration data using one or more of the show commands

Returning a Hardware Component to Juniper Networks, Inc.

In the event of a hardware failure, 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 Web page at https://www.juniper.net/support/guidelines.html.

For product problems or technical support issues, contact the Juniper Networks Technical Assistance Center (JTAC) by using the Case Manager link at https://www.juniper.net/support/ or at 1-888-314-JTAC (within the United States) or 1-408-745-9500 (from outside the United States).

To return a 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) attached to the component body.

Figure 50: Serial Number ID Label

MX104 Chassis Serial Number Label

The chassis serial number is located on the rear of the chassis (see).

Figure 51: MX104 Chassis Serial Number Label
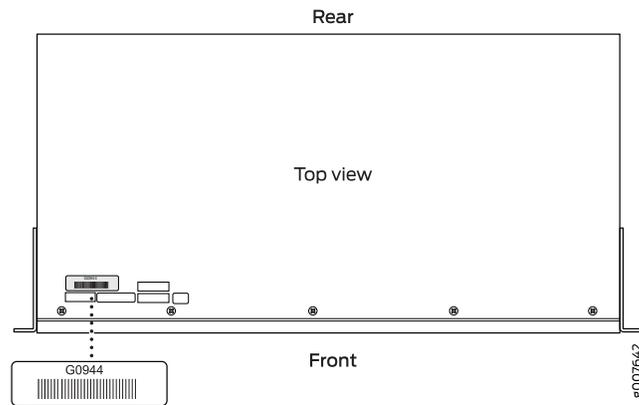
MX104 Fan Tray Serial Number Label

The fan tray serial number is located on the rear of the fan tray (see Figure 52 on page 164).

Figure 52: MX104 Fan Tray Serial Number Label
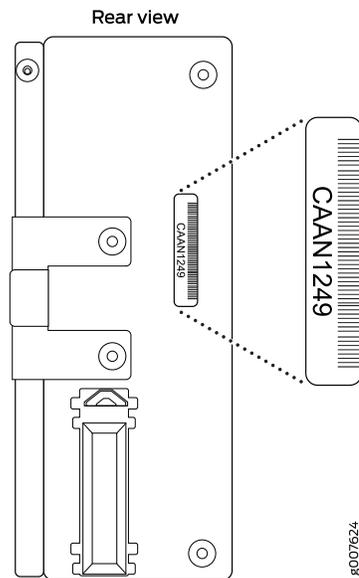
MX104 MIC Serial Number Label

The MIC serial number label is located on the top of the MIC (see Figure 53 on page 165).

Figure 53: MX104 MIC Serial Number Label
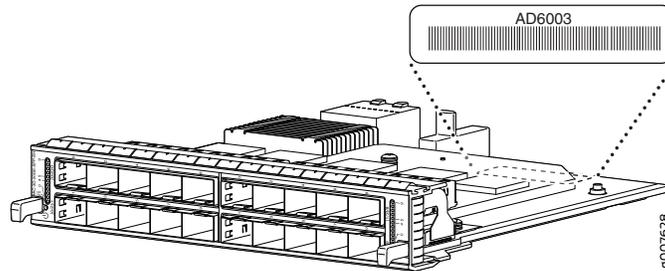
> **NOTE:** The location of the serial number label may vary depending on model. Look for an alphanumeric sticker similar to the one shown in .

MX104 Power Supply Serial Number Label

The power supply serial number is located on the top of the power supply (see).

Figure 54: MX104 Power Supply Serial Number Label
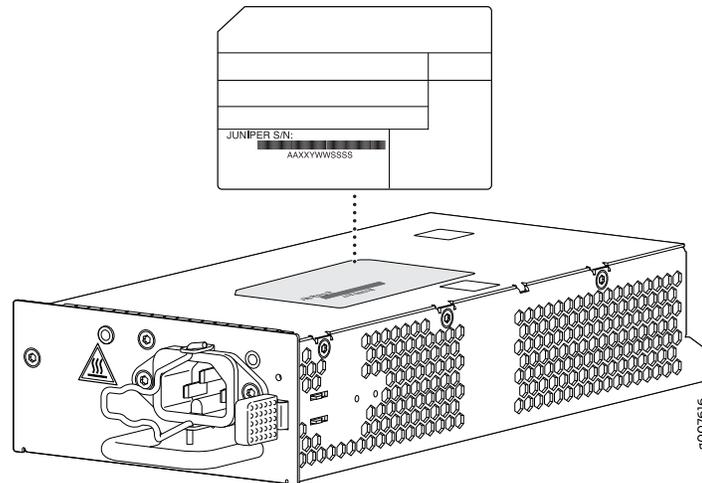
MX104 Routing Engine Serial Number Label

The Routing Engine serial number is located on the top of the Routing Engine (see).

Figure 55: MX104 Routing Engine Serial Number Label
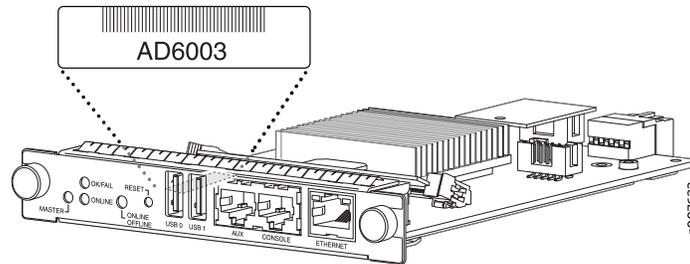
Guidelines for Packing Hardware Components for Shipment

To pack and ship individual components:

- When you return components, make sure 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 strap to one of the ESD points on the chassis.

4. Shut down power to the router by pressing the AC input switch or DC circuit breaker for all power supplies to the off (**O**) position.

5. Disconnect power from the router.

6. Remove the cables that connect to all external devices.

7. Remove all field replaceable units (FRUs) from the router.

8. Remove the router from the rack. 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   •   Contacting Customer Support on page 161

Safety and Compliance Information

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.

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 vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker.

Aviso Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos

eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes.

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

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

Related Documentation

- General Safety Warnings for Juniper Networks Devices on page 172
- Installation Safety Warnings for Juniper Networks Devices on page 175
- *Maintenance and Operational Safety Warnings for Juniper Networks Devices*
- General Electrical Safety Warnings for Juniper Networks Devices on page 189
- DC Power Electrical Safety Warnings for Juniper Networks Devices on page 195

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

-
-

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.

Varning! 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 on page 175
- *Maintenance and Operational Safety Warnings for Juniper Networks Devices*
- General Electrical Safety Warnings for Juniper Networks Devices on page 189
- DC Power Electrical Safety Warnings for Juniper Networks Devices on page 195

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 56 on page 175).

- 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 57 on page 175). If you are returning a component, place it in an electrostatic bag before packing it.

Figure 56: ESD Point on the MX104 Router Chassis
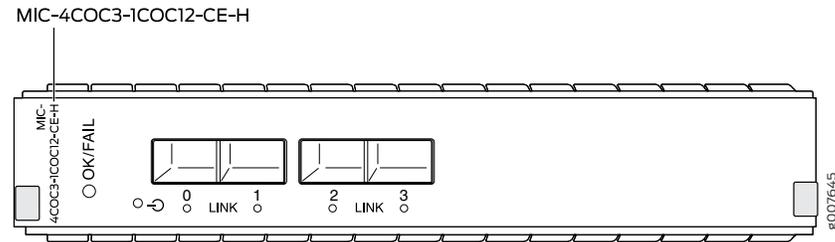
Figure 57: Placing a Component into an Electrostatic Bag
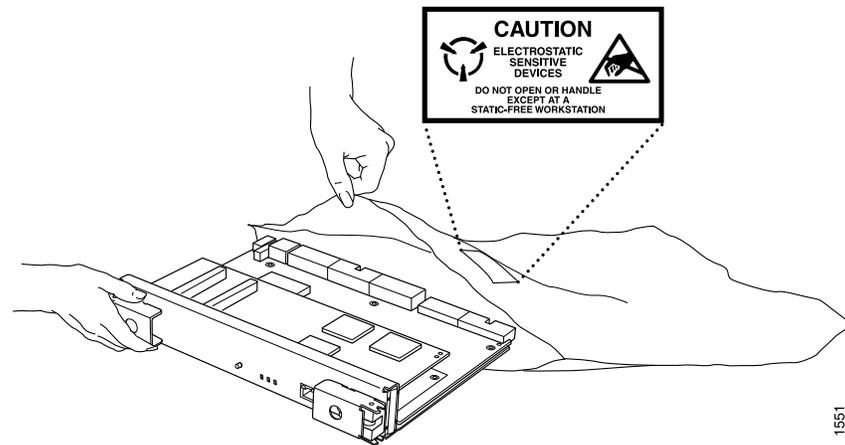
> **NOTE:** Figure 57 on page 175 shows a component that is not supported on MX104 routers.

Related Documentation

- Connecting the MX104 Router to Earth Ground on page 102

Installation Safety Warnings for Juniper Networks Devices

Observe the following warnings before and during hardware equipment installation:

- Intrabuilding Ports Warning on page 176
- Installation Instructions Warning on page 176
- Rack-Mounting Requirements and Warnings on page 176
- Ramp Warning on page 180

Intrabuilding Ports Warning

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

Installation Instructions Warning

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

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

Varoitus Lue asennusohjeet ennen järjestelmän yhdistämistä virtalähteeseen.

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

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

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

Advarsel Les installasjonsinstruksjonene før systemet kobles til strømkilden.

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

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

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

Rack-Mounting Requirements and Warnings

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

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

- The chassis must be installed into a rack that is secured to the building structure.

- The chassis should be mounted at the bottom of the rack if it is the only unit in the rack.

- When mounting the chassis in a partially-filled rack, load the rack from the bottom to the top, with the heaviest component at the bottom of the rack.

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

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

- De router moet in een stellage worden geïnstalleerd die aan een bouwsel is verankerd.

- Dit toestel dient onderaan in het rek gemonteerd te worden als het toestel het enige in het rek is.

- Wanneer u dit toestel in een gedeeltelijk gevuld rek monteert, dient u het rek van onderen naar boven te laden met het zwaarste onderdeel onderaan in het rek.

- Als het rek voorzien is van stabiliseringshulpmiddelen, dient u de stabilisatoren te monteren voordat u het toestel in het rek monteert of het daar een servicebeurt geeft.

Varoitus Kun laite asetetaan telineeseen tai huolletaan sen ollessa telineessä, on noudatettava erityisiä varotoimia järjestelmän vakavuuden säilyttämiseksi, jotta vältytään 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 edificio.

- Esta unidade deverá ser montada na parte inferior da estante, caso seja esta a única unidade a ser montada.

- Ao montar esta unidade numa estante parcialmente ocupada, coloque os itens mais pesados na parte inferior da estante, arrumando-os de baixo para cima.

- Se a estante possuir um dispositivo de estabilização, instale-o antes de montar ou reparar a unidade.

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

- El router debe instalarse en un bastidor fijado a la estructura del edificio.

- Colocar el equipo en la parte inferior del bastidor, cuando sea la única unidad en el mismo.

- Cuando este equipo se vaya a instalar en un bastidor parcialmente ocupado, comenzar la instalación desde la parte inferior hacia la superior colocando el equipo más pesado en la parte inferior.

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

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

- Router måste installeras i en ställning som är förankrad i byggnadens struktur.

- Om denna enhet är den enda enheten på ställningen skall den installeras längst ned på ställningen.

- Om denna enhet installeras på en delvis fylld ställning skall ställningen fyllas nedifrån och upp, med de tyngsta enheterna längst ned på ställningen.

- Om ställningen är försedd med stabiliseringsdon skall dessa monteras fast innan enheten installeras eller underhålls på ställningen.

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 on page 171
- General Safety Warnings for Juniper Networks Devices on page 172
- *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.

> **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 on page 181
- General Safety Warnings for Juniper Networks Devices on page 172

Laser Safety Warnings for Juniper Networks Devices

- Class 1 Laser Product Warning on page 181
- Class 1 LED Product Warning on page 182
- Laser Beam Warning on page 182
- Radiation from Open Port Apertures Warning on page 183

Class 1 Laser Product Warning

> **WARNING:** Class 1 laser product.
>
> **Waarschuwing** Klasse-1 laser produkt.
>
> **Varoitus** Luokan 1 lasertuote.
>
> **Attention** Produit laser de classe I.
>
> **Warnung** Laserprodukt der Klasse 1.
>
> **Avvertenza** Prodotto laser di Classe 1.
>
> **Advarsel** Laserprodukt av klasse 1.
>
> **Aviso** Produto laser de classe 1.
>
> **¡Atención!** Producto láser Clase I.
>
> **Varning!** Laserprodukt av klass 1.

Class 1 LED Product Warning

WARNING: Class 1 LED product.

Waarschuwing Klasse 1 LED-product.

Varoitus Luokan 1 valodiodituote.

Attention Alarme de produit LED Class I.

Warnung Class 1 LED-Produktwarnung.

Avvertenza Avvertenza prodotto LED di Classe 1.

Advarsel LED-produkt i klasse 1.

Aviso Produto de classe 1 com LED.

¡Atención! Aviso sobre producto LED de Clase 1.

Varning! Lysdiodprodukt av klass 1.

Laser Beam Warning

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

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

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

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

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

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

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

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

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

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

Radiation from Open Port Apertures Warning

WARNING: Because invisible radiation might be emitted from the aperture of the port when no fiber-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 emiteres fra portens åpning når det ikke er tilkoblet en fiberkabel.

Aviso Dada a possibilidade de emissão de radiação invisível através do orifício da via de acesso, quando esta não tiver nenhum cabo de fibra conectado, deverá evitar 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 on page 171

Maintenance and Operational Safety Warnings for MX104 Routers

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 weggeworpen te worden.

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

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

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

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

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

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

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

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

Jewelry Removal Warning

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

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

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

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

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

Avvertenza Prima di intervenire su apparecchiature collegate alle linee di alimentazione, togliersi qualsiasi monile (inclusi anelli, collane, braccialetti ed orologi). Gli oggetti metallici si riscaldano quando sono collegati tra punti

di alimentazione e massa: possono causare ustioni gravi oppure il metallo può saldarsi ai terminali.

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

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

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

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

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 149º F (65º 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 65º C wordt overschreden. Om te voorkomen dat de luchtstroom wordt beperkt, dient er minstens 15,2 cm speling rond de ventilatie-openingen te zijn.

Varoitus Ettei router-sarjan reititin ylikuumentuisi, sitä ei saa käyttää tilassa, jonka lämpötila ylittää korkeimman suositellun ympäristölämpötilan 65º 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 65º 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 65º 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 65º 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 65º C (149º 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 65º 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 65º C. Para impedir la restricción de la entrada de aire, deje un espacio mínimo de 15,2 cm alrededor de las aperturas para ventilación.

Varning! Förhindra att en router överhettas genom att inte använda den i ett område där den maximalt rekommenderade omgivningstemperaturen på 65º C överskrids. Förhindra att luftcirkulationen inskränks genom att se till att det finns fritt utrymme på minst 15,2 cm omkring ventilationsöppningarna.

Product Disposal Warning

WARNING: Disposal of this product must be handled according to all national laws and regulations.

Waarschuwing Dit produkt dient volgens alle landelijke wetten en voorschriften te worden afgedankt.

Varoitus Tämän tuotteen lopullisesta hävittämisestä tulee huolehtia kaikkia valtakunnallisia lakeja ja säännöksiä noudattaen.

Attention La mise au rebut définitive de ce produit doit être effectuée conformément à toutes les lois et réglementations en vigueur.

Warnung Dieses Produkt muß den geltenden Gesetzen und Vorschriften entsprechend entsorgt werden.

Avvertenza L'eliminazione finale di questo prodotto deve essere eseguita osservando le normative italiane vigenti in materia

Advarsel Endelig disponering av dette produktet må skje i henhold til nasjonale lover og forskrifter.

Aviso A descartagem final deste produto deverá ser efectuada de acordo com os regulamentos e a legislação nacional.

¡Atención! El desecho final de este producto debe realizarse según todas las leyes y regulaciones nacionales

Varning! Slutlig kassering av denna produkt bör skötas i enlighet med landets alla lagar och föreskrifter.

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.

General Electrical Safety Warnings for Juniper Networks Devices

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 isäntälaite on yhdistetty maahan normaalikäytön aikana.

Attention Cet équipement doit être relié à la terre. S'assurer que l'appareil hôte est relié à la terre lors de l'utilisation normale.

Warnung Dieses Gerät muß geerdet werden. Stellen Sie sicher, daß das Host-Gerät während des normalen Betriebs an Erde gelegt ist.

Avvertenza Questa apparecchiatura deve essere collegata a massa. Accertarsi che il dispositivo host sia collegato alla massa di terra durante il normale utilizzo.

Advarsel Dette utstyret skal jordes. Forviss deg om vertsterminalen er jordet ved normalt bruk.

Aviso Este equipamento deverá estar ligado à terra. Certifique-se que o host se encontra ligado à terra durante a sua utilização normal.

¡Atención! Este equipo debe conectarse a tierra. Asegurarse de que el equipo principal esté conectado a tierra durante el uso normal.

Varning! Denna utrustning är avsedd att jordas. Se till att värdenheten är jordad vid normal användning.

Grounding Requirements and Warning

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

WARNING: When installing the network device, you must always make the ground connection first and disconnect it last.

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

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

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

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

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

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

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

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

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

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.

Varning! Denna enhet har mer än en strömförsörjningsanslutning; alla anslutningar måste vara helt avlägsnade innan strömtillförseln till enheten är fullständigt bruten.

Power Disconnection Warning

WARNING: Before working on the chassis or near power supplies, switch off the power at the DC circuit breaker.

Waarschuwing Voordat u aan een frame of in de nabijheid van voedingen werkt, dient u bij wisselstroom toestellen de stekker van het netsnoer uit het stopcontact te halen; voor gelijkstroom toestellen dient u de stroom uit te schakelen bij de stroomverbreker.

Varoitus Kytke irti vaihtovirtalaitteiden virtajohto ja katkaise tasavirtalaitteiden virta suojakytkimellä, ennen kuin teet mitään asennuspohjalle tai työskentelet virtalähteiden läheisyydessä.

Attention Avant de travailler sur un châssis ou à proximité d'une alimentation électrique, débrancher le cordon d'alimentation des unités en courant alternatif; couper l'alimentation des unités en courant continu au niveau du disjoncteur.

Warnung Bevor Sie an einem Chassis oder in der Nähe von Netzgeräten arbeiten, ziehen Sie bei Wechselstromeinheiten das Netzkabel ab bzw. schalten Sie bei Gleichstromeinheiten den Strom am Unterbrecher ab.

Avvertenza Prima di lavorare su un telaio o intorno ad alimentatori, scollegare il cavo di alimentazione sulle unità CA; scollegare l'alimentazione all'interruttore automatico sulle unità CC.

Advarsel Før det utføres arbeid på kabinettet eller det arbeides i nærheten av strømforsyningsenheter, skal strømledningen trekkes ut p vekselstrømsenheter og strømmen kobles fra ved strømbryteren på likestrømsenheter.

Aviso Antes de trabalhar num chassis, ou antes de trabalhar perto de unidades de fornecimento de energia, desligue o cabo de alimentação nas unidades de corrente alternada; desligue a corrente no disjuntor nas unidades de corrente contínua.

¡Atención! Antes de manipular el chasis de un equipo o trabajar cerca de una fuente de alimentación, desenchufar el cable de alimentación en los equipos de corriente alterna (CA); cortar la alimentación desde el interruptor automático en los equipos de corriente continua (CC).

Varning! 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
-

General Electrical Safety Guidelines and Electrical Codes for Juniper Networks Devices

- Install the router in compliance with the following local, national, or international electrical codes:

  - United States—National Fire Protection Association (NFPA 70), United States National Electrical Code.

  - Canada—Canadian Electrical Code, Part 1, CSA C22.1.

  - Other countries—International Electromechanical Commission (IEC) 60364, Part 1 through Part 7.

- Locate the emergency power-off switch for the room in which you are working so that if an electrical accident occurs, you can quickly turn off the power.

- Do not work alone if potentially hazardous conditions exist anywhere in your workspace.

- Never assume that power is disconnected from a circuit. Always check the circuit before starting to work.

- Carefully look for possible hazards in your work area, such as moist floors, ungrounded power extension cords, and missing safety grounds.

- Operate the router within marked electrical ratings and product usage instructions.

- For the router and peripheral equipment to function safely and correctly, use the cables and connectors specified for the attached peripheral equipment, and make certain they are in good condition.

Many router components can be removed and replaced without powering off or disconnecting power to the router. Never install equipment if it appears damaged.

Related Documentation
-

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 31.

  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。

g017253

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 34 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 34.

- 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 on page 195

DC Power Electrical Safety Warnings for Juniper Networks Devices

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

- DC Power Copper Conductors Warning on page 195
- DC Power Disconnection Warning on page 196
- DC Power Wiring Terminations Warning on page 197

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).

Varning! Innan du utför någon av följande procedurer måste du kontrollera att strömförsörjningen till likströmskretsen är bruten. Kontrollera att all strömförsörjning är BRUTEN genom att slå AV det överspänningsskydd som skyddar likströmskretsen och tejpa fast överspänningsskyddets omkopplare i FRÅN-läget.

DC Power Wiring Terminations Warning

WARNING: When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations must be the appropriate size for the wires and must clamp both the insulation and conductor.

Waarschuwing Wanneer geslagen bedrading vereist is, dient u bedrading te gebruiken die voorzien is van goedgekeurde aansluitingspunten, zoals het gesloten-lus type of het grijperschop type waarbij de aansluitpunten omhoog wijzen. Deze aansluitpunten dienen de juiste maat voor de draden te hebben en dienen zowel de isolatie als de geleider vast te klemmen.

Varoitus Jos säikeellinen johdin on tarpeen, käytä hyväksyttyä johdinliitäntää, esimerkiksi suljettua silmukkaa tai kourumaista liitäntää, jossa on ylöspäin käännetyt kiinnityskorvat. Tällaisten liitäntöjen tulee olla kooltaan johtimiin sopivia ja niiden tulee puristaa yhteen sekä eristeen että johdinosan.

Attention Quand des fils torsadés sont nécessaires, utiliser des douilles terminales homologuées telles que celles à circuit fermé ou du type à plage ouverte avec cosses rebroussées. Ces douilles terminales doivent être de la

taille qui convient aux fils et doivent être refermées sur la gaine isolante et sur le conducteur.

Warnung Wenn Litzenverdrahtung erforderlich ist, sind zugelassene Verdrahtungsabschlüsse, z.B. Ringoesen oder gabelförmige Kabelschuhe mit nach oben gerichteten Enden zu verwenden. Diese Abschlüsse sollten die angemessene Größe für die Drähte haben und sowohl die Isolierung als auch den Leiter festklemmen.

Avvertenza Quando occorre usare trecce, usare connettori omologati, come quelli a occhiello o a forcella con linguette rivolte verso l'alto. I connettori devono avere la misura adatta per il cablaggio e devono serrare sia l'isolante che il conduttore.

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

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

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

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

Related Documentation

- General Safety Warnings for Juniper Networks Devices on page 172
- General Electrical Safety Warnings for Juniper Networks Devices on page 189

Site Electrical Wiring Guidelines for MX104 Routers

- Distance Limitations for Signaling on page 199
- Radio Frequency Interference on page 199
- Electromagnetic Compatibility on page 199

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 metallically 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 metallically 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 on page 171
- General Safety Warnings for Juniper Networks Devices on page 172

Agency Approvals for MX104 Routers

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)

Related Documentation
- Compliance Statements for EMC Requirements for MX104 Routers on page 202
- Compliance Statements for NEBS for MX104 Routers on page 201
- Compliance Statements for Acoustic Noise for MX104 Routers on page 203
- Compliance Statements for Environmental Requirements on page 203

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 on page 200
- Compliance Statements for EMC Requirements for MX104 Routers on page 202
- Compliance Statements for Acoustic Noise for MX104 Routers on page 203
- Compliance Statements for Environmental Requirements on page 203

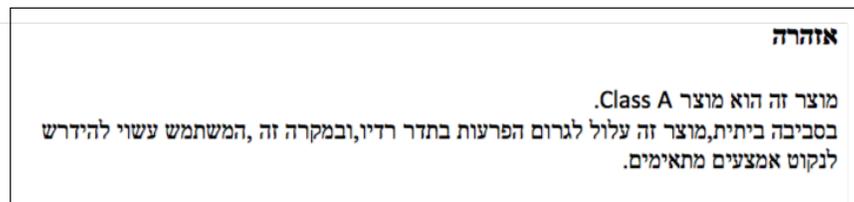## Compliance Statements for EMC Requirements for MX104 Routers

Canada

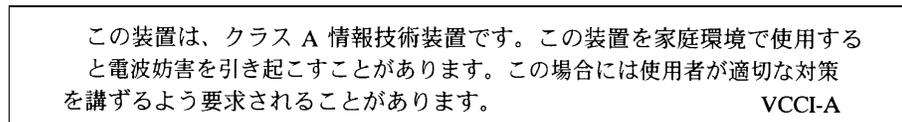CAN ICES-3 (A)/NMB-3(A)

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

<div dir="rtl">

אזהרה

מוצר זה הוא מוצר Class A.
בסביבה ביתית,מוצר זה עלול לגרום הפרעות בתדר רדיו,ובמקרה זה, המשתמש עשוי להידרש לנקוט אמצעים מתאימים.

</div>

Translation from Hebrew—Warning: This product is Class A. In residential environments, the product might cause radio interference, and in such a situation, the user might be required to take adequate measures.

Japan

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

The preceding translates as follows:

This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this product is used near a radio or television receiver in a domestic environment, it might cause radio interference. Install and use the equipment according to the instruction manual. VCCI-A.

United States

The hardware equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio

frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Related Documentation
- Agency Approvals for MX104 Routers on page 200
- Compliance Statements for NEBS for MX104 Routers on page 201
- Compliance Statements for Acoustic Noise for MX104 Routers on page 203
- Compliance Statements for Environmental Requirements on page 203

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 on page 201
- Compliance Statements for EMC Requirements for MX104 Routers on page 202
- Compliance Statements for Environmental Requirements on page 203