Cisco XR 12406 Router Installation Guide

March 2009

C O N T E N T S

Cisco XR 12406 Router Installation Guide

Preface

Revised: March, 2009, OL-13831-01

The *Cisco XR 12406 Router Installation Guide* provides information related to installation and removal of Cisco XR 12406 Router Chassis.

The preface contains the following sections:

- Changes to This Document
- Obtaining Documentation and Submitting a Service Request
- Audience
- Purpose
- Installation Guide Organization
- Document Conventions

Changes to This Document

Table 1 lists the technical changes made to this document since it was first printed.

Table 1   Changes to This Document

Revision	Date	Change Summary
OL-13831-01	March 2009	Added Performance Route Processor-3 (PRP-3) hardware details. PRP-3 has been introduced in Cisco IOS XR Software Release 3.8.0. PRP-3 will be supported on Cisco IOS XR Software Release 3.8.0 and later releases.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.

Audience

The audience for the Cisco XR 12406 Router Installation Guide user documentation are the people who will install and configure a Cisco XR 12404 Router. The user typically has a substantial background in installing and configuring router- and switch-based Internets but may or may not have experience with Cisco products and supported protocols.

The reader of this documentation should be familiar with electronic circuitry and wiring practices and have experience as an electronic or electromechanical technician.

Purpose

This installation and configuration guide explains the hardware installation and basic configuration procedures for a Cisco XR 12404 Router. It contains procedures for installing the hardware, creating a basic configuration file, and starting up the router.

Installation Guide Organization

The *Cisco XR 12406 Router Installation Guide* contains the following chapters, appendix, and index.

- Chapter 1, "Cisco XR 12406 Router Overview"—Presents a high-level system overview and physical description of the major components of Cisco XR 12406 Router, including the power and cooling systems, Performance Route Processor (PRP), clock and scheduler cards (CSC), switch fabric cards (SFC), and alarm cards, and gives a functional overview.

- Chapter 2, "Preparing for Installation"—Describes safety, site requirements for power, environmental safety, cabling, rack-mounting, electrostatic discharge (ESD), unpacking, site log, and site preparation checklist.

- Chapter 3, "Installing the Cisco XR 12406 Router"—Gives the procedures for the initial installation and setup of Cisco XR 12406 Router.

- Chapter 4, "Troubleshooting the Installation"—Explains how to identify and solve problems that might occur during installation.

- Chapter 5, "Maintaining the Router"—Explains safety at the field-replaceable unit (FRU) level, removal and replacement procedures for field-replaceable units and assemblies, and associated procedures to troubleshoot and verify FRU and device operation.

- Appendix A, "Cisco XR 12406 Router Technical Specifications and Warnings"—Provides technical specifications, connector cable specifications, regulatory statements, and translated safety warnings for the Cisco XR 12406 Router.

- Appendix B, "Repacking the Router"

- Index—Contains a keyword and subject index of pertinent terms and information.

Document Conventions

This publication uses the following conventions:

- Ctrl represents the key labeled *Control*. For example, the key combination **Ctrl-z** means hold down the **Control** key while you press the **z** key.

Command descriptions use these conventions:

- Examples that contain system prompts denote interactive sessions, indicating the commands that you should enter at the prompt. The system prompt indicates the current level of the EXEC command interpreter.

  For example, the prompt router> indicates that you should be at the *user* level, and the prompt router# indicates that you should be at the *privileged* level. Access to the privileged level usually requires a password. Refer to the related software configuration and reference documentation for additional information.

- Commands and keywords are in **boldface** font.

- Arguments for which you supply values are in *italic* font.

- Elements in square brackets ([ ]) are optional.

- Alternative but required keywords are grouped in braces ({ }) and separated by vertical bars (|).

Examples use these conventions:

- Terminal sessions and sample console screen displays are in screen font.

- Information you enter is in **boldface screen** font.

- Nonprinting characters, such as passwords, are in angle brackets (< >).

- Default responses to system prompts are in square brackets ([ ]).

- Exclamation points (!) at the beginning of a line indicate a comment line.

⚠️

Caution Means *be careful*. You are capable of doing something that might result in equipment damage or loss of data.

✐

Note Means *reader take note*. Notes contain helpful suggestions or references to materials not contained in this manual.

⏱️

Timesaver Means *the described action saves time*. You can save time by performing the action described in the paragraph.

Warning **This warning 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. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Cisco XR 12406 Router Overview

This chapter provides an overview of the Cisco XR 12406 Router. It contains physical descriptions of the router hardware and major components, and functional descriptions of the hardware-related features.

Router Description

The Cisco XR 12406 Router, shown in Figure 1-1 and Figure 1-3, is a member of the Cisco XR 12000 Series Router family. The Cisco XR 12406 Router scales the Internet Service Provider edge from speeds of T3/E3 (44.7/34.4 Mbps) up to OC-192/STM-64 or 10GE (10 Gbps).

Note Illustrations are shown without the front door for clarity.

Figure 1-1   Cisco XR 12406 Router—Front View (with PRP installed)
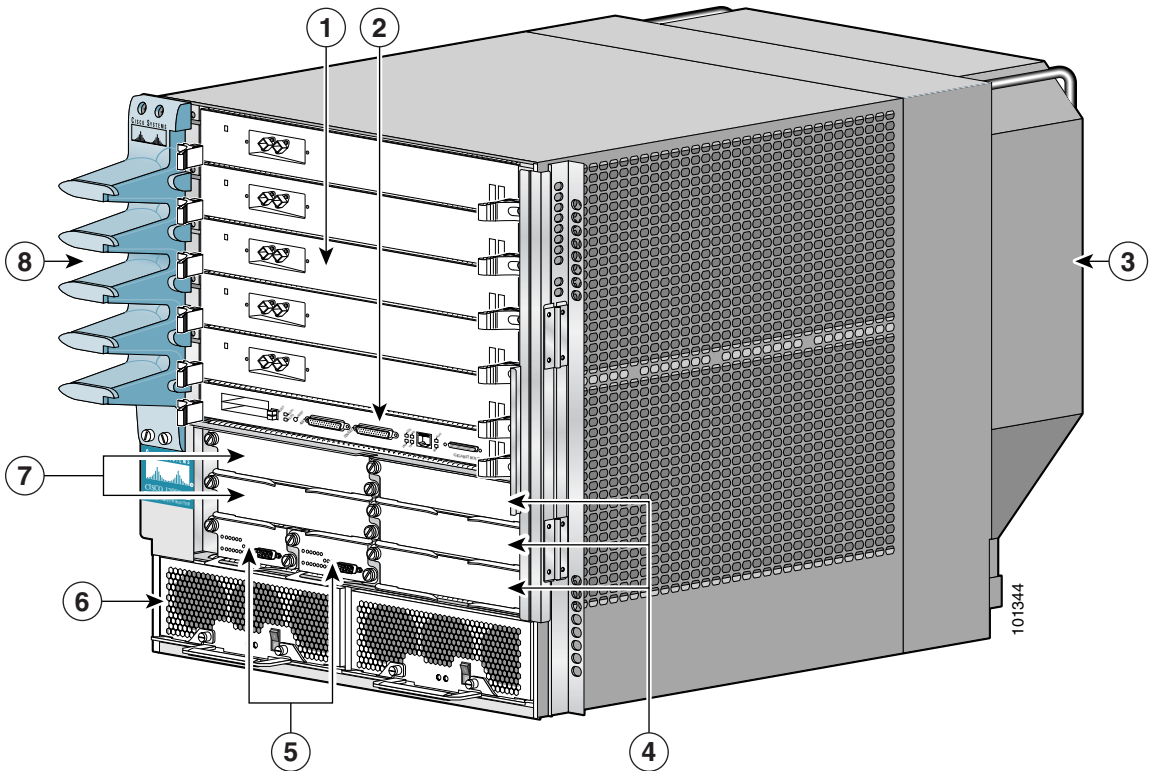
1	Line card slots (five)	**5**	Alarm card slots (two)
2	Route processor slot	**6**	Power module bays (two)
3	Blower module	**7**	CSC slots (2)
4	SFC slots (3)	**8**	Cable management bracket

Figure 1-2   *Cisco XR 12406 Router—Front View (with PRP-3 installed)*
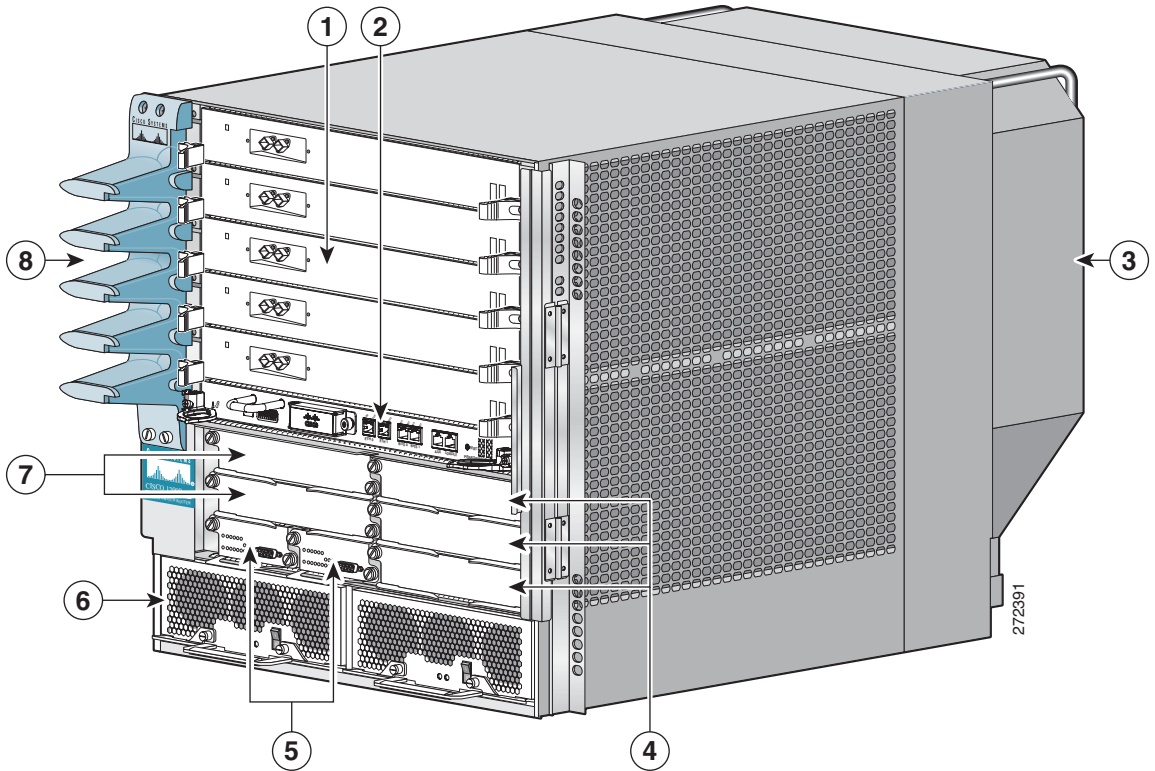
Figure 1-3   Cisco XR 12406 Router—Rear View
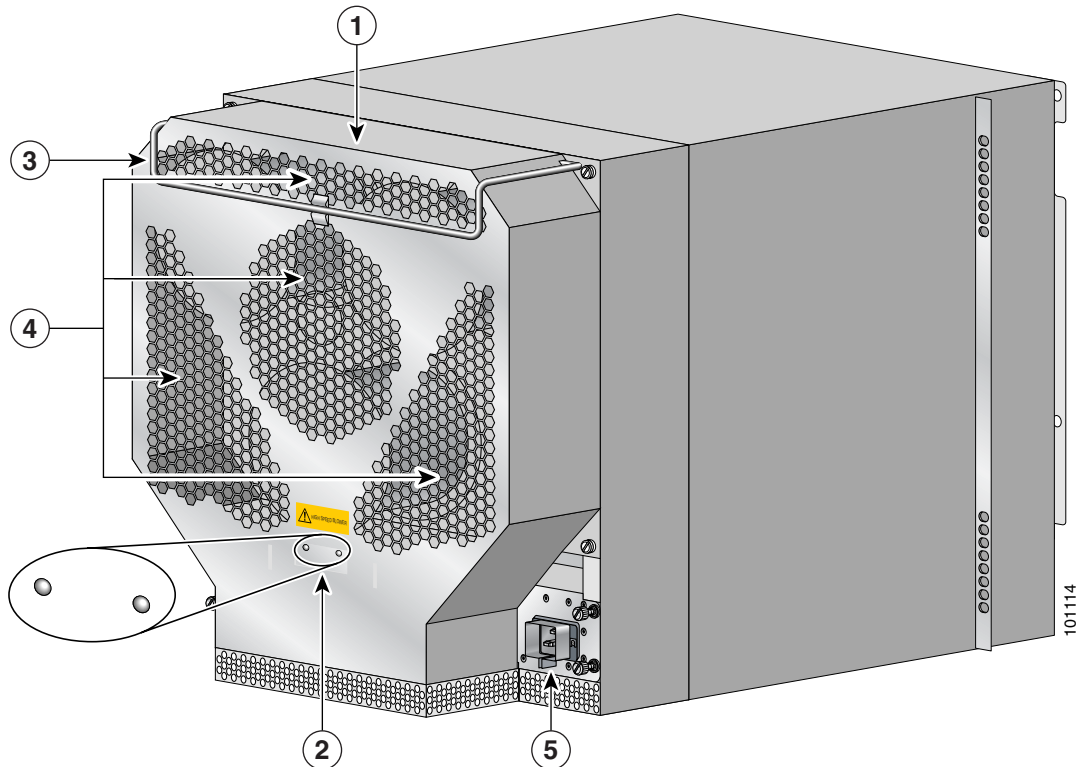
1	Blower module	**4**	Air exhaust vents
2	Blower module LEDs	**5**	PDU (behind Blower module; AC PDU shown)
3	Blower module handle	—	

With a chassis height of 18.5 inches (46.9 cm), four Cisco XR 12406 Routers can be installed in a single standard 7-foot (2.15-m) equipment rack.

Cisco XR 12406 Router supports system software downloads for most Cisco XR IOS software upgrades, which enables you to remotely download, store, and boot from a new Cisco XR IOS image.

Features

Cisco XR 12406 Router has the following key features:

- Route Processor (PRP-2)—Slot 5 (bottom slot) is the recommended slot for the first route processor. When the router is equipped with a redundant route processor, it can be installed in any of the five regular line card slots.

- Line Cards—Up to five OC-192 line cards, four if redundant route processors are installed. These slots support the online insertion and removal (OIR) feature so installed cards are hot-swappable: A failed card can be removed and replaced with the router powered on.

- Clock and Scheduler Cards (CSCs) and Switch Fabric Cards (SFCs)—Two dedicated hot-swappable slots for CSCs; three dedicated hot-swappable slots for SFCs.

> **Note**   When operating your router with a single CSC, the second CSC slot must have a CSC blank filler (MAS-GSR6-CSCBLNK=) installed to ensure EMI compliance.

- Two dedicated alarm card slots (for 1+1 redundancy)

- Alarm and Illumination—Alarm and illumination for operating ranges in the card cage, clock and scheduler card, and switch fabric card bays.

- Two hot-swappable AC-input power supplies or DC-input power entry modules (PEMs).

> **Note**   When operating your router on a single AC-input power supply or DC-input PEM, the second power module bay must have a blank filler (MAS-GSR-PWRBLANK=) installed to ensure EMI compliance.

- All power modules and other field replaceable units (FRUs), except for the air blower module and the power distribution unit (PDU), can be removed from the front of the chassis.

- All source power connections are located at the rear of the chassis on the PDU (see Figure 1-3).

- A new stylish front door hides router cabling and can be installed to open from the right side or left side to give you total flexibility.

- Network Equipment Building Systems—Cisco XR 12406 Router complies with the Network Equipment Building System (NEBS) Criteria Level 3 requirements defined in SR-3580 for flammability, structural, and electronics compliance.

- Electromagnetic Compatibility and Electrostatic Discharge Compliant— The Cisco XR 12406 Router complies with emissions, immunity, and electrostatic discharge (ESD) standards for both product and packaging.

- Bonding and Grounding—Bonding and grounding for safety, circuit protection, noise currents, reliability, and operations compliance.

- Environmental Monitoring—the Cisco XR 12406 Router complies with environmental monitoring standards for operating temperature and humidity, as well as handling temperature and humidity (except for heat dissipation).

- Shock and Vibration—the Cisco XR 12406 Router has been shock- and vibration-tested for operating ranges, handling, and earthquake standards to NEBS (Zone 4 per GR-63-Core). These tests have been conducted in earthquake environment and criteria, office vibration and criteria, transportation vibration and criteria, and packaged equipment shock criteria.

- Fiber Cable Management—Fiber cable management with support for high-density fiber Fast Ethernet (FE) ports.

- Current 1.275-inch pitch line cards will fit in the line card cage with the addition of a front panel adapter cover. The line card adapter cover is included with the 1.275-inch line card.

Physical and Functional Description

The following are the main components that make up the Cisco XR 12406 Router:

- One route processor with a second (redundant) route processor option
- Up to 5 line cards (4 if there are redundant route processors)
- 2 clock scheduler cards (CSCs)
- 3 switch fabric cards (SFCs)
- 2 alarm cards
- 2 power modules
- Backplane and maintenance bus
- Blower module
- 2 air filters

These components and their functions are described in this section. See Chapter 5, "Maintaining the Router" for instructions to remove and replace the FRUs.

Route Processor

The route processor for the Cisco XR 12406 Router is the Performance Route Processor (PRP-2). For detailed information about the Performance Route Processor, refer to the Cisco document, *Performance Route Processor Installation and Configuration Guide*.

The PRP-2 and PRP-3 performs the following primary functions:

- Executes routing protocol stacks
- Performs all protocol communications with other routers
- Builds and distributes forwarding information to all line cards
- Uploads the operating system software images to all installed line cards during power-up
- Provides out-of-band system console and auxiliary ports and an Ethernet port for router configuration and maintenance
- Monitors and manages the power and temperature of system components such as line cards, power supplies, and fans

The Cisco PRP-2 and PRP-3 delivers all these functions with enhanced performance and capabilities. It also delivers the following feature enhancements (depending on the software version running):

- Gigabit Ethernet management port

- Hard-drive support (optional part)

- BITS input ports

- 1 GB compact image Flash memory support (optional part)

- Memory scalability up to 4 GB with PRP-2 and up to 8 GB with PRP-3.

The PRP-2 and PRP-3 communicates with the line cards either through the switch fabric or through the MBus. The switch fabric connection is the main data path for routing table distribution as well as for packets that are sent between the line cards and the PRP. The MBus connection allows the PRP-2 and PRP-3 to download a system bootstrap image, collect or load diagnostic information, and perform general, internal system maintenance operations.

The PRP-2 can be designated as either the Designated System Controller (DSC) or the Secure Domain router (SDR).

The Designated System Controller (DSC) performs the following functions:

- Implements control plane operations for the chassis

- Monitors temperature and voltage

- Monitors line cards

- On boot up, the first card to become active is designated as the DSC.

The Secure Domain Router (SDR) controls domain security features independent of any other SDRs on the network.

In addition to the functionality listed for the PRP-2, PRP-3 provides the following specific functions:

- Reduced boot time.

- Increased overall scalability.

- Improved memory access rates and scale.

- Improved CPU performance through dual 1.3-GHz PPC processor cores.

- Improved packet processing using hardware-based acceleration.

- 10-G bandwidth backplane connectivity.

- Support for all 124xx and 128xx chassis, except low speed fabric (2.5G).
- New ROMMON that supports IPv4 network configuration directly.

Performance Route Processor Overview

The performance route processor (PRP-2) uses a Motorola PowerPC 7457 CPU that runs at an external bus clock speed of 133 MHz and has an internal clock speed of 1.3 GHz.

Figure 1-4 identifies the slots, ports, and LEDs on the PRP front panel.

Figure 1-4   Performance Route Processor-2 (PRP-2) Front Panel
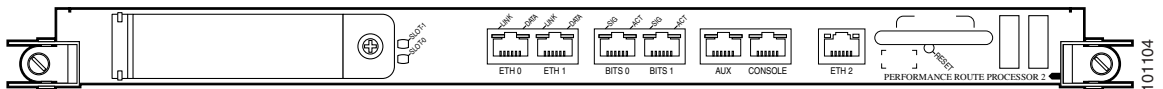
Table 1-1   Performance Route Processor-2 (PRP-2) Front Panel Hardware Components

1	PCMCIA flash disk slots (shown with cover in place) and slot LEDs	**4**	Console serial port
2	RJ-45 Ethernet ports and data status LEDs	**5**	Reset button
3	Auxiliary serial port	**6**	Alphanumeric messages

Figure 1-5   Performance Route Processor 3 (PRP-3) Front Panel
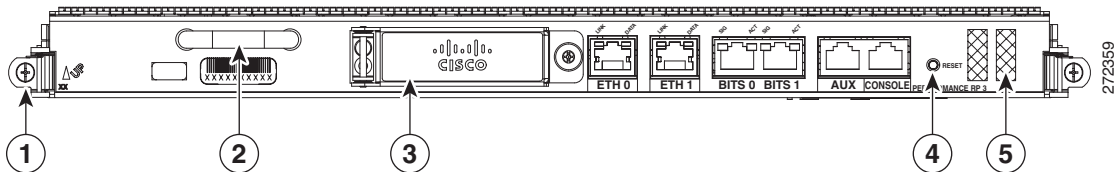
Table 1-2   PRP3 Front Panel Hardware Components Detail

Numeric Callout	Hardware Components
1	Ejecter Lever
2	Handle
3	External Compact Flash
4	Reset button
5	Alphanumeric LEDs

PRP-3 is the route processor for the Cisco XR 12404 and 12804 Router chassis running Cisco IOS XR Software Release 3.8.0 or a later release. The PRP-3 is available as product number PRP-3 or PRP-3= for a primary route processor and is available as PRP-3/R for a redundant route processor. PRP-3 has significant improvements over PRP-2. These improvements include increased speed, improved scalability, higher system memory, faster packet processing. Because PRP-3 does not support Cisco IOS, the bootflash memory no longer exists in PRP-3. PRP-3 ROMMON has software intelligence to download a Cisco IOS XR image without the support of bootflash memory.

Note   PRP-3 supports Cisco XR 12404 (10 G per slot fabric) and Cisco XR 12804 (40 G per slot fabric) Router chassis only. PRP-3 does not support Cisco XR 12004, 12006, 12010, and 12016 Router chassis (2.5 G low-speed fabric).

PRP PCMCIA Card Slots and Status LEDs

Two PCMCIA card slots (slot 0 and slot 1) provide the PRP with additional flash memory capacity. All combinations of different flash devices are supported by the PRP. You can use ATA flash disks, Type 1 or Type 2 linear flash memory cards, or a combination of the two.

Note   The PRP only supports +5.2 VDC flash memory devices. It does *not* support +3.3 VDC PCMCIA devices.

Status LEDs (Slot-0 / Slot-1) indicate when the flash memory card in that slot is accessed (see Figure 1-4). Each slot has an eject button (located behind the cover) to remove a flash card from the slot.

Note PRP-3 does not have PCMCIA slots (slot 0 and slot 1). PRP-3 has an external CompactFlash (disk0:) that replaces the PCMCIA slots.

PRP Ethernet Ports and Status LEDs

The PRP has two 8-pin media-dependent interface (MDI) RJ-45 ports for either IEEE 802.3 10BASE-T (10 Mbps) or IEEE 802.3u 100BASE-TX (100 Mbps) Ethernet connections. These ports are labeled ETH 0 and ETH 1.

The transmission speed of the Ethernet port is not user-configurable. You set the speed through an autosensing scheme on the PRP which is determined by the network that the Ethernet port is connected to. However, even at an autosensed data transmission rate of 100 Mbps, the Ethernet port can only provide a usable bandwidth of substantially less than 100 Mbps. You can expect a maximum usable bandwidth of approximately 20 Mbps when using an Ethernet connection.

The following LEDs on the front panel indicate traffic status and port selection (Figure 1-6):

- LINK, EN, TX, RX—Indicate link activity (LINK), port enabled (EN), data transmission (TX), and data reception (RX).

- PRIMARY—Indicates which Ethernet port is selected (ETH 0 or ETH 1).

Note Because both ports are supported on the PRP, ETH 0 is always on. ETH 1 lights when it is selected.

Figure 1-6   *PRP-2 Port Activity LEDs—Partial Front Panel*
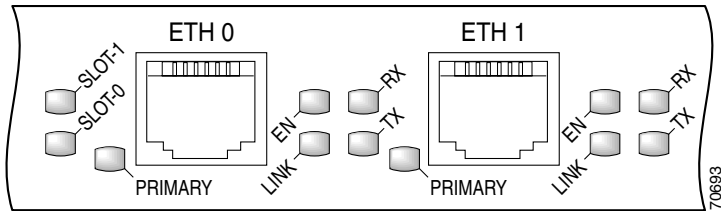
Figure 1-7   *PRP-3 Port Activity LEDs—Partial Front Panel*
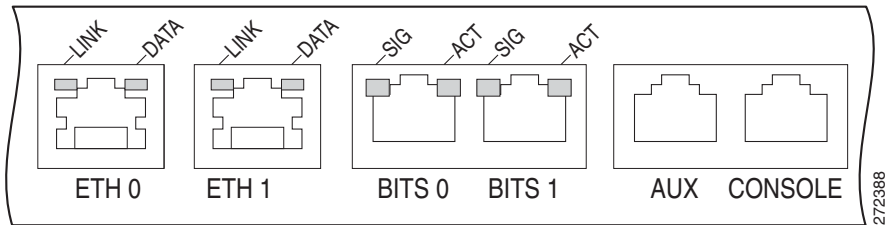
PRP Auxiliary and Console Ports

The auxiliary and console ports on the PRP are EIA/TIA-232 (also known as RS-232) asynchronous serial ports. These ports connect external devices to monitor and manage the system.

- The auxiliary port—A (male) plug that provides a data terminal equipment (DTE) interface. The auxiliary port supports flow control and is often used to connect a modem, a channel service unit (CSU), or other optional equipment for Telnet management.

- The console port—A (female) receptacle that provides a data circuit-terminating equipment (DCE) interface for connecting a console terminal.

PRP-3 LEDs

The PRP-3 has the following LED indicators:

- Two Ethernet port LEDs used in conjunction with each of the three RJ-45 Ethernet connectors:

  - LINK—Indicates link activity

  - DATA—Indicates data transmission or reception

- Two BITS port LEDs used in conjunction with each of the two BITS ports:

  - SIG—Indicates carrier signal available

  - ACT—Indicates that the interface is active

Note   BITS feature is not supported in Release 3.8.0.

- One auxiliary port (AUX) and one console port (CONSOLE) LED:

  - AUX—Used as a backup for the command outputs on the Console.

  - CONSOLE—Used for configuring the router by connecting an RJ-45 cable to the console terminal. The router can be configured through the console terminal.

PRP Memory Components

This section describes various types of memory used on the PRP to support router functions. Table 1-3 provides a quick reference of the different types of memory, and Figure 1-8 shows the location on the PRP board.

Table 1-3   PRP-2 Memory Components

Type	Size	Quantity	Description	Location
SDRAM[1]	2 GB (default) or 4 GB (optional)	1 or 2	2-GB or 4-GB DIMMs (based on desired SDRAM configuration) for main Cisco IOS XR software functions	U15 (bank 1)[2] U18 (bank 2)
SRAM[3]	2 MB (fixed)	—	Secondary CPU cache memory functions	—
NVRAM[4]	2 MB (fixed)	1	System configuration files, register settings, and logs	—
HDD	40 GB	1	Contains log and crash information for specific Cisco IOS XR versions.	—
Flash memory	2 GB or 4 GB (optional) Compact Flash	1	Contains Cisco IOS XR boot image (bootflash), crash information, and other user-defined files	P3
	4 MB Boot ROM	1	Stores the ROMMON minimum boot image (MBI).	
	Flash disks[5] 2 GB (default) or 4 GB (optional)	1 or 2	Contains Cisco IOS XR software images, system configuration files, and other user-defined files on up to two flash disks	Flash disk slot 0 and slot 1
	1 GB CF[6]	1	Contains large Cisco IOS XR software images	—

1. Default SDRAM configuration is 2-GB for PRP-2. Bank 1 (U15) must be populated first. You can use one or both banks to configure SDRAM combinations of 2 GB and 4 GB for the PRP-2. 1.5-GB configurations.and DIMM devices that are not from Cisco are not supported.

2. If both banks of the PRP-2 are populated, bank 1 and bank 2 must contain the same size DIMM.

3. SRAM is not user configurable or field replaceable.

4. NVRAM is not user configurable or field replaceable.

5. ATA Flash disks are supported in the PRP-2.

6. Optional PRP-2 hardware. Compact disks that are not from Cisco are not supported.

Figure 1-8   PRP-2 Memory Locations
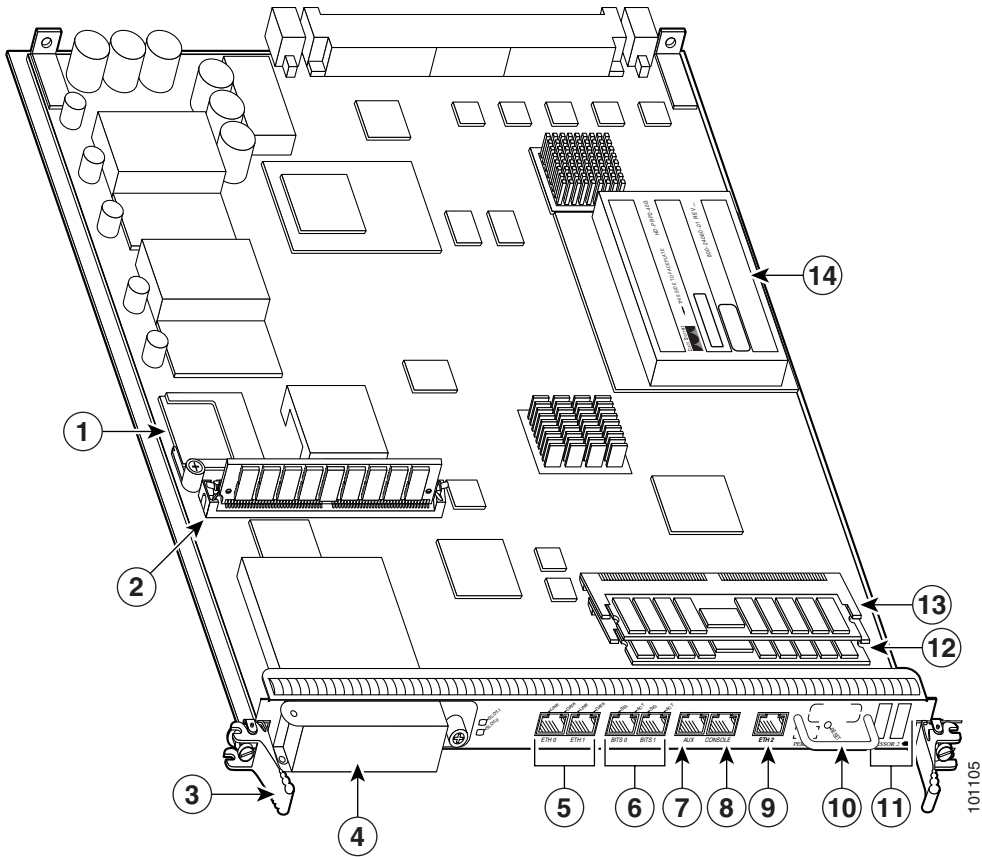
Figure 1-9   *PRP-3 Memory Locations*
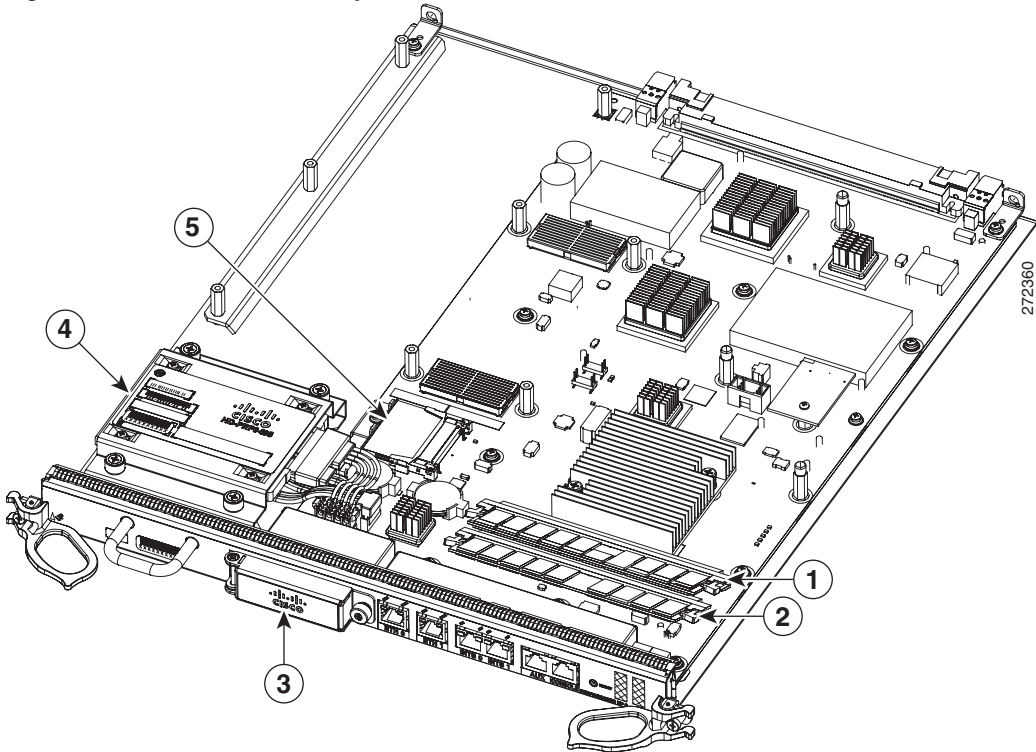
1	SDRAM DIMM: Bank 1 - Socket number U8
2	SDRAM DIMM: Bank 2 - Socket number U10
3	External CompactFlash
4	Hard disk (80 GB)
5	Internal CompactFlash

Table 1-4   PRP-3 Memory Components

Type	Size	Quantity	Description	Location
SDRAM[1]	2 GB (Default) for each DDR2 DRAM for a total system memory of 4 GB, option for upgrade to total system memory of 8 GB (4 GB each).	2	Two 2-GB default DDR2 DRAM for main CiscoIOSXR software functions. Provision for optional upgrade to 4 GB also possible to provide total system memory of 8 GB.	U8 (bank 1)[2] U10 (bank 2)
NVRAM[3]	2 MB (fixed)	1	System configuration files, register settings, and logs	—
Flash memory	2 GB (default) or 4 GB (optional) Flash disks[4]	2 (Internal and External Compact Flash)	Contains Cisco IOS XR software images, system configuration files, and other user-defined files on two CompactFlash.	Internal and External Compact Flash[5]
Flash boot ROM	8 MB	1	Flash EPROM for the ROM monitor program boot image	—
HDD[6]	80 GB SATA	1	Contains log and crash information for specific Cisco IOS XR versions	—

1. Default SDRAM configuration is a total of 4 GB (2 x 2GB) system memory for PRP-3. Bank 1 (U15) must be populated first. You can use one or both banks to configure DDR2 DRAM combinations of 2 GB or 4 GB for the PRP-3. DIMM devices that are not from Cisco are not supported.

2. If both banks of the PRP-3 are populated, bank 1 and bank 2 must contain the same size DIMM.

3. NVRAM is not user configurable or field replaceable.

4. ATA Flash disks are supported in the PRP-3.

5. PRP-3 provides an onboard internal CompactFlash and also an external CompactFlash. The external CompactFlash in PRP-3 replaces the two PCMCIA slots (slot0 and slot1) of PRP-2.

6. Hard disk drives that are not from Cisco are not supported.

PRP SDRAM

The PRP uses Error Checking and Correction (ECC) Synchronized Dynamic Random Access Memory (SDRAM) to store routing tables, protocols, network accounting applications, and to run Cisco IOS software.

Table 1-5 lists the DRAM configurations for the PRP. If you are using:

- One DIMM—Bank 1 (U15) must be populated first.
- Two DIMMs—You cannot mix memory sizes; both banks must contain the same size DIMM.

Table 1-5   PRP-2 DRAM Configurations

Total SDRAM	SDRAM Sockets	Number of DIMMs
Total SDRAM	SDRAM Sockets	Number of DIMMs
2 GB[1]	U15 (bank 1) U18 (bank 2)	One 2 GB DIMM or Two 2 GB DIMMs
4 GB	U15 (bank 1) U18 (bank 2)	One 4 GB DIMM or Two 4 GB DIMMs

1. Default shipping configuration.

⚠

Caution   DRAM DIMMs must be 3.3-volt, 60-nanosecond devices only. Do not attempt to install other devices in the DIMM sockets. To prevent memory problems, use the memory products approved by Cisco, listed in Table 1-5.

PRP-3 provides more system memory than PRP-2. PRP-3 is shipped with 2 GB of system memory in each DDR2 DRAMs, for a total of 4 GB and provides an upgrade option for a total of 8 GB (4 GB x 2 DRAM).

✎

Note   The two DIMMs must be of the same sizes. Do not use two different DIMM sizes together.

Table 1-6   PRP3 DDR2 DRAM Configuration

Total SDRAM	SDRAM Sockets	Number of DIMMs
4 GB	U8 (bank 1) U10 (bank 2)	Two 2 GB DIMMs
8 GB	U8 (bank 1) U10 (bank 2)	Two 4 GB DIMMs

PRP SRAM

Static Random Access Memory (SRAM) provides 2 MB of secondary CPU cache memory. Its principal function is to act as a staging area for routing table updates, and for information sent to and received from the line cards. SRAM is *not* user-configurable and cannot be upgraded in the field.

PRP NVRAM

Non-volatile Random Access Memory (NVRAM) provides 2 MB of memory for system configuration files, software register settings, and environmental monitoring logs. Built-in lithium batteries retain the contents of NVRAM for a minimum of 5 years. NVRAM is *not* user configurable and cannot be upgraded in the field.

PRP Flash Memory

Use flash memory to store multiple Cisco IOS XR software and microcode images that you can use to operate the router. You can download new images to flash memory over the network (or from a local server) to replace an existing image, or to add it as an additional image. The router can be booted (manually or automatically) from any of the stored images in flash memory.

Flash memory also functions as a Trivial File Transfer Protocol (TFTP) server to allow other servers to boot remotely from the stored images, or to copy them into their own flash memory.

The system uses two types of flash memory on PRP-2:

- Onboard flash memory (called *bootflash)*—Contains the Cisco IOS boot image

- Flash memory disks (or cards)—Contain the Cisco IOS software image

Table 1-7 lists supported flash disk sizes and Cisco part numbers.

Table 1-7   Supported Flash Disk Sizes

Flash Disk Size[1]	Part Number
2 GB[2]	MEM-FD2G=
4 GB	MEM-FD4G=

1. 4 GB is supported with 2 GB mode prior to Release 3.8.0.

2. Default shipping configuration.

PRP-3 Compact Flash

PRP-3 provides more flash memory than PRP-2. PRP-3 uses flash memory to store Cisco IOS XR software images. PRP-3 includes a default internal flash memory of 2 GB and also has an external flash memory of 2 GB. A flash memory upgrade option is also available for a total of 8 GB (2 x 4 GB).

PRP-2 and PRP-3 compactflashes are not compatible with each other and hence PRP-2 compactflash cannot be used in PRP-3 and vice versa. PRP-3 uses Multiword DMA to access the compactflash device, a PRP-2 compactflash does not support this access type.

Note   The PRP-3 external CompactFlash disk replaces the two PCMCIA slots of PRP-2. The external CompactFlash disk can be installed or removed from the PRP-3 front panel. The internal CompactFlash disk memory is denoted as compactflash, while the external CompactFlash disk is denoted as disk0:.

Table 1-8   PRP-3 CompactFlash Disk Sizes

Flash Disk Size	Part Numbers
2 GB	FLASH-PRP3-2G(=)
4 GB	FLASH-PRP3-4G(=)

Line Cards

The Cisco XR 12406 Router is shipped pre-installed with the number and type of line cards that you ordered. Line cards and route processors can be installed in two basic combinations to support route processor redundancy and a variety of physical network media:

- Nonredundant route processor—One route processor and up to five CiscoXR12000 Series Router line cards.

- Redundant route processors—Two route processors and up to four CiscoXR12000 Series Router line cards.

Line cards can be installed in any slot—zero (0) through five (5)—in the card cage. Slot number 5 is the recommended default route processor slot. Single-mode and multimode line cards are shown in Figure 1-10.

Note   Refer to the current s software release notes for the most up-to-date list of supported line cards (see "Obtaining Documentation and Submitting a Service Request" section on page -xii).

Line cards provide the interfaces to the router's external physical media. External connections are made from the front of the chassis to the connectors on the line card face plates. The line cards communicate with the route processor and exchange packet data with each other through the switch fabric cards in the switch fabric and alarm card cage.

Caution   Unoccupied card slots in the line card and route processor card cage must have a blank filler panel installed (12000-WIDE-BLANK=) for electromagnetic compatibility (EMC) and to ensure proper air flow through the chassis. When the faceplate of a line card does not completely fill the card slot opening, a narrow card filler panel must be installed (ACS-GSR16-LCFILL=).

A cable-management bracket attaches to the faceplate of each line card to manage and organize the network interface cables connected to the individual ports on the line card.

Line cards installed in the router support online insertion and removal (OIR), which means you can remove and replace a line card while the router remains powered on.

Note For instructions on removing, replacing, and configuring the line cards, see the configuration note shipped with each line card when ordered as an FRU.

Figure 1-10 **Sample Line Cards**

Single Mode   Multimode

Ejector lever

Port 0

Status LEDs

Port 1

Port 2

Port 3

160-pin
backplane
signal
connector

Alphanumeric
LED display

Ejector lever

Front view   Rear view

H10781
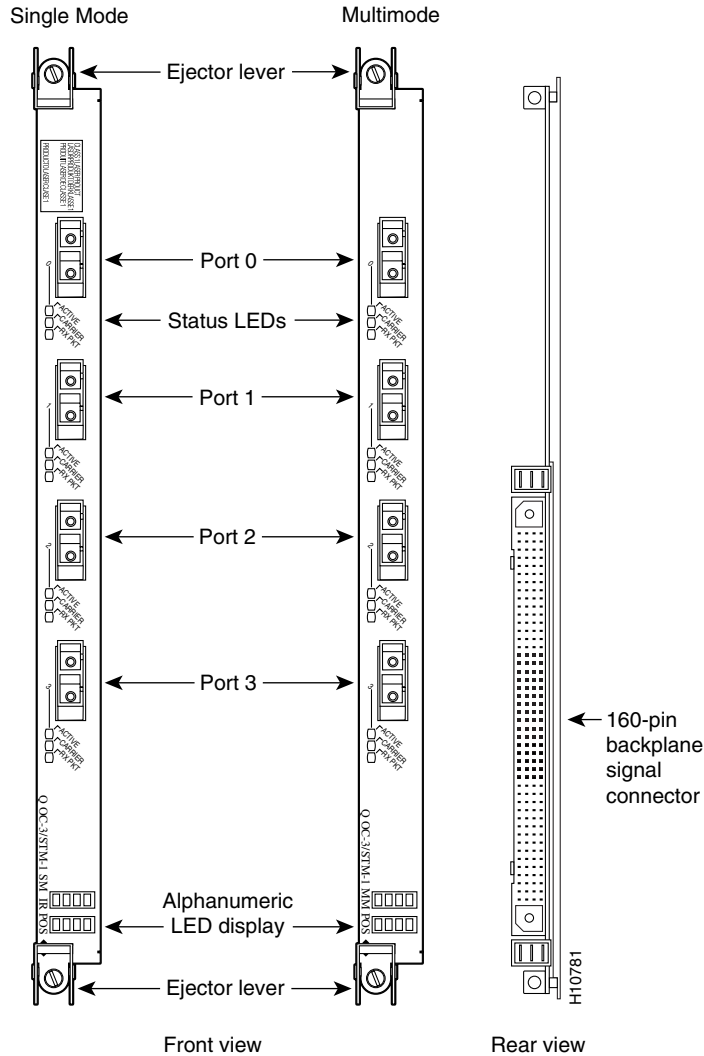
Multigigabit Crossbar Switch Fabric

The Cisco XR 12406 Router switch fabric circuity provides synchronized gigabit-speed interconnections for the line cards and the route processor. The switch fabric circuitry resides in five fabric card slots: two for CSCs; three for SFCs (Figure 1-11).

Figure 1-11   Clock and Scheduler and Switch Fabric Card Bays
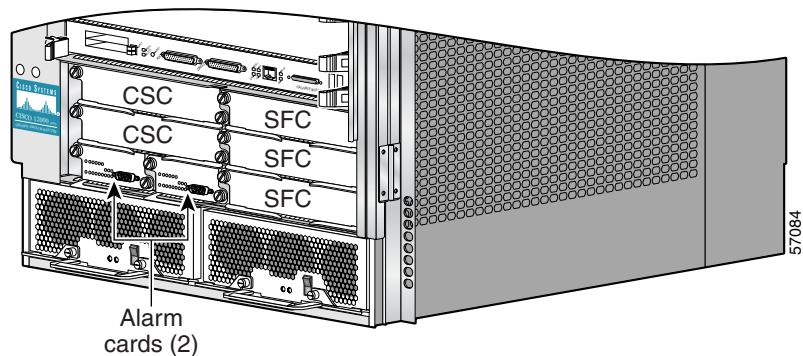
Alarm cards (2)

Switch Fabric Card Types

The CSCs are installed in the half-width slots labeled CSC 0 and CSC 1 on the lower left side of the chassis, located directly beneath the route processor and line card cage and directly above the alarm card bays. The three SFCs are installed in the half-width slots labeled SFC 0, SFC 1, and SFC 2 on the lower right side of the chassis.

Note   To operate the Cisco XR 12406 Router, you must have at least one CSC card installed, in addition to SFC and alarm cards.

The CSC contains the following functionality:

- System clock—The system clock synchronizes data transfers between line cards or between the route processor and a line card, through the switch fabric. In systems with redundant CSCs, the two system clocks are synchronized so that if one system clock fails, the other clock takes over. The system clock signal is sent to all line cards, the route processor, and switch fabric cards.

- Scheduler—The scheduler handles requests from the line cards for access to the switch fabric. When the scheduler receives a request from a line card for switch fabric access, the scheduler determines when to allow the line card access to the switch fabric.

- Switch fabric—The switch fabric carries the user traffic between line cards or between the route processor and the line cards. The switch fabric card contains only the switch fabric circuitry and receives scheduling information and system clock information from the CSC.

The SFC contains only the switch fabric circuitry, which carries user traffic between line cards or between the route processor and the line cards. The SFC receives scheduling information and the system clock sent from the CSC.

Switch Fabric Switching Capacity and Router Type

The Cisco XR 12406 Router is based on a 10-Gbps switch fabric, where each CSC or SFC provides a 10-Gbps full-duplex connection to each line card in the system. The 10-Gbps switch fabric consists of the Clock and Scheduler Card (product number GSR6-CSC= for original fabrics, and 12406E-CSC= for enhanced fabric versions) and the Switch Fabric Card (product number GSR6-SFC= for original fabrics, and 12406E-SFC= for enhanced fabric versions). The 10-Gbps switch fabric cards are labeled simply CSC and SFC.

Note You cannot mix 2.5-Gbps switch fabric cards and 10-Gbps switch fabric cards in a chassis. The router will not operate with a mix of switch fabric card types.

Switch Fabric Redundancy

Equipping the router with two CSCs provides data path, scheduler, and reference clock redundancy. The interfaces between the line cards and the switch fabric are monitored constantly. If the router detects a loss of synchronization (LOS), it automatically activates the data paths of the redundant CSC, and data flows across the redundant path. The switch to the redundant CSC occurs within 0.5 second, with little or no loss of data.

Note The enhanced Cisco XR 12406 chassis (XR-12000/6 configured with 12406/120 fabric option) ships with redundant CSC which is required to maintain High Availability for the system.

Alarm Cards

The Cisco XR 12406 Router has two alarm card slots (Figure 1-12). Each alarm card performs the following function or indicates the following condition:

- Alarm output
- CSC status
- SFC status
- Alarm card status
- Power source and power entry module status
- Alarm relay contacts

The entire alarm function has been implemented on redundant alarm cards with OIR maintenance (hot-swappable) functionality.

Figure 1-12   Alarm Card Features
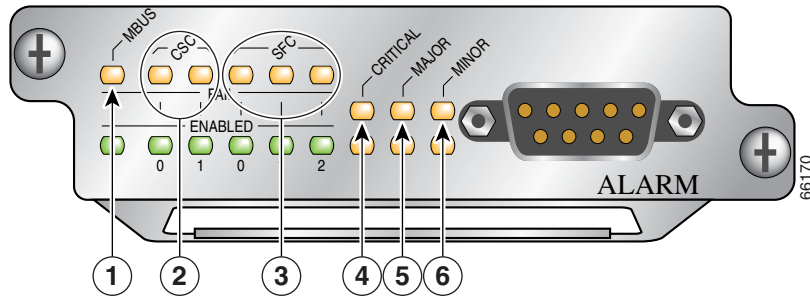
1	MBus status LED	5	Major alarm LED
2	CSC status LEDs (two)	6	Minor alarm LED
3	SFC status LEDs (three)	–	Alarm relay contact connector
4	Critical alarm LED	—	

Note   The Cisco XR 12406 Router must be populated with two alarm cards, to meet EMI standards.

Alarm Output Function

The alarm output function consists of a group of relays, LEDs, and their associated drivers connected to an output port on the MBus module.

The alarm output function is controlled by the software on the route processor. When a signal is received from the route processor, the MBus module on the alarm card activates specific relays to signal an alarm condition. There are three alarm condition severity levels: critical, major, and minor. The critical, major, and minor LEDs are paired for redundancy to protect against a single failed LED.

Note   Alarm cards for some Cisco XR 12000 Series Router have both audible and visible alarm indicators. The alarm card for the Cisco XR 12406 Router provides only visible alarm indicators as local alerts to unusual conditions in the router.

The Cisco IOS XR software running on the route processor determines whether a given alarm condition is a critical, major, or minor alarm. Typing the **show** commands **sh gsr table** and **sh env all** gives you the table of limits and current readings for the LEDs.

Clock and Scheduler Card and Switch Fabric Card Status

The alarm card provides OK and FAIL indications for all clock and scheduler cards and switch fabric cards in the system. Redundant signals from the fabric cards are brought out to the LEDs on each alarm card. The alarm card does not control how these LEDs are used.

The MBus auxiliary power supply consists of a 50W DC-DC power supply and some current-sharing circuitry. Because the alarm card itself is powered by this supply, the on-board MBus module can report problems with the supply only when the redundant alarm card is in the chassis and providing MBus power.

Alarm Card Status

The ENABLED/FAIL pair of LEDs labeled MBUS indicate the status of the alarm card. The green ENABLED LED indicates that the MBus module on the alarm card is operating properly. The yellow FAIL LED indicates that the alarm card has detected an error in itself or with the MBus power supply.

Power Source Monitoring

The alarm card monitors the power modules and signals when there is a condition outside the normal range of operation. It discloses problems such as the following:

- Power source voltage is not being provided to a component

- A fault exists in the power source or power module

- Output voltage—Voltage monitor signal is outside the allowable range

- Output current—Current monitor signal is outside the allowable range

Alarm Relay Contact Connector

The 9-pin D-type alarm relay contact connector on the faceplate of the alarm card (see Figure 1-12) is used to connect external alarm indication equipment to the router so that alarm indicator signals in the router can be repeated elsewhere outside the router.

The pins on this connector are tied directly to the critical, major, and minor alarm relay contacts (normally open, normally closed, and common). Any event that causes one of the alarm LEDs on the alarm card faceplate to go on also activates the corresponding relay contact closure. The relay interface is rated at a maximum of 2A, 60V, or 50VA, whichever is greater.

Because alarm contact cables are entirely dependent on site-specific circumstances, alarm connector cables are not available from Cisco. For information about alarm connector wiring requirements and the pinout for the alarm connector interface, see the "Alarm Card Alarm Relay Connector Specifications" section on page A-5.

Power Subsystems

The Cisco XR 12406 Router can be powered by either an AC or DC power subsystem, as described in the following sections:

- AC Power Subsystem, page 1-29
- DC Power Subsystem, page 1-33
- Power Distribution, page 1-37

Note   The Cisco XR 12406 Router can be either AC powered or DC powered; the router cannot accept two different types of power modules at the same time.

Note   The enhanced Cisco XR 12406 chassis (XR-12000/6 configured with 12406/120 fabric option) ships with a redundant power supply, which is required to maintain high availability for the system.

> **Note** A Cisco XR 12406 Router operating from an AC power source can be converted to operate from a DC power source, and vice versa. The conversion can be done in the field, but the system must be powered down.

AC Power Subsystem

The AC power subsystem consists of the following system components:

- AC PDU (one)
- AC-input power supplies (one for nonredundant operation; two for redundant operation)

> **Caution** To ensure that the chassis configuration complies with the required power budgets, use the on-line power calculator. Failure to properly verify the configuration may result in an unpredictable state if one of the power units fails. Contact your local sales representative for assistance.

AC PDU

Facility AC power connects to AC-powered the Cisco XR 12406 Router though the AC PDU on the chassis rear panel (Figure 1-13).

Figure 1-13   AC Power Distribution Unit
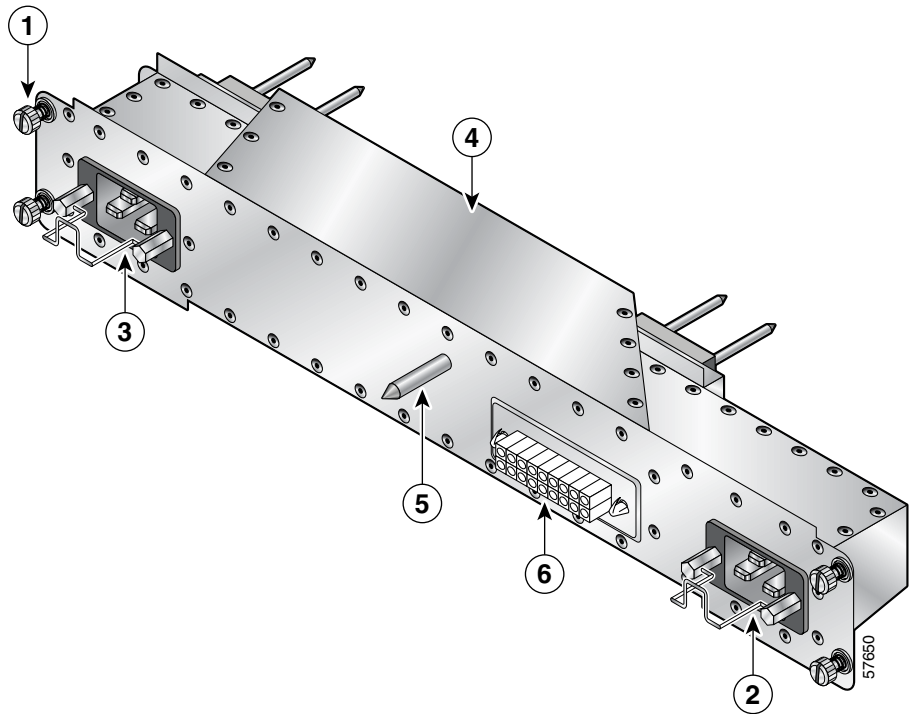
1	Captive screw	**4**	AC power distribution unit
2	AC power cord receptacle A	**5**	Guide pin
3	AC power cord receptacle B	**6**	Blower module connector

Depending on whether the router is configured for nonredundant or redundant power operation, the router ships with either one or two 14-foot (4.3-m) AC power cords to connect the PDU to the facility AC power source. AC power cords with different source AC power plugs are available. (See Figure 2-3 on page 2-16.)

Note   For true redundancy, connect each power supply to a separate power circuit protected by its own circuit breaker.

AC-Input Power Supply

The AC-input power supply is a removable power module that installs in one of the bottom two bays on the front of the chassis (see Figure 1-1). These power modules support the OIR feature and are hot-swappable (Figure 1-14).

Figure 1-14 **AC-Input Power Supply**
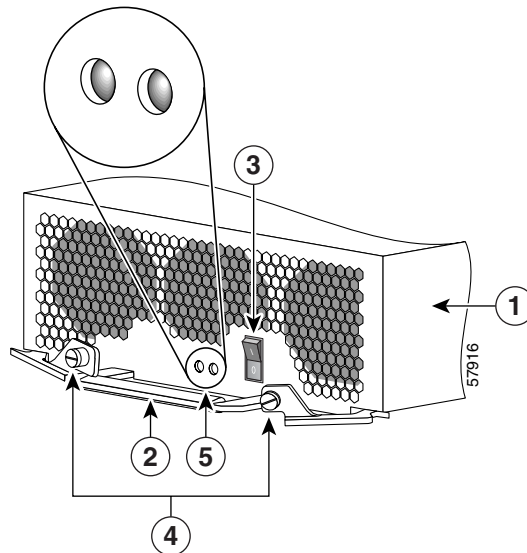
1	AC-input power supply	**4**	Release levers captive screws
2	Handle	**5**	LEDs
3	Power standby switch	—	

Note   When operating your router on a single power module, the second power module bay must have a blank filler (MAS-GSR-PWRBLANK=) installed to ensure EMI compliance.

An AC-input power supply has the following features (see Figure 1-14):

- Original series Cisco XR 12406 Routers: A power factor corrector (PFC) allows the power supply to accept AC power source voltage from an AC power source operating from 100 to 120 VAC 20-amp service in North America, and a range of from 185 to 264 VAC 16-amp service in an international environment.

- Enhanced series Cisco XR 12406 Routers: Supports 220 VAC only which requires 20-amp service in North America, and 16-amp service in an international environment.

- Each AC-input power supply weighs approximately 14 pounds (6.4 kg), and can deliver up to 1400 W for original versions, or up to 1950 W for enhanced versions of the router.

- Each AC-input power supply requires a dedicated 20A service in North America (16 A international).

- A power standby switch on the faceplate temporarily disables the DC output power circuitry in the AC-input power supply.

Note This switch does not interrupt the incoming AC power in the AC-input power supply. Portions of the power supply circuitry are still under AC power as long as AC power is connected to the router.

- A handle is provided for ease in removing and replacing the power supply.

- Captive screws on the power supply ejector levers secure it in the power supply bay.

- Two LEDs on the faceplate to provide status information. Table 1-9 summarizes the function of these indicators.

Table 1-9   AC-Input Power Supply LED indicators

LED Label	Function	State	Description
AC	Input power	On	AC power source is present and is within specified limits.
		Off	Power source is not within specified limits.

Table 1-9   AC-Input Power Supply LED indicators (continued)

LED Label	Function	State	Description
DC	Output Power	On	Power supply is operating normally in a power-on condition.
		Off	Power supply is operating in a fault condition and shutdown has occurred.

DC Power Subsystem

The DC power subsystem consists of the following system components:

- DC PDU (one)
- DC-input PEMs (one for nonredundant operation; two for redundant operation)

⚠

Caution   To ensure that the chassis configuration complies with the required power budgets, use the on-line power calculator. Failure to properly verify the configuration may result in an unpredictable state if one of the power units fails. Contact your local sales representative for assistance.

DC PDU

Facility DC power connects to DC-powered routers though the connector blocks on the DC PDU (Figure 1-15).

Figure 1-15   DC Power Distribution Unit
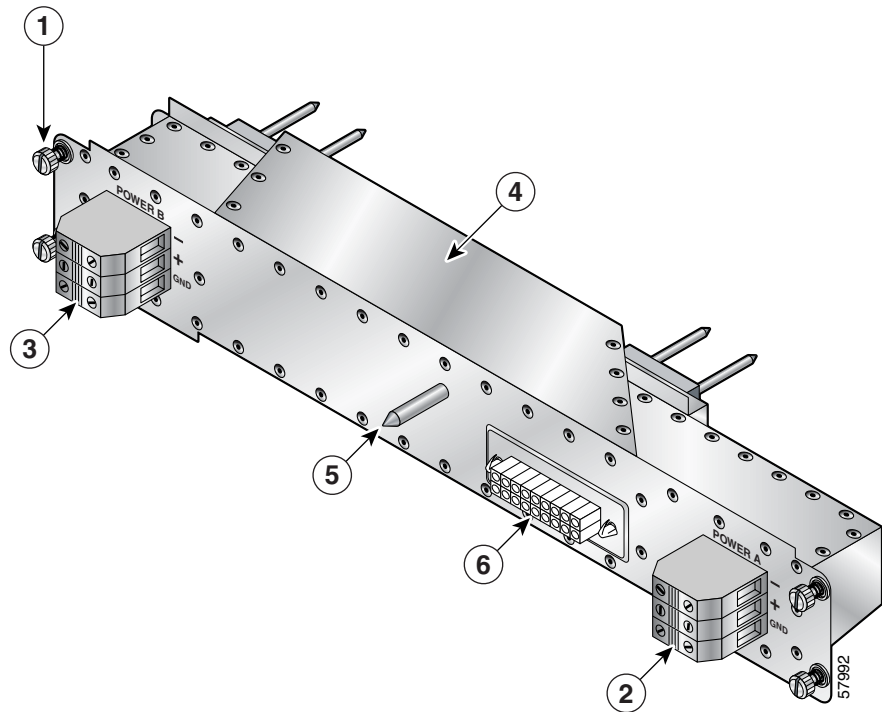
1	Captive screw	**4**	DC power distribution unit
2	DC power connector block A	**5**	Guide pin
3	DC power connector block B	**6**	Blower module connector

DC-input power is connected through the DC PDU on the chassis rear panel. The DC PDU is equipped with two DC power connector blocks. Each DC power connector block is equipped with three terminal ports. Leads from the DC source power should be connected to the terminal block. A negative lead is connected to the top port, a positive lead to the middle port, and a ground lead to the bottom port.

DC-Input Power Entry Module

The DC-input PEM (Figure 1-16) is a removable power module that installs in one of the bottom two bays on the front of the chassis (see Figure 1-1). These power modules support the OIR feature and are hot-swappable.

Note   When operating your router on a single power module, the second power module bay must have a blank filler (MAS-GSR-PWRBLANK=) installed to ensure EMI compliance.

Caution   The Cisco XR 12406 Router is configured for either AC power or DC power. Do not mix AC-input power supplies and DC-input PEMs.

Figure 1-16   DC-Input Power Entry Module
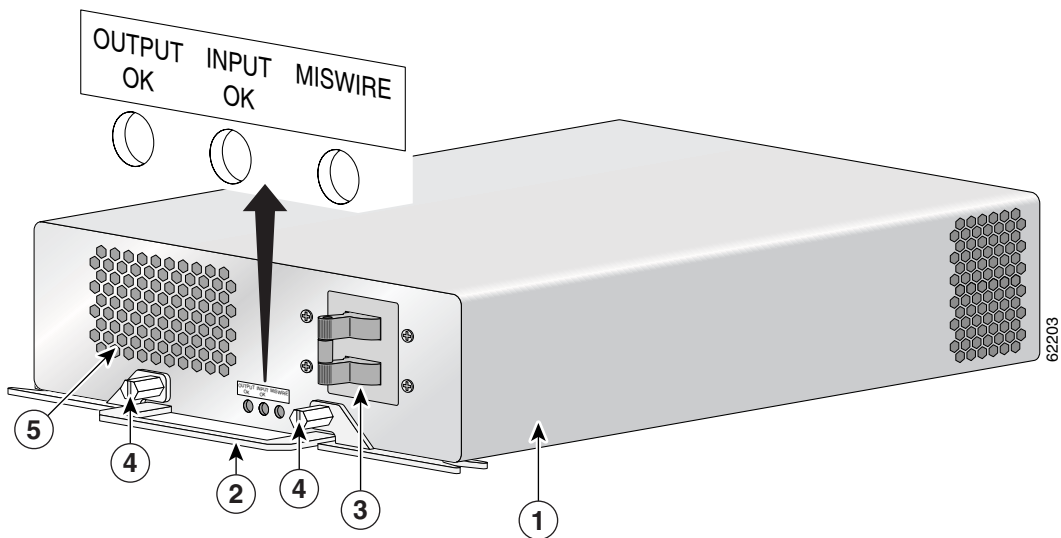
1	DC-input PEM	4	Captive screws on release levers
2	Handle	5	Air inlet for cooling fan
3	Circuit breaker ON/OFF switch	—	

A DC-input PEM (shown in Figure 1-16) has the following features:

- A circuit breaker switch on the faceplate turns the PEM on and off.

- A handle is provided for ease in removing and replacing the PEM.

- Captive screws on the PEM ejector levers secure it in the PEM bay.

- Three LEDs on the faceplate to provide status information. Table 1-10 summarizes the function of these indicators.

Table 1-10   DC-input PEM LED Indicators

LED Label	Color	Function
OUTPUT OK	Green	PEM is operating normally in a powered-on condition.
INPUT OK	Green	DC power is present at the PEM input and within the specified limits.
MISWIRE	Amber	Indicates input is wired backward at the PDU input.

- Each PEM weighs 10.5 pounds (4.76 kg), and can deliver up to 1400 W at -48 VDC.

- Each PEM requires a hardwired source DC power cable from the site DC power source to the DC PDU in the router. The DC power cable leads to the PDU should be #6 American Wiring Gauge (AWG) high-strand-count wires.

- Only a DC power source that complies with the safety extra-low voltage (SELV) requirements in UL1950, CSA 950, EN 60950, and IEC950 can be connected to a PEM.

- The router requires a dedicated 45A DC circuit breaker for the DC power source. This circuit breaker should protect against short-circuit and overcurrent faults in accordance with United States National Electrical Code NFPA 70 (United States), Canadian Electrical Code, part I, CSA C22.1 (Canada), and IEC 364 (other countries).

✎
Note   We recommend that you install an uninterruptable power source (UPS) as a safeguard against power loss.

Power Distribution

The router chassis backplane distributes -48 VDC power throughout the router and to all cards in the card cages.

All cards have multiple DC-DC converters that convert the -48 VDC into +2.5 VDC, +3.3 VDC, +5 VDC, and other voltages as required by the line card. The DC-DC converters are turned on by the MBus modules under the control of the route processor and MBus software.

Power for the blower module is supplied directly from the backplane through a connector in the PDU that passes DC voltage from the backplane to the blower module. An blower module controller card in the blower module converts –48 VDC into DC voltage that powers the blower module fans.

⚠️
Caution   To ensure that the chassis configuration complies with the required power budgets, use the on-line power calculator. Failure to properly verify the configuration may result in an unpredictable state if one of the power units fails. Contact your local sales representative for assistance.

Blower Module

The Cisco XR 12406 Router is equipped with a blower module to distribute air within the chassis. The blower module is located on the rear of the chassis (see Figure 1-3). The blower module draws room air into the chassis through two air filters on the side of the chassis, pulls the air through the chassis card cages, and expels it through exhaust vents on the back of the blower module (Figure 1-17).

⚠️
Caution   Exhaust from other equipment vented directly into the router air inlet may cause overheating. The front, back, and sides of the router must remain unobstructed to ensure adequate air flow and prevent overheating inside the chassis. Allow sufficient air flow by maintaining 6 inches (15.24 cm) of clearance at both the inlet and exhaust openings on the chassis.

If the air temperature inside the route processor and line card cage rises, the system environmental monitor shuts down all internal power to prevent equipment damage from excessive heat.

If the system detects that one of three fans within a blower module has failed, it displays a warning message on the console screen. If multiple fans fail, the system shuts down to prevent equipment damage.

Figure 1-17   Internal Air Flow—Top View

Top view
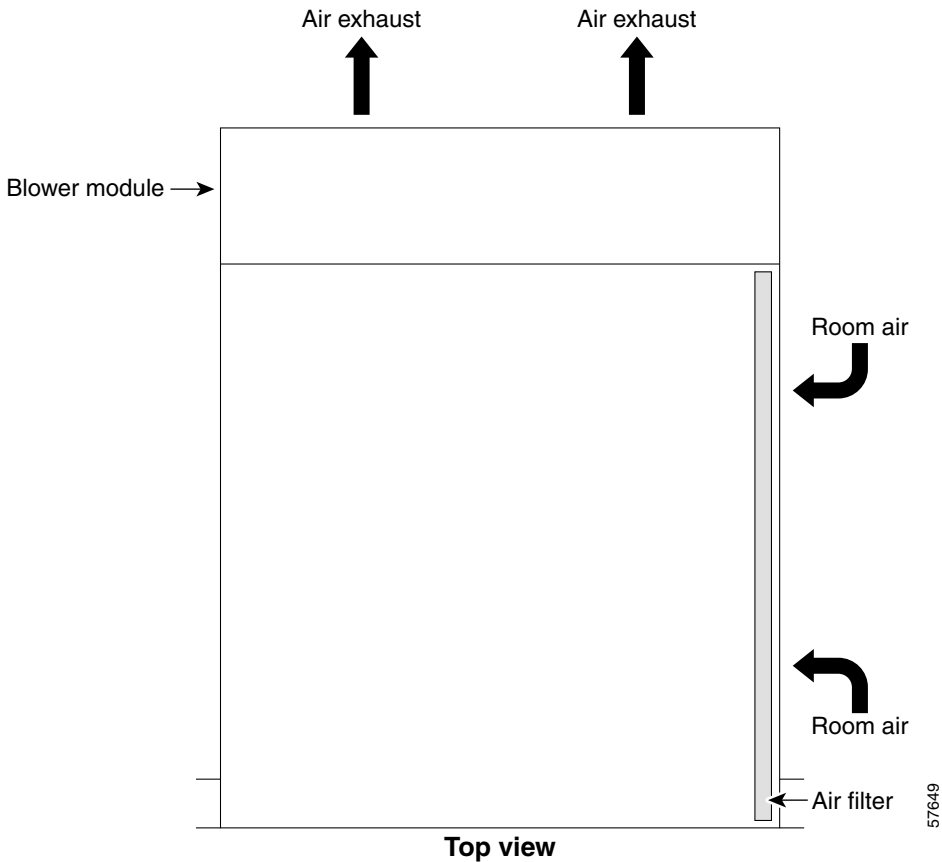
The two LEDs on the blower module provide a visual indication of blower module status. Both LEDs are visible on the blower module from the rear of the chassis.

- OK—Left LED; Green. When on, this LED indicates that the blower module is operating normally. This LED should come on as soon as the blower module is installed and receives power from the backplane connector.

- Fail—Right LED; Red. The red LED should remain off during normal operation. If the red LED is on, the system has detected a fan failure or other fault in the blower module. Replace the existing blower module with a spare.

Chassis Backplane and Maintenance Bus

All of the card cages for the Cisco XR 12406 Router are tied together electrically through a passive system backplane in the back of the chassis. Nearly all of the wiring and circuitry in the chassis is contained within or connected to the chassis backplane. The chassis backplane distributes DC power to all of the cards in the chassis as well as the blower module, and provides the physical communication pathway between cards, both for network data and system communication across the internal system maintenance bus (MBus).

The maintenance bus and MBus modules manage the maintenance functions of the system. The MBus is integrated into the backplane and consists of two separate buses, providing MBus redundancy.

Both MBus networks are linked to all the following items:

- Route processor and line cards
- CSCs, SFCs, and alarm cards
- Power modules
- Blower module

The MBus module located on each component communicates over the MBus and is powered by DC voltage directly from the alarm card. The MBus performs the functions of power-up/down control for each component, component (device) discovery, code download, diagnostics, and environmental monitoring and alarms.

Power-on and Power-off Control

Each MBus module directly controls the DC-DC converters on the component on which it is mounted, based on commands the component receives from its on-board EPROM and from the route processor. Each MBus module is tied directly to DC voltage from the alarm card.

When power is applied to the router, all MBus modules immediately power on. The MBus modules on the route processor and CSC immediately turn on the DC-DC converter, powering up the respective card. The line card MBus module waits to power on the line card until it receives a command from the route processor.

Device Discovery

The route processor uses the MBus to detect the system configuration. The route processor sends a message over the MBus requesting identity information from all installed devices. The responses provide component type, as well as slot numbers for the line cards, CSCs, SFCs, and alarm cards.

Code Download

A portion of the line card operating software can be downloaded from the route processor to the line card over the MBus. Because the MBus is relatively slow compared to the switch fabric, only enough code is downloaded to the line card for it to access the switch fabric and complete the download process.

Diagnostics

The diagnostic software image is downloaded from the route processor to the line card during the test sequence.

Environmental Monitoring and Alarms

The MBus module on each component monitors the environment of that component as follows:

- Line cards and the route processor are monitored for temperature by two temperature sensors mounted on each card. The MBus module makes voltage adjustments through software for the +2.5 VDC, +3.3 VDC, and +5 VDC DC-DC converters.

- Clock and scheduler cards and switch fabric cards are monitored for temperature by two temperature sensors mounted on each card. The MBus module makes voltage adjustments through software for the +2.5 VDC and +3.3 VDC converters.

- The MBus module on the alarm card makes voltage adjustments for +5 VDC.

- Environmental monitoring includes voltage monitoring, temperature monitoring, and sensing for the blower module fans.

Air Filters

The Cisco XR 12406 Router is equipped with two user-serviceable air filters (Figure 1-18).

Figure 1-18   *Air Filter Locations*
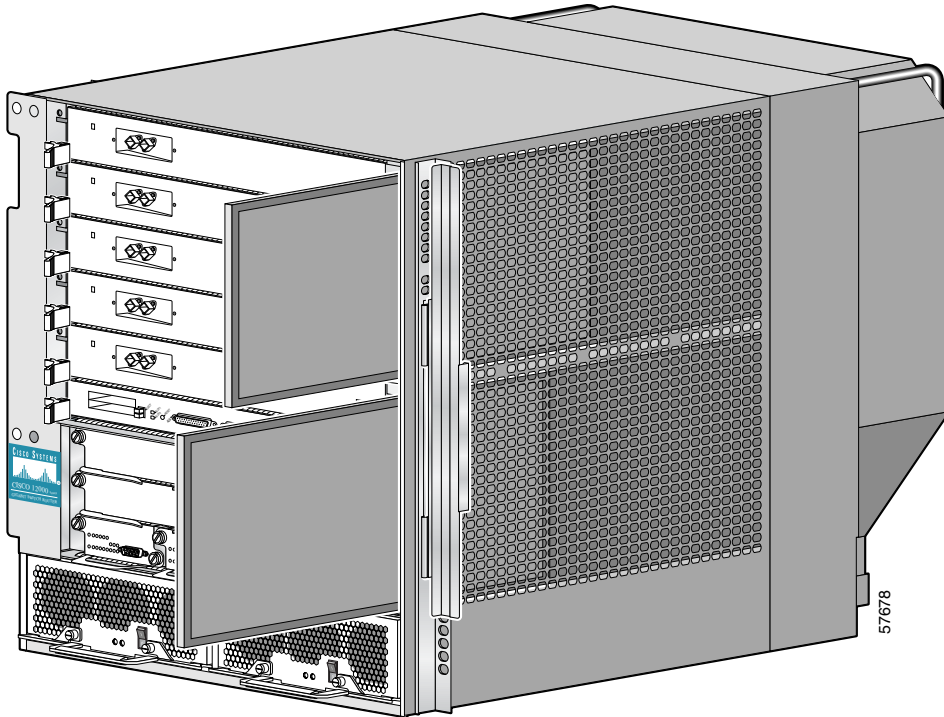
The air filters are located on the right of the front side of the chassis. The air filters are housed behind a door that is spring-loaded in the closed position.

⚠

Caution   Air filters should be clean when the router is operating. Inspect and clean the air filters once a month, more often in dusty environments.

Do not run the router without the air filters installed. You should inspect and clean the air filters once a month, more often in dusty environments.

Cable-Management System

The Cisco XR 12406 Router cable-management system organizes the interface cables entering and exiting the system, keeping them free of sharp bends and out of the way.

⚠️

Caution   Excessive bending in an interface cable can degrade performance.

The cable-management system (Figure 1-19) consists of the following components:

- One vertical cable-management bracket on the chassis
- One line card cable-management bracket on each line card

When you face the front of the router chassis, the chassis cable-management bracket is installed on the left side of the chassis, adjacent to the line card and route processor card cage. The chassis cable-management bracket organizes the line card and route processor cables to keep them from binding, and it eliminates interference when access to the front of the chassis is necessary for maintenance and reading the LEDs.

A line card cable-management bracket attaches to each line card with captive screws. Cable ties on the bracket hold the network interface cables in place, keep the cables organized relative to their assigned connectors, and manage the bend radius of each cable as it enters the connector on the line card.

On line cards with multiple ports, the line card cable-management bracket keeps the network interface cables organized when your remove and replace the line card. You can unplug the network interface cables from their connectors on the line cards and leave the cables bundled in the line card cable-management bracket while you remove the bracket from the line card. That way, when you replace the line card, the network interface cables are already aligned with the correct line card cable connectors.

Figure 1-19   Chassis Cable-Management System
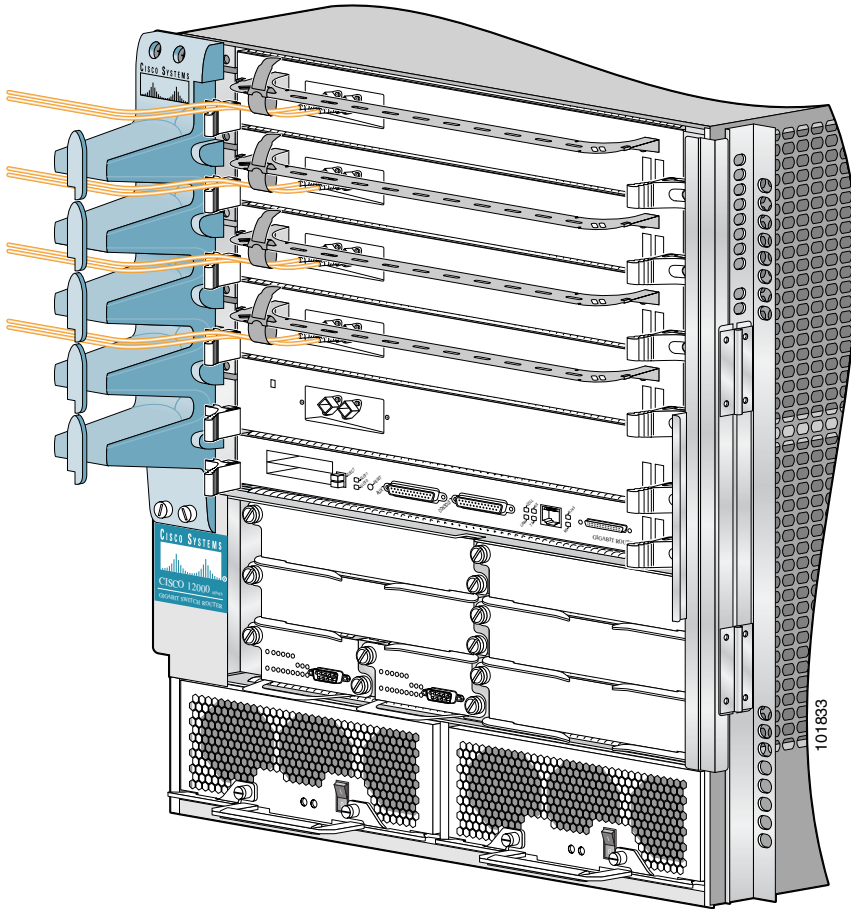
Figure 1-20   Chassis Cable Management System (with PRP-3 Installed)
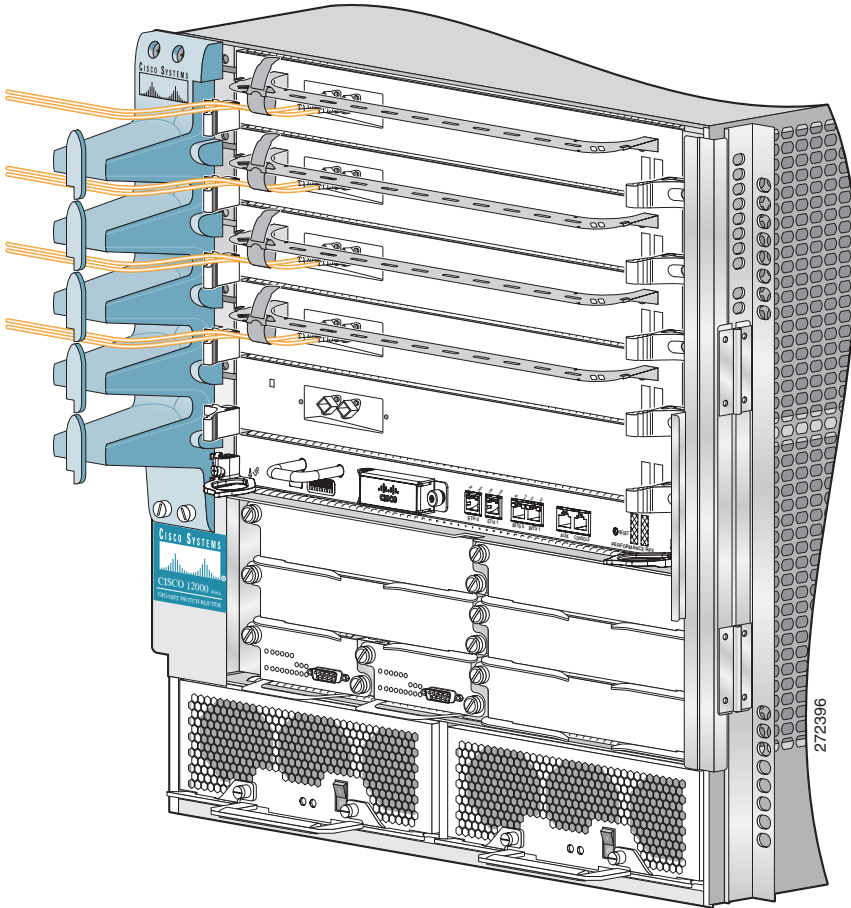
Field-Replaceable Units

The field-replaceable units (FRUs) for the Cisco XR 12406 Router include the following units:

Note For information on ordering FRUs, contact a customer service representative (see the section titled Obtaining Documentation and Submitting a Service Request, page -xii).

- Route processor
- Line cards
- CSCs
- SFCs
- Alarm cards
- PDU:
    - For AC powered systems, AC PDU
    - For DC-powered systems, DC PDU
- Power modules:
    - For AC-powered systems, AC-input power supplies
    - For DC-powered systems, DC-input PEMs
- AC power cords (for AC powered systems)
- Blower module
- Air filters
- Chassis cable-management bracket

Upgrading a Cisco 12000 Series Internet Router to a Cisco XR 12000 Series Router

A Cisco XR 12000 Series Router can be upgraded to a Cisco XR 12406 Router by updating the line cards and software images. For information on this process, including supported line cards and software upgrade procedures, please refer to the Cisco document, *Upgrading a Cisco 12000 Series Router from Cisco IOS Software to Cisco IOS XR Software*.

Technical Specifications

For technical specifications and compliance information for the Cisco XR 12406 Router, see Appendix A, "Cisco XR 12406 Router Technical Specifications and Warnings."

■ **Technical Specifications**

C H A P T E R 2

Preparing for Installation

This chapter provides specific information about preparing your site for the installation of the Cisco XR 12406 Router. The following sections are included in this chapter:

- Tools and Equipment, page 2-2
- Safety and Compliance, page 2-2
- Safety with Electricity, page 2-8
- Installation Site Requirements, page 2-9
- Unpacking and Repacking the Router, page 2-21
- Transporting a Cisco XR 12000 Series Router, page 2-22
- Site Preparation Checklist, page 2-22

Before installing a Cisco XR 12406 Router, you should have the following information:

- Power and cabling requirements that must be in place at your installation site
- Equipment you will need to install the router
- Environmental conditions your installation site must meet to maintain normal operation

✎
Note Do not unpack the router until you are ready to install it.

Tools and Equipment

The Cisco XR 12406 Router can be installed with a minimum number of tools. The following tools are required:

- 1/4-inch and 3/16-inch flat-blade screwdrivers
- 9/16-inch wrench
- 10-mm wrench (either open-end or socket)
- 2-mm allen wrench
- ESD-preventive wrist strap
- Antistatic mat
- Tape measure
- Wire cutters
- Pliers

Safety and Compliance

The following guidelines help to ensure your safety and protect the equipment. This section does not include every potentially hazardous situation, so be alert.

General Safety Guidelines

The following are some general safety guidelines you should be aware of when installing or maintaining the Cisco XR 12406 Router.

- Never attempt to lift an object that might be too heavy for you to lift by yourself.

⚠

Caution   *Do not* attempt to *lift* the chassis by the blower module handle. The blower module handle is intended for lifting the blower module only when it is disconnected from the chassis.

- Always disconnect the power source and unplug all power cables before lifting, moving, or working on the router.

- Keep the work area clear and dust free during and after installation.

- Keep tools and router components away from walkways and equipment rack aisles.

- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the router.

- Fasten your tie or scarf and sleeves.

- Cisco equipment operates safely when it is used in accordance with its electrical ratings and product usage instructions.

- Do not work alone if potentially hazardous conditions exist.

- Always unplug the power cables when performing maintenance or working on the router, unless the replacement part is hot swappable and designed for online insertion and removal (OIR).

- The installation of the router should be in compliance with national and local electrical codes: in the United States, National Fire Protection Association (NFPA) 70, United States National Electrical Code; in Canada, Canadian Electrical Code, part I, CSA C22.1; in other countries, International Electrotechnical Commission (IEC) 364, part 1 through part 7.

- Before installing, configuring, or maintaining the router, review the safety warnings listed in the *Regulatory Compliance and Safety Information for the Cisco 12000 Series Router* that accompanied your router.

- A Cisco XR 12406 Router with an AC power distribution unit (PDU) and AC-input power supplies are shipped with AC power cords equipped with three-wire electrical grounding-type plugs that will fit into only a grounding-type power outlet. This is a safety feature. The equipment grounding should be in accordance with local and national electrical codes.

- A Cisco XR 12406 Router with a DC PDU and DC-input power entry modules (PEMs) require an external 45A DC circuit breaker for each DC power source. This circuit breaker should protect against short-circuit and overcurrent faults in accordance with United States National Electrical Code NFPA 70 (United States), Canadian Electrical Code, part I, CSA C22.1 (Canada), and IEC 364 (other countries).

- Only a DC power source that complies with the safety extra-low voltage (SELV) requirements in UL 1950, CSA-C22.2 No. 950, EN60950, ACA TS001, AS/NZS 3260, and IEC60950 should be connected to a Cisco XR 12406 Router with DC PDU and DC-input PEMs.

- A Cisco XR 12406 Router configured with DC-input PEMs should be installed in a restricted access area in accordance with Articles 110-16, 110-17, and 110-18 of the National Electric Code, ANSI/NFPA 70.

- A Cisco XR 12406 Router configured with a DC PDU shall have a readily accessible disconnect device incorporated in the fixed wiring.

Compliance and Safety Information

The Cisco XR 12406 Router is designed to meet the regulatory compliance and safety approval requirements. Refer to the *Regulatory Compliance and Safety Information for the Cisco 12000 Series Router* if you require additional compliance information (see the "Obtaining Documentation and Submitting a Service Request" section on page -xii for site information).

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage to circuit boards can occur if proper grounding is not established. The boards can produce intermittent or complete failures if they are mishandled.

When handling circuit boards, observe the following guidelines to prevent ESD damage:

- Always use an ESD-preventive ankle or wrist strap and ensure that the strap makes adequate contact with your skin.
- The ankle or wrist strap protects equipment from ESD voltages on the body only; ESD voltages on clothing can still cause damage to electronic components.

Attaching an ESD-Preventive Strap

Attach an ESD antistatic strap to your body and to an open metal part of the chassis on the Cisco XR 12406 Router (Figure 2-1).

Figure 2-1   ***Attaching an ESD-Preventive Strap to the Cisco XR 12406 Router Chassis***

⚠️
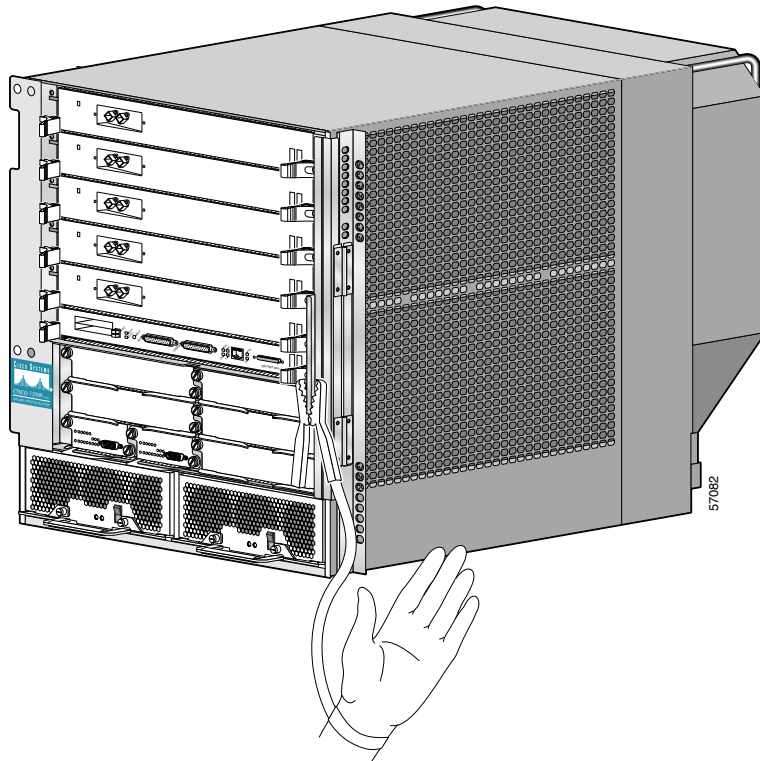
Caution   Periodically check the resistance value of the antistatic wrist strap. The resistance measurement should be between 1 and 10 megohms.

Laser Safety

Single-mode Cisco XR 12000 series router line cards are equipped with lasers. The lasers emit invisible radiation. *Do not* stare into open line card ports. Observe the following warning to prevent eye injury:

⚠

Warning   **Avoid exposure to laser radiation. Do not stare into an open aperture, because invisible laser radiation may be emitted from the aperture when a cable is not inserted in the port.**

Lifting Guidelines

A fully configured Cisco XR 12406 Router weighs approximately 205 pounds (93 kg). Before you install the router, ensure that your site is properly prepared so that you will not have to move the router later to accommodate power source and/or network connections.

⚠

Caution   To prevent damage, never attempt to lift or tilt the router chassis using the handles on the blower module or line cards. These handles do not support the weight of the chassis.

Whenever you lift any heavy or awkward equipment, follow these precautions to avoid injury to yourself or damage to the equipment:

- When using moving equipment, such as a safety hand truck, pallet jack, or forklift to move the equipment to another location, use only moving equipment that is capable of preventing the router from tipping.

- Have a second person help lift the equipment; avoid lifting the equipment alone.

- Ensure that your footing is solid; balance the weight of the object between your feet.

- Lift the equipment slowly; never move suddenly or twist your body as you lift.

- Keep your back straight and lift with your legs, not your back. If you must bend down to lift the equipment, bend at the knees, not at the waist, to reduce the strain on your lower back muscles.

- Always disconnect all external cables before lifting or moving the router.

Safety with Electricity

Most Cisco XR 12406 router field replaceable units (FRUs) support online insertion and removal (OIR), which means they can be removed and installed (hot-swapped) while the router remains powered on.

- Line cards, switch fabric cards (SFCs), alarm cards, and the blower module are hot-swappable.

- Power modules, clock and scheduler cards (CSCs), and RPs also support OIR, but are hot-swappable only when the system is equipped with two power modules, two CSCs, or two RPs, respectively.

- The power distribution unit (PDU) does not support OIR.

Installation Site Requirements

This section provides the site requirement guidelines that you must consider before installing a Cisco XR 12406 Router:

Rack-Mounting Guidelines

Before installing a Cisco XR 12406 Router in a rack, consider the general rack-mounting guidelines in the following sections.

Types of Equipment Racks

A Cisco XR 12406 Router can be mounted in most two-post, four-post, or telco-type 19-inch equipment racks that comply with the Electronics Industries Association (EIA) standard for equipment racks (EIA-310-D). The rack must have at least two posts with mounting flanges on which to mount the router chassis. The distance between the center lines of the mounting holes on the two mounting posts must be 18.31 inches ± 0.06 inch (46.50 cm ± 0.15 cm).

Equipment Dimensions and Site Layout

Figure 2-2 shows the footprint and outer dimensions of the chassis for the Cisco XR 12406 Router.

Figure 2-2   Chassis Outer Dimensions and Footprint
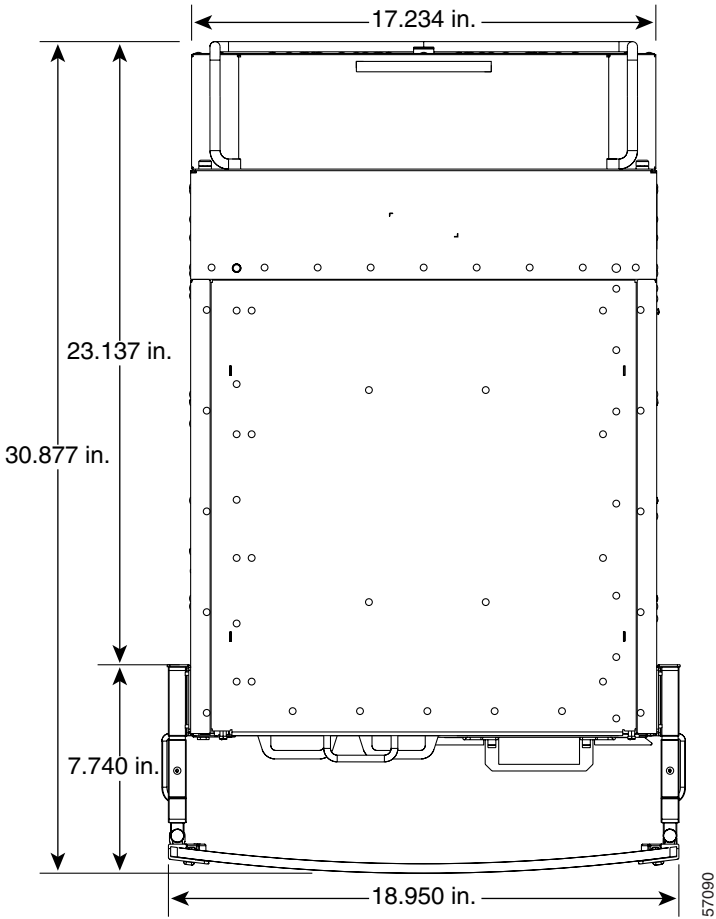
To help maintain trouble-free operation, consider the following precautions when planning your rack installation:

- The site of the rack must include provisions for source AC or DC power, grounding, and network interface cables.

- For the actual installation, allow sufficient space to work around the rack. You will need at least 3 feet adjacent to the rack to move, align, and insert the chassis. You need at least 2 feet in front of the chassis to insert power modules.

- Maintain at least 24 inches (61 cm) of clearance in front of and behind the chassis for maintenance after installation.

- To mount the router between two posts or rails, the usable aperture (the width between the *inner* edges of the two mounting flanges) must be at least 17.5 inches (44.5 cm).

- For the enhanced model of the Cisco XR 12406 Router, the mounting rails on a 4-post rack must be recessed no more than 1.5 inches for the front door to fully open and close and to provide adequate room for cable routing.

- The height of the Cisco XR 12406 Router is 18.5 inches (46.9 cm). Most 7-foot (2.15-m) equipment racks will accommodate four Cisco XR 12406 Routers. Allow sufficient space in the rack for the router.

- When fully populated with cards, a Cisco XR 12406 Router can weigh as much as 205 pounds (93 kg). If you use a telco-style rack, the weight of the chassis is cantilevered off of the two rack posts. Ensure that the weight of the router does not make the frame unstable. Be sure that the frame is bolted to the floor and is secured to the building structure, either to wall or to overhead brackets.

- Do not route cables in such a way as to disrupt movement in front of or behind the rack. To avoid noise interference in network interface cables, do not route them directly across or along power cables. Use appropriate strain-relief methods to protect cables and equipment connections.

- Install and use the cable-management brackets included with the router to keep cables organized and out of the way of line cards, power modules, and blower modules. Consider the equipment and cabling that is already installed in the rack. Ensure that cables from other equipment do not impair access to the card cages, requiring you to disconnect cables unnecessarily to perform equipment maintenance or upgrades.

Ventilation

The blower module is mounted at the rear of the chassis; air flow to the air filters and blower module should not be blocked.

Note   Warm air is exhausted from the rear of the chassis. Maintain 6 inches (15.24 cm) of clearance at both the inlet and exhaust openings on the chassis to allow sufficient air flow.

- When placing multiple a Cisco XR 12406 Router in the same rack, ensure that there is sufficient ventilation to accommodate the routers.
- Equipment located near the bottom of the rack can generate excessive heat that is drawn upward and into the intake ports of equipment above, possibly leading to overheating.
- The heated exhaust air from other equipment can enter the inlet air vents and cause overheating inside the router.
- A ventilation system that is too powerful in an enclosed rack can also prevent cooling by creating negative air pressure around the chassis and redirecting the air away from the air intake vent. If necessary, operate the router with the rack door open or in an open rack.
- The correct use of baffles inside an enclosed rack can assist in cooling the router.

Environmental Guidelines

This section offers guidelines for operating a Cisco XR 12406 Router in various environments. The following environmental considerations are discussed:

- Airflow

- Temperature and humidity

Airflow

The air circulation system for a Cisco XR 12406 Router consists of one blower module mounted at the rear of the chassis. The blower module maintains acceptable operating temperatures for the internal components by drawing cooling air in through replaceable air filters located on the right side of the chassis. Air circulates through the card cage and exhausts at the rear of the chassis.

Observe the following guidelines when selecting a site in which to install a Cisco XR 12406 Router:

- Dust free—The site should be as dust free as possible. Dusty environments can clog the air filter or power supply intake vents, reducing the cooling air flow through the router. This can cause an over temperature condition in the router.

- Air flow—Allow sufficient air flow by maintaining a minimum of 6 inches (15.24 cm) of clearance at both the inlet and exhaust openings on the chassis and the power modules. If the air flow is blocked or restricted, or if the inlet air is too warm, an over temperature condition can occur within the router. Under extreme conditions, the environmental monitoring system shuts down the power to protect the router components.

Temperature and Humidity

The operating environmental site requirements are listed in Appendix A, "Cisco XR 12406 Router Technical Specifications and Warnings." The temperature and humidity ranges listed are those within which the Cisco XR 12406 Router will continue to operate. You can maintain normal operation by anticipating and correcting environmental irregularities before they approach critical values.

The environmental monitoring functionality built into the Cisco XR 12406 Router protects the system and components from potential damage from overvoltage and over temperature conditions. To assure normal operation and avoid maintenance difficulty, plan and prepare your site before you install the router.

Power Connection Guidelines

A Cisco XR 12406 Router can be configured with either an AC-input power subsystem or a DC-input power subsystem. Site power requirements differ depending on which source power scheme is used. Follow these precautions and recommendations when planning power connections to the router:

- Check the power at your site before installation and periodically after installation to ensure that you are receiving clean power.

- If necessary, install a power conditioner.

- Install proper grounding to avoid damage from lightning and power surges.

Note When operating your router on a single power module, the second power module bay must have a blank filler (MAS-GSR-PWRBLANK=) installed to ensure EMI compliance.

Power Connection Guidelines for AC-Powered Routers

When the Cisco XR 12406 Router operates with an AC PDU, observe these guidelines:

- Original series Cisco XR 12406 routers: A power factor corrector (PFC) allows the power supply to accept AC power source voltage from an AC power source operating from 100 to 120 VAC 20-amp service in North America, and a range of from 185 to 264 VAC 16-amp service in an international environment.

- Enhanced series Cisco XR 12406 routers: Supports 220 VAC only which requires 20-amp service in North America, and 16-amp service in an international environment.

- Use only the 14-foot (4.3-meter) AC power cords shipped with the system.

- Provide a dedicated power source with its own circuit breaker for each AC-input power supply installed in the router.

- Install an uninterruptable power source where possible.

Power plug types used in North America, Australia, and Europe are described in Table 2-1 and shown in Figure 2-3.

Table 2-1   AC-Input Power Cord International Options

Label	Description	Cisco Product Number
United States	110 VAC (original Cisco XR 12000 series routers)	CAB-GSR6-US
United States	220 VAC (enhanced Cisco XR 12000 series routers)	CAB-GSR6-220V-US
North America	20A, 250 VAC	CAB-GSR16-US=
Australia, New Zealand	15A, 250 VAC	CAB-GSR16-AU=
Europe, Argentina, Brazil	16A, 250 VAC	CAB-GSR16-EU=
Italy	16A, 250 VAC	CAB-GSR16-IT=
United Kingdom	13A, 250 VAC (13A replaceable fuse)	CAB-GSR16-UK=

Figure 2-3   *AC Power Plugs*

North American plug
L6-20 20A

Australian plug
AS 3112 15A

European plug
CEE 7/7 16A

Italian plug
CEI 23-16/VII 16A

United Kingdom plug
BS 1363 13A
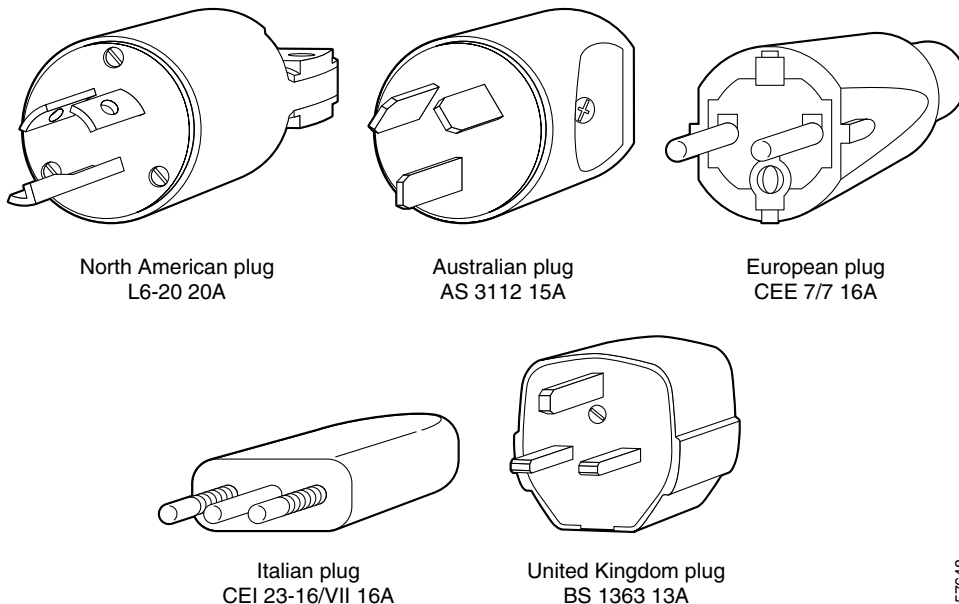
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Power Connection Guidelines for DC-Powered Routers

When the Cisco XR 12406 Router operates with a DC PDU, observe these guidelines:

- A Cisco XR 12406 Router configured with a DC PDU and DC-input PEMs require a dedicated 45A DC circuit breaker for each DC power source. This circuit breaker protects against short-circuit and overcurrent faults in accordance with United States National Electrical Code NFPA 70 (United States), Canadian Electrical Code, part I, CSA C22.1 (Canada), and IEC 364 (other countries).

- DC power cable leads should be #6 American Wiring Gauge (AWG) high-strand-count wire.

- Provide a dedicated power source for each power entry module installed in the router.

- Install an uninterruptable power source where possible.

Grounding Connections

Before you connect power or turn on your Cisco XR 12406 Router, you must provide an adequate system ground for the router. The equipment grounding should be in accordance with local and national electrical codes.

For installations other than in a network equipment building system (NEBS) environment, you may chose to rely on the safety earth ground connection supplied via the International Electrotechnical Commission (IEC) 320 inlets for AC-powered units and the main terminal block ground connection for DC-powered units.

- On Cisco XR 12406 Routers configured for AC-input operation, the AC PDU is equipped with two three-wire electrical grounding-type connectors that accept three-wire, grounding-type AC power cords such as the power cords shipped with the router. This is a safety feature.

- On Cisco XR 12406 Routers configured for DC-input operation, the DC PDU is equipped with two DC power connector blocks, each with wire-connection terminals for connecting the negative lead (top terminal), the positive lead (middle terminal), and the ground lead (bottom terminal). This is a safety feature.

> **Note** The Cisco XR 12404 Router grounding architecture conforms to the DC-I (DC-isolated) method of grounding as described in Telcordia GR-1089-CORE. A DC-I architecture means that there is no connection between the DC return terminal and the frame ground. DC return and frame ground are isolated from one another at the router.

If the router is installed in a NEBS environment, we strongly recommend that you connect the central office ground system or interior equipment grounding system to the supplemental bonding and grounding point on the router chassis. This grounding point consists of three threaded inserts is located on the side of the chassis near the back of the chassis (Figure 2-4). It is also referred to as the NEBS bonding and grounding receptacle, and is intended to satisfy the Telcordia NEBS requirements for supplemental bonding and grounding connections.

Figure 2-4   *Supplemental Bonding and Grounding Port for NEBS Compliance*
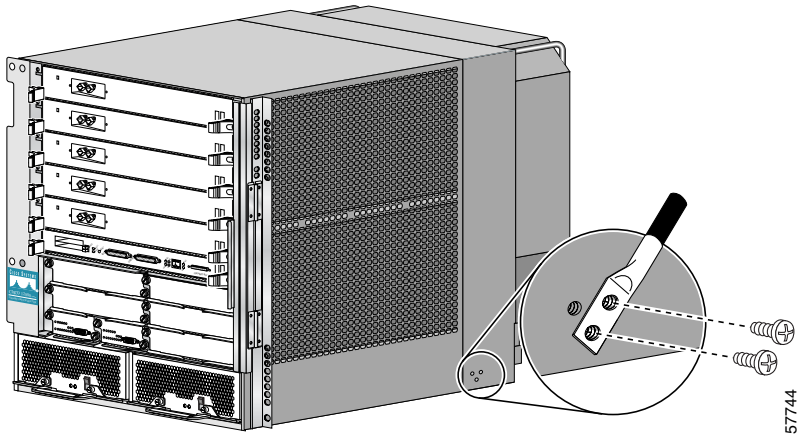
Use a cable lug with two holes at 0.63" (16 mm) centers to connect to the chassis with two 6.3 mm (M6) screws as shown in Figure 2-5. The lug can be ordered from Cisco (Part Number 32-0607-01).

Figure 2-5   *Cable Lug*
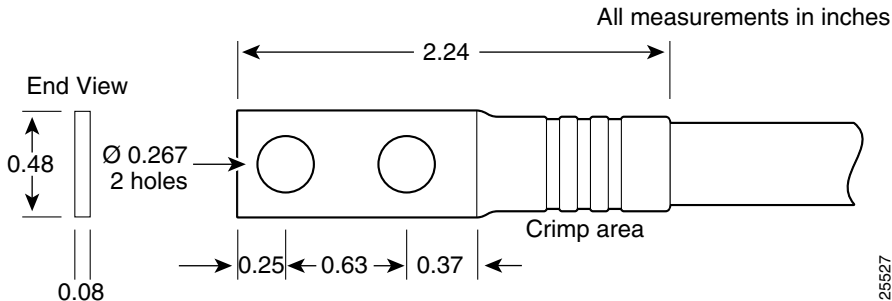
The dual-hole lug is crimped onto a grounding wire of a wire size and length determined by your router location and facility environment. The crimping tool shown in Figure 2-6 is a standard crimping tool obtainable from any normal hardware source.

Figure 2-6   Crimping the Lug
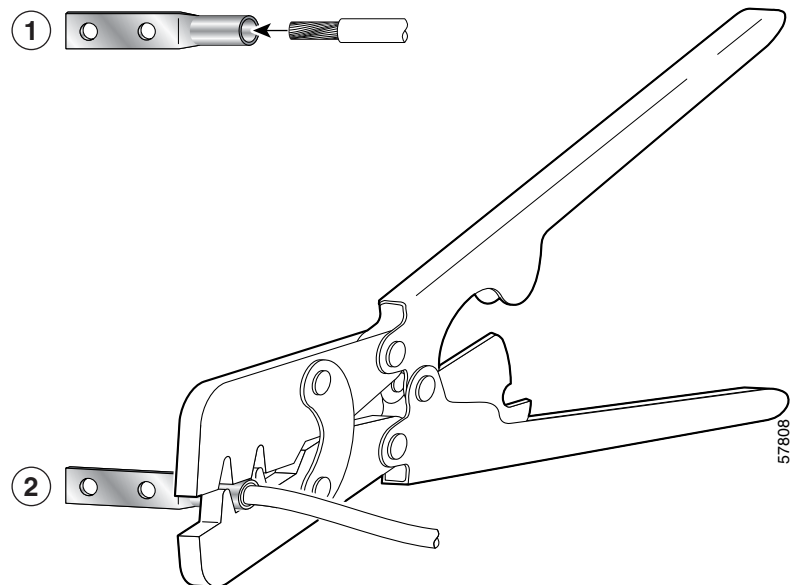
1	Place ground wire in the lug	2	Crimp the lug

Note The three threaded inserts that make up the grounding receptacle are set in a triangle so that you can choose any two of the three holes to attach the lug and grounding cable.

Site Wiring

This section presents site wiring guidelines for setting up the plant wiring and cabling at your site. When planning the location of the new system, consider the following:

- Electromagnetic interference (EMI)
- Distance limitations for signaling and unshielded conductors

Electromagnetic Interference

EMI can occur between the signals on the wires and external or ambient EMI fields when the wires are run for any significant distance. Bad wiring practice can result in radio interference emanating from the plant wiring.

Warning   **Strong EMI, especially when it is caused by lightning or radio transmitters, can destroy the signal drivers and receivers in the Cisco XR 12406 Router, can create an electrical hazard by conducting power surges through lines, and can damage the equipment.**

To predict and remedy strong EMI, you may need to consult experts in radio-frequency interference (RFI).

If you use twisted-pair cable in your plant wiring with a good distribution of grounding conductors, the plant wiring is unlikely to emit radio interference. If you exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

Distance Limitations

If wires exceed recommended distances, or if wires pass between buildings, give special consideration to the effect of a lightning strike in your vicinity. The electromagnetic pulse (EMP) caused by lightning or other high-energy phenomena can easily couple enough energy into unshielded conductors to destroy electronic devices. If you have had problems of this sort in the past, you may want to consult experts in electrical surge suppression and shielding.

Most data centers cannot resolve infrequent but potentially catastrophic problems without pulse meters and other special equipment. These problems can take time to identify and resolve, so take precautions by providing a properly grounded and shielded environment, with special attention to issues of electrical surge suppression.

Unpacking and Repacking the Router

The shipping package for Cisco XR 12000 series routers is engineered to reduce the potential of product damage associated with routine material handling experienced during shipment. To minimize potential damage to the product, transport these products in their Cisco-specified packaging. Failure to do so may result in damage to the router or degradation of its performance. Also, do not remove the Internet router from its shipping container until you are ready to install it. The router should always be transported or stored in an upright position. Keep the router in the shipping container until you have determined a location for installation.

Refer to the unpacking instructions (*Cisco XR 12406 Router Unpacking and Repacking Instructions* document) that came with the router to unpack it from the shipping pallet and verify the contents. This document also includes instructions to repack the router if you need to transport it.

If you do not receive everything you ordered, contact a customer service representative for assistance. See the section titled Obtaining Documentation and Submitting a Service Request, page -xii.

Transporting a Cisco XR 12000 Series Router

The shipping package for Cisco XR 12000 Series Routers is engineered to reduce the potential of product damage associated with routine material handling experienced during shipment. To minimize potential damage to the product, transport these products in their Cisco-specified packaging. Failure to do so may result in damage to the router or degradation of its performance. Also, do not remove the Internet router from its shipping container until you are ready to install it. The router should always be transported or stored in an upright position. Keep the router in the shipping container until you have determined a location for installation.

Site Preparation Checklist

The Cisco XR 12406 Router comes with a site log. Keep this in a common place near the router where anyone who performs tasks can have access to it. Site log entries might include the following:

* Installation progress—Make entries in the site log to record installation. Note any difficulties encountered and their remedies during the installation process.

* Upgrades and removal/replacement procedures—Use the site log as a record of system maintenance and expansion history, for example:

    – FRU installed, removed, or replaced

    – Configuration changes

    – Software upgrades

    – Corrective or preventive maintenance procedures performed

    – Intermittent problems

    – Your comments

Table 2-2 shows a sample site log. You can make copies of the sample or design your own site log.

Table 2-2   Sample Site Log

Date	Description of Action Performed or Symptom Observed	Initials

Installing the Cisco XR 12406 Router

This chapter describes how to install the Cisco XR 12406 router. It includes the following sections:

Required Tools

You need the following items to install the Cisco XR 12406 router:

- Number 2 Phillips screwdriver
- Small flat-bladed screwdriver
- Tape measure (optional)
- Level (optional)

Installing a Router

This section provides the procedures for installing the Cisco XR 12406 router and contains the following sections:

Your installation site should already be prepared before you begin installing the router. For complete information about site preparation see Chapter 2, "Preparing for Installation".

Make sure that you have considered the following before you install the router:

- The exhaust vents on the blower module mounted at the rear of the chassis are not blocked.
- The air filter is mounted on the right side as you face the router; air flow to the blower module is not blocked.
- There is 24 inches (61 cm) of clearance at the rear of the chassis so you can read the blower module LEDs and perform maintenance on the module.
- There is 24 inches (61 cm) of clearance in front of the router chassis to enable working with line cards and power supplies, and attaching Network Interface Cable (NICs) or other components.
- Location is temperature controlled, air conditioned, and dust free.

- Power cables and power supplies have been checked for compatibility with your power service.
- Labels on the equipment have been checked to ensure that the power service at your site is suitable for the router.
- AC power source receptacles are easy to reach.

Installing the Rack-Mounting Brackets—Optional

The rack-mounting brackets temporarily bear the weight of the router while it is being positioned in the rack.

While the use of the rack-mounting is optional, installing them makes it much easier to mount the router in a rack, and also ensures that the router is level. The rack-mounting brackets can be left in place following the router installation.

Warning   **Two or more people should install the router to minimize the risk of personal injury and damage to the equipment.**

Refer to Figure 3-1 and use the following procedure to install the rack-mounting brackets.

Step 1   Measure and mark the hole at the same height on both the left and right rack rails.

Step 2   Mount the right mounting bracket:

   a. Hold the right rack-mount bracket against the right rack rail and align the bottom screw hole in the bracket with the marked screw hole on the rail.

   b. Insert a screw through the bottom hole in the bracket and finger tighten the screw.

   c. Insert and finger tighten a second screw in the top hole in the bracket.

Step 3   Follow Step 2a through Step 2c to mount the left rack-mount bracket.

Step 4   Use a level to verify that the tops of the two brackets are level, or use a measuring tape to verify that both brackets are the same distance from the tops of both rack rails.

Step 5   Use a screwdriver to tighten all the screws.

Figure 3-1   *Installing the Optional Rack-Mount Brackets*
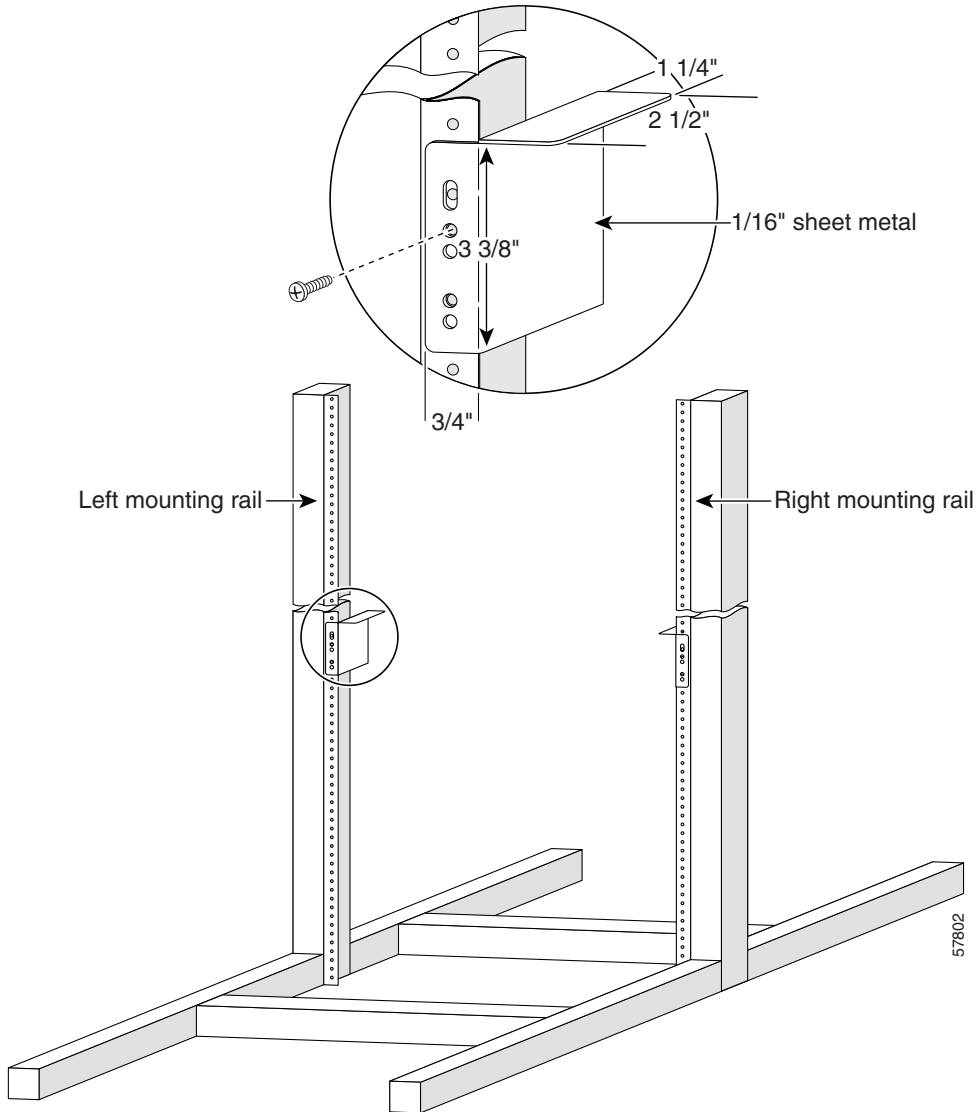
Installing Center-Mounting Brackets (optional)

To install the Cisco XR 12406 router in the center-mounting position, you must first install the upper and lower center-mounting brackets on the equipment rack rails, then secure the chassis to the center-mounting brackets. If you do not plan to use the optional center-mounting brackets, proceed directly to the "Installing the Chassis in a Rack" section on page 3-8.

The optional center-mounting bracket installation kit ships in an accessories box included in the router shipping container.

Refer to Figure 3-2 and use the following procedure to install the optional center-mounting brackets.

Step 1   Measure and mark the hole at the same height on both the left and right posts.

⚠️

Caution   When installing the right side lower center-mounting bracket, ensure that the bracket does not impede airflow through the air filter, which could cause overheating in the router.

Step 2   Mount the lower right bracket:

a.   Hold the lower right bracket against the right rack rail and align the bottom screw hole in the lower bracket with the marked screw hole.

b.   Pick a bottom bracket hole that aligns with a hole in the rack rail, then insert a screw in the hole and finger tighten the screw.

c.   Insert a second screw in the top hole in the bracket and finger tighten that screw.

Step 3   Repeat Step 2a through Step 2c to mount the lower left center-mounting bracket so that it is at the same height as the lower right bracket.

Step 4   Use a level to verify that the tops of the two brackets are level, or use a measuring tape to verify that both brackets are the same distance from the tops of both rack rails.

Step 5   Use a screwdriver to tighten all the screws.

Step 6   Repeat Step 1 through Step 5 for both upper center-mounting brackets.

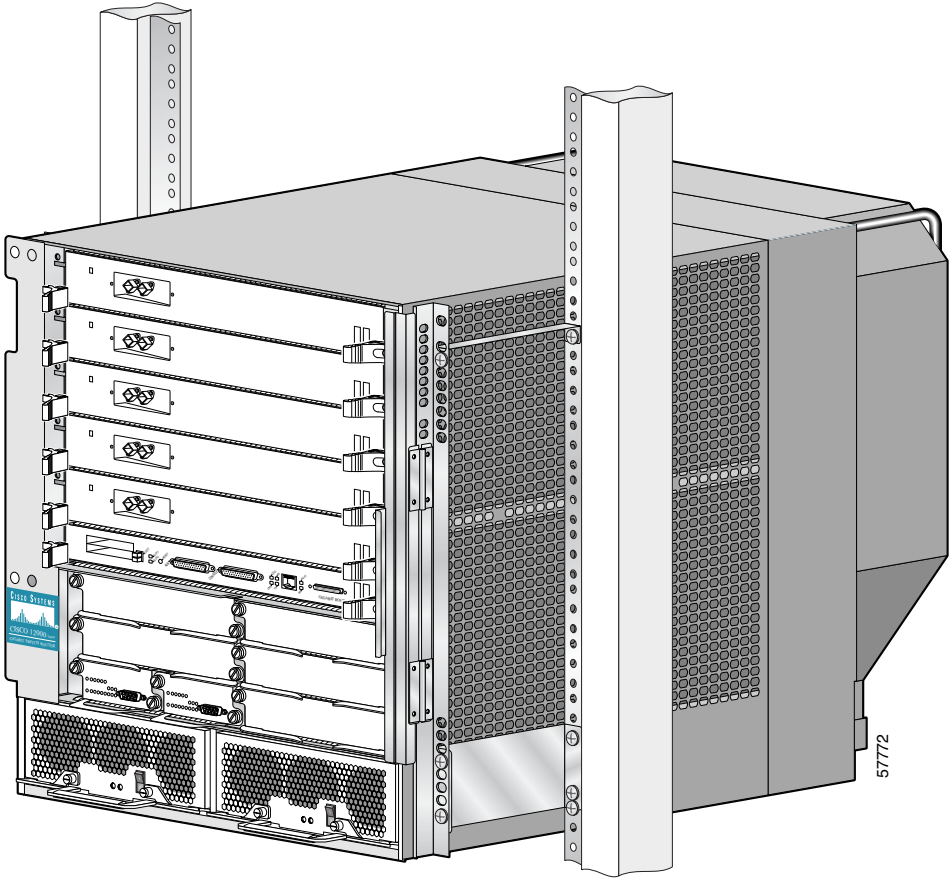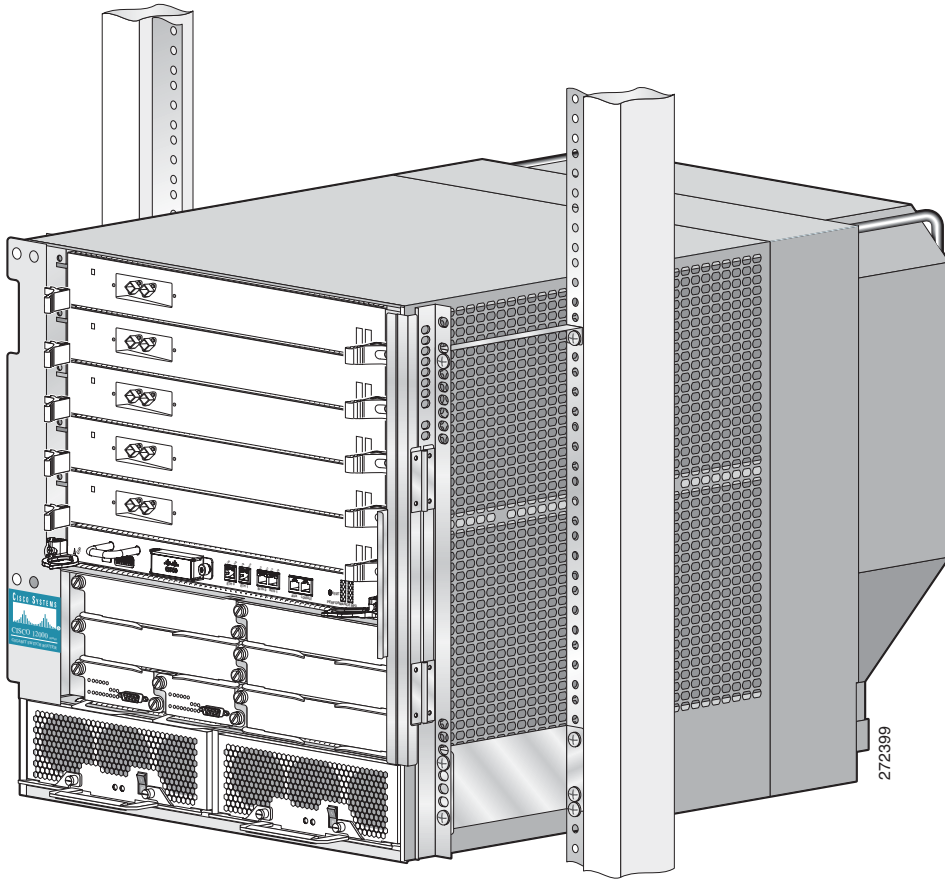*Figure 3-2   Lower and Upper Center-Mounting Brackets*

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Figure 3-3   Lower and Upper Center-Mounting Brackets (with PRP-3 Installed)

Installing the Chassis in a Rack

You install the chassis in the equipment rack by setting the chassis in position against the rack rails and then securing it to the rack or optional center-mounting brackets with screws through holes in the rack-mounting flanges on either side of the chassis.

To accommodate racks with different hole patterns in their rails, the chassis rack-mounting flanges have two groups of eight oblong screw holes on either side as shown in Figure 3-4. The mounting holes in the chassis flanges are spaced so that one mounting hole in each hole group aligns with a hole in the rack rail or optional center-mounting bracket. By using the corresponding mounting hole (in the same hole group) on the opposite side of the chassis, you can level the chassis in the rack.

⚠

Warning   **Two or more people should install the router to minimize the risk of personal injury and damage to the equipment.**

Refer to Figure 3-4 and use the following procedure to install the chassis in a rack.

Step 1   Move the router as close to the installation location as possible without interfering with the installation process.

Step 2   With one person lifting from the front and one from the rear of the chassis, lift the chassis off the pallet and position the chassis in the rack.

✎

Note   A third person might be needed to assist in lifting and positioning the chassis in the rack.

Step 3   Install the screws to secure the chassis to the rack:

    a. Look at the bottom mounting holes on the chassis rack-mount flanges. Align one of the holes with a mounting hole in the rack.

    b. Install one of the mounting screws provided.

    c. On the other side of the chassis, adjust the position of the chassis so that the same mounting hole in the bottom group of mounting holes is aligned with a hole in the rack.

    d. Install one of the mounting screws provided.

Step 4   Repeat Step 3a through Step 3d for additional mounting holes.
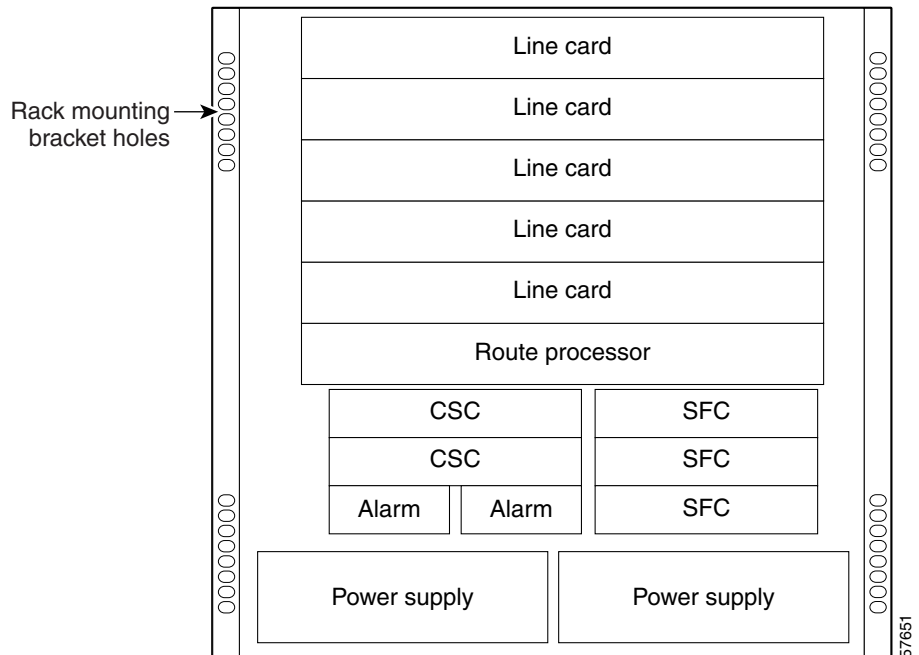
⚠

Caution   Do not allow the chassis to hang free until you have installed a screw in all four
hole groups (at least two screws on each side of the chassis).

Step 5   Use a screwdriver to tighten all the screws.

Figure 3-4   ***Chassis Mounting Bracket Holes***

Installing the Chassis on a Tabletop or Flat Surface

Use the following procedure to install the Cisco XR 12406 router on a tabletop or other stable flat surface.

Step 1 Move the router as close to the installation location as possible.

⚠

Caution Do not lift the chassis by the blower module handle. This handle is designed to support only the weight of the blower module.

Step 2 With one person positioned at the front of the chassis and one at the rear, lift the chassis off the pallet and position the chassis on the flat surface.

Step 3 Secure the chassis to the flat surface to ensure that it does not fall off.

You can use the same mounting hardware that secured your router to the shipping pallet to secure the chassis to the flat surface.

Supplemental Bonding and Grounding Connections

Before you connect power or turn on your Cisco XR 12406 router, you must provide an adequate system ground for the router. The equipment grounding should be in accordance with local and national electrical codes.

If you are not installing the Cisco XR 12406 router in a NEBS environment, you can choose to bypass these guidelines and rely on the safety earth ground connection supplied using the 5-15 15A North American plug to the AC-powered PEMs, and the main terminal block ground connection for DC-powered PEMs.

- On Cisco XR 12406 routers configured for AC-input operation, the AC PDU is equipped with a three-wire electrical grounding-type connector that accept three-wire, grounding-type AC power cords such as the power cords shipped with the router. This is a safety feature.

- On Cisco XR 12406 routers configured for DC-input operation, the DC PDU is equipped with a DC power connector block with wire-connection terminals for connecting the negative lead (top terminal), the positive lead (middle terminal), and the ground lead (bottom terminal). This is a safety feature.

> **Note** The Cisco XR 12406 router grounding architecture conforms to the DC-I (DC-isolated) method of grounding as described in Telcordia GR-1089-CORE. A DC-I architecture means that there is no connection between the DC return terminal and the frame ground. DC return and frame ground are isolated from one another at the router.

If the router is installed in a NEBS environment, we strongly recommend that you connect the central office ground system or interior equipment grounding system to the supplemental bonding and grounding point on the router chassis. This grounding point consists of threaded inserts is located on the side of the chassis near the back of the chassis (Figure 3-5). It is also referred to as the NEBS bonding and grounding receptacle, and is intended to satisfy the Telcordia NEBS requirements for supplemental bonding and grounding connections.

Figure 3-5   Supplemental Bonding and Grounding Port for NEBS Compliance
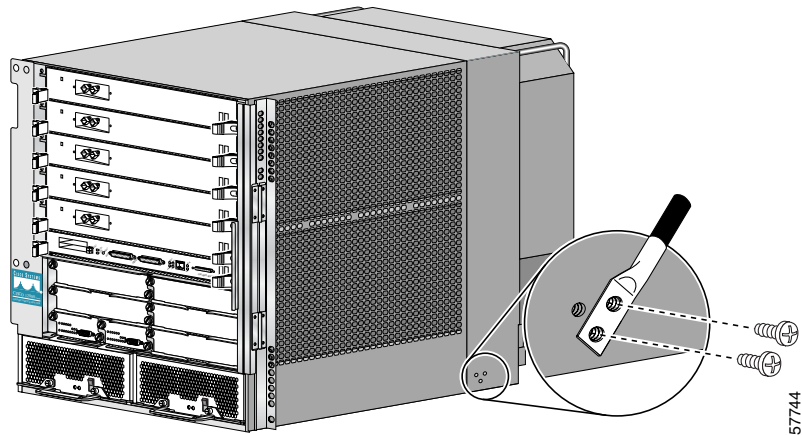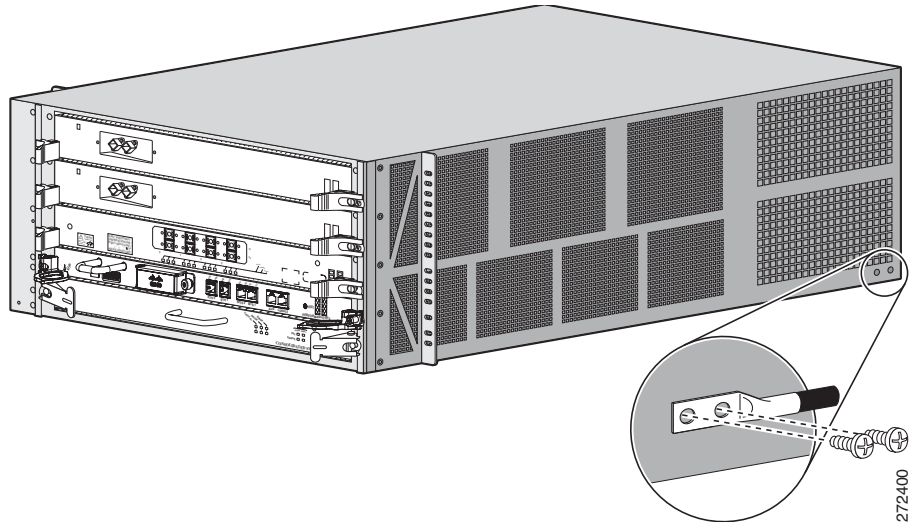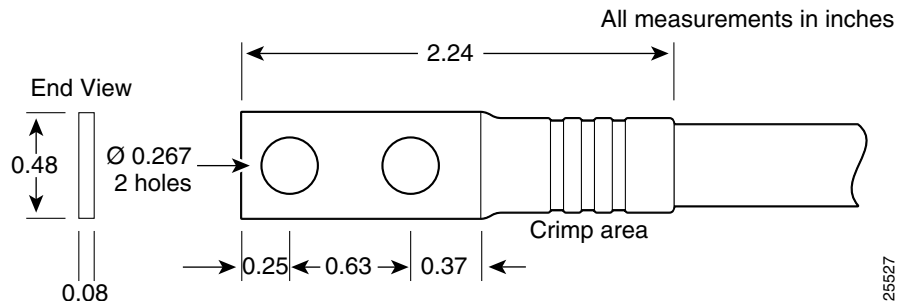

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Figure 3-6   Supplemental Bonding and Grounding Port for NEBS Compliance (with PRP-3 Installed)

Use a dual-hole lug to connect to the chassis with two 6.3-mm (M6) screws on the 0.63-inch (16-mm) centers as shown in Figure 3-5 and Figure 3-7. The lug can be ordered from Cisco (Part Number 32-0607-01).

Figure 3-7   Cable Lug

The dual-hole lug is crimped onto a grounding wire of a wire size and length determined by your router location and facility environment. The crimping tool shown in Figure 3-8 is a standard crimping tool obtainable from many sources.

Figure 3-8   Crimping the Lug
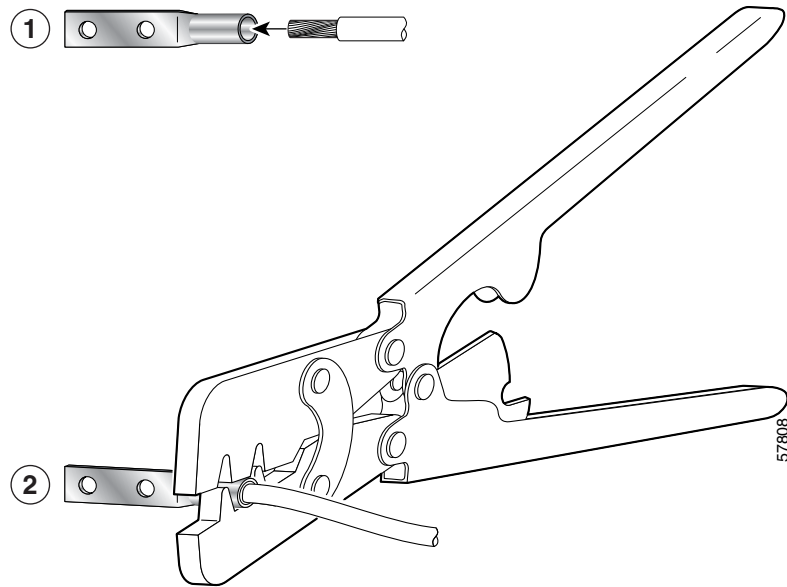
1	Place ground wire in the lug	2	Crimp the lug

Note   The three threaded inserts that make up the grounding receptacle are set in a triangle so that you can choose any two of the three holes to attach the lug and grounding cable.

Connecting RP and Line Card Cables

Refer to Figure 3-9 and use the following procedure to connect RP and line card cables.

Step 1 Proceeding from left to right, identify the cables that attach to the first RP or line card.

Step 2 Connect the network interface cables:

    a. Carefully route the identified cable through the cable-management tray and over to the card interface port; connect one cable at a time.

    b. Proceeding from left to right carefully wrap the cables using the velcro straps.

⚠

Caution Carefully adjust the cable in the cable-management brackets to prevent any kinks or sharp bends in the interface cable. Kinks and sharp bends can destroy or degrade the ability of the optical fiber to propagate the signal-encoded beam of light accurately from one end of the cable to the other. Also, allow adequate strain relief in the interface cable.

Step 3 Route the cable through the fingers on the vertical chassis cable-management bracket and turn the latch on the front of the bracket to secure the cables in the bracket.

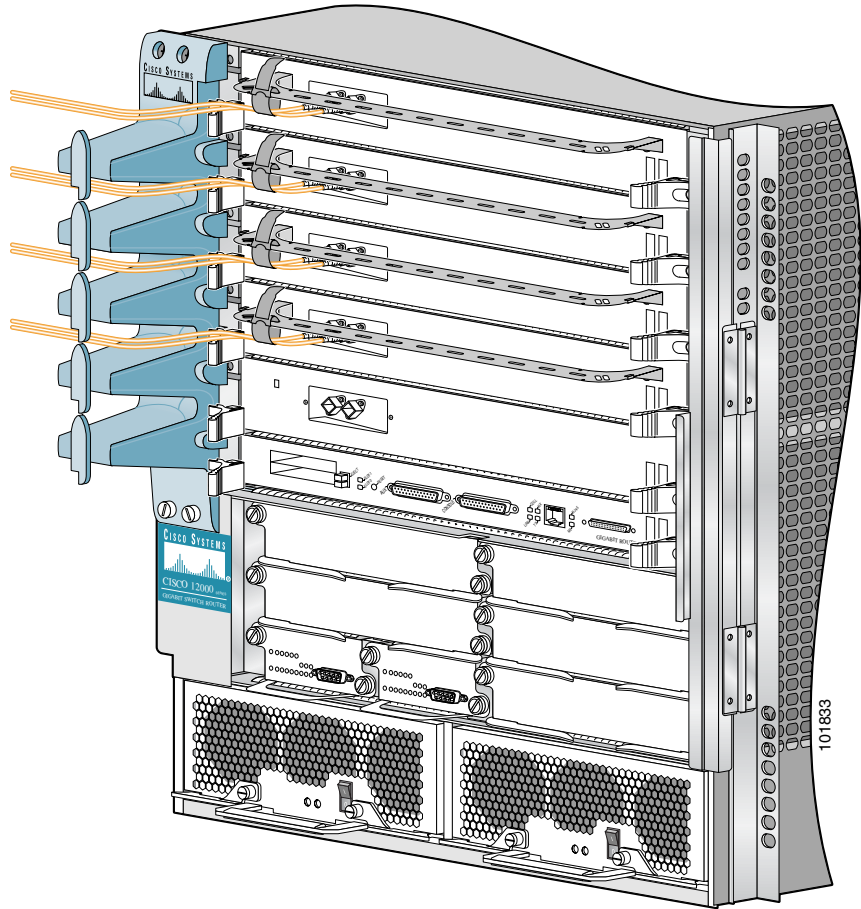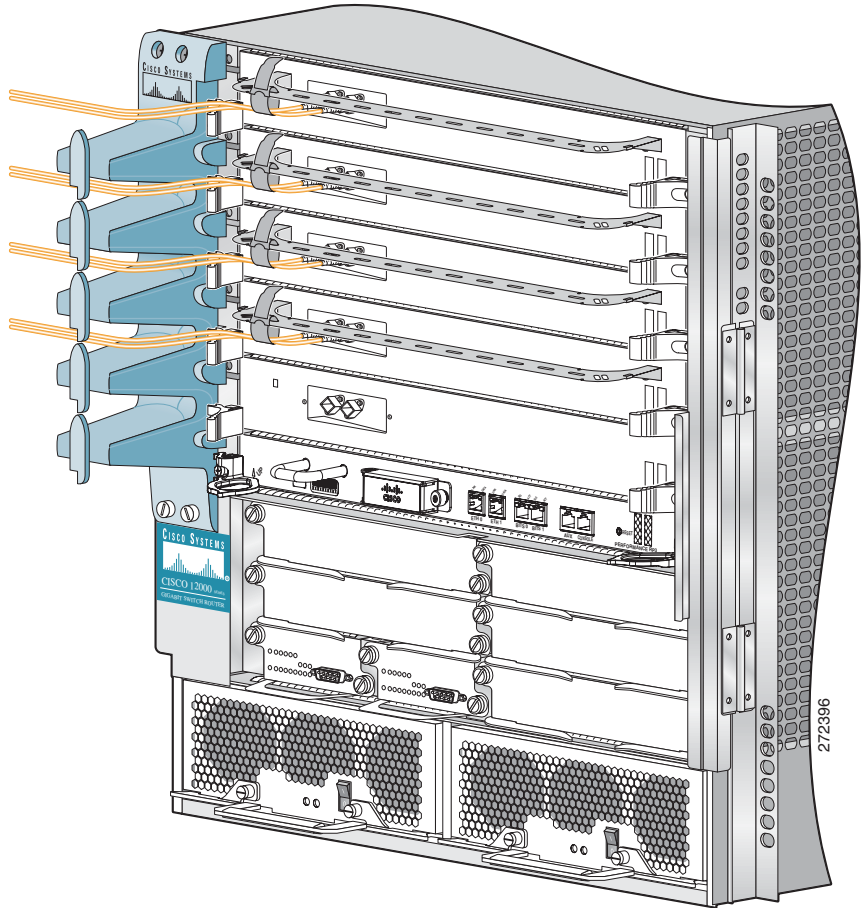*Figure 3-9   Chassis Cable-Management Bracket*

Figure 3-10   ***Chassis Cable-Management Bracket (with PRP-3 Installed)***

Connecting Alarm Card Cables

The Cisco XR 12406 router has two alarm cards. Each alarm card is equipped with a standard DB-9 connector, labeled ALARM. This connector can be used to connect the router to an external site alarm maintenance system so that critical, major, and minor alarms generated in the router also energize alarm relays on the alarm card which activate the external site alarm. Appendix A, "Cisco XR 12406 Router Technical Specifications and Warnings," lists the pin-to-signal correspondence between the connector pins and the alarm card relay contacts.

Because alarm connector cables are entirely dependent on installation site circumstances, these cables are not available from Cisco Systems.

Note   Only safety extra-low voltage (SELV) circuits can be connected to the alarm connector. Maximum rating for the alarm circuit is 2A, 50VA.

To comply with the intrabuilding lightning surge requirements of GR-1089-CORE, Issue II, Revision 01, February 1999, use a shielded cable when connecting to the external alarm port on the alarm card. The cable must consist of shielded cable terminated by shielded connectors on both ends, with the cable shield material tied to both connectors.

Connecting to the Console and Auxiliary Ports

This section provides the information for connecting console terminals and other auxiliary devices to the console and auxiliary ports on the router. Both Data Set Ready (DSR) and Data Carrier Detect (DCD) signals are active when the system is running. The console port does not support modem control or hardware flow control.

The system console port on the PRP is a DCE RJ-45 receptacle for connecting a data terminal, which you must configure. The console port is labeled *Console*, as shown in Figure 3-11.

Check your terminal's documentation to determine the baud rate of the terminal you plan to use. If your documentation does not specify settings use the following terminal settings:

1. Baud to 9600

2. Data bits to 8

3. Parity to no parity

4. Stop bits to 2

The console port requires a straight-through RJ-45 cable.

Note To comply with Telcordia GR-1089 NEBS standard for electromagnetic compatibility and safety, connect all console, auxiliary, Ethernet, and BITS interfaces only to intrabuilding or non-exposed wiring or cabling. The intrabuilding cable must be shielded and the shield must be grounded at both ends.

Figure 3-11   PRP Console and Auxiliary Port Connections
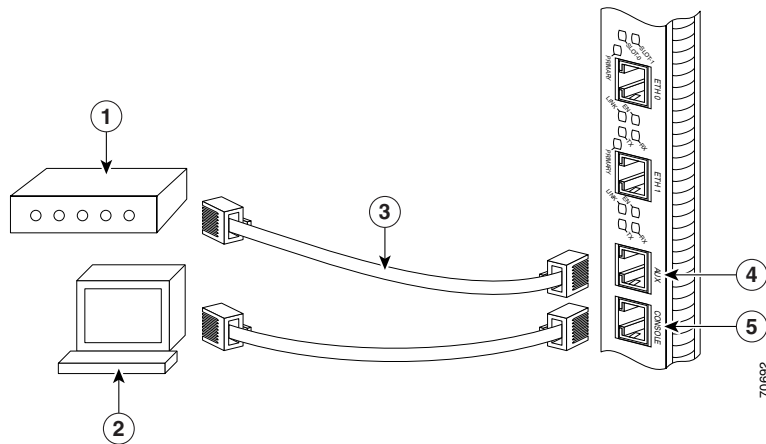
1	Modem	**4**	Auxiliary port
2	Console terminal	**5**	Console port
3	RJ-45 Ethernet cables	–	—

> ✎
>
> **Note**   The console and auxiliary ports are both asynchronous serial ports; any devices connected to these ports must be capable of asynchronous transmission. Asynchronous is the most common type of serial device; for example, most modems are asynchronous devices.

PRP Console Port Signals

The console port on the PRP is a DCE RJ-45 receptacle. Table 3-1 lists the signal-to-pin correspondence for the PRP console port.

Table 3-1   PRP Console Port Signals

Console Port Pin	Signal	Input/Output	Description
1[1]	—	—	—
2	DTR	Output	Data Terminal Ready
3	TxD	Output	Transmit Data
4	GND	—	Signal Ground
5	GND	—	Signal Ground
6	RxD	Input	Receive Data
7	DSR	Input	Data Set Ready
8[1]	—	—	—

1.   These pins are not connected.

PRP Auxiliary Port Signals

The auxiliary port on the PRP is a DTE, RJ-45 plug for connecting a modem or other DCE device (such as a CSU/DSU or another router) to the router. The port is labeled *AUX*, as shown in Figure 3-11. The asynchronous auxiliary port supports hardware flow control and modem control. Table 3-2 lists the signal-to-pin correspondence for the PRP auxiliary port.

Table 3-2   PRP Auxiliary Port Signals

Auxiliary Port Pin	Signal	Input/Output	Description
1	RTS	Output	Request To Send
2	DTR	Output	Data Terminal Ready
3	TxD	Output	Transmit Data
4	GND	—	Signal Ground
5	GND	—	Signal Ground
6	RxD	Input	Receive Data
7	DSR	Input	Data Set Ready
8	CTS	Input	Clear To Send

Installing a Flash Memory Card

By default, a Flash memory card (Figure 3-12) containing a valid Cisco IOS XR software image is inserted in PCMCIA slot 0 before the router is shipped. PCMCIA slot 0 (SLOT-0) is the bottom slot and slot 1 (Slot-1) is the top slot. Both Flash memory card slots on each RP can be used at the same time.

The software configuration register is set to 0x0102, which causes the router to boot automatically from the Cisco IOS XR software image stored on the Flash memory card.

Figure 3-12   Flash Memory Card Slot Opening
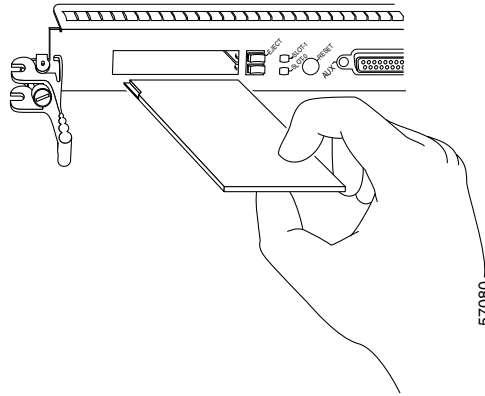
Figure 3-13   PRP-3 External CompactFlash Opening
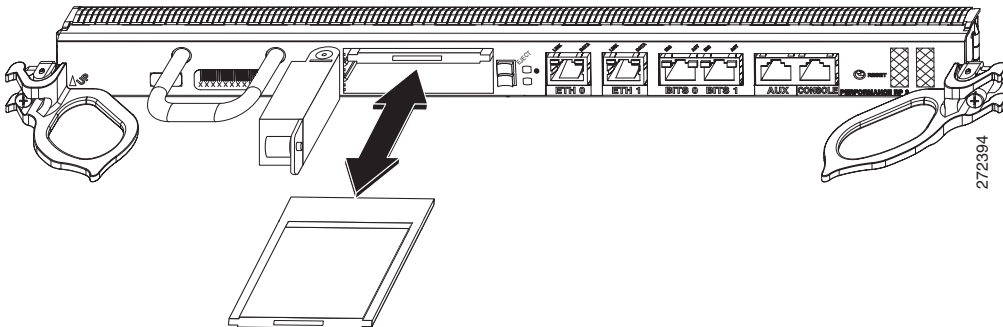
Ensure that a console terminal is connected to the RP console port and turned on, or that you have a remote login to the router from another device through a Telnet session.

Connecting the PRP to an Ethernet Network

The PRP includes two 10/100 Mbps Ethernet ports, each using an 8-pin RJ-45 receptacle for either IEEE 802.3 10BASE-T (10 Mbps) or IEEE 802.3u 100BASE-TX (100 Mbps) connections. The transmission speed of the Ethernet ports is auto-sensing by default and is user configurable.

To connect cables to the PRP Ethernet interfaces (ports labeled ETH0 and ETH1), attach the Category 5 UTP cable directly to a RJ-45 receptacle on the PRP.

Note The Ethernet interfaces on the PRP are end-station devices, not repeaters; therefore, you *must* connect an Ethernet interface to a repeater or hub.

RJ-45 cables are not available from Cisco Systems, but are available from outside commercial cable vendors.

Note Use cables that comply with EIA/TIA-568 standards. See Table 3-4 on page 3-25 and Table 3-5 on page 3-26 for cable recommendations and specifications.

Note To comply with Telcordia GR-1089 NEBS standard for electromagnetic compatibility and safety, connect all console, auxiliary, and Ethernet interfaces only to intrabuilding or non-exposed wiring or cabling. The intrabuilding cable must be shielded and the shield must be grounded at both ends.

**Caution** The Ethernet ports are used primarily as Telnet ports into the router, and for booting or accessing Cisco IOS XR software images over a network to which an Ethernet port is directly connected. Cisco Express Forwarding (CEF) functions are switched off by default for security reasons. Cisco strongly cautions you to consider the security implications of switching on CEF routing functions on these ports.

Figure 3-14 shows an example of the functionality of an Ethernet port. In this example, you cannot access Network 2.0.0.0 through the Ethernet port (ETH0) on the PRP in Router A; you can only access the hosts and Router C, which are in Network 1.0.0.0 (see dotted arrows in Figure 3-14).

To access Network 2.0.0.0 from Router A, use an interface port on one of the line cards (in this example, a Packet-over-SONET [POS] line card in Router A) to go through Router B, through Router C, and into Network 2.0.0.0. (see solid arrows in Figure 3-14).

Figure 3-14   Using the Ethernet Port on the PRP
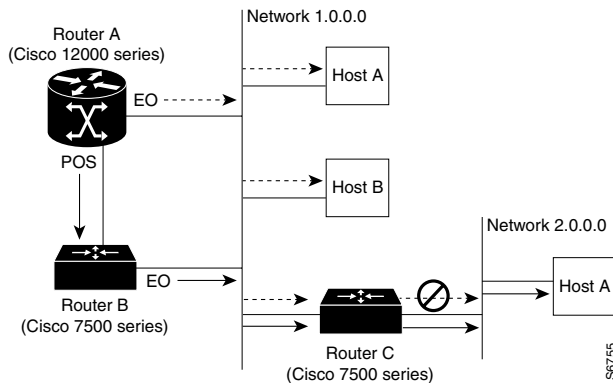
PRP Ethernet Connections

Figure 3-15 shows a PRP RJ-45 receptacle and cable connector. The RJ-45 connection does not require an external transceiver. The RJ-45 connection requires Category 5 unshielded twisted-pair (UTP) cables, which are not available from Cisco Systems, but are available from commercial cable vendors. Table 3-3 lists the signal-to-pin correspondence for the RJ-45 receptacle.

Figure 3-15   RJ-45 Receptacle and Plug (Horizontal Orientation)

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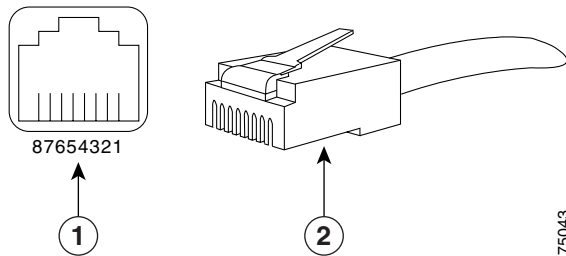
1	RJ-45 receptacle	2	Category 5 UTP cable with plug

Warning   **The ports labeled Ethernet, 10BASE-T, Token Ring, Console, and AUX are safety extra-low voltage (SELV) circuits. SELV circuits should only be connected to other SELV circuits. Because the BRI circuits are treated like telephone network voltage, avoid connecting the SELV circuit to the telephone network voltage (TNV) circuits.**

Table 3-3   PRP RJ-45 Ethernet Receptacle Pinout

Ethernet Port Pin	Signal	Description
1	TxD+	Transmit data +
2	TxD–	Transmit data –
3	RxD+	Receive data +
4	Termination Network	No connection
5	Termination Network	No connection
6	RxD–	Receive data –
7	Termination Network	No connection
8	Termination Network	No connection

Depending on your RJ-45 cabling requirements, use the connector pinouts shown in Figure 3-16 or Figure 3-17.

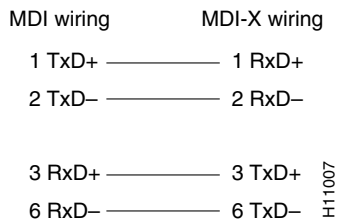*Figure 3-16*   ***Straight-Through Cable Pinout (Connecting MDI Ethernet Port to MDI-X Wiring)***

MDI wiring   MDI-X wiring

1 TxD+ ——————— 1 RxD+

2 TxD– ——————— 2 RxD–

3 RxD+ ——————— 3 TxD+

6 RxD– ——————— 6 TxD–

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Figure 3-17   ***Crossover Cable Pinout for Connecting Two PRPs***

PRP   PRP

1 TxD+   1 TxD+

2 TxD–   2 TxD–

3 RxD+   3 RxD+

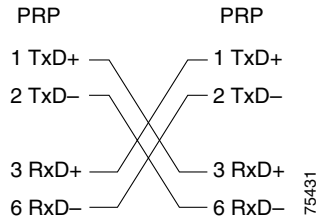6 RxD–   6 RxD–

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Table 3-4 lists the cabling specifications for 100-Mbps transmission over unshielded twisted-pair (UTP) cables.

Note   The transmission speed of the Ethernet ports is auto-sensing by default and is user configurable.

Table 3-4   ***Specifications and Connection Limits for 100-Mbps Transmission***

Parameter	RJ-45
Cable specification	Category 5[1] UTP, 22 to 24 AWG[2]
Cable length (max)	—
Segment length (max)	328 feet (100 m) for 100BASE-TX
Network length (max)	656 feet (200 m)[3] (with 1 repeater)

1. EIA/TIA-568- or EIA-TIA-568 TSB-36-compliant. Not supplied by Cisco.

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2. AWG = American Wire Gauge. This gauge is specified by the EIA/TIA-568 standard.

3. This length is specifically between any two stations on a repeated segment.

Table 3-5 lists IEEE 802.3u physical characteristics for 100BASE-TX.

Table 3-5   IEEE 802.3u Physical Characteristics

Parameter	100BASE-TX
Data rate (Mbps)	100
Signaling method	Baseband
Maximum segment length	100 m between DTE[1] and repeaters
Media	Category 5 UTP (for RJ-45)
Topology	Star/Hub

1. DTE = data terminal equipment.

Connecting to an AC Power Source

This section presents the procedure for connecting your router to an AC power source.

- Original series Cisco XR 12406 routers: A power factor corrector (PFC) allows the power supply to accept AC power source voltage from an AC power source operating from 100 to 120 VAC 20-amp service in North America, and a range of from 185 to 264 VAC 16-amp service in an international environment.

- Enhanced series Cisco XR 12406 routers: Supports 220 VAC only which requires 20-amp service in North America, and 16-amp service in an international environment.

Warning   **The AC-input PEM power switch should be in the off position before connecting to an AC power source.**

When operating your router on a power source, the power supply bays must have one of the following power combinations installed before operating the router (Table 3-6):

Table 3-6   Required Power Combinations

Router Power	Combination
AC power	1 AC-input power supply 1 power supply blank
	2 AC-input power supplies
DC power	1 DC-input PEM 1 PEM blank
	2 DC-input PEMs

Refer to Figure 3-18 and use the following procedure to connect AC power to the AC PDU.

> **Note**   When operating your router on a single power module, the second power module bay must have a blank filler (MAS-GSR-PWRBLANK=) installed to ensure EMI compliance.

Step 1   Attach an ESD-preventive strap to your wrist and connect the leash to the chassis or to another grounded, bare metal surface.

Step 2   Locate the two AC power cords and remove them from their shipping packaging. Verify that the AC power cords shipped with the power supplies are the correct type for your site.

> **Note**   If you have received the wrong type of AC power cord, contact your service representative for a replacement.

Step 3   Plug the socket end of each AC power cord into a receptacle on the PDU (Figure 3-18).

Figure 3-18   *AC Power Distribution Unit*
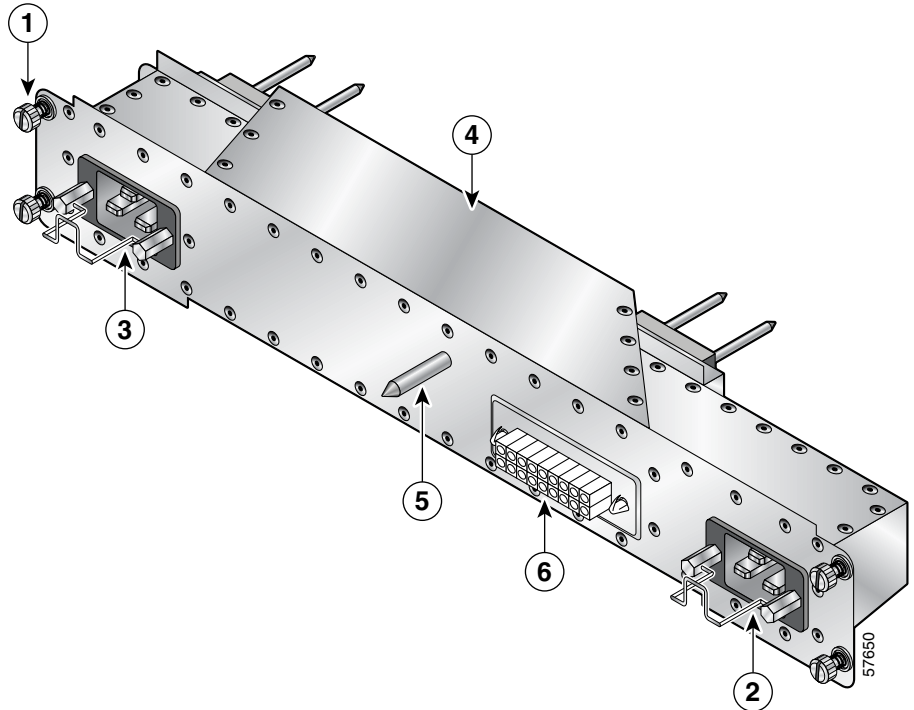
1	Captive screws (four)	**4**	AC power distribution unit
2	AC power cord receptacle A	**5**	Guide pin
3	AC power cord receptacle B	**6**	Blower module connector

Step 4   Insert the plug end of each AC power cord into the AC power source outlet.

For full redundancy, connect each AC-input power supply to an independent power circuit with its own circuit breaker. We also recommend that you use an uninterruptable power source (UPS) to protect against power failures at your site.

Step 5   Verify that the AC power source circuit breaker servicing each of the AC-input power supplies is switched on.

Connecting to a DC Power Source

Each DC PDU should be connected to separate DC sources using six threaded terminals. Two terminals for negative (source DC), two terminals for positive (source DC return), and two terminals for ground. The DC power cable leads should be 6 American Wiring Gauge (AWG) high strand count wire. The PEM accepts DC power source voltage from a dedicated 35–Amp service DC power source operating between -48 to -60 VDC.

Note   We recommend each DC PDU be connected to an independent power source for full redundancy. We also recommend that you use an uninterruptable power source (UPS) to protect against power failures at your site.

Use the following procedure to connect the router to a DC power source.
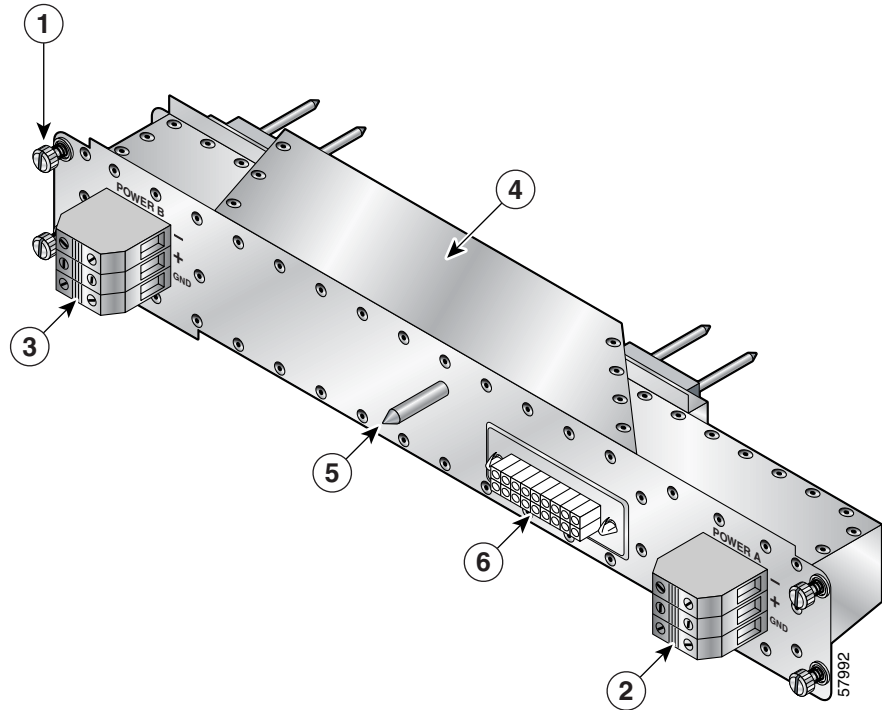
Warning   **The circuit breaker switch on the faceplate of the DC-input PEM should be in the OFF position.**

Step 1   Attach an ESD-preventive strap to your wrist and connect the leash to the chassis or to another grounded, bare metal surface.

**Step 2** Locate the DC power blocks on the back of the PDU (Figure 3-19).

Figure 3-19   *DC PDU*

1	Captive screws (four)	4	DC PDU
2	DC power connector block (A)	5	Guide pin
3	DC power connector block (B)	6	Blower module connector

Step 3   Connect the source DC power leads to the three terminal ports in the DC power connector block in the following order (Figure 3-20):

- Ground lead first (bottom port on the connector block)
- Positive lead second (middle port on the connector block)
- Negative lead last (top port on the connector block)

a. Push the lead into the connector block port.

b. Use a flat-blade screwdriver to tighten the set screw and secure the lead.

c. Repeat Step 3a and Step 3b for the remaining leads and for the second PDU connector block.

Figure 3-20   *DC PDU Power Connector Block*
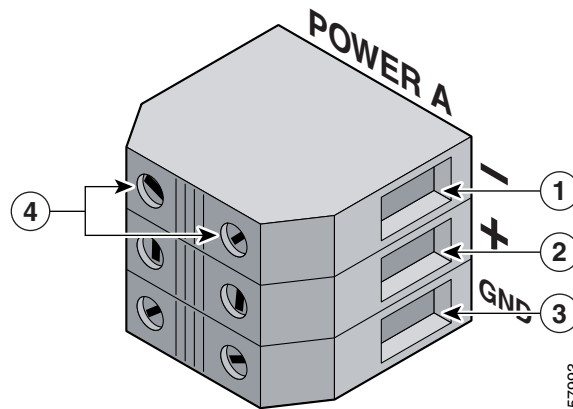
1	Negative terminal port	**3**	Ground terminal port
2	Positive terminal port	**4**	Terminal port connector screws

Step 4   Verify that the source DC circuit breaker servicing the DC PDU is switched on.

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Powering On the Router—First Time

Use the following procedure to power on the router for the first time.

Step 1   Check the following list *before* you power on the router:

- All cards are fully inserted in the card cage and all captive screws are tight

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Caution   Do not overtighten the captive screws on the cards you might strip the
threads on the screw or in the insert in the component faceplate.

- Line card cable-management brackets are attached to their respective line
  cards

- Interface cables are routed neatly through the line card cable-management
  bracket

- Interface cables are completely seated in their line card connectors

- Interface cables are routed neatly through the chassis cable-management
  bracket

- PEMs are fully inserted in to each AC PEM bay or DC PDU and DC PEM bay

- PEM cables are securely connected to the PEM

- Power cables are securely connected to the PDU, the power source and are
  secured with appropriate strain relief.

- Empty card slots or card bays are filled with card blanks to ensure proper air
  flow through the chassis and electromagnetic compatibility (EMC)

Step 2   Power on the router by switching on all the circuit breakers and/or plug the power cord into an active power source that controls power to the router's AC PEM or DC power distribution unit (PDU).

Step 3   You should observe the following LED confirmation:

- For a router equipped with AC-input power supplies:

    - Green LED labeled AC—When the power module is fully seated in its bay and is receiving source power within the required range, this LED should be on. It indicates that AC power is present and is within specified limits. The power supply fan should also be on.

    - Green LED labeled DC—Power supply is operating normally in a powered-on condition.

- For a router equipped with DC-input PEMs:

    - Green LED labeled INPUT OK—When the power module is fully seated in its bay and is receiving source power within the required range, this LED should be on. It indicates that DC power is present and is within specified limits. The power supply fan should also be on.

    - Green LED labeled OUTPUT OK—DC-input PEM is operating normally in a powered-on condition.

    - Amber LED labeled MISWIRE—Should be off. When it is on, it indicates that the input is wired backward at the PDU input.

Step 4   Visually check the two LEDs on the front of the blower module at the back of the router:

- Green LED labeled OK—Should be on
- Red LED labeled FAIL—Should be off

Step 5   Listen for the blowers in the blower module; you should immediately hear them operating.

> **Note**   In a noisy environment, the blowers might be difficult to hear; in that case, place your hand in front of the exhaust vents at the rear of the chassis to verify that the blowers are operating.

Step 6   Visually check the LEDs on the two alarm cards (Figure 3-21):

LEDs that normally should be off:

- One MBUS status LED labeled FAIL
- Two CSC status LEDs labeled FAIL
- Three SFC status LEDs labeled FAIL
- Three router alarm LEDs labeled CRITICAL, MAJOR, MINOR

LEDs that normally should be on:

- One MBUS status LED labeled ENABLED
- Two CSC status LEDs labeled ENABLED
- Three SFC status LEDs labeled ENABLED

Figure 3-21   Alarm Card LEDs On/Off Conditions
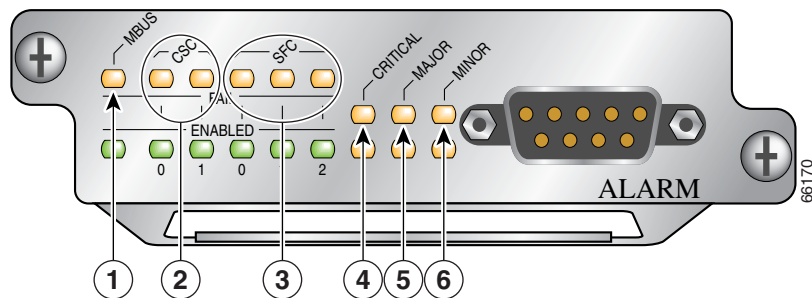
1	MBus status LED	**4**	Critical alarm LED
2	CSC status LEDs (two)	**5**	Major alarm LED
3	SFC status LEDs (three)	**6**	Minor alarm LED

Step 7   On the console terminal, verify that the console displays the system banner and that the system and all interfaces initialize successfully.

If the router does not power on, or if any interfaces do not initialize properly, see Chapter 4, "Troubleshooting the Installation". If you are still unable to resolve the problem, contact your Cisco service representative for assistance.

External Network Interface

After configuration, the RP and line cards can communicate with external networks.

You do not need to configure the network interfaces immediately, but you cannot connect to a network until you configure the interfaces for operation in your networking environment.

Note   The interface-specific LEDs on the line cards go on when the line card interfaces are configured.

To verify correct operation of each line card interface, complete the first-time setup procedures and configuration, then check the status of the interfaces against the LED descriptions in the configuration notes for each line card.

If the system does not complete each of the boot process steps, go to Chapter 4, "Troubleshooting the Installation".

Manually Booting the System

If your router does not find a valid system configuration image, or if you interrupt the boot sequence, the system might enter read-only memory (ROM) monitor mode and display the ROM monitor prompt (rommon>). From ROM monitor mode, you have access to a number of commands to locate and boot a valid system image.

Boot Process Overview

The example below assumes that the router is plugged into a power source and the router is running, blower module fans are audible, and alarm card ENABLED LEDs are lit up.

The following is an example of a typical boot process:

- The RP MBus module receives the correct DC voltage and starts executing MBus software.

- The RP determines the router configuration by sending a message through the alarm card requesting all installed devices to identify themselves. Their responses provide slot numbers and card and component types. The RP, line cards, CSCs, and SFCs are then powered up.

- The power-on-reset logic of the RP is delayed long enough to allow power and both local and CSC clocks to stabilize.

- After the power-on reset logic is released, the RP begins to execute the ROM monitor software.

- If the ROM monitor is configured to autoboot, it automatically loads and boots the Cisco IOS XR software.

- If the ROM monitor is not configured to autoboot, boot the Cisco IOS XR software manually. See the "Manually Booting the System" section on page 3-41.

- When the Cisco IOS XR software boots, it polls all other cards in the system, powers them up, and loads the Cisco IOS XR software they require.

Starting the Router and Observing Initial Conditions

Observe the following conditions the first time you start your router:

- Power cables to the PDU are fully connected to both the PDU and the power source, and are secured with appropriate strain relief.

- Empty card slots or card bays are filled with card blanks. This ensures proper air flow through the chassis and electromagnetic compatibility (EMC).

- All cards are fully inserted in their cages and bays.

- All captive screws are tightened.

- Line card cable-management brackets are attached to their respective line cards.

- Interface cables are completely seated in their line card connectors.

- Interface cables are routed neatly through the chassis cable-management bracket.

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Caution   Do not overtighten the captive screws on the cards; you might strip the threads on the screw or in the insert in the component faceplate.

- Power modules are fully inserted in their bays and the ejector levers are completely closed and secured.
- Check the power module LEDs:

    For a router equipped with AC-input power supplies, when a power supply is seated in its bay and is receiving the required power source:

    – The green LED labeled AC should be on. It indicates that AC power source is present and is within specified limits.

    – The green LED labeled DC should be on. It indicates that the power supply is operating normally in a powered-on condition.

    For a router equipped with DC-input PEMs—When a PEM is seated in its bay and is receiving the required power source:

    – The green LED labeled INPUT OK should be on. It indicates that DC power source is present and is within specified limits.

    – The green LED labeled OUTPUT OK should be on. It indicates that the PEM is operating normally in a powered-on condition.

    – The amber LED labeled MISWIRE should be off. When it is on, it indicates that the input is wired backward at the PDU input.

- Each power module fan should also be on.

At the rear of the chassis, observe the status of the two LEDs on the blower module. When the blower module is operating correctly, the left LED should should be on (green) and the right LED (red) should be off.

Listen for the blowers in the blower module; they should be running. In a noisy environment, the blower might be difficult to hear. In that case, place your hand near the exhaust vents at the top and bottom rear of the chassis to verify that the blower is operating.

RP Alphanumeric LED

RP alphanumeric LEDs are located at one end of the RP faceplate, near the ejector lever. Figure 3-22 shows the RP LED displays.

Figure 3-22   RP Alphanumeric LED Displays
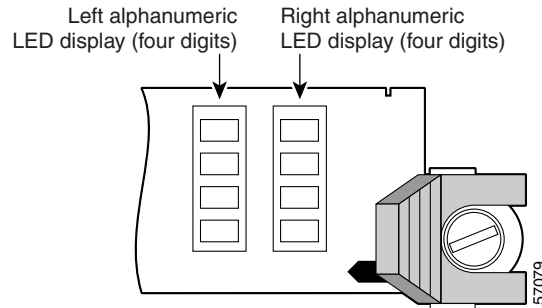
Each 4-digit display shows part of a 2-line system message. During the RP boot process, the LED displays present a sequence of messages similar to that shown in Table 3-7.

Table 3-7   LED Display Meaning and Signal Source

LED Display	Meaning	Source
MROM *nnnn*	The MBus microcode begins to execute; *nnnn* is the microcode version number. For example, microcode version 1.17 displays as 0117.[1] **Note** This display might not be visible because it occurs for only a brief time.	MBus controller
LMEM TEST	Low memory on the RP is being tested.	RP ROM monitor
MEM INIT	The size of main memory on the RP is being discovered.	RP ROM monitor
RP RDY	The system is operational and ready to execute basic Cisco IOS XR software commands at the ROM monitor prompt (rommon>).	RP ROM monitor

Table 3-7   LED Display Meaning and Signal Source (continued)

LED Display	Meaning	Source
RP UP	A valid Cisco IOS XR image is running.	RP IOS XR software
PRI RP	The RP is enabled and recognized as the system primary. A valid Cisco IOS XR image is running.	RP IOS XR software
SEC RP	The RP is enabled and recognized as the system secondary. A valid Cisco IOS XR image is running.	RP IOS XR software

1. The version of MBus microcode running on your system might be different.

RP Interfaces Using the RP LEDs

The Cisco XR 12000 Series Router uses the performance route processor (PRP-2).

Note   When not explicitly specified, this publication uses the term route processor (RP) to indicate the PRP.

The RJ-45 port LEDs on the RP indicate the following conditions:

- System and RP status
- Which Flash memory card slot is active
- Which Ethernet connection is in use
- What is occurring on the Ethernet interface

The alphanumeric LED displays indicate a successful RP boot.

## PRP Interfaces Using the PRP LEDs

The PRP faceplate has eight device or port LED activity indicators (Figure 3-23). Each LED goes on when its corresponding PCMCIA slot is accessed. The ports are:

- Two PCMCIA slot activity LEDs labeled SLOT-0 and SLOT-1.

- Four RJ-45 Ethernet port activity LEDs. These LEDs are used by the RJ-45 Ethernet connectors. Each connector includes four LEDs that indicate link activity (LINK), port enabled (EN), data transmission (TX), and data reception (RX).

- Two Ethernet port-selection LEDs labeled PRIMARY. These two LEDs, when on, identify which of the two Ethernet connections is selected. Because both ports are supported on the PRP, the LED on port ETH0 is always on. The ETH1 LED goes on when it is selected.

Figure 3-23   PRP LEDs
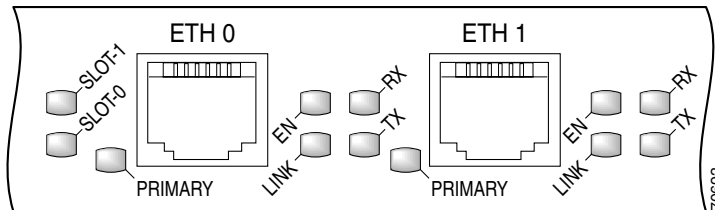
LINK	Indicates link activity
EN	Indicates the port is enabled
TX	Indicates data transmission
RX	Indicates data reception

Figure 3-24   *PRP-3 LEDs*
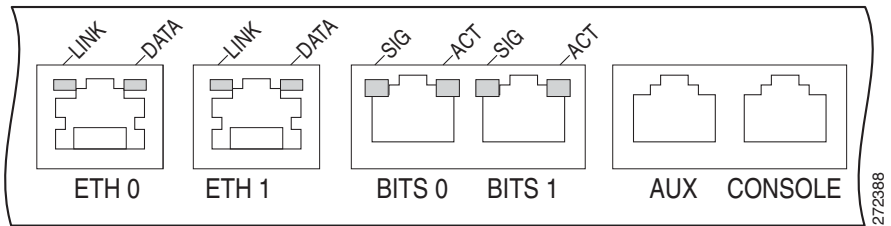
Manually Booting the System

Manually Booting the System

If your router does not find a valid system configuration image, or if you interrupt the boot sequence, the system might enter read-only memory (ROM) monitor mode and display the ROM monitor prompt (`rommon>`). From ROM monitor mode, you have access to a number of commands to locate and boot a valid system image.

■ **Manually Booting the System**

Troubleshooting the Installation

This chapter provides troubleshooting guidelines for Cisco XR 12406 router. If the solutions provided in this chapter do not make the router fully functional, contact your Cisco service representative for assistance.

Identifying Startup Problems

Startup problems are commonly caused by the power source failures or by a card that is not seated properly in the backplane. Although an overtemperature condition is unlikely at initial startup, the environmental monitoring functions are included here because they also monitor internal voltages.

When you start up the router for the first time, you should observe the startup sequence. The normal startup sequence is as follows:

- Each card in the system has an MBus module and at least one DC-DC converter. Each MBus module controls the DC-DC converter for its card. The MBus module receives direct current voltage directly from the power supplies through the backplane. When the power supply is powered on, each MBus module boots from an onboard electrically erasable programmable read-only memory (EEPROM) device. Each MBus module processor reads a set of identification pins on the card to the backplane connector. These pins tell the MBus module processor what kind of card it is mounted on, which determines how the MBus module will function.

- The clock and scheduler card (CSC), containing the system clock, immediately powers up.

- The MBus module on the RP monitors the progress of the CSC power up. When the CSC has powered up, the MBus module on the RP turns on its DC-DC converter, powering up the RP.

- The RP sends instructions to each line card to power up. Each line card processor begins to perform its own boot process and notifies the RP when the boot process is complete through its MBus module.

- The RP sends a command to each switch fabric card to power up. As each switch fabric card powers up, its progress is monitored by its MBus module processor. When the power-up process is complete, the switch fabric card MBus module notifies the RP that the switch fabric card is online.

- As the boot process progresses for each card, the status of the card is shown on the alphanumeric LED displays. The left display is powered by the DC-DC converter on the card; the right display is powered by the DC voltage that powers the MBus module.

By checking the state of the LEDs on the power supplies and the alphanumeric displays on the RP and line cards, you can determine when and where the system failed in the startup sequence.

Using the System LEDs to Troubleshoot

You can determine when and where the system failed in the startup sequence by checking the state of the LEDs on the power modules and line cards, and on the alphanumeric displays on the RP.

✎

Note   You can use the **test gsr led** Cisco IOS software command to perform an LED lamp test, which turns on all of the system LEDs at the same time for a specified period. This test allows you to verify that there are no failed LEDs.

You should observe the following when you power on the router:

- INPUT OK LEDs—These LEDs should light immediately; they should remain on as long as the system is receiving power from the power source and the power switch is in the on position.

    The LEDs indicate the status of the PEM and internal DC voltages. If either LED does not light, or if they shut off while the power switch is on, there could be a problem with either the power source, the internal DC voltage used to power internal components, or the cooling subsystem.

    The LEDs remain on when all of the following conditions are met:

    - AC PEMs: The AC power source voltage is operating between 100-120 VAC and is using 15-Amp service for North America, or is operating between 185-264 VAC and is using 10-Amp service in an international environment.

    - DC PEMs: The DC power source is supplying power to the PEMs and the power switch is in the on position.

    ✎

    Note   The amber OUTPUT FAIL LED is normally off, but lights if the PEM detects a fault.

    - The power supplies are providing –48 VDC to internal components.

> – All internal DC voltages are within tolerance.
>
>   If the AC power source or any of the internal DC voltages exceed allowable tolerances, the OUTPUT OK LED shuts off, or will shut off shortly after you turn on the power. Because both the RP (which uses +2.5, +3.3 and +5 VDC), and the fan tray assembly (which uses –48 VDC) are required for operation, a problem with any of the internal DC lines can prevent the system from starting up or continuing operation.
>
>   For example, if there is a problem with the –48 VDC line that supplies the fan tray, the system powers up, but will also recognize that the fans are not operating. The system will initiate a fan failure shutdown sequence, display the appropriate warning messages, and then shut down after two minutes.
>
>   If there is a problem with any of the other DC lines, the RP will not be able to initialize the system software, so the system might attempt to start up and fail during the boot sequence.

- The blower module immediately begins operating.
- The alphanumeric LED displays on the RP indicate the following:
  - The left display indicates which RP software component is running.
  - The right display indicates the phase of the boot process that is currently occurring.

Problem-Solving with Subsystems

The key to solving router problems is to isolate the problem to a specific subsystem. The first step in solving startup problems is to compare what the system *is doing* to what it *should be doing*. Because a startup problem is usually attributable to a single component, it is more efficient to first isolate the problem to a subsystem rather than trying to troubleshoot each component in the system.

For troubleshooting purposes, the Cisco XR 12406 router consist of the following subsystems:

- Power subsystem—Includes the following components:

    - AC-input or DC-input power distribution unit (PDU)

    - AC or DC power entry modules (PEMs). The Cisco XR 12406 router can be configured for source AC or source DC power (you can not mix AC and DC power).

    - Chassis backplane power distribution. The –48 VDC power from the power supplies is transferred to the chassis backplane, which distributes –48 VDC power to the cards in the card cages through the backplane connectors. The blower module receives power from the chassis backplane and passes MBus data back to the chassis backplane through a PDU connector.

      DC-to-DC converters on the two alarm cards convert –48 VDC to +5 VDC and put it back on the chassis backplane, where it is picked up to power the MBus modules on other cards and the blower module.

    - DC-to-DC converters. Each card in the router is equipped with DC-to-DC converters. These converters are controlled by the MBus module on each card. The DC-to-DC converters take –48 VDC and convert it into the voltages required by the card circuitry.

- Processor subsystem—Includes the RP, up to five line cards (when no optional, redundant RP is installed) and two alarm cards. The RP downloads a copy of the Cisco XR IOS image to each line card processor. The system uses alphanumeric LED displays to display status and error messages, which can help in troubleshooting.

- Cooling subsystem—Consists of the blower module, which circulates air through the card cages to cool the cards, and the fan in each of the power modules, which circulates cooling air through the power module bays.

⚠

Caution   Replace the blower module within 2 minutes of removing it from the chassis or the router will go into a critical failure mode and shutdown due to an overtemp condition.

Troubleshooting an AC Power Subsystem

AC PEMs provide –48 VDC OUTPUT. The +5 VDC OUTPUT from the CSF powers the MBus module on each card in the system. The MBus module, in turn, control the DC-DC converters also present on each card in the system. The DC-DC converter takes –48 VDC from the power supply and converts it into +2.5, +3.3 and +5 VDC, which is distributed to the card circuitry.

AC PEMs are monitored by the MBus module and the RP for over- or undervoltage and over- or undercurrent conditions.

Begin checking the AC-input power subsystem by first looking at the LEDs on the AC-input power supplies. Figure 4-1 shows the location of the LEDs on the power supply.

Figure 4-1   *AC-Input Power Supply LEDs*
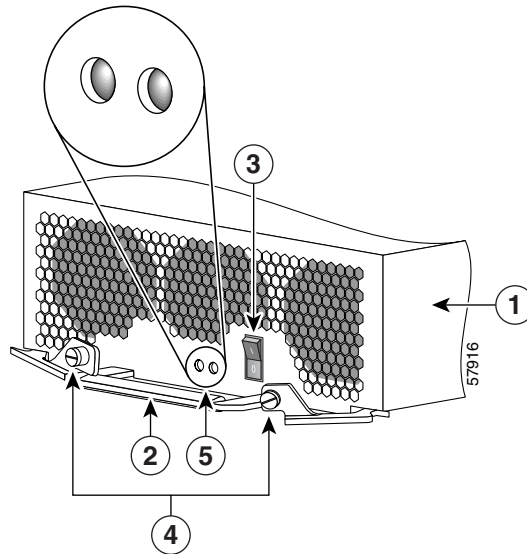
1	AC-input power supply	**4**	Captive screws on release levers
2	Handle	**5**	LEDs
3	Power standby switch	**–**	–

Table 4-1 summarizes the function of these indicators.

Table 4-1   ***AC-Input Power Supply LED indicators***

LED Label	Function	State	Description
AC (Left LED)	Input power	On	AC power source is present and is within specified limits.
		Off	Power source is not within specified limits.
DC (Right LED)	Output Power	On	Power supply is operating normally in a power-on condition.
		Off	Power supply is operating in a fault condition and shutdown has occurred.

The following conditions must exist for an AC PEM to operate normally:

- The PEM is fully seated in its bay and the ejector levers are secured.
- AC-input power is within the required range is correctly connected to PEMs.
- The power switch on the PEM is switched on.
- The green LEDs labeled AC and DC on the PEM are on.

Follow these steps to help isolate a problem with an AC PEM.

Step 1   If the AC LED is off, verify that the power supply is fully seated in its bay, the ejector levers are flush with the power supply faceplate, and the captive screws are secured.

- If the AC LED goes on, go to Step 6.
- If the AC LED remains off, go to Step 2

Step 2   Check the AC power source.

- Check the AC power cord from the power source to the router.

    - Verify that the power cord is seated securely in the PDU and the AC outlet.

    - Verify that the power cord is not worn or damaged. If the insulation appears cracked or broken, or the plugs appear loose, replace the power cord with a new power cord.

- Make sure that the AC power source circuit breaker is on and has not tripped, and that the circuit breaker has the proper current rating.

- Verify that each power supply in the router is attached to a separate AC power source.

- If the router is connected to an uninterruptable power supply (UPS), verify that the UPS is functioning correctly.

Note   There may be a UPS for each power supply in the system.

If the AC power source appears to be okay, but the power supply AC LED remains off, go to Step 3.

Step 3   Plug the power cord into a different, but compatible AC outlet.

- If the power supply AC LED goes on, the original AC outlet is faulty and cannot be used. Notify the appropriate facilities personnel and go to Step 6.

- If the power supply AC LED remains off, go to Step 4.

Step 4   Exchange the existing power cord for another power cord.

- If the power supply AC LED goes on, the original power cord is faulty and must be replaced. After replacing the power cord, go to Step 6.

- If the AC LED still fails to go on when connected to a different power source with a new power cord, the power supply is probably faulty. Go to Step 5.

Step 5   If a spare power supply is available, replace the existing module with the spare and restart the system.

- If the AC LED on the spare power supply goes on, the original power supply is faulty and should be returned for replacement. Go to Step 6.

Step 6   Is the power supply DC LED on?

- If yes, the power supply is functioning normally.

- If no, and there is no other system activity (blower module is off; line cards are unpowered), the power supply is faulty and needs to be replaced.

- If no, but the blower module is operating, it means all internal DC voltages are within tolerance. Suspect a faulty DC LED.

  – Use the **show environment** command to check the voltages on each card. The blower module uses –48 VDC.

> **Note**   In a Cisco XR 12406 router with two power supplies, the output power from the second power supply is adequate to maintain router operation.

If you are unable to resolve the problem or if you determine that either the power supply or power cable is faulty, contact a service representative for assistance.

Troubleshooting a DC Power Subsystem

The DC PEMs and PDUs provide DC power to the router which is distributed to the card circuitry.

Begin checking the power subsystem by first looking at the three LEDs on PEM. The INPUT OK LED on an DC PEM goes on when DC power is applied; the OUTPUT OK LED goes on when the PEM power switch is turned on.

- The amber OUTPUT FAIL LED is normally off, but goes on if the PEM detects a fault.

- The DC PEMs are monitored by the MBus module and the RP for over-or-under voltage and current conditions.

Figure 4-2 shows the location of the LEDs on the DC PEM.

Figure 4-2   DC-Input Power Entry Module LEDs
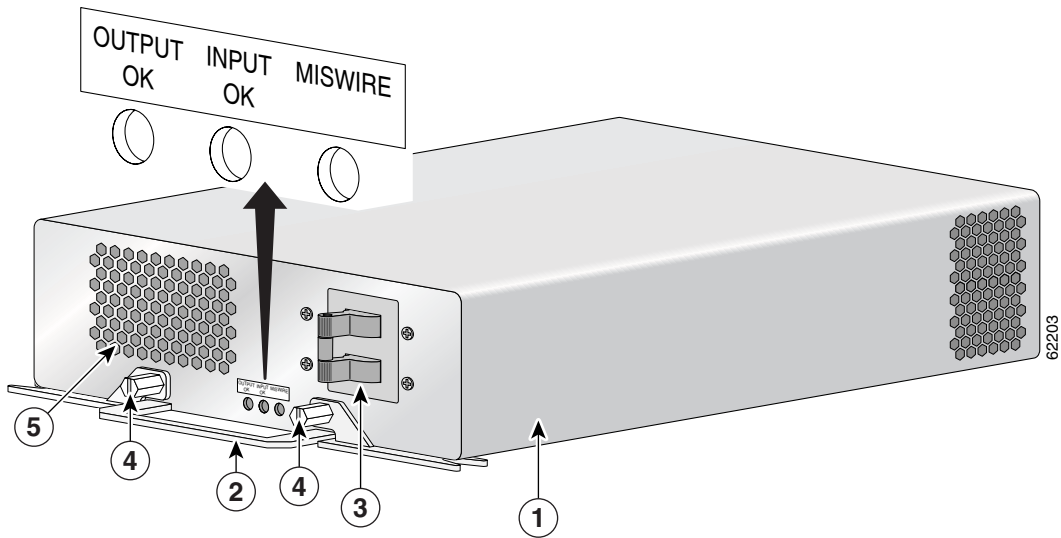
1	DC-input PEM	4	Captive screws on release levers
2	Handle	5	Air inlet for cooling fan
3	ON/OFF circuit breaker switch	—	

Table 4-2 summarizes the function of these indicators.

Table 4-2   DC-Input PEM LED Indicators

LED Label	Color	Function
OUTPUT OK	Green	PEM is operating normally in a powered-on condition.
INPUT OK	Green	DC power is present at the PEM input and within the specified limits.
MISWIRE	Amber	Indicates input is wired backward at the PDU input.

The following conditions must exists for a DC PEM to operate normally:

- The PEM is fully seated in its bay and the ejector levers are secured.

- DC-input power is within the required range is correctly connected to the chassis PDU terminal connector blocks.

- The circuit breaker on the PEM is switched on.

- The green LEDs labeled OUTPUT OK and INPUT OK on the PEM are on, and the amber LED labeled MISWIRE is off.

Follow these steps to help isolate a problem with a DC PEM:

Step 1   Is the MISWIRE LED on?

- If yes, the source DC positive and negative cable leads are connected in reverse order to the terminal connector block on the PDU. Power off the PEM circuit breaker switch and reconnect the cable leads correctly.

- If no, go to Step 2.

Step 2   If the INPUT OK LED is off, verify that the PEM is fully seated in its bay, the ejector levers are flush with the PEM faceplate, and the captive screws are secured.

- If the INPUT OK LED goes on, go to Step 6.

- If the INPUT OK LED remains off, go to Step 3.

Step 3   Verify that the PEM circuit breaker switch is on.

- If yes, go to Step 4.

- If no, switch the circuit breaker on.

  – If the INPUT OK LED remains off, go to Step 4.

  – If the INPUT OK LED goes on, go to Step 6.

Step 4   Power off the PEM circuit breaker switch and check the DC power source.

- Check the DC power wires from the power source to the router.
    - Verify that the power wires are fastened securely at the PDU and the DC source.
    - Verify that the power wires are not worn or damaged. If the insulation appears cracked or broken, have the power wires replaced.
- Make sure that the DC power source circuit breaker is on, and that it has the proper current rating.
- Verify that each PEM in the router is attached to a separate DC power source.
- Power on the PEM circuit breaker.
    - If the PEM INPUT OK LED goes on, go to Step 6.
    - If the PEM INPUT OK LED remains, go to Step 5.

Step 5   Remove the PEM and insert it in the second bay in the router, or into a bay on another Cisco XR 12406 router.

- If the INPUT OK LED remains off, the PEM is faulty and needs to be replaced.
- If the INPUT OK LED goes on, the input portion of the PEM is working normally, go to Step 6.

Step 6   Is the OUTPUT OK LED on?

- If yes, the power source is good and the PEM is operating normally.
- If no, and there is no other system activity (blower module is off; line cards are unpowered), the PEM is fault. Replace the PEM.
- If no, but the blower module is operating, it means all internal DC voltages are within tolerance. Suspect a faulty OUTPUT OK LED.
    - Use the **show environment** command to check the voltages on each card. The blower module uses –48 VDC.

> ✎
>
> **Note**   In a Cisco XR 12406 router with two power supplies, the output power from the second power supply is adequate to maintain router operation.

If you are unable to resolve the problem or if you determine that either the PEM or power wiring is faulty, contact a service representative for assistance.

Troubleshooting the Processor Subsystem

The Cisco XR 12406 router processor subsystem consists of the RP, the line cards, and the alarm cards. The RP and the line cards each have two processors. One processor is the main processor; the other processor is a component in the MBus module.

- The MBus module begins operation as soon as power is applied to the system. The MBus module determines the type of card it is mounted on and whether it should turn on the DC-DC converter.

- The RP MBus module turns on card power after a brief delay; the line card MBus modules delay turning on power until they receive a command from the RP.

A Cisco XR 12406 router requires that one RP be installed, or the system cannot operate. A line card that is partially connected to the backplane will send incomplete signals to the RP, which could cause the system to hang. If necessary, you can troubleshoot individual line cards, but first ensure that the RP is installed properly and the system software has initialized successfully.

A power-on self-test (POST) runs immediately at power-on to determine the condition of the RP memory. Results are displayed in the alphanumeric LED display as a pass/fail message.

Troubleshooting the RP

The LEDs on the route processor can help you to isolate a problem with the route processor. Figure 4-3 shows the RP alphanumeric LED displays.

Figure 4-3   RP Alphanumeric LED Displays

Left alphanumeric
LED display (four digits)

Right alphanumeric
LED display (four digits)

57079
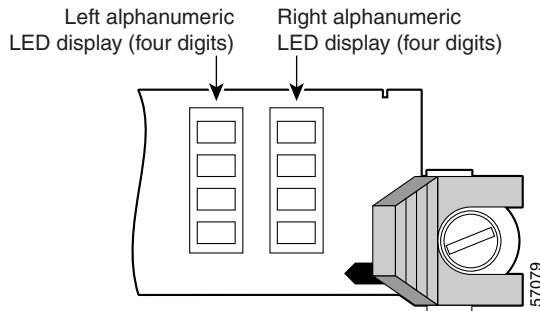
Each four-digit display shows part of a two-line system message. During the RP boot process, the LED displays present a sequence of messages similar to that shown in Table 4-3.

Table 4-3   RP LED Display, Definition, and Source

LED Display	Definition	Source
MROM *nnnn*	The MBus microcode begins to execute; *nnnn* is the microcode version number. For example, microcode version 1.17 displays as 0117.[1] **Note** This display might not be visible because it occurs for only a brief time.	MBus controller
LMEM TEST	Low memory on the RP is being tested.	RP ROM monitor
MEM INIT	The size of main memory on the RP is being discovered.	RP ROM monitor
RP RDY	The system is operational and ready to execute basic Cisco IOS XR software commands at the ROM monitor prompt (`rommon>`).	RP ROM monitor
RP UP	A valid Cisco IOS XR image is running.	RP IOS software
PRI RP	The RP is enabled and recognized as the system primary. A valid Cisco IOS image is running.	RP IOS software
SEC RP	The RP is enabled and recognized as the system secondary. A valid Cisco IOS image is running.	RP IOS software

1.   The version of MBus microcode running on your system might be different.

The RP has 8 device or port LED activity indicators that show the status of the Ethernet connections (Figure 4-4).

Figure 4-4   RP LEDs
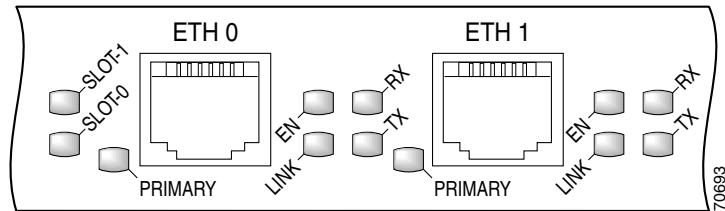
LINK	Indicates link activity
EN	Indicates the port is enabled
TX	Indicates data transmission
RX	Indicates data reception

Figure 4-5   PRP-3 LEDs
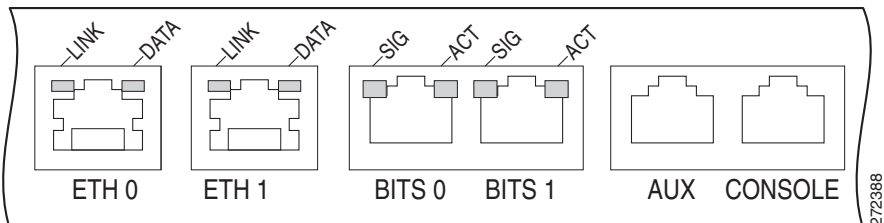
The RJ-45 port LEDs on the RP indicate:

- Which Flash memory card slot is active.
    - Each LED lights when its corresponding PCMCIA slot is accessed (SLOT 0 and SLOT 1).
- Which Ethernet connection is in use.
    - 4 RJ-45 Ethernet port activity LEDs indicate link activity (LINK), port enabled (EN), data transmission (TX), and data reception (RX).

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- What is occurring on the Ethernet interface.

    - 2 Ethernet port-selection LEDs (labeled PRIMARY) identify which of the Ethernet connections are selected. Because both ports are supported on the PRP, the LED on port ETH0 is always on. The LED on port ETH1 lights when it is selected.

Check the following to help isolate a problem with the RP:

- Are both alphanumeric LED displays on?

    - The two displays are powered separately. The left display receives power from the DC-DC converter on the RP. The right display is powered directly from the power supply. If the RP is not powered up, its right display may be on. If both displays are off, the RP may not be properly seated in the backplane connector. There also might be a problem with the MBus module on the RP, or the system power supply might be off.

- If both displays are on, check the message being displayed. As soon as the DC-DC converter is turned on by the MBus module, the processor on the RP begins the boot process. Status messages are displayed as the boot process continues. Table 4-4 lists messages that the RP alphanumeric LED can display. If one of the messages appears frozen, the boot process could be halted. Make a note of the message. Turn off the system power supply power switches, then turn them back on to reset the system. This starts the boot process again. If the system halts again, the RP could be faulty and might need to be replaced.

    - If the power modules and blower module appear operational, but none of the RP LEDs or displays are on, suspect that the RP has not been properly installed or that the +5 VDC output from the alarm card is faulty.

    - Turn the power switch for each PEM to the off position.

    - Loosen the two captive screws on the left and right sides of the RP faceplate, and use the ejector levers to eject and reseat the RP. Tighten the captive screws, then power up the system by turning the PEM power switches on.

- Is a critical, major, or minor alarm LED on the alarm card on?

    - If any of the three alarm card alarm LED pairs is on, a fault has been detected in the system. Check the console for messages indicating the source of the problem.

- There could be a false error indication originating from the RP (Table 4-4). Try reseating the RP. If that does not work you must replace the RP.

⚠

Caution   The RP reset switch resets the RP and the entire system. To prevent system errors and problems, use it only at the direction of a Cisco-certified service representative.

Table 4-4   RP Alphanumeric LED Messages

LED Display[1]	Indications[2]
LMEM TEST	Low-memory test running
LCAH INIT	Lower 15k cache initialization
BSS INIT	Initialize main memory for ROM
NVRAM INIT	Initialize NVRAM
EXPT INIT	Initialize interrupt handlers
TLB INIT	Initialize TLB
CACH INIT	Initialize CPU data and instruction cache
CACH PARY	Enable CPU cache parity
MEM INIT	Initialize main memory
NVRAM SIZE	Size of the NVRAM
PCMC INIT	Initialize the PCMCIA

Table 4-4   RP Alphanumeric LED Messages (continued)

LED Display[1]	Indications[2]
EXIT INIT	Exit the initialization sequence
IOS UP	The Cisco XR IOS software is up and running
MSTR RP	The RP is enabled and recognized by the system

1. The messages shown do not indicate a specific sequence.

2. Some messages appear for a fraction of a second; others last several seconds.

PRP-3 Alphanumeric LEDs

The following section discusses the alphanumeric LED messages and the console output displayed in sequence for a single PRP-3 and for dual PRP-3. The alphanumeric LED messages help in identifying the state of the route processor and accordingly troubleshooting the problems faced.

Single PRP-3 Scenario

Table 4-5 displays the alphanumeric LED messages and the console output when the chassis is powered on or when the PRP-3 board is inserted into the slot.

Table 4-5   Single PRP-3 Alphanumeric Display LED—Chassis Is Powered ON/Inserting PRP-3

LED Display	Description or Console Message
02A8/HW OK/RIO	Immediately when the board is powered on.
OK/CPU SENT/RPT	Displays "1.330GHz dual-core MPC8641D Rev 2.1, 532MHz MPXclk".
INIT/MEM	Displays "Discovering memory in slot DIMM1 .... Found 2GB DIMM Discovering memory in slot DIMM2 .... Found 2GB DIMM"

LED Display	Description or Console Message
TEST/MEM	Displays "Testing low memory .... OK Loading main ROMMON image .... OK Verifying loaded image .... OK Load succeeded; launching target .... OK"
LNCH/RMON	Displays "Cisco ROMMON System Bootstrap, Version 0.16.0 (bld1) DEVELOPMENT SOFTWARE Compiled on 08/27/08 at 15:04:49 PDT [BLD-rommon] Copyright (c) 1994-2008 by Cisco Systems, Inc. MPC8641D platform with 4 GB of main memory"
RDY/RP	DISPLAYS "Loading disk0:c12k-os-mbi-3.8.0.15I/mbiprp-rp.vm (14809672 bytes)... !!!"

LED Display	Description or Console Message
RUN/IOX	Displays "RP/0/2/CPU0:Sep 10 15:56:29.018: syslogd_helper: [84]: dsc_event_handler: Got SysMgr dSC
	event : 1
	RP/0/2/CPU0:Jan 1 00:00:04.809 : mbus-prp3[58]: mbus-prp3: mbus_platform_init() failed (0x6).
	RP/0/2/CPU0:Sep 10 15:56:07.015 : dumper[53]: No HDD Controller found by process dumper
	RP/0/2/CPU0:Sep 10 15:56:21.538 : sysmgr[85]: %OS-SYSMGR-5-NOTICE : Card is COLD started
	RP/0/2/CPU0:Sep 10 15:56:22.622 : dsc[169]: Memory Sanity Check Enabled
	RP/0/2/CPU0:Sep 10 15:56:29.007 : dsc[169]: %PLATFORM-DSC-3-ERR_I_AM_DSC : Setting myself as DSC
	RP/0/2/CPU0:Sep 10 15:57:20.071 : sysldr[370]: %PLATFORM-POWERMGR-3-ROM_ERROR_STATUS :
	Unable to get Mbus ROM status from SYSDB. Error ='sysdb' detected the 'warning' condition 'A SysDB client tried to access a nonexistent item or list an empty directory'
	RP/0/2/CPU0:Sep 10 15:57:25.078 : sysldr[370]: % PLATFORM-SYSLDR-6-INFO : Waiting for startup config to be applied before booting LCs
	Primary Clock is CSC_1 Fabric Clock is Redundant
	Bandwidth Mode : Full Bandwidth
RP/ACTV	When RP is up and running Cisco IOS XR software.

Table 4-6 displays the alphanumeric LED messages and the console output when the chassis is loaded from ROMMON.

Table 4-6   *Single PRP-3 Scenario — Chassis loaded from ROMMON*

LED Display	Description or Console Message
INIT/NV	Displays the LED message during the initialization of the NVRAM infra code.
OK/RIO	Displays the LED message immediately when the board is powered ON.
OK/CPU	Displays "1.330GHz dual-core MPC8641D Rev 2.1, 532MHz MPXclk".
CONT...	

Dual PRP-3 Scenario

If dual PRP-3 is installed and the chassis is powered on or a board is inserted, all the LED messages are same as for a single PRP-3, except for an LED message '1404/MRAM' that is displayed on the front panel when the console display is as follows:

```
Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
           cisco Systems, Inc.
           170 West Tasman Drive
           San Jose, California 95134-1706
Cisco IOS XR Software for the Cisco XR PRP, Version 3.8.0.15I
Copyright (c) 2008 by Cisco Systems, Inc.
RP/0/2/CPU0:Sep 10 16:34:19.351: syslogd_helper: [84]:
dsc_event_handler: Got SysMgr dSC event : 1
```

Tip   The LED message "I404/MRAM" is displayed between RDY/RP and RUN/IOX alphanumeric messages.

Table 4-7 displays the LED alphanumeric messages on a standby PRP-3, if the current active PRP-3 is reloaded.

Table 4-7   *Dual PRP-3 Scenario*

LED Display	Description or Console Message
INIT/NV	Displays the LED message during the initialization of the NVRAM infra code.
02A8/HW OK/RIO	LED message displayed immediately after the board is powered on.
OK/CPU SENT/RPT	Displays "1.330GHz dual-core MPC8641D Rev 2.1, 532MHz MPXclk".
INIT/MEM	Displays "Discovering memory in slot DIMM1 .... Found 2GB DIMM Discovering memory in slot DIMM2 .... Found 2GB DIMM"
TEST/MEM	Displays "Testing low memory .... OK Loading main ROMMON image .... OK Verifying loaded image .... OK Load succeeded; launching target .... OK"
LNCH/RMON	Displays "Cisco ROMMON System Bootstrap, Version 0.16.0 (bld1) DEVELOPMENT SOFTWARE Compiled on 08/27/08 at 15:04:49 PDT [BLD-rommon] Copyright (c) 1994-2008 by Cisco Systems, Inc. MPC8641D platform with 4 GB of main memory"
RDY/RP or PWRD	DISPLAYS "Loading disk0:c12k-os-mbi-3.8.0.15I/mbiprp-rp.vm (14809672 bytes)... !!!" **Tip** Instead of RDY/RP, sometimes PWRD is displayed in the normal booting process.

LED Display	Description or Console Message
RUN/MBI	Displays "Copyright (c) 2008 by Cisco Systems, Inc.
	Install (Node Preparation): Install device root is /disk0/
	Install (Node Preparation): Using boot device sequence compactflash: from rommon
	Install (Node Preparation): Trying device disk0:
	Install (Node Preparation): Checking size of device disk0:
	Install (Node Preparation): OK
	Install (Node Preparation): Checking free space on disk0:
	Install (Node Preparation): OK
	Install (Node Preparation): Starting package and meta-data sync
	Install (Node Preparation): Cleaning packages not in sync list
	Install (Node Preparation): Complete
	Install (Node Preparation): Syncing package/meta-data contents: /disk0/instdb/ldpath
	Install (Node Preparation): Please Wait...
	Install (Node Preparation): Completed syncing: /disk0/instdb/ldpath
	Install (Node Preparation): Syncing package/meta-data
	contents: /disk0/instdb/ldpath.committed
	Install (Node Preparation): Please Wait...
	Install (Node Preparation): Completed syncing: /disk0/instdb/ldpath.committed
	Install (Node Preparation): Completed sync of all packages and meta-data.
RP/STBY	ios con0/2/CPU0 is in standby

Troubleshooting the Line Cards

As each line card powers up, a power-on self-test (POST) is performed on the line card memory. A full set of field diagnostics can also be run on a line card from the system console, providing a pass/fail message both in the line card alphanumeric LED display and on the system console.

To help isolate a problem with a line card, visually check the two alphanumeric LED displays.

- Are both alphanumeric LED displays on?

    The two displays are powered separately. The left display receives power from the DC-DC converter on the line card. The right display is powered directly from the backplane. Therefore, even if the line card has not powered up, the right display could be on.

- If both displays are off:
    - The line card may not be fully seated into the backplane connector.
    - There may be a problem with the MBus module on the line card.
    - The system power could be off.

- If both displays are on:
    - Check the message being displayed. As soon as the DC-DC converter is turned on by the MBus module, the processor on the line card begins the boot process. Status messages are displayed in the alphanumeric displays as the boot process continues on the line card.

The system attempts to boot identical line cards in parallel. In addition, the system boots line cards as soon as they are powered on and become available for backup.

During the line card boot process, which occurs immediately after the RP boot process, you can observe the alphanumeric LED displays on each line card (Table 4-8).

Table 4-8   Line Card LED Display, Definition, and Source

LED Display[1]	Definition	Source
MROM *nnnn*	MBus microcode begins to execute; *nnnn* is the microcode version number. For example, microcode version 1.17 would display as 0117.[2]	MBus controller
LMEM *TEST*	Low memory on the line card is being tested.	Line card ROM monitor
MEM *INIT*	Main memory on the line card is being discovered.	Line card ROM monitor
ROMI *GET*	ROM image is being loaded into line card memory.	RP Cisco IOS XR software
FABL WAIT	Line card is waiting for the fabric downloader to load.[3]	RP Cisco IOS XR software
FABL DNLD	Fabric downloader is being loaded into line card memory.	RP Cisco IOS XR software
FABL STRT	Fabric downloader is being launched.	RP Cisco IOS XR software
FABL RUN	Fabric downloader has been launched and is running.	RP Cisco IOS XR software
IOS DNLD	Cisco IOS XR software is being downloaded into line card memory.	RP Cisco IOS XR software
IOS STRT	Cisco IOS XR software is being launched.	RP Cisco IOS XR software
IOS UP	Cisco IOS XR software is running.	RP Cisco IOS XR software
IOS RUN	Line card is enabled and ready for use.	RP Cisco IOS XR software

1. The LED sequence shown in Table 4-8 might occur too quickly for you to view. The sequence in this table is provided as an example of how the line cards should function at startup.

2. The numeric display might not be visible, because it occurs for only a brief time.

3. The fabric downloader loads the Cisco IOS XR software image onto the line card.

Table 4-9 provides a list of messages that can be displayed by the line card alphanumeric LED display. Some of these messages are displayed only for a fraction of a second; others last for several seconds.

Table 4-9   Line Card Alphanumeric LED Display Messages

LED Display[1]	Indications[2]
MEM TEST	POST memory test running
LROM RUN	POST memory test has finished running
BSS INIT	Initialize main memory for ROM
RST SAVE	Save reset reason register
IO RST	Reset the I/O system on the card
EXPT INIT	Initialize interrupt handlers
TLB INIT	Initialize TLB
CACH INIT	Initialize CPU data and instruction cache
MEM INIT	Initialize main memory
LROM RDY	Ready to access download
ROMI GET	Getting ROM images
FABL WAIT	Wait for load of fabric downloader
FABL DNLD	The fabric downloader loads
FABL STRT	The fabric downloader launches

Table 4-9   Line Card Alphanumeric LED Display Messages (continued)

LED Display[1]	Indications[2]
FABL RUN	The fabric downloader launch is complete
IOS DNLD	The Cisco XR IOS software downloads
IOS STRT	The Cisco XR IOS software launches
IOS UP	The Cisco XR IOS software runs in DRAM
IOS RUN	The line card is enabled and ready for use

1. The messages shown do not indicate a specific sequence.

2. Some messages appear only for a fraction of a second; others last several seconds.

Troubleshooting the Alarm Cards

The Cisco XR 12406 router uses two alarm cards to monitor the status of the CSCs and SFCs and to indicate various alarm conditions. The alarm cards have four primary functions:

- Redundant generation of the DC MBus supply voltage for the line cards

- Power system monitoring functions

- OK/FAIL status indication of the CSCs and SFCs

- Hardware implementation of the alarm system relay outputs and indicators

To help isolate a problem, you can visually check the LEDs on the alarm cards.

Figure 4-6 shows the location of the alarm card LEDs.

Figure 4-6   Alarm Card LEDs

1	MBus status LED	**4**	Critical alarm LED
2	CSC status LEDs (two)	**5**	Major alarm LED
3	SFC status LEDs (three)	**6**	Minor alarm LED

The following LED conditions are displayed when the system is operating properly:

Note   Green = ENABLED, amber = FAIL

- The following green LEDs are normally on:
    - The MBUS status LED
    - Two CSC status LEDs
    - Three SFC status LEDs
- The following amber LEDs are normally off:
    - The MBUS status LED
    - Two CSC status LED
    - Three SFC status LEDs
- The three amber router alarm (CRITICAL, MAJOR, MINOR) LEDs are normally off.

Monitoring Alarm Card Status

The MBUS LEDs indicate the operational status of the alarm card.

- A green MBUS LED indicates that the card has been detected by the system and is operating properly.

- An amber MBUS LED indicates that the system has detected a fault in the alarm card.

Monitoring Clock Scheduler Card Status

The CSC 0 and CSC 1 LEDs indicate the status of the clock scheduler cards:

- A green LED indicates that the CSC is operating properly.

- An amber LED indicates that there is a CSC fault and a warning message is logged on the system console describing the fault. The system will continue to operate during a CSC fault condition.

Monitoring Switch Fabric Card Status

The SFC 0, SFC 1, and SFC 2 LEDs indicate the status of the switch fabric cards.

- A green LED for each SFC indicates that the SFC is operating properly.

- An amber LED indicates that there is an SFC fault and a warning message is logged on the system console describing the fault. The system will continue to operate during a SFC fault condition.

Monitoring Critical, Major, and Minor Alarm Status

The alarm card uses three pairs of alarm status LEDs to identify system alarm conditions detected through the MBus. Those alarm conditions are:

- Critical

- Major

- Minor

Note   The alarm status LEDs are paired for redundancy to protect against a single failed LED. If any of the six LEDs is on, check the system console for messages describing the fault.

Because there are two alarm cards in the Cisco XR 12406 router, a system alarm condition detected through the MBus causes the same LEDs to light on both alarm cards.

The alarms can warn of an overtemperature condition on a component in one of the card cages, a fan failure in a blower module, an overcurrent condition in a power supply, or an out-of-tolerance voltage on one of the cards in one of the card cages. The LEDs are driven by MBus software, which sets the threshold levels for triggering the different stages of alarms.

The RP continuously polls the system for temperature, voltage, current, and fan speed values. If an over-threshold value is detected, the RP:

- Sets the appropriate alarm severity level on the alarm card

- Lights one of the LEDs on the alarm display

- Energizes the appropriate alarm display relays

- Activates any external audible or visual alarms wired to the alarm display

- Logs a message about the threshold violation on the system console

Troubleshooting the Cooling Subsystem

The Cisco XR 12406 router has a blower module located on the rear of the chassis, which provides cooling air for the router components. The blower module receives power and signals though a connector recessed in the blower module. This connector mates with a connector mounted on the PDU. The blower module contains three fans, one connector, and one controller card.

Figure 4-7 shows the location of the LEDs on the blower module.

Figure 4-7   ***Blower Module Location and Features***
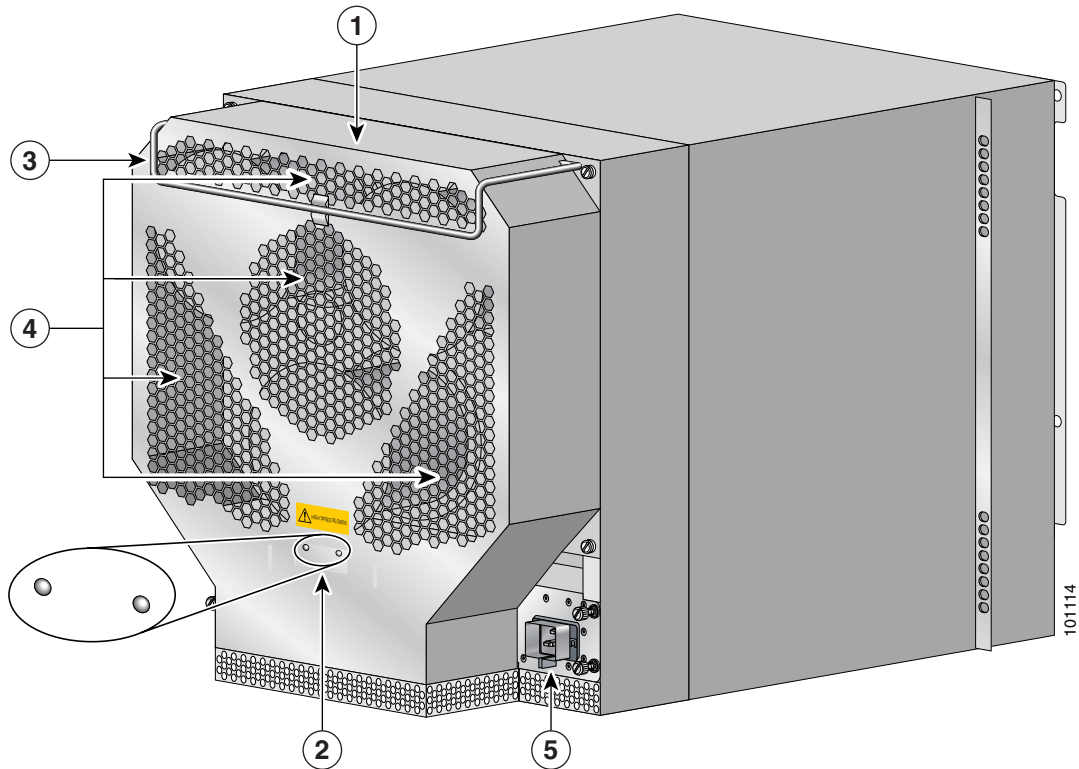
1	Blower module	**4**	Air exhaust vents
2	Blower module LEDs	**5**	Power distribution unit (PDU)
3	Blower module handle	—	

There are two LEDs on the blower module at the rear of the chassis.

- OK (green)—Indicates the blower module is functioning normally.
- FAIL (red)—Indicates there is a failure in the blower module. The FAIL LED should remain off during normal operation.

If the green LED is off and/or the red LED is on, check the following to help isolate a problem with the cooling system:

- Listen for the blower fans. In noisy environments, place your hand behind the blower module to feel for air being forced out the exhaust vents. If the blower module fans are on, the DC voltage from the power modules to the blower module is correct.

- If the blower module fans are not on, there could a problem with either the blower module or the DC power from the power modules.

    – Check the output power LED on each power module (DC LED on an AC PEM; OUTPUT OK LED on a DC PEM). If the output power LED on a power module is off, but the input power LED is on, the power module is probably faulty and should be replaced.

    – If the output power LED on the power module is on (DC output is OK), but the blower module remains off, make sure that the blower module is seated properly in the chassis.

    Remove the blower module by loosening the four captive screws holding it to the chassis, pull the blower module away from the chassis, then firmly push the blower module against the chassis to reseat the blower module. Tighten the four captive screws.

- If the blower module remains off, there could be a problem with the blower module controller card and the blower module should be replaced.

- The following console monitor message indicates that the system has detected an overtemperature or out-of-tolerance power condition in the router:

```
Queued messages:
%ENVM-1-SHUTDOWN: Environmental Monitor
initiated shutdown
```

    If an environmental shutdown results from an out-of-tolerance power condition, the output fail LED on the PEM will light before the system shuts down. Refer to the "Troubleshooting the Processor Subsystem" section on page 4-13."

- Although overheating is unlikely at initial startup, be sure that heated exhaust air from other equipment is not entering the air filter, and that there is sufficient clearance (at least 6 inches (15.24 cm)) around the front and rear of the chassis to allow cooling air to enter and hot air to exhaust.

- Check the condition of the two air filters located in slots on the right side of the chassis. If the air filters appear dirty, remove the filters and either vacuum them or replace them.

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- The preceding message could also indicate a faulty component or temperature sensor. Before the system shuts down, use the **show environment all** or **show environment table** command to display the internal system environment, including voltages and temperatures measured at each card.

If you are still unable to resolve the problem, contact a service representative for assistance.

Maintaining the Router

The Cisco XR 12406 router is equipped as ordered and is ready to install and start up when it leaves the factory. After you install and configure the router, you may need to perform other procedures to ensure that the router continues to operate properly. Also, as your networking requirements change, you may need to upgrade your system by adding or changing components.

Before performing the procedures in this chapter, be sure to review the safety information in the "Laser Safety" section on page 2-7, and the "Lifting Guidelines" section on page 2-7.

You should also be familiar with the *Regulatory Compliance and Safety Information for the Cisco 12000 Series Router* document *(*78-4347-19*)*, which was shipped with the router.

⚠️
Caution All procedures in this chapter assume that you are wearing and ESD-preventative wrist strap. Refer to "Preventing Electrostatic Discharge Damage" section on page 2-5 for additional information.

The following sections describe tools and procedures necessary to maintain the
Cisco XR 12406 router.

Tools and Equipment

The following section lists tools and equipment for unpacking, performing maintenance, and setting up your Cisco XR 12406 router.

- ESD-preventive strap
- 3/16-inch flat-blade screwdrivers
- 1/4-inch flat-blade screwdrivers
- 9/15-inch (14-mm) wrench
- 3/4-inch (19-mm) socket and ratchet wrench
- 2-mm allen wrench
- Vacuum cleaner
- Antistatic bag (or similar ESD-preventive container)
- Number 2 Phillips screwdriver

Powering Off the Router

Unless otherwise noted, the maintenance tasks described in this chapter can be performed while the router remains powered on. Most Cisco XR 12406 router field replaceable units (FRUs) support online insertion and removal (OIR), which means they can be removed and installed (hot-swapped) while the router remains powered on.

- Line cards, switch fabric cards (SFCs), alarm cards, and the blower module are hot-swappable.
- Power modules, clock and scheduler cards (CSCs), and RPs also support OIR, but are hot-swappable only when the system is equipped with two power modules, two CSCs, or two RPs, respectively.
- AC and DC power distribution units (PDU) do not support OIR.

Use the following procedure to power off an AC- or a DC-powered router.

Step 1 Turn off the power switches (AC) or circuit breaker switches (DC) on the PEMs.

Step 2 Turn off the facility circuit breakers for power source lines connected to the PDU.

Step 3 When the procedure requires that the router be disconnected from source power:

    a. AC-powered systems—Unplug the AC power cords from the power outlets.

    b. DC-powered systems—Disconnect and remove the source DC wires from the power connector blocks on the PDU.

Step 4 Verify that the following conditions:

    a. LEDs on the PEMs are off.

    b. LEDs on the RP, line cards, and alarm cards are off.

    c. LEDs on the blower module are off.

Removing and Installing the Front Cover

The front cover has release buttons on both sides that give you the flexibility to open it from either the left side or from the right side. Use the following procedures to remove and install the front cover.

Removing the Front Cover

To remove the front cover, grasp both sides of cover and press both release buttons simultaneously to release the door from its hinges (see Figure 5-1).

Installing the Front Cover

Use the following procedure to install the front cover.

Step 1 Align the hinges on each side of the cover with the hinges on each side of the chassis (see blowout in Figure 5-1)

Step 2 Push the front cover until the hinges snap into place.

Figure 5-1   Removing or Installing the Front Cover
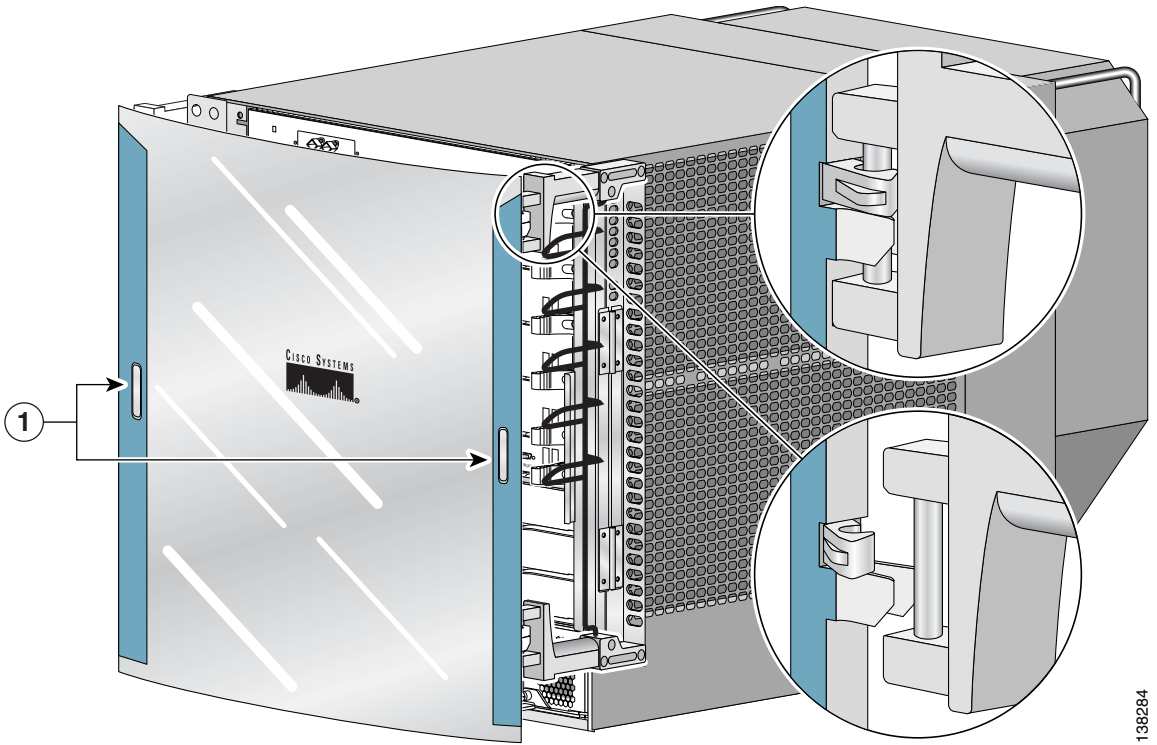
1	Release buttons

Removing and Replacing the Air Filters

The Cisco XR 12406 router is equipped with two user-serviceable air filters that remove dust drawn into the router by the blower module. You should examine the air filters once a month (or more often in dusty environments). If the filter appears dirty, you can either vacuum or replace it. If the filter appears worn or torn, dispose of it in a responsible manner and install a replacement air filter.

Use the following procedure to clean or replace the air filters.

Step 1   Open the spring-loaded air filter door on the right side of the chassis and remove an air filters by pulling the small tab on the edge of the filters (see Figure 5-2).

Step 2   Visually check the condition of the air filters.

- If the filters appears dirty, you can either vacuum or replace them.

⚠

Caution   Do not vacuum the air filter while it is installed in the housing.

- If the filters appear worn or torn, dispose of them in a responsible manner and install replacement air filters.

Figure 5-2   *Removing the Air Filters*
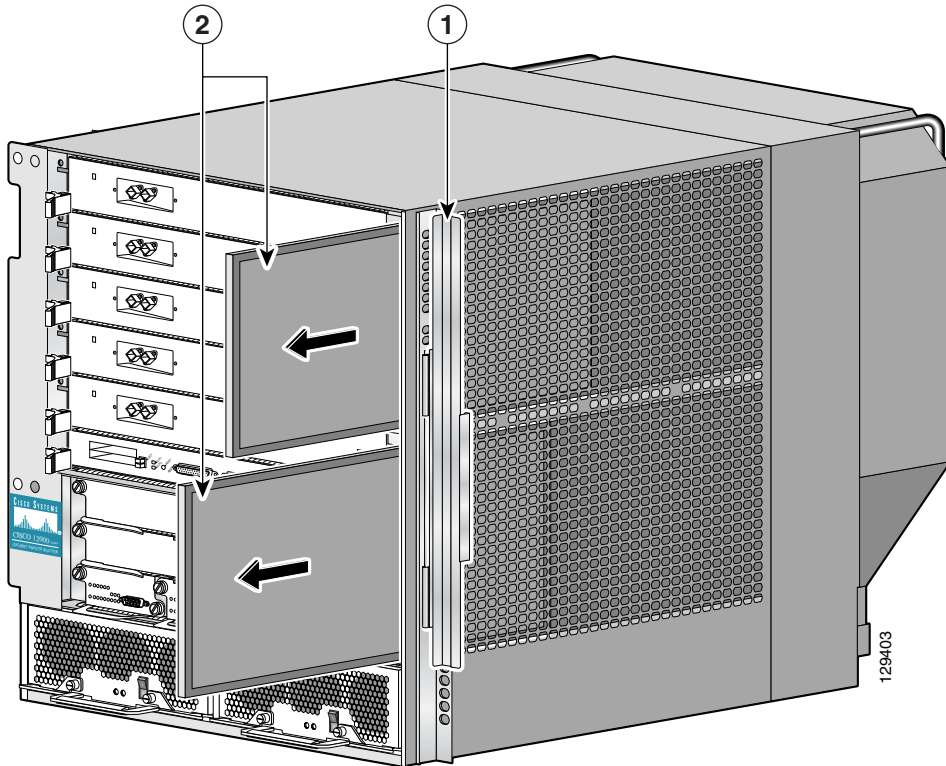
| **1** | Air filter door | **2** | Air filters |

Step 3   Reinstall the air filter into the chassis noting the direction of the airflow arrows on the top of the air filter frame (Figure 5-3).

⚠

Caution   The arrows located on the edge of each air filter frame that indicate the direction of *air flow*. Always install the air filters with the arrow pointing in toward the RP and line card cage.

Figure 5-3   *Cisco XR 12404 Router Air Filter Direction of Air Flow*
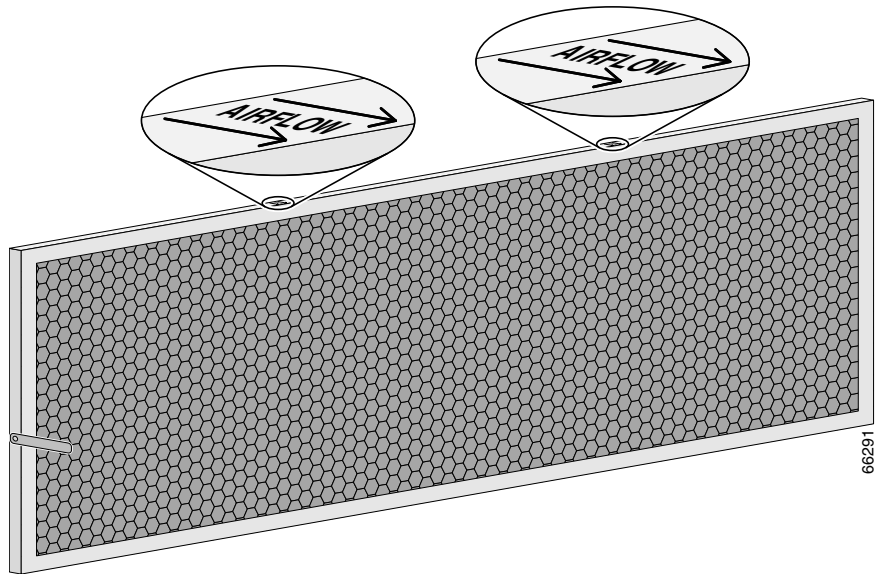
Removing and Replacing the Blower Module

Use the following procedure to remove and replace the blower module.

⚠

Caution   Although the blower module supports OIR and can be replaced without interruption to system operation, do not operate the system without the blower module for more than a few minutes to prevent overheating.

Step 1   Remove the blower module from the chassis (Figure 5-4):

    a.   Lift the blower module handle to its carrying position.

    b.   Loosen the four captive screws on the blower module faceplate.

    c.   Remove the blower module by grasping it on each side and pulling it straight back from the chassis.

Figure 5-4   Removing the Blower Module
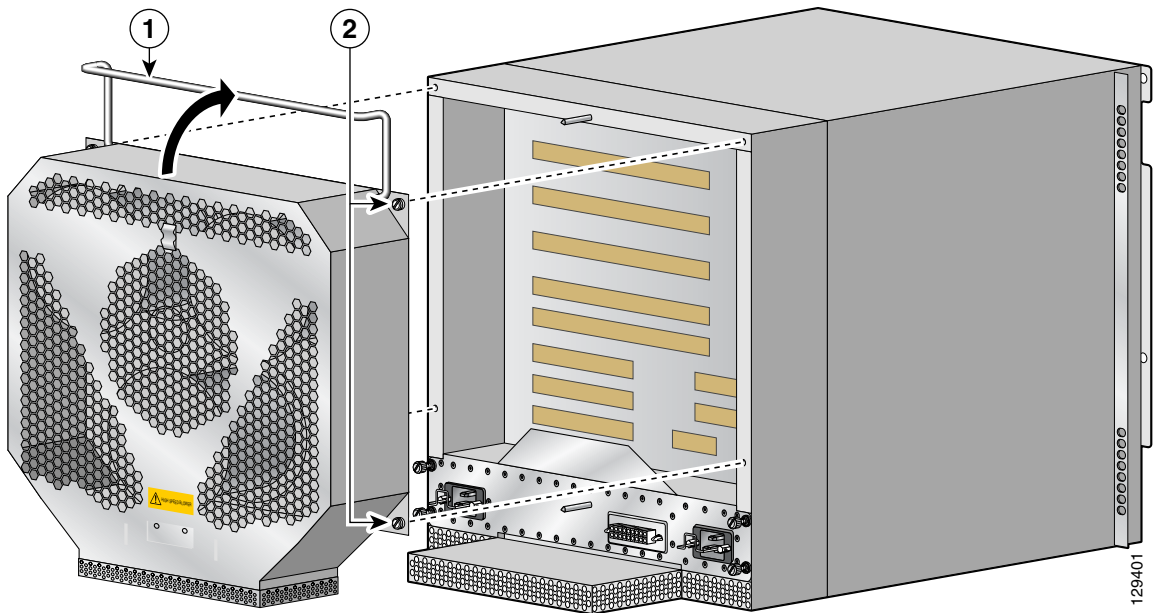
1	Carrying handle	**2**	Captive screws (2 on each side)

Step 2 Install the new blower module (Figure 5-5):

    a. Position the alignment holes on the blower module with the guide pins at the top of the chassis and on the PDU at the bottom of the chassis.

    b. Slide the blower toward the chassis until it mates with the backplane connector.

⚠

Caution   Electrical and control line connections for the blower module and backplane occur automatically when the connectors on the blower module and PDU mate. To prevent damage to the blower module and PDU connectors, do not use excessive force when installing the blower module against the rear of the chassis.

    c. Tighten the four captive screws to secure the blower module to the chassis.

    The (green) OK indicator should be on. If the OK indicator is not on, see the "Troubleshooting the Blower Installation" section on page 5-12.

    d. Lower the blower module handle to its operating position.

Figure 5-5   Installing the Blower Module
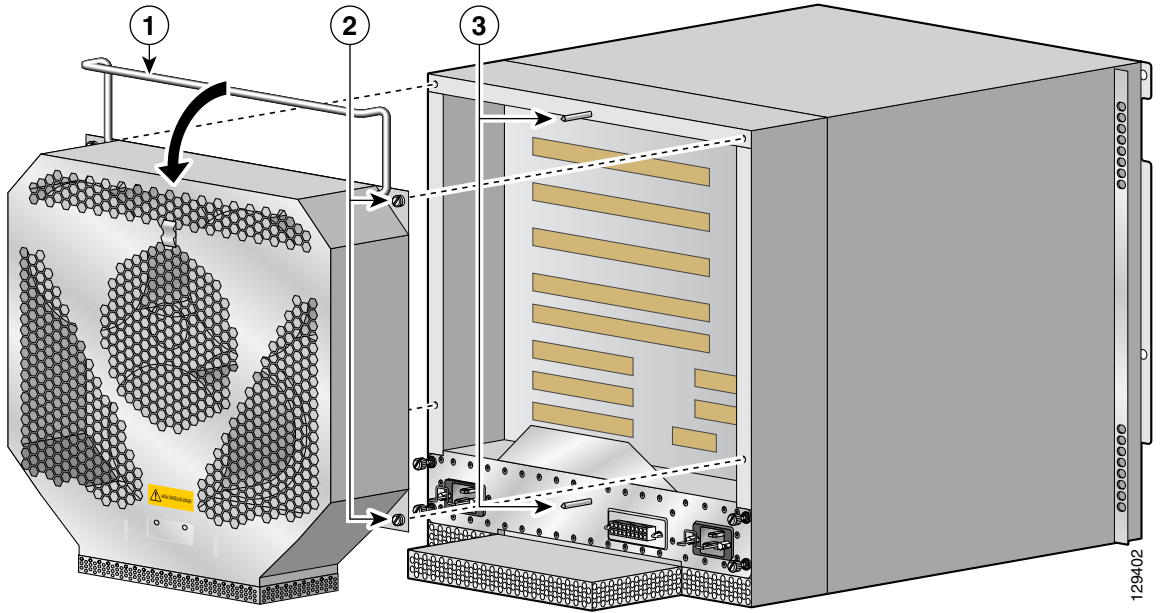
1	Carrying handle	**3**	Guide pins
2	Captive screws (2 on each side)	—	

Troubleshooting the Blower Installation

Use the following procedure to troubleshoot the blower module if it is not operating properly after installation.

⚠️

Caution   To prevent overheating, do not operate the system without the blower module operational for more than a few minutes.

Step 1   Be sure the router is powered on and that all power cords are connected properly.

Step 2   Loosen the four captive screws and reseat the blower module to the chassis. Retighten the captive screws to ensure the blower module is properly seated to the backplane connector.

Step 3   Check the blower module status indicators:

- OK (green)—This indicator should light as soon as the blower module is installed and receives power from the backplane connector. It indicates that the blower module is operating normally.

- Fail (red)—This indicator remains off during normal operation. If the indicator is on, the system has detected a fan failure or other fault in the blower module.

    – If this indicator remains on and the blower module fans fail to operate normally after several attempts to reseat the blower module, replace the existing blower module with a spare.

    – If the spare blower module also fails, power off the router and contact a Cisco service representative for assistance.

Installation Guidelines

The Cisco XR 12406 router support online insertion and removal (OIR). If you are replacing a redundant power supply, you can remove and install the power supply while the system remains powered on without causing an electrical hazard or damage to the system. This feature enables you replace a power supply while the system maintains all routing information and ensures session preservation.

However, to maintain operational redundancy, proper cooling, and meet EMI compliance standards, you must have both working power supplies installed. When you remove a failed power supply with the router in operation, perform the replacement as quickly as possible. Make sure you have the tools and the replacement power supply ready before beginning the removal and installation procedure.

Removing and Replacing an AC Power Entry Module

Although an AC PEM supports OIR, in order to maintain operational redundancy, proper cooling, and meet EMI compliance standards, you must have both working power supplies installed. When you remove a failed power supply with the router in operation, perform the replacement as quickly as possible. Make sure you have the tools and the replacement power supply ready before beginning the removal and installation procedure.

Use the following procedure to remove and replace an AC PEM.

Step 1   Power off the faulty PEM (see item 3 in Figure 5-6).

Figure 5-6   AC Power Supply Components
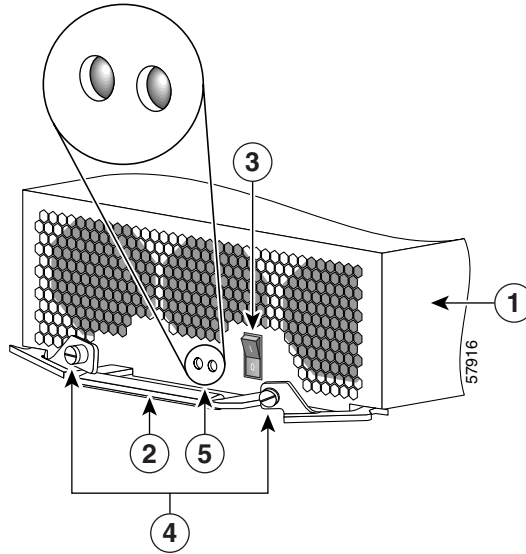
1	AC PEM	**4**	Captive screws/release levers
2	Handle	**5**	AC input/DC output status indicators
3	Power On/Off switch	—	

Step 2   Unplug the power supply cord from its AC outlet.

Step 3   Power off the circuit breaker assigned to that AC outlet.

Step 4   Remove the PEM from the chassis (Figure 5-7):

   a.   Loosen the captive screw on each ejector lever.

   b.   Pivot open the levers to eject the power supply.

   c.   Slide the power supply out of its bay while supporting it with your other hand.

⚠️

Warning   **The power supply weighs approximately 14 lb (6.35 kg). Use two hands to remove the power supply.**

Figure 5-7   *Releasing the AC Power Supply*
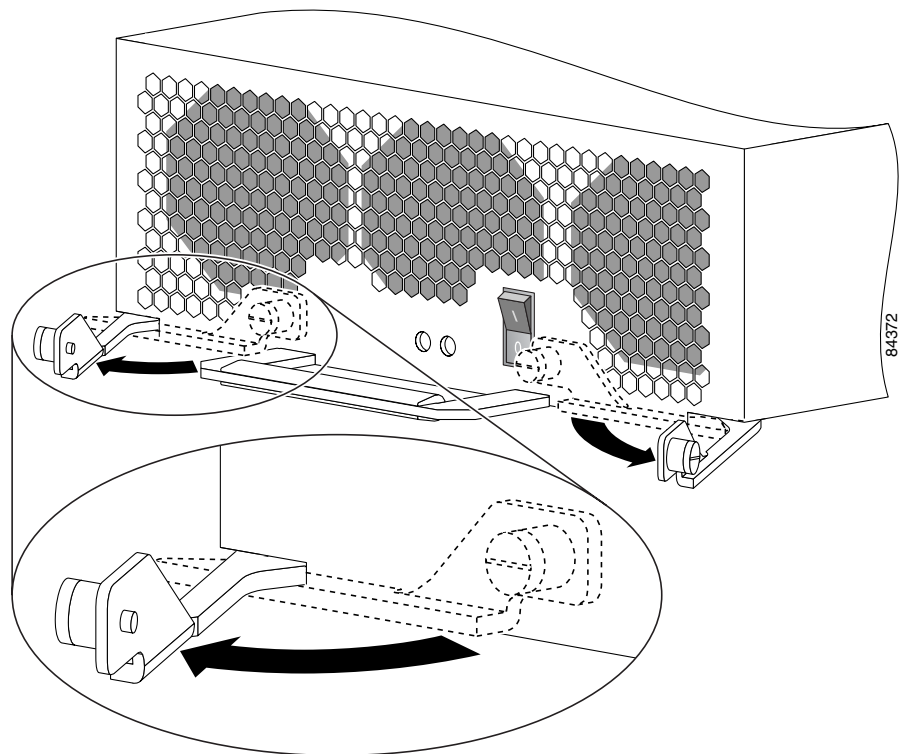
Step 5   Install the new power supply (Figure 5-8):

    a.   Slide the power supply into the bay until it mates with its backplane connector.

⚠

Caution   To prevent damage to the power shelf backplane connector, do not use excessive force when inserting the power supply into the chassis.

    b.   Close the ejector levers and tighten the captive screws to securely seat the power supply to the backplane connector.

Figure 5-8   Seating the AC Power Supply
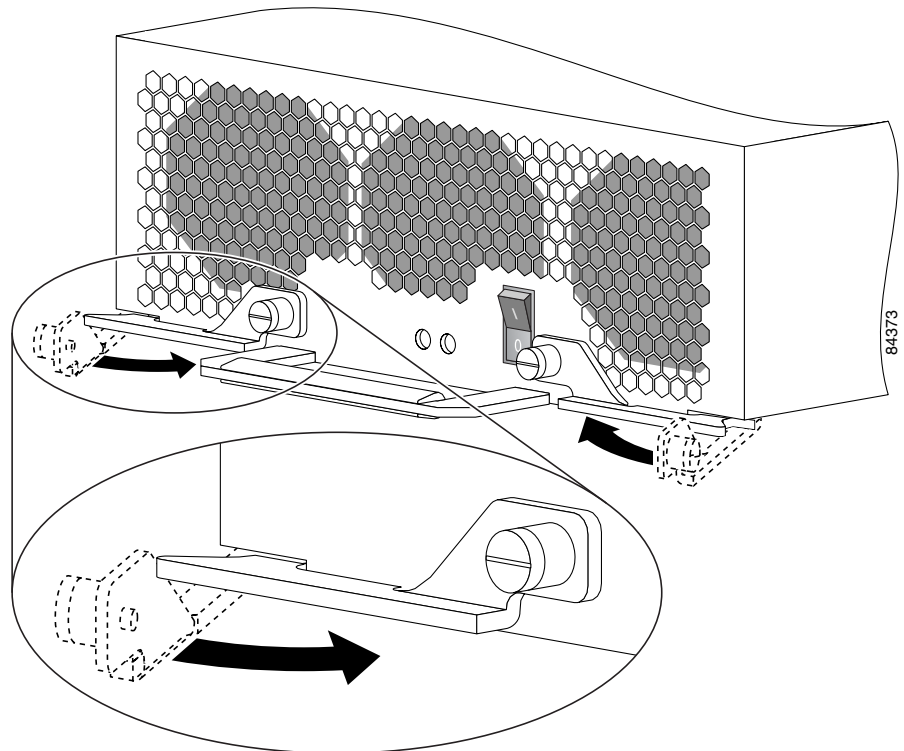
Step 6   Plug the power supply cable into its AC outlet.

Step 7   Power on the circuit breaker to that AC outlet.

Step 8   Set the power switch to the On (1) position.

The AC Input and DC Output power indicators on the front of the power supply should be on. If the indicators do not are not on, see the .

# Troubleshooting the AC Power Entry Module Installation

Use the following procedure to troubleshoot the AC PEM if it is not operating properly after installation.

Step 1   Reseat the PEM and make sure that the:

–   Captive screws on the ejector levers are tightened securely.

–   Power switch is set to the On (1) position.

Step 2   Ensure that the router is powered on and that all power cords are connected properly. Make sure that the:

•   Power cords on the back of the chassis are secured to the PDU with their retention clips.

•   Power cords at the power source end are connected to a dedicated AC power outlet.

–   Each AC power supply operating in the nominal range of 200 to 240 VAC requires a minimum service of 20 A, North America (or 13 A, international).

•   Source AC circuit breaker is switched on.

Step 3   Check the power supply status indicators:

- AC Input (green)—Indicates that the power supply is operating normally, and the source AC voltage is within the nominal operating range of 200 VAC to 240 VAC. This indicator lights when the power supply switch is set to the On (1) position.

    - If the AC Input power indicator remains off after checking all of the power sources, replace the power supply with a spare.

    - If the spare power supply does not work, replace the PDU.

- DC Output (green)—Indicates that the power supply is operating normally, and the output DC voltage is within the nominal operating range of –48 VDC to –60 VDC. This indicator lights when the power switch is set to the On (1) position.

    If the indicator is off, toggle the power switch off and then on. If the indicator remains off after several attempts to power it on, replace the power supply with a spare.

Removing and Replacing an AC PDU

The AC PDU does *not* support online insertion and removal (OIR) and cannot be replaced while the system is operating. You must power off the router before replacing the PDU.

⚠️

Caution   To remove and replace the AC PDU, the system must be powered off. Notify the network administrator and other appropriate personnel that all routing traffic stops while the PDU is replaced.

Use the following procedure to remove and replace an AC PDU.

Step 1   Power off both PEMs by setting the power switches to the off (0) position.

Step 2   Unplug the power supply cords from their AC outlets.

Step 3   Power off the circuit breakers assigned to the AC outlets.

Step 4 Loosen the captive screw on each ejector lever and pivot the levers open to unseat the power supply from its PDU connector (Figure 5-9).

- It is not necessary to remove the power supply from its bay.

- Repeat this step for the second power supply.

Figure 5-9   Unseating the AC Power Supply
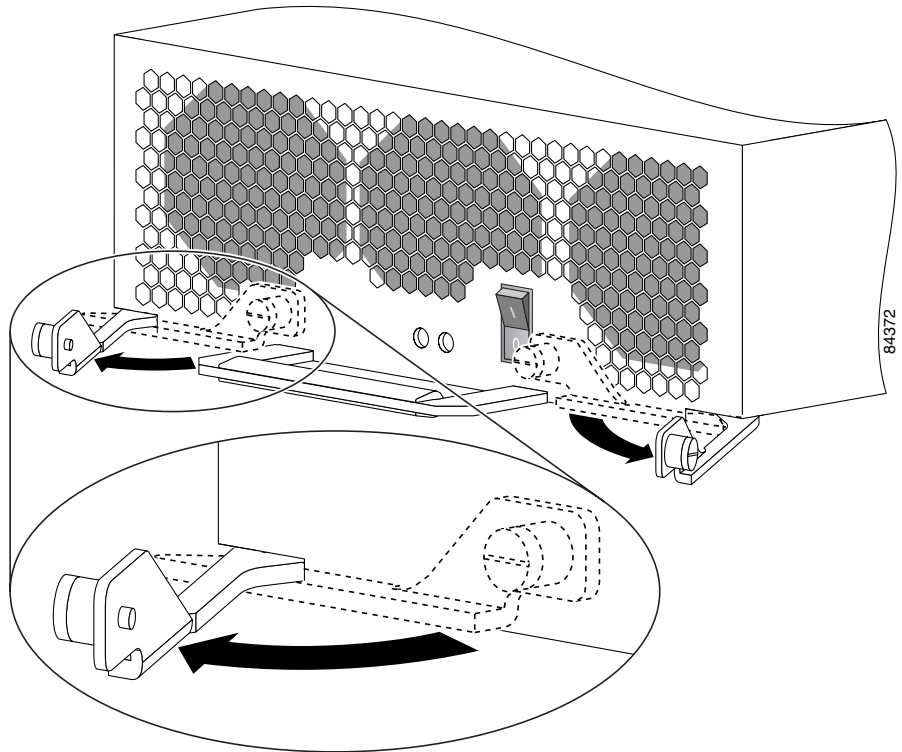
Step 5   Release the retention clip and disconnect each power supply cord from the PDU (items 2 and 3 in Figure 5-10).

Figure 5-10   AC Power Distribution Unit
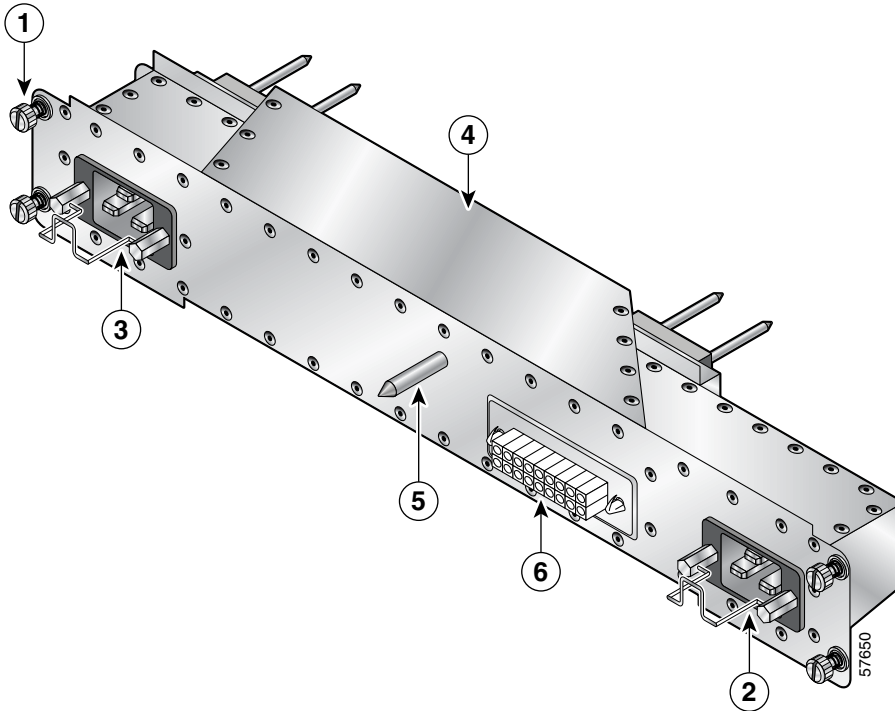
1	Captive screw	4	AC power distribution unit
2	AC power cord connector/retention clip (A)	5	Guide pin
3	AC power cord connector/retention clip (B)	6	Blower module connector

Step 6   Remove the blower module (Figure 5-11):

   a.   Lift the blower module handle to its raised (carrying) position.

   b.   Loosen the (4) captive screws on the blower module.

   c.   Remove the blower module by grasping it on each side and pulling it straight
            back from the chassis.

Figure 5-11   ***Removing the Blower Module***
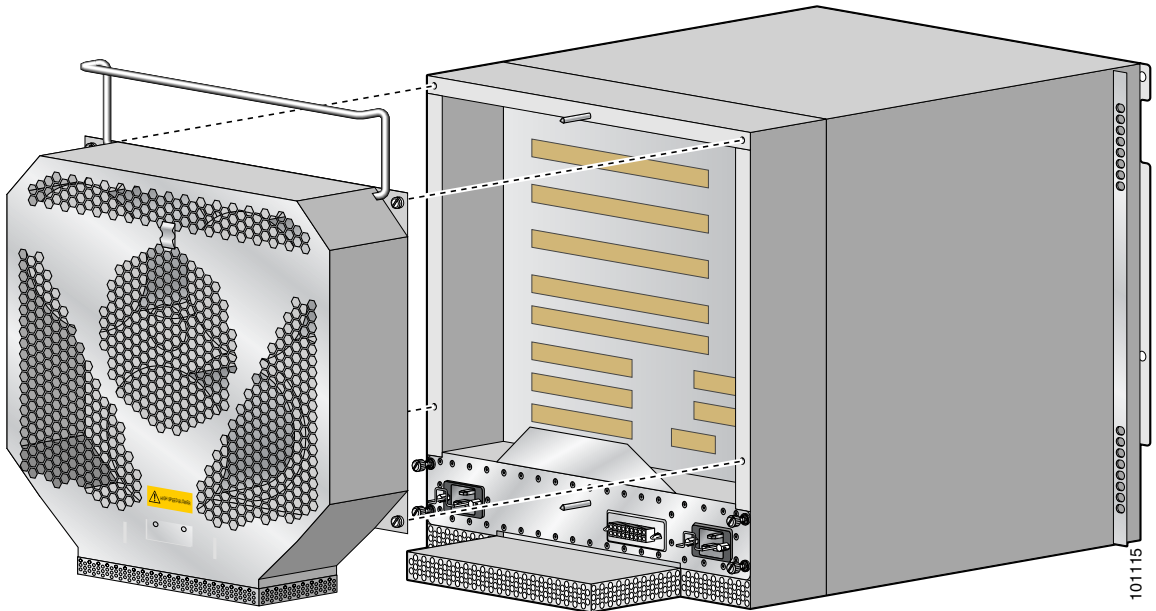
Step 7   Remove the PDU from the chassis (Figure 5-12):

   a.   Loosen the (4) captive screws on the PDU.

   b.   Grasp the PDU and pull it out slightly.

   c.   Move the PDU to the left and pivot the right side through the opening to remove the PDU from the chassis opening.

> ✎
>
> **Note**   Tilting the PDU at a slight angle makes it easier to remove it from the chassis.

Figure 5-12   Removing the AC PDU
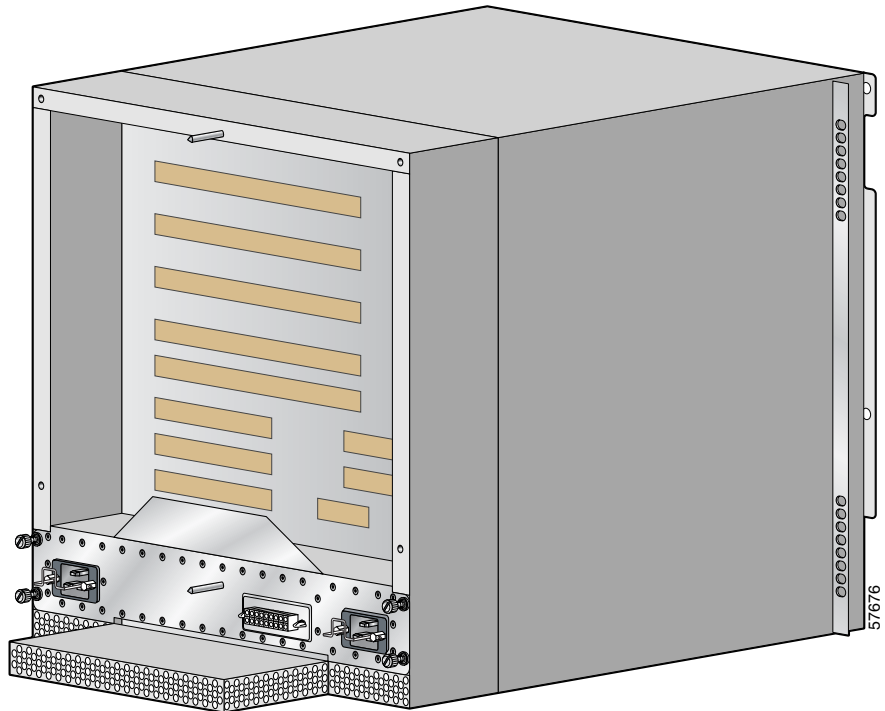
Step 8   Install the new PDU and tighten its (4) captive screws to secure it to the chassis.

Step 9   Install the blower module (Figure 5-13):

   a.   Position the alignment holes on the blower module with the guide pins on the chassis and PDU.

   b.   Slide the blower over the guide pins toward the chassis until it mates with the PDU connector.

⚠

Caution   To prevent damage to the connectors, do not use excessive force when installing the blower module.

   c.   Tighten the (4) captive screws to secure the blower module to the chassis.

   d.   Lower the carrying handle to its operating position.

Figure 5-13   Installing the Blower Module
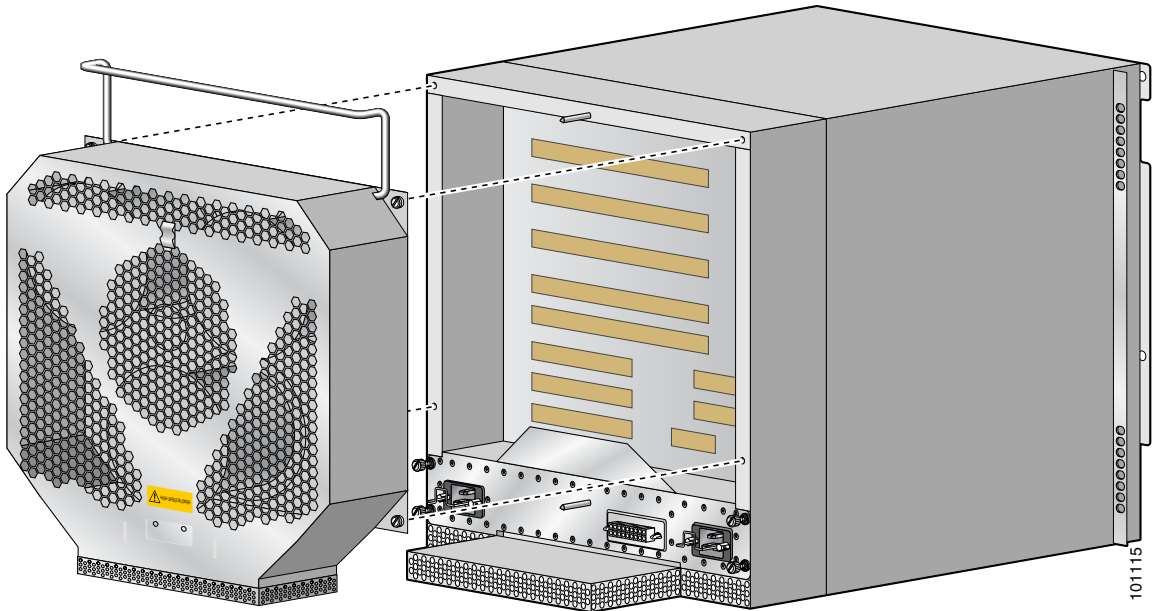
Step 10   Reconnect the power cords to the PDU and secure them using their retention clips.

Step 11   Plug the power cords into their AC outlets.

Step 12   Power on the circuit breakers assigned to the AC outlets.

Step 13   Reinstall the power supplies (Figure 5-14):

   a. Push the power supply into its bay until it mates with its PDU connector.

⚠

Caution   To prevent damage to the connectors, do not use excessive force when inserting the power supply into the chassis.

   b. Close the ejector levers and tighten the captive screws to securely seat the power supply to the chassis.

   c. Repeat steps **a.** and **b.** for the second power supply.

Figure 5-14   Seating the AC Power Supply
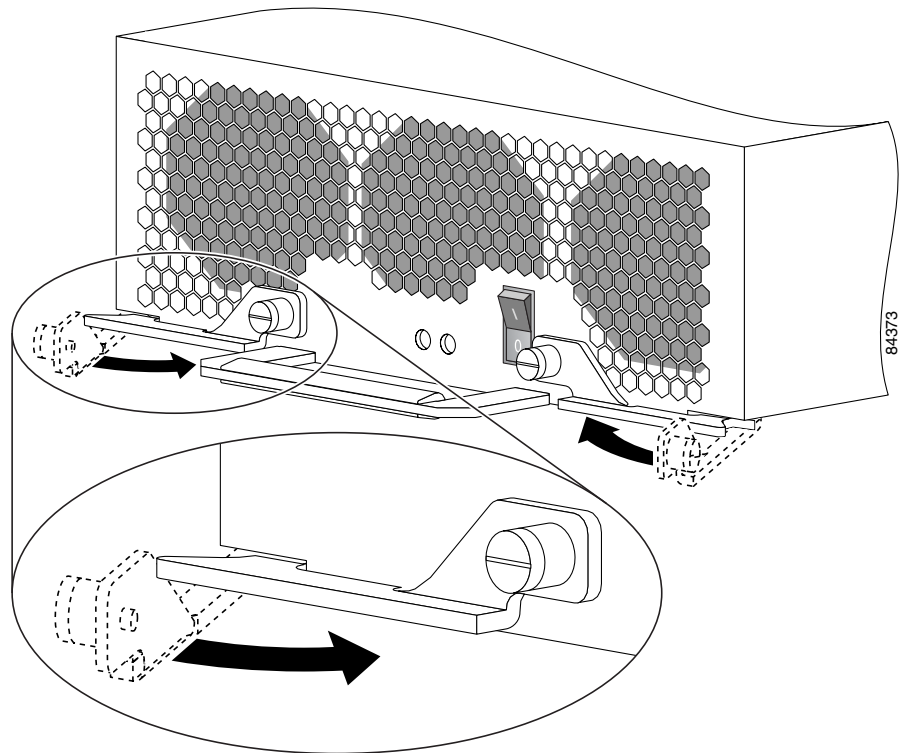
Step 14   Set the power switch on both power supplies to the on (1) position.

The AC Input Power and DC Output Power indicators on the power supplies should be on. If the indicators do are not on, see the "Troubleshooting the AC Power Entry Module Installation" section on page 5-17.

Removing and Replacing a DC PEM

Although a DC PEM supports OIR, in order to maintain operational redundancy, proper cooling, and meet EMI compliance standards, you must have both working power supplies installed. When you remove a failed power supply with the router in operation, perform the replacement as quickly as possible. Make sure you have the tools and the replacement power supply ready before beginning the removal and installation procedure.

Use the following procedure to remove and replace a DC PEM.

Step 1   Power off the faulty PEM (item 3 in Figure 5-15).

Figure 5-15   DC Power Entry Module Components
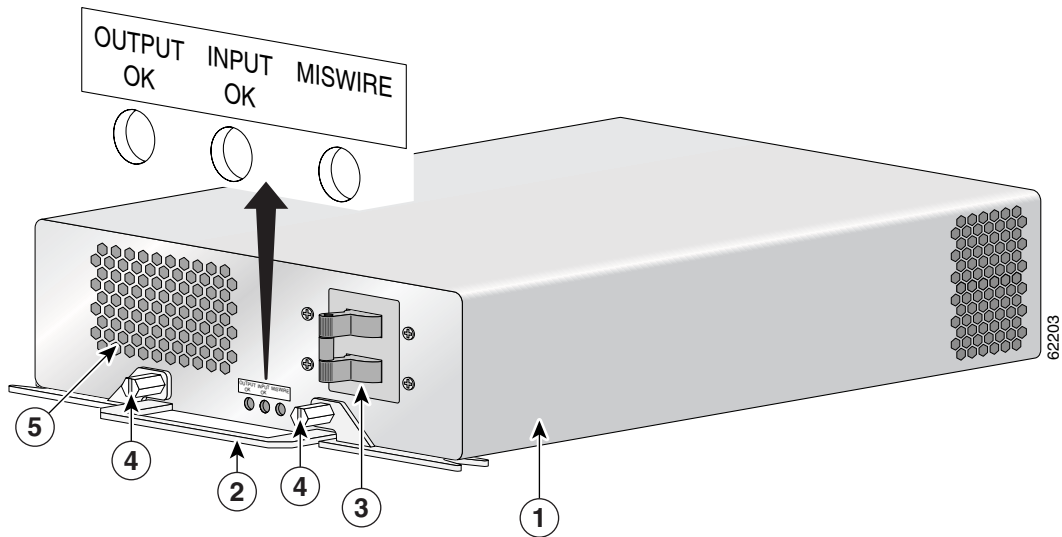
1	DC PEM	**4**	Captive screws/release levers
2	Handle	**5**	Cooling fan
3	Power On/Off switch	**6**	AC input/DC output/miswire status indicators

Step 2   Power off the circuit breaker assigned to the power supply.

Step 3   Remove the power supply from the chassis (Figure 5-16):

   a. Loosen the captive screw on each ejector lever.

   b. Pivot the levers open to release the power supply from its bay.

   c. Slide the power supply out of its bay while supporting it with your other hand.

⚠

Warning   **The power supply weighs approximately 10 lb (4.5 kg). Use two hands to remove the power supply.**

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Figure 5-16   *Releasing the DC Power Supply*
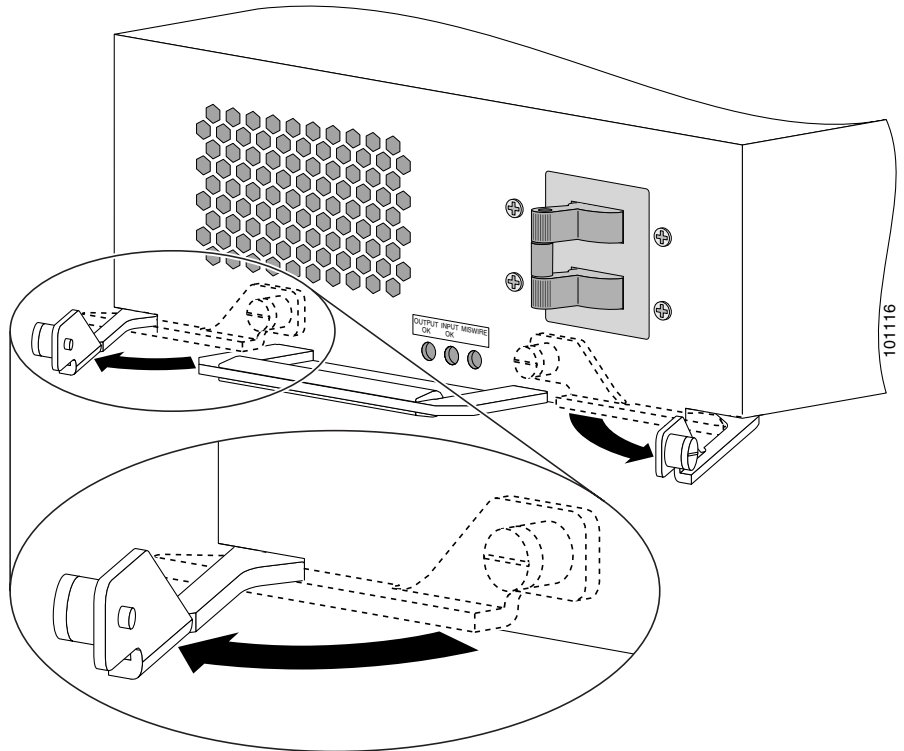
Step 4   Install the new power supply:

    a.   Slide the power supply into the bay until it mates with its backplane connector.

⚠

Caution   To prevent damage to the power shelf backplane connector, do not use excessive force when inserting the power supply into the chassis.

    b.   Close the ejector levers and tighten the captive screws to securely seat the power supply to the backplane connector (Figure 5-17).

Figure 5-17   *Seating the DC Power Supply*
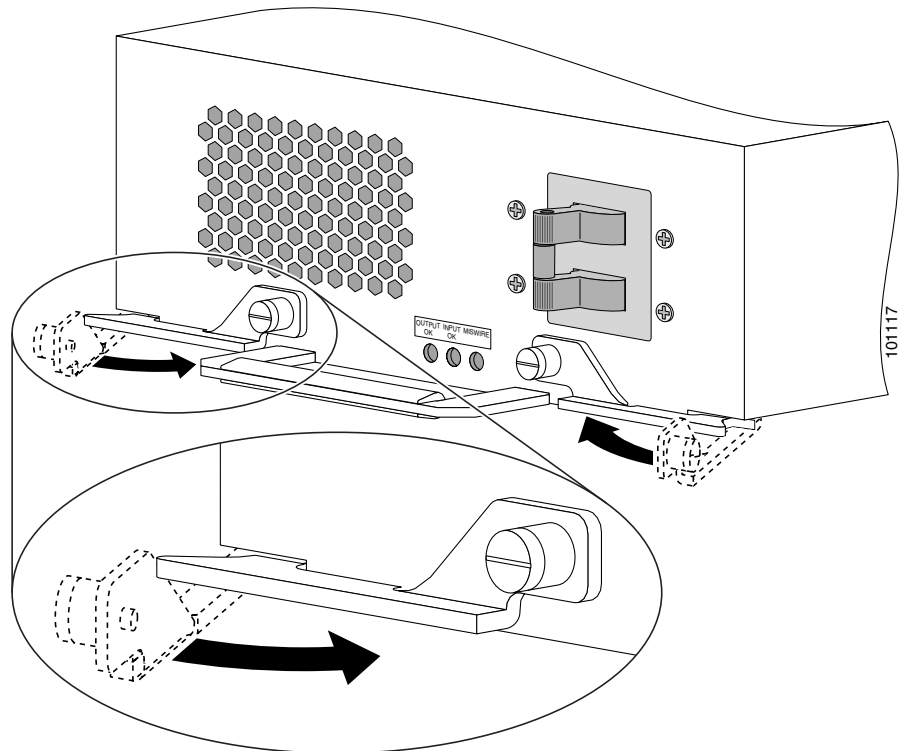
Step 5   Power on the circuit breaker.

Step 6   Power on the PEM.

The AC Input and DC Output power indicators on the front of the power supply should be on. If the indicators do are not on, or the Miswire indicator is on, see the "Troubleshooting the DC Power Supply Installation" section on page 5-30.

Troubleshooting the DC Power Supply Installation

Use the following procedure to troubleshoot the DC power supply if it is not operating properly after installation.

Step 1   Make sure the power supply is seated properly:

- Eject and reseat the power supply. Make sure that the:
    - Captive screw on the ejector lever are tightened securely.
    - Power switch is set to the on (1) position.

Step 2   If the Input OK and Output OK LEDs are off, or if the Output Fail LED is on, make sure that the:

- Power switch is set to the on (1) position.
- Power leads are securely connected to the power connector block on the PDU.
- Power cables are securely connected at the DC source connection.
- The source DC circuit breaker is turned on.

Step 3   Check the power supply status indicators:

- Output OK (green)—Indicates that the PEM is operating normally, and the source DC output voltage is within the nominal operating range of –48 to –60 VDC. This indicator should light when the power switch is set to the On (1) position.

    If the indicator is off, toggle the power switch off and then on. If the indicator remains off after several attempts to power it on, replace the power supply with a spare.

- Input OK (green)—Indicates that the power supply is operating normally, and the source DC input voltage is within the nominal operating range of -40.5VDC to -75VDC. This indicator should light when the power supply switch is set to the On (1) position.

    – If the Input OK indicator remains off after checking all of the power sources, replace the power supply with a spare.

    – If the spare power supply does not work, replace the PDU.

- Miswire (amber)—Indicates the input wiring is incorrect at the PDU power connection block.

    Correct wiring to the DC power connector block (see Figure 5-24).

Removing and Replacing a DC PDU

The DC PDU does *not* support online insertion and removal (OIR) and cannot be replaced while the system is operating. You must power off the router before replacing the PDU.

⚠

Caution   To remove and replace the DC PDU, the system must be powered off. Notify the network administrator and other appropriate personnel that all routing traffic stops while the PDU is replaced.

Use the following procedure to remove and replace a DC PDU.

Step 1   Power off *both* PEMs (item 3in Figure 5-18).

Figure 5-18   DC Power Entry Module Components
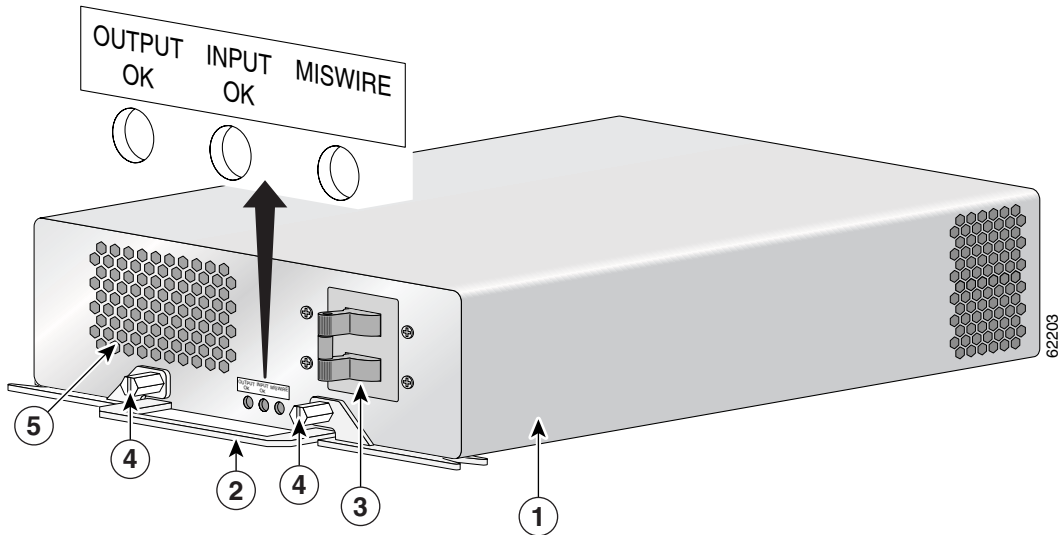
1	DC PEM	**4**	Captive screws/release levers
2	Handle	**5**	Cooling fan
3	Power On/Off switch	**6**	AC input/DC output/miswire status indicators

Step 2   Power off the circuit breakers assigned to the PEMs.

Step 3   Loosen the captive screw on each ejector lever and pivot the levers open to unseat the power supply from its PDU connector (Figure 5-19).

- It is not necessary to remove the power supply from its bay.

- Repeat this step for the second power supply.

Figure 5-19   Unseating the DC Power Supply
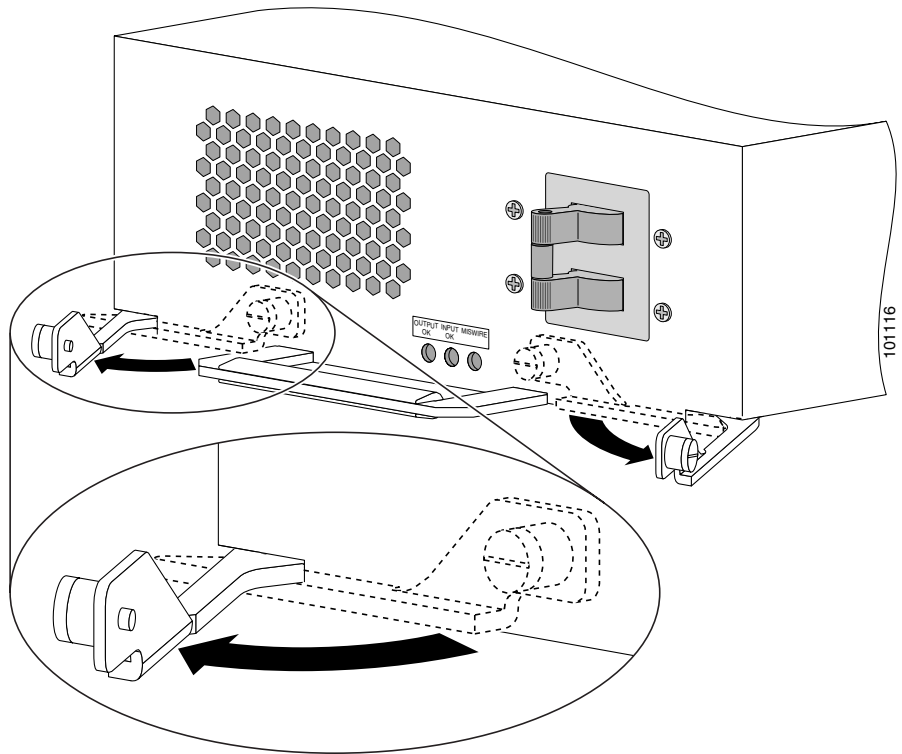
Step 4   Remove the blower module (Figure 5-20):

    a.   Lift the blower module handle to its raised (carrying) position.

    b.   Loosen the (4) captive screws on the blower module.

    c.   Remove the blower module by grasping it on each side and pulling it straight back from the chassis.

Figure 5-20   ***Removing the Blower Module***
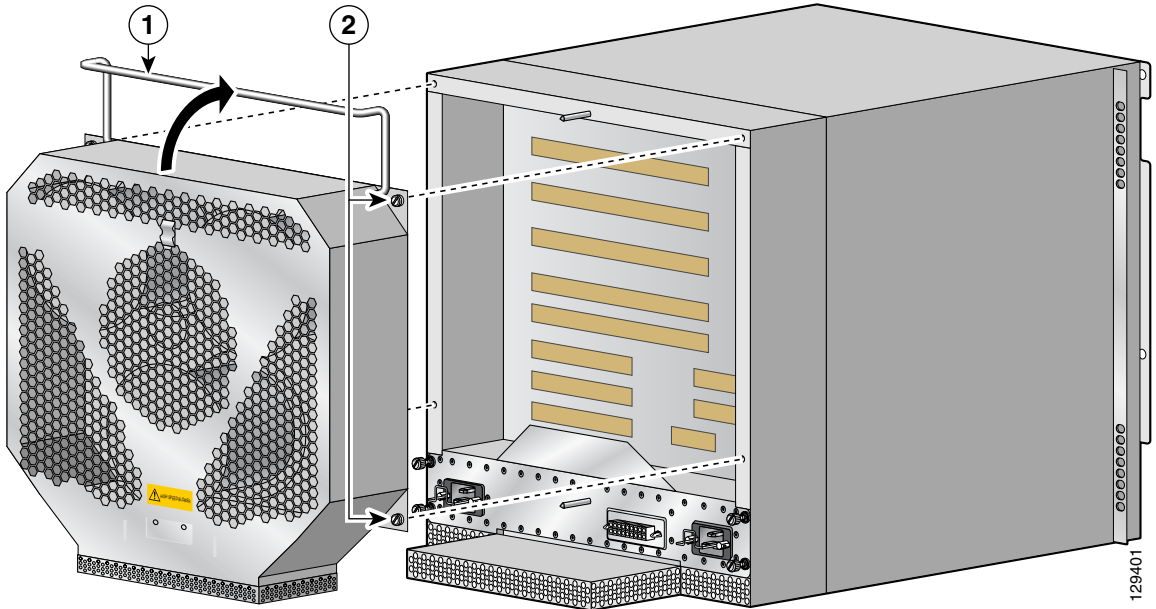
Step 5   Disconnect the DC power leads from the PDU power connector blocks in the following order (Figure 5-21):

a.   Negative lead from the top port.

b.   Positive lead from the middle port.

c.   Ground lead from the bottom port.

d.   Repeat these steps for the second power connector block.

Warning   **To prevent injury and damage to the equipment, always remove the source DC power leads and ground from the power shelf terminals in the following order: (a) negative (–), (b) positive (+), (c) ground.**

Figure 5-21   *Disconnecting the DC Power Leads*
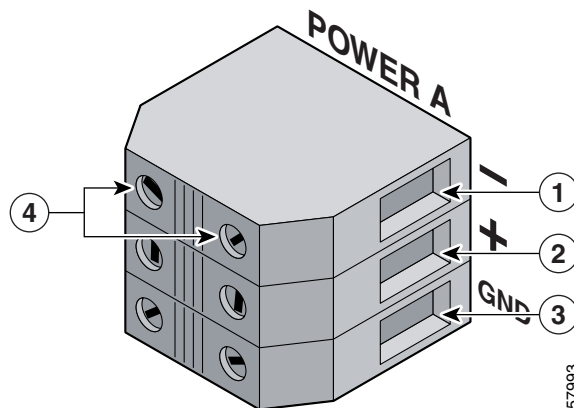
1	Negative terminal port	**3**	Ground terminal port
2	Positive terminal port	**4**	Terminal port connector screws

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Step 6 Remove the PDU from the chassis (Figure 5-22):

    a. Loosen the (4) captive screws on the PDU.

    b. Grasp the PDU and pull it out slightly.

    c. Move the PDU to the left and pivot the right side through the opening to remove the PDU from the chassis.

       ✎

       Note   Tilting the PDU at a slight angle makes it easier to remove it from the chassis.

Figure 5-22   Removing the DC PDU
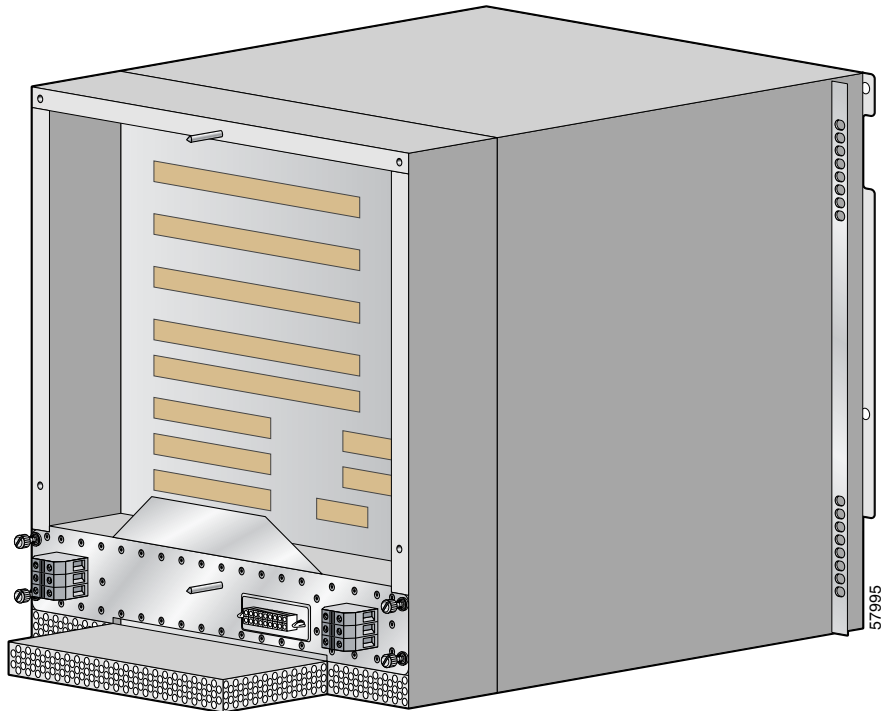
Step 7   Install the new PDU and tighten its (4) captive screws to secure it to the chassis.

Step 8   Install the blower module (Figure 5-23):

a.   Position the alignment holes on the blower module with the guide pins on the chassis and PDU.

b.   Slide the blower over the guide pins toward the chassis until it mates with the backplane connector.

⚠️

Caution   To prevent damage to the connectors, do not use excessive force when installing the blower module.

c.   Tighten the (4) captive screws to secure the blower module to the chassis.

d.   Lower the carrying handle to its operating position.

Figure 5-23   *Installing the Blower Module*
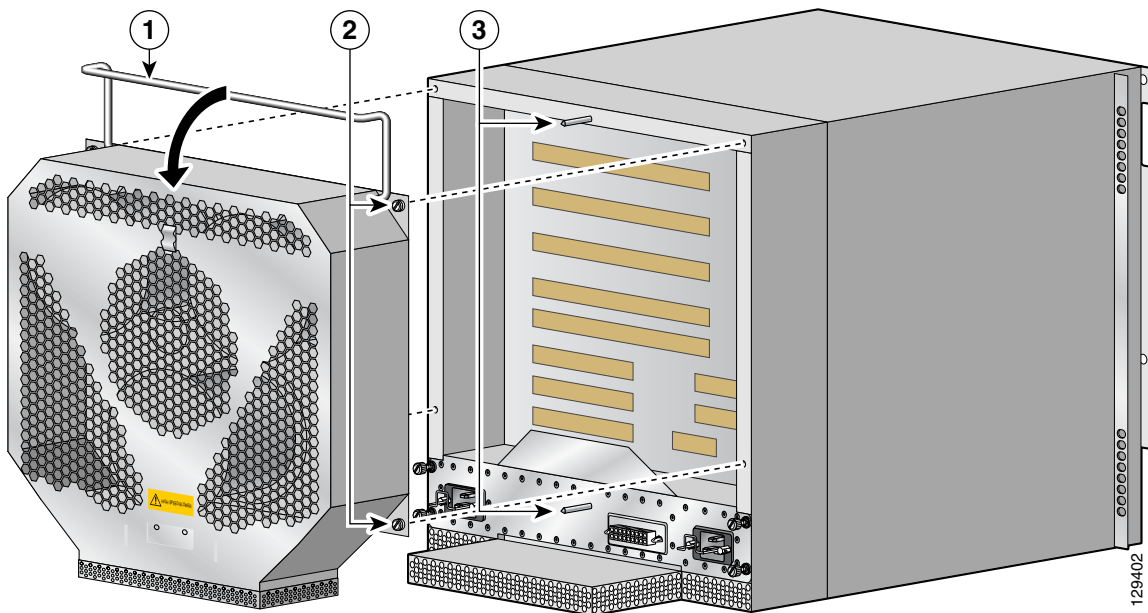
Step 9   Reconnect the DC power leads to each of the PDU power connector blocks in the following order (Figure 5-24):

a.   Ground lead to the bottom port.

b.   Positive lead to the middle port.

c.   Negative lead to the top port.

d.   Repeat these steps for the second power connector block.

Warning   **To prevent injury and damage to the equipment, always attach the ground and source DC power leads to the power block connector in the following order: (a) ground to ground, (b) positive (+) to positive (+), (c) negative (−) to negative (−).**

Figure 5-24   Disconnecting the DC Power Leads
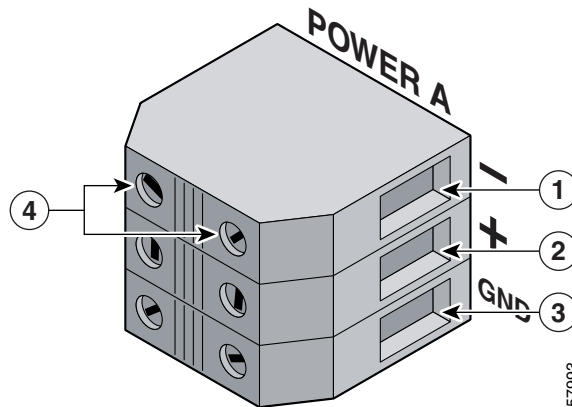
1	Negative terminal port	**3**	Ground terminal port
2	Positive terminal port	**4**	Terminal port connector screws

Step 10 Reinstall the PEMs:

    a. Slide each PEM into its bay until it mates with its PDU connector.

> ⚠
>
> **Caution** To prevent damage to the connectors, do not use excessive force when inserting the power supply into the chassis.

    b. Close the ejector levers and tighten the captive screws to securely seat the power supply to the chassis (Figure 5-25).

    c. Repeat steps **a.** and **b.** for the second power supply.

Figure 5-25   ***Seating a DC Power Supply***
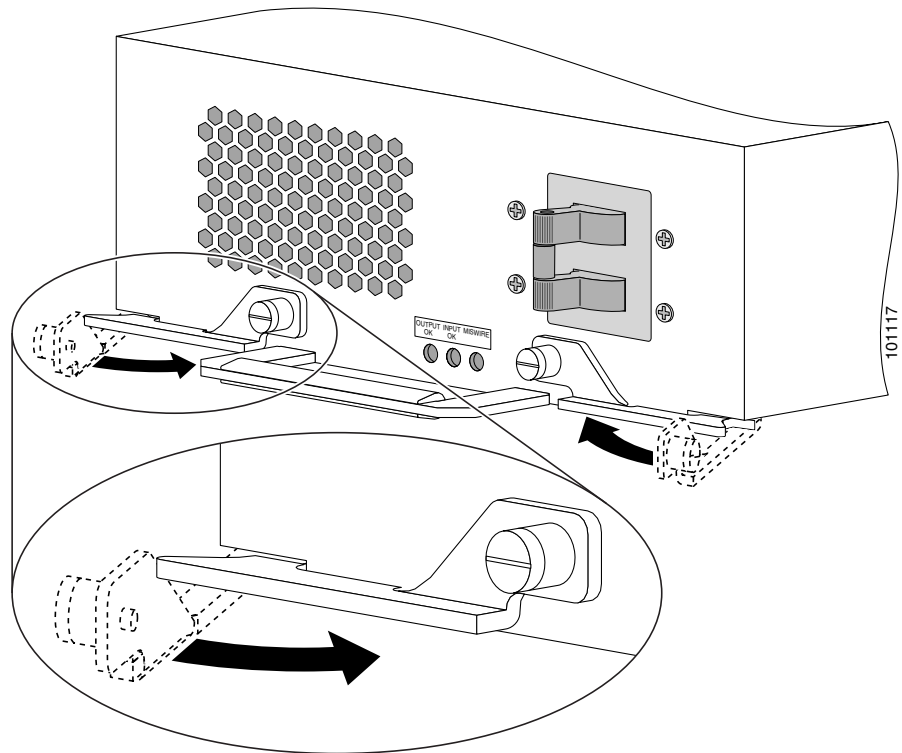
Step 11   Power on the circuit breakers assigned to the PEMs.

Step 12   Power on the PEMs.

The Output Power OK and Input Power OK indicators on the power supplies should be on. If the indicators do are not on, see the "Troubleshooting the DC Power Supply Installation" section on page 5-30.

Troubleshooting the DC PDU Installation

Refer to Figure 5-26 and use the following procedure to troubleshoot the DC PDU installation.

Figure 5-26   DC Power Entry Module Components
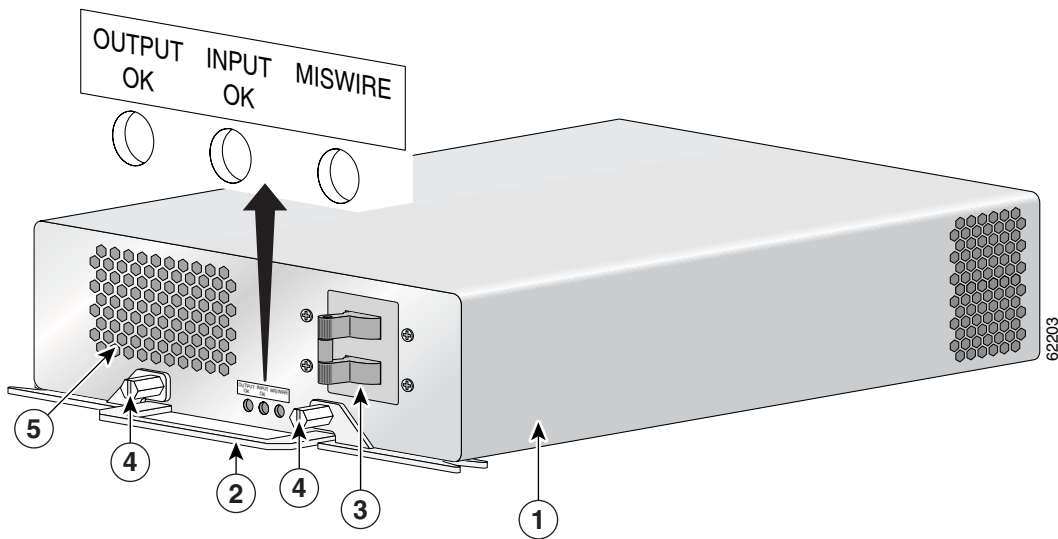
1	DC PEM	4	Captive screws/release levers
2	Handle	5	Cooling fan
3	Power On/Off switch	6	AC input/DC output/miswire status indicators

Step 1   If the Input OK and Output OK LEDs are off, make sure that the:

- PEM is firmly seated in the bay and the captive screws are tightened securely.
- DC power source circuit breakers are switched on.
- DC power cables are securely attached to the PDU terminal block.
- Power switch is set to the on (1) position.

Step 2   If the amber MISWIRE LED is on, the wires on the power block are reversed.

a.   Power off the PEMs and make sure the DC power source circuit breakers are switched off. Go to Step 9 of the installation procedure and reconnect the wires correctly to each of the power connector blocks.

b.   Switch on the DC source power circuit breakers and power on the PEMs.

If the problem still exists, replace the PEM.

If replacing the PEM does not correct the problem, contact a Cisco service representative for assistance.

Removing and Replacing an RP or a Line Card

Line cards can occupy any slot, 0 (the top slot) through 4, in the RP and line card cage (Figure 5-27). The Cisco XR 12406 router is configured with the RP in slot 5 (the bottom slot). A redundant RP can be installed in any slot, but requires a line card spacer to comply with EMI emission standards.

Cisco XR 12406 router line cards support OIR, so they can be removed and installed while the router remains powered up. RPs also support OIR, but are hot-swappable only when the system is equipped with two RPs.

⚠

Caution   If you are removing, but not replacing a card in the chassis, you must have a blank filler in place for EMI shielding and to ensure proper cooling.

Additional line card information can be found in the installation and configuration documentation for each type of line card.

Figure 5-27   *Cisco XR 12406 Router Card Cage Slot Locations*

Rack mounting → bracket holes

| Line card |
| Line card |
| Line card |
| Line card |
| Line card |
| Route processor |

CSC	SFC
CSC	SFC
Alarm	Alarm	SFC

| Power supply | Power supply |

57651
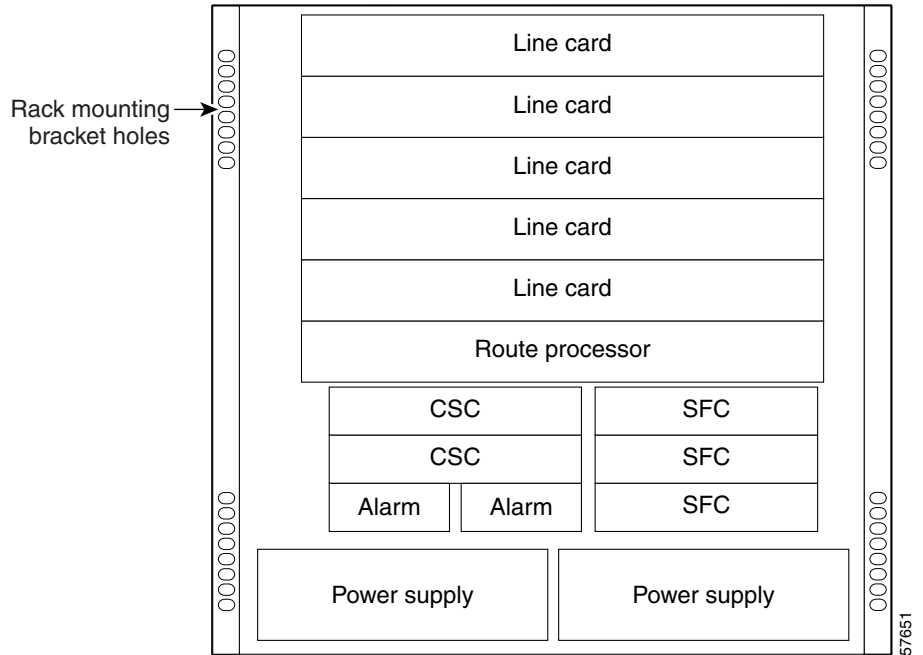
Use the following procedure to remove and replace an RP or line card.

Step 1 Identify the RP or line card to be replaced and write down the following information:

- The RP cable connections on the RP.

- The number and type of RP or line card, so that you will know the location of the card when you re-install it or the replacement, in the card cage.

- The network interface cable connection ports, on the RP or line card.

Step 2 On cards with multiple ports, start with the left port on the card and disconnect the interface cable connectors from each of the ports.

Step 3 After all the interface cables are disconnected, loosen the two captive screws on the cable-management bracket and pull the bracket away from the card.

Step 4 Loosen the two ejector lever captive screws at each end of the line card faceplate.

Step 5   Simultaneously pivot the ejector levers away from each other to unseat the card from the backplane connector (Figure 5-28).

Figure 5-28   *Removing an RP or Line Card from the Card Cage*

57087
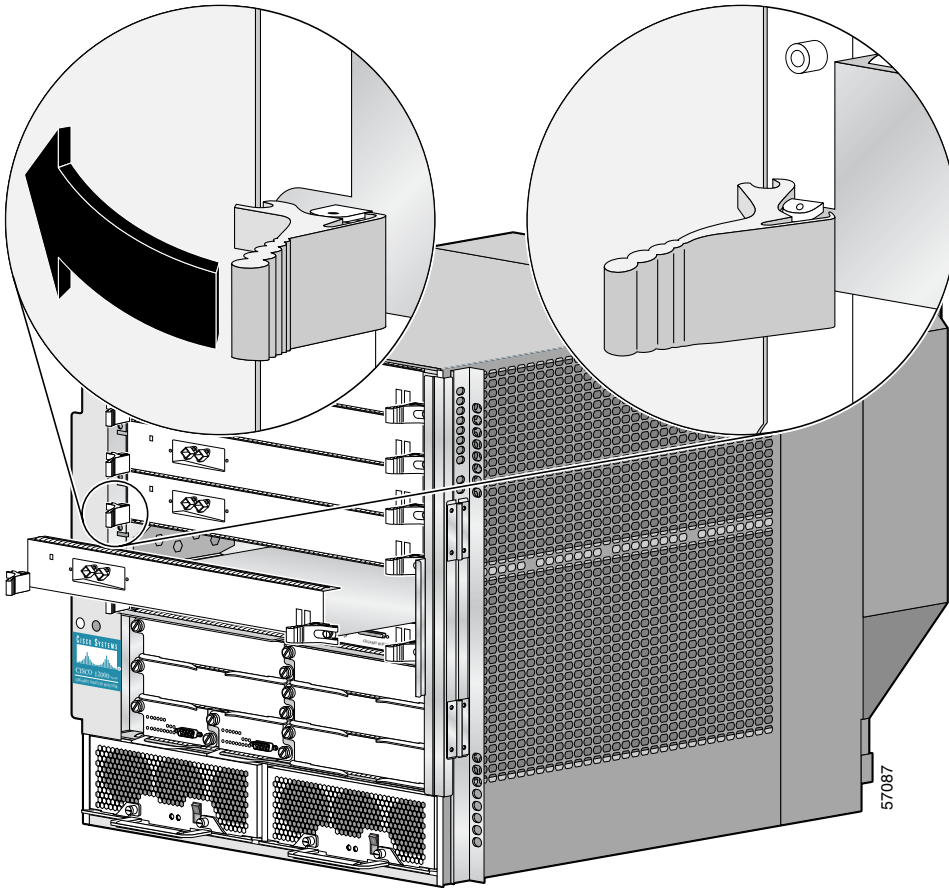
Step 6   Grasp the edges of the card carrier with both hand to support it and remove the card.

⚠

Caution   Remove each RP or line card completely from the slots. A card left partially inserted into the slot can damage the EMI shielding on card in the slot directly below.

- Immediately place the RP or line card in an antistatic bag to protect it against ESD and to prevent dust from getting to the fiber-optic connectors on fiber-optic line cards.

- If you plan to return the defective unit to the factory, repackage it in the shipping container you received with the replacement RP or line card.

Step 7   Remove the RP or line card from its shipping package and antistatic bag.

⚠

Caution   Handle the RPs and line cards by the metal card carrier edges only; avoid touching the board itself or any connector pins.

Step 8   Seat the RP or line card:

a.   Set both edges of the RP or line card into the card slot and partially slide the card into the chassis.

b.   Pivot the ejector levers away from each other by rotating each ejector lever outward away from the faceplate.

c.   Continue sliding the card into the slot until the ejector levers make contact with the front of the card cage, then *stop*.

d.   Seat the card by grasping each ejector levers and simultaneously pivot them toward the card faceplate.

✎

Note   The line card will not boot properly if not fully seated.

Step 9   Tighten the captive screws on the card.

✎

Note   The card captive screws must be tightened to meet EMI specification standards.

Repeat Step 1 through Step 9 for any additional replacement RPs or line cards, and then proceed to the next section.

Attaching the Cable-Management Bracket and Connecting Cables

The Cisco XR 12406 router line cards use cable-management brackets to:

- Organizing the network interface cables
- Keeping the network interface cables out of the way
- Positioning connectors at their respective ports on the line card faceplate
- Keeping the cables free of sharp bends (excessive bending in a network interface cable can cause performance degradation)

When you install a new RP or line card, you need to attach the line card cable-management bracket to the faceplate of the card before connecting the cables. The type of cable-management bracket used by a line card is determined by the card type and the number of network interface ports it has.

Use the following procedure to attach the cable-management bracket and cables to a line card.

Step 1   Orient the top of the cable-management bracket with the top of the line card faceplate (the end opposite the two four-character alphanumeric displays.)

Step 2   Align the two captive screws on the bracket with the threaded insert holes near the ejector levers on each end of the line card faceplate and finger-tighten the screws.

Step 3   Use a flat-blade screwdriver to secure the two captive screws.

⚠️

Caution   Do not overtighten the captive screws; overtightening the screws can strip the threads on the screw or the insert in the faceplate.

Figure 5-29   Line Card Cable-Management Bracket

For fiber-optic or copper cable line cards
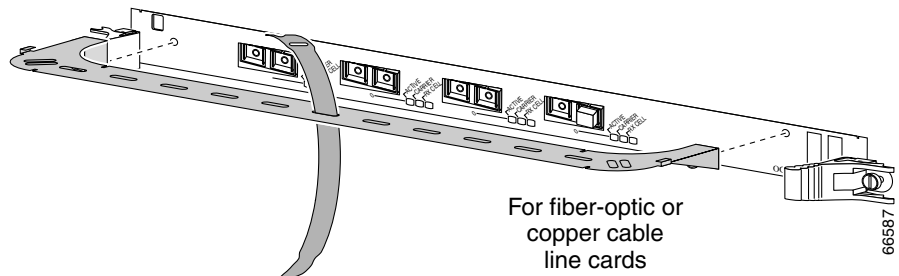
Step 4   Repeat steps 1 through 3 for any remaining line cards.

Step 5 Attach an appropriate number of velcro straps through the slots in the cable-management bracket to support the network interface cables (Figure 5-30).

    a. Pull the small end of the velcro strap through the slot in the cable-management bracket.

    b. Insert the small end of the velcro strap into the slot in the wide end of the velcro strap.

    c. Pull the small end through the velcro strap slot to secure it to the cable-management bracket.

Figure 5-30   Line Card Cable-Management Brackets with Velcro Straps
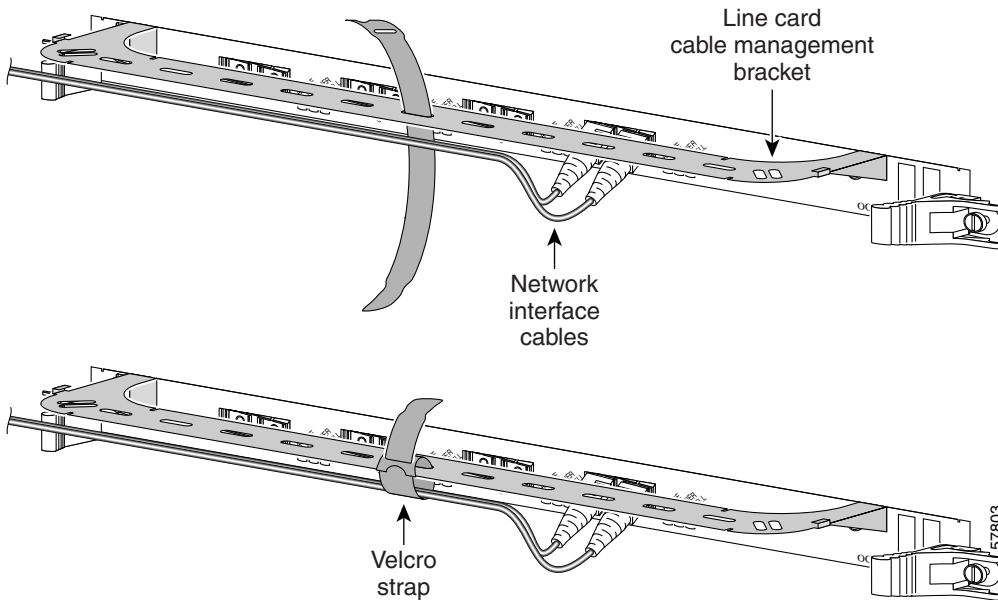
Step 6 Proceeding from the left port on the line card to the right port (on line cards with multiple ports), identify the network interface cable for the line card port and insert the cable connector into the line card port (see Figure 5-30).

    a. Align the interface cable with the cable-management bracket.

    b. Repeat for the remainder of the interface cables for this line card.

> **Note** Carefully adjust the interface cables in the cable-management bracket to prevent any kinks or sharp bends in the interface cables. Kinks and sharp bends can destroy or degrade the ability of the optical fiber to propagate the signal-encoded beam of light accurately from one end of the cable to the other. Also, allow adequate strain relief in the interface cables.

Step 7 Secure the interface cables to the cable-management bracket by wrapping the velcro straps around them (see Figure 5-30).

> **Note** Do not wrap the velcro straps too tightly.

Removing and Installing a Clock and Scheduler Card, Switch Fabric Card, or Alarm Card

The Cisco XR 12406 router is based on a 10-Gbps switch fabric, where each SFC or CSC provides a 10-Gbps full-duplex connection to each line card in the system. The 10-Gbps switch fabric consists of the Clock Scheduler Card and the Switch Fabric Card. The chassis has slots for two CSCs, three SFCs, and two alarm cards (Figure 5-31).

Figure 5-31   CSC, SFC, and Alarm Card Slot Locations
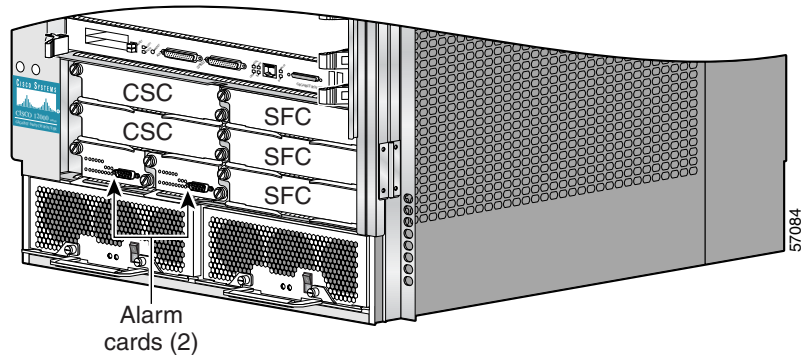
Removing and Replacing a Clock Scheduler Card

If a router is not configured with redundant CSCs, it has one CSC installed in either of the CSC slots, and has a CSC blank filler installed in the second CSC slot.

⚠
Caution   The CSCs support OIR, so when the router is equipped with two CSCs, you can remove either CSC while the system remains powered on. In a router equipped with only one CSC, you must shut down the router before removing the CSC.

⚠

Caution   When operating a router with a single CSC, the second CSC slot must have a CSC blank filler installed to ensure electromagnetic compatibility (EMC) compliance, to avoid overheating, and to ensure compliance with regulatory electromagnetic interference (EMI) standards.

Use the following procedure to remove and replace a CSC.

Step 1   Loosen the two captive screws on each side of the CSC (Figure 5-32).

Figure 5-32   Removing and Installing a Clock Scheduler Card
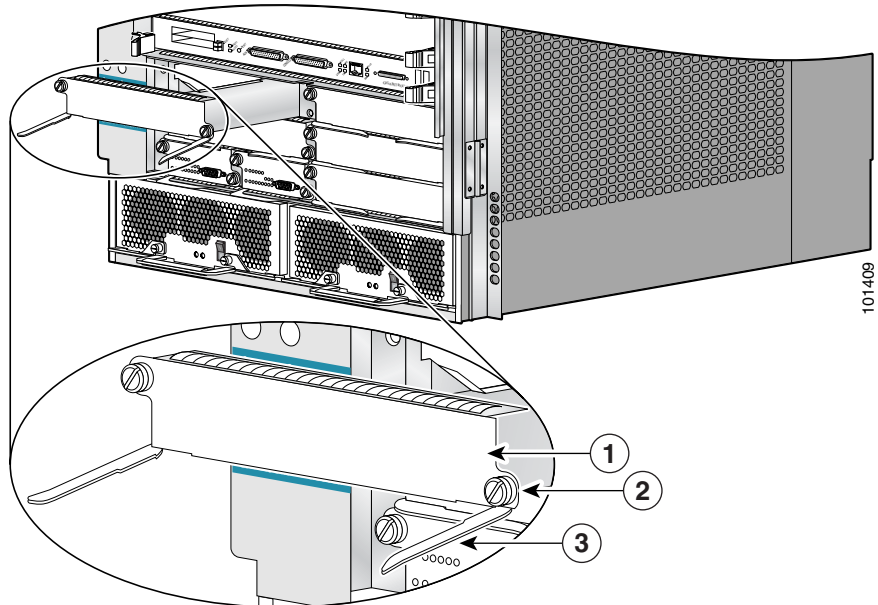
1	CSC	**3**	Ejector lever (2)
2	Captive screw (2)	—	

Step 2 Grasp the card ejector levers and pivot them away from the CSC faceplate (see Figure 5-32).

Step 3 Slide the CSC halfway out of the slot, then *stop*.

Step 4 Touching only the metal card carrier, use your free hand to support the bottom of the CSC and slide the card completely out of the chassis.

- Always place the CSC directly into an antistatic bag or other ESD-preventive container.

- If you plan to return the defective CSC to the factory, repackage it in the shipping container you received with the replacement card.

Step 5 Set both edges of the CSC carrier into the card slot carrier alignment grooves on either side of the CSC slot and slide the card halfway into the chassis.

Step 6 Pivot the ejector levers outward away from the faceplate.

Step 7 Slide the card into the CSC slot until the ejector levers make contact with the front of the card cage, then *stop*.

Step 8 Pivot the ejector levers toward the faceplate until the connector properly seats in the backplane.

Step 9 Tighten the two captive screws.

⚠

Caution Do not overtighten the captive screws; over tightening can strip the threads on the screw or in the insert in the CSC faceplate.

Verifying the Installation of the Clock Scheduler Card

To verify router operation after installing a replacement CSC, see the "Verifying the Installation of Alarm Cards, Clock Scheduler Cards, and Switch Fabric Cards" section on page 5-57.

Removing and Replacing a Switch Fabric Card

Use the following procedure to remove and replace a SFC.

⚠️

Caution   Two CSCs are required to remove and replace a SFC while the system remains powered on. If the router has a non-redundant configuration and only one CSC is installed, you must power off the router before removing the SFC.

Step 1   Loosen the captive screw on each side of the SFC faceplate (Figure 5-33).

Figure 5-33   Removing and Installing a Switch Fabric Card
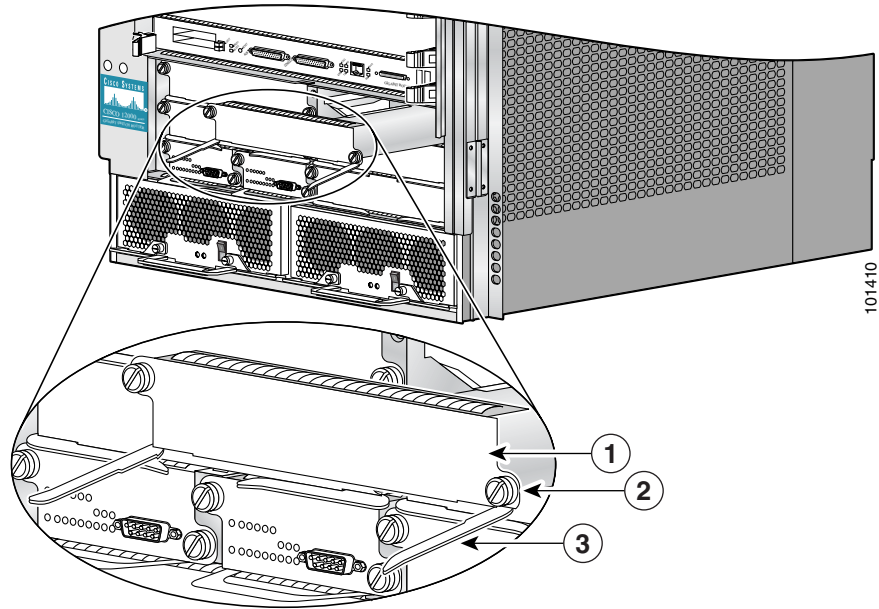
1	SFC	**3**	Ejector lever (2)
2	Captive screw (2)		—

Step 2 Grasp the card ejector levers and pivot them away from the SFC faceplate (see Figure 5-33).

Step 3 Slide the SFC halfway out of the slot, then *stop*.

Step 4 Touching only the metal card carrier, use your free hand to support the bottom of the SFC and slide the card completely out of the chassis.

- Always place the SFC directly into an antistatic bag or other ESD-preventive container.

- If you plan to return the defective SFC to the factory, repackage it in the shipping container you received with the replacement card.

Step 5 Set both edges of the SFC carrier into the card slot carrier alignment grooves on either side of the SFC slot and slide the card halfway into the chassis.

Step 6 Pivot the ejector levers outward away from the faceplate.

Step 7 Slide the card into the SFC slot until the ejector levers make contact with the front of the card cage, then *stop*.

Step 8 Pivot the ejector levers toward the faceplate until the connector properly seats in the backplane.

Step 9 Tighten the two captive screws.

⚠

Caution Do not overtighten the captive screws; over tightening can strip the threads on the screw or in the insert in the SFC faceplate.

Verifying the Installation of the Switch Fabric Card

To verify router operation after installing a replacement SFC, see the "Verifying the Installation of Alarm Cards, Clock Scheduler Cards, and Switch Fabric Cards" section on page 5-57.

Removing and Replacing an Alarm Card

Use the following procedure to remove and replace an alarm card.

Note The alarm cards support OIR, so you can remove and install an alarm card while the system remains powered on.

Step 1 Loosen the captive screw on each side of the alarm card.

Figure 5-34   Removing and Installing an Alarm Card
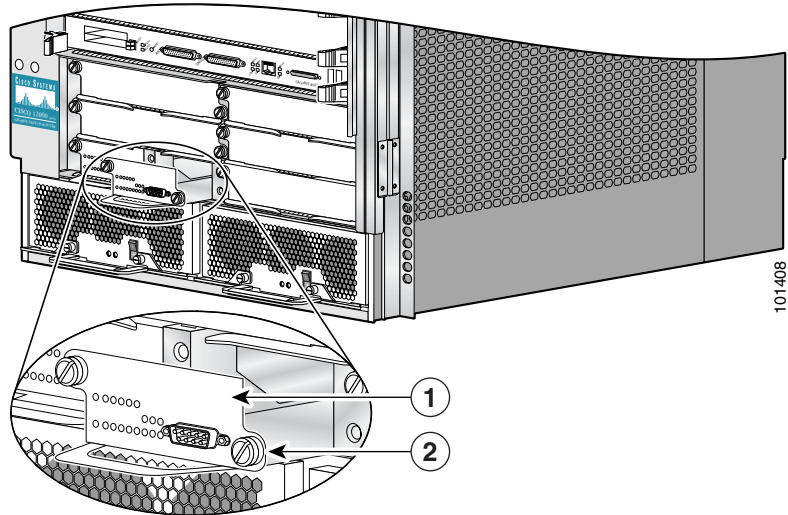
| **1** | Alarm card | **2** | Captive screw (2) |

Step 2 Grasp the handle on the front of the alarm card and slide the alarm card halfway out of the slot, then *stop*.

Step 3 Touching only the metal card carrier, use your free hand to support the bottom of the alarm card and slide the card completely out of the chassis.

- Always place the alarm card directly into an antistatic bag or other ESD-preventive container.

- If you plan to return the defective alarm card to the factory, repackage it in the shipping container you received with the replacement card.

Step 4 Set both edges of the alarm card carrier into the card slot carrier alignment grooves on either side of the alarm card slot and slide the card into the chassis until its connector makes contact with the backplane, then *stop*.

Step 5 Push the alarm card firmly to seat it in the backplane.

Step 6 Tighten the two alarm card captive screws.

⚠

Caution Do not overtighten the captive screws; over tightening can strip the threads on the screw or in the insert in the alarm card faceplate.

Verifying the Installation of the Alarm Card

To verify router operation after installing a replacement alarm card, see the "Verifying the Installation of Alarm Cards, Clock Scheduler Cards, and Switch Fabric Cards" section on page 5-57.

Verifying the Installation of Alarm Cards, Clock Scheduler Cards, and Switch Fabric Cards

To verify proper router operation after installing a replacement CSC or SFC, you can visually check the LEDs on the two alarm cards.

Figure 5-35 shows the location of the alarm card LEDs.

Figure 5-35   Alarm Card LEDs

1	MBus status LED	**4**	Critical alarm LED
2	CSC status LEDs (two)	**5**	Major alarm LED
3	SFC status LEDs (three)	**6**	Minor alarm LED

The following LED conditions are displayed when the system is operating properly:

Note   Green = Enabled, amber = Fail

- The following green LEDs are normally on:
    - The MBUS status LED
    - Two CSC status LEDs
    - Three SFC status LEDs

- The following amber LEDs are normally off:
  - The MBUS status LED
  - Two CSC status LED
  - Three SFC status LEDs

- The three amber router alarm (Critical, Major, Minor) LEDs are normally off.

See the "Troubleshooting the Processor Subsystem" section on page 4-13 if the alarm cards indicate an error condition.

Upgrading the RP and Line Card Memory

To upgrade the RP and line card memory, refer to the *Cisco 12000 Series Router Memory Replacement Instructions*.

This publication contains the latest information about memory requirements and replacement procedures for the Cisco XR 12406 router RP and line cards. Consult this publication before replacing memory on your RP or line card, or adding memory to your RP or line card.

You can find Cisco XR 12000 Series Router memory replacement instructions at Cisco.com.

Cisco XR 12406 Router Technical Specifications and Warnings

This appendix provides technical specifications, regulatory information, and translated safety warnings and agency approvals for the Cisco XR 12406 Router.

Specifications

This section lists the Cisco XR 12406 Router specifications in these tables:

- For physical specifications, see Table A-1 on page A-1
- For electrical specifications for systems equipped with the AC-input power subsystem, see Table A-2 on page A-2
- For electrical specifications for systems equipped with the DC-input power subsystem, see Table A-3 on page A-3
- For a list of the environmental specifications, see Table A-4 on page A-4

Table A-1   Cisco XR 12406 Router Physical Specifications

Description	Value
Chassis height	18.5 in (46.9 cm)
Chassis width	17.3 in (43.9 cm)

Table A-1   Cisco XR 12406 Router Physical Specifications (continued)

Description	Value
Chassis depth	28.0 in (71.1 cm), including cable-management system
Weight	
• Chassis, minimum configuration	140 lb (64 kg)
• Chassis fully configured, using all card slots, and 2 AC input power supplies	205 lb (93 kg)

The electrical specifications and values listed in Table A-2 are for a Cisco XR 12406 Router system equipped with the AC-input power distribution unit (PDU) and AC-input power supply modules.

Table A-2   AC-Input Power Supply Electrical Specifications

Description	Value
Rated input voltage[1]	Original Cisco XR 12000 series routers: 100–240 VAC nominal (range: 85 to 264 VAC) 220–240 VAC (UK) Enhanced Cisco XR 12000 series routers: supports 220 VAC only.
Rated input line frequency[1]	50/60 Hz nominal (range: 47 to 63 Hz) 50/60 Hz UK
Input current rating[1]	15A maximum @ 200 VAC
Source AC service requirement[1]	20A North America; 16A international; 13A UK
Nominal output voltage and current	–54.5 VDC @ 30A maximum
Total AC input power	1708 VA (original series) 2600 VA (enhanced series)
Redundancy	2 AC-input power supply modules are required for 2N redundancy

1. For each AC-input power supply module.

⚠

Caution   To ensure that the chassis configuration complies with the required power budgets, use the on-line power calculator. Failure to properly verify the configuration may result in an unpredictable state if one of the power units fails. Contact your local sales representative for assistance.

The electrical specifications and values listed in Table A-3 are for a Cisco XR 12406 Router system equipped with the DC-input PDU and DC-input power entry modules (PEMs).

Table A-3   DC Power Entry Module Electrical Specifications

Description	Value
Rated input voltage[1]	–48 VDC nominal in North America –60 VDC nominal in the European Community (range: –40.5 to –75 VDC)
Input current rating[1]	60A maximum @ 40.5 VDC
Source DC service requirement[1]	60A
Nominal output voltage and current	–48 VDC @ 40A maximum
Total DC input power	1630 VA (original series) 2600 VA (enhanced series)
Redundancy	2 DC-input PEMs are required for 2N redundancy

1. For each DC-input PEM.

⚠

Caution   To ensure that the chassis configuration complies with the required power budgets, use the on-line power calculator. Failure to properly verify the configuration may result in an unpredictable state if one of the power units fails. Contact your local sales representative for assistance.

Cisco XR 12406 Router Installation Guide

Table A-4   Cisco XR 12406 Router Environmental Specifications

Description	Value
Temperature	32° to 104°F (0° to 40°C) operating −4° to 149°F (−20° to 65°C) non-operating
Humidity	10 to 90% noncondensing operating 5 to 95% noncondensing non-operating
Altitude	0 to 10,000 ft. (0 to 3,050 m) operating 0 to 30,000 ft. (0 to 9,144 m) non-operating
Heat dissipation	5,828 Btu/hr maximum (AC original series) 8,871 Btu/hr maximum (AC enhanced series) 5,562 Btu/hr maximum (DC original series) 8,871 Btu/hr maximum (DC enhanced series)
Cooling	Facing the router, right-side-to-back cooling
Shock	5 to 500 Hz, 0.5g[1] (0.1 oct/min[2]) operating 5 to 100 Hz, 1g (0.1 oct/min) non-operating 100 to 500 Hz, 15g (0.2 oct/min) 500 to 1,000 Hz, 1.5g (0.2 oct/min)

1. g = Gravity

2. oct/min = Octave per minute

⚠

Caution   Exhaust from other equipment vented directly into the Cisco XR 12406 Router air inlet may cause overheating. Install the router so that it is protected from a direct flow of hot air from other equipment.

Alarm Card Alarm Relay Connector Specifications

The alarm card alarm relay connector is a standard DB-9 connector. The relay interface is rated at max 2A, 60V, or 50VA, whichever is greater. The connector pins and their definitions are listed in Table A-5.

Table A-5   Alarm Card Alarm Relay Contact Connector Pinout

Pin	Name	Definition
1	Critical_NO	Critical, normally open contact
2	Critical_C	Critical, common contact
3	Major_NO	Major, normally open contact
4	Minor_NO	Minor, normally open contact
5	Minor_C	Minor, common contact
6	Critical_NC	Critical, normally closed contact
7	Major_NC	Major, normally closed contact
8	Major_C	Major, common contact
9	Minor_NC	Minor, normally closed contact

Compliance Information

Compliance information for the Cisco XR 12406 Router is presented in the following tables:

- Table A-6, "Electromagnetic Emissions Requirements"
- Table A-7, "Immunity Tests"
- Table A-8, "Network Equipment Building Systems—NEBS"
- Table A-9, "European Telecommunication Standards Institute—ETSI"
- Table A-10, "Safety Approval Requirement"

Table A-6   Electromagnetic Emissions Requirements

Country	Standard Requirements	Class: Up to 1 GHz
Australia	AS/NZS 3548:1995	A
Canada	ICES003-1998/CISPR22:1996	A
Hungarian	MSZEN55022	A
Japan	VCCI V-3/99.04	A
Korea	EN55022-1998/EN50082-1	A
New Zealand	AS/NZS 3548:1995	A
Singapore	CISPR22:1996	A
Taiwan	BSMI/CNS 13438	A
USA	FCC CFR 47-PART 15 1998	A[1]
China/others	CISPR22:1997	A
Europe/EU	EN55022-1998/EN55024-ITE	B
ETSI	EN 300386-2/EN55022	B (Noncentral office)

1. Up to 40 GHz

Table A-7   *Immunity Tests*

Test Type or Specification	Applies to	Class/Level/Criteria
Electrostatic Discharge EN61000-4-2:1995	System/enclosure	Level 4/8KV contact, 15KV air/B
Radiated Immunity IEC61000-4-3:1995 ENV50140:1993	System/enclosure	Level 3/10V/m/A 1KHz 80% AM (80MHz - 1 GHz)
Fast Transients EN61000-4-4:1995	AC power lines	Level 4/4 KV 2.5 kHz Rep Freq/B
	DC lines	Level 4/4 KV 2.5 kHz Rep Freq/B
	Signal lines	Level 4/1 KV 5kHz Rep Freq/A Level 4/2 KV 5kHz Rep Freq/B
Surge Immunity EN61000-4-5:1995	AC power line (live-neutral) 2 ohms	Class 4/2KV/B
	AC power line (live-earth) 12 ohms	Class 4/4KV/B
	DC power line (live-earth)	Class 4/500V/B
	DC Power line (return-earth)	Class 4/500V/B
	Signal lines 2 ohms	Indoor: 500V Outdoor: 4KV/R
Conducted RF Immunity EN61000-4-6:1996+ ENV50141:1993	AC power line DC power line Signal lines	Level 3/10V/A (150kHz-80MHz)
Voltage Dips + Sag Interruptions AC Power Lines EN61000-4-11:1995	AC power lines	30% 10 ms (0.5 period)/B 30% 5000ms (25 periods) 60% 100 ms (5 periods)/C 60% 1000 ms (50 periods) >95% 10ms (0.5 period)/C >95% 5000 ms (250 periods)

Table A-8   Network Equipment Building Systems—NEBS

NEBS Requirements
SR-3580—NEBS criteria levels (Level 3-compliant)
GR-1089-Core—NEBS EMC and safety
GR-63-Core—NEBS physical protection

Table A-9   European Telecommunication Standards Institute—ETSI

ETSI Specifications
ETS 300 386-1—Levels for equipment with a "high priority of service" that is installed in "locations other than telecommunication centers."
ETS 300 386-2:1997—Levels for equipment with a "high priority of service" that is installed in "locations other than telecommunications centers."
ETSI 300 132-2: September 1996—DC power supply interfaces at the input to telecommunications equipment Sections 4.8, 4.9.

Table A-10   Safety Approval Requirement

Category	Approval Agency and Requirement
Safety Certification	UL 1950 CSA-22.2 No. 950 EN60950 ACA TS001 AS/NZS 3260 IEC60950 EN60825

Regulatory, Compliance, and Safety Information

This section includes regulatory, compliance, and safety information in the following sections:

Translated Safety Warnings and Agency Approvals

The complete list of translated safety warnings and agency approvals is available in the *Regulatory Compliance and Safety Information for Cisco 12000 Series Routers* publication (Document Number 78-4347-19).

Electromagnetic Compatibility Regulatory Statements

FCC Class A Compliance

This equipment was 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 installation guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you are required to correct the interference at your own expense.

Modifying the equipment without Cisco authorization may result in the equipment no longer complying with FCC requirements for Class A digital devices. In that event, your right to use the equipment may be limited by FCC regulation and you may be required to correct any interference to radio or television communication at your own expense.

You can determine whether your equipment is causing interference by turning it off. If the interference stops, it was probably caused by the Cisco equipment or one of its peripheral devices. If the equipment causes interference to radio or television reception, try to correct the interference by using one or more of the following measures:

- Turn the television or radio antenna until the interference stops.

- Move the equipment to one side or the other of the television or radio.

- Move the equipment farther away from the television or radio.

- Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

CISPR 22

This apparatus complies with CISPR 22/EN55022 Class B radiated and conducted emissions requirements.

Canada

English Statement of Compliance

This class A digital apparatus complies with Canadian ICES-003.

French Statement of Compliance

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Europe (EU)

This apparatus complies with EN55022 Class B and EN55024 standards when used as ITE/TTE equipment, and EN300386 for Telecommunications Network Equipment (TNE) in both installation environments, telecommunication centers and other indoor locations.

VCCI Class A Notice for Japan

⚠

Warning   **This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio disturbance may arise. When such trouble occurs, the user may be required to take corrective actions.** Statement 191

警告   これは、情報処理装置等電波障害自主規制協議会（VCCI）の規定に基づく クラスA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取るように要求 されることがあります。

Class A Notice for Hungary

⚠

Warning   **This equipment is a class A product and should be used and installed properly according to the Hungarian EMC Class A requirements (MSZEN55022). Class A equipment is designed for typical commercial establishments for which special conditions of installation and protection distance are used.** Statement 256

Figyelem   **Figyelmeztetés a felhasználói kézikönyv számára: Ez a berendezés "A" osztályú termék, felhasználására és üzembe helyezésére a magyar EMC "A" osztályú követelményeknek (MSZ EN 55022) megfeleloen kerülhet sor, illetve ezen "A" osztályú berendezések csak megfelelo kereskedelmi forrásból származhatnak, amelyek biztosítják a megfelelo speciális üzembe helyezési körülményeket és biztonságos üzemelési távolságok alkalmazását.**

Class A Notice for Taiwan and Other Traditional Chinese Markets

⚠

Warning   **This is a Class A Information Product, when used in residential environment, it may cause radio frequency interference, under such circumstances, the user may be requested to take appropriate countermeasures.** Statement 257

警告   這是甲類資訊產品，在居住環境中使用時，可能會造成射頻干擾，
在這種情況下，使用者會被要求採取某些適當的對策。

Class A Notice for Korea

⚠

Warning   **This is a Class A Device and is registered for EMC requirements for industrial use. The seller or buyer should be aware of this. If this type was sold or purchased by mistake, it should be replaced with a residential-use type.** Statement 294

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Compliance Label

The compliance information label is located on the Cisco 12006 and Cisco 12406 Router as shown in Figure A-1.

Figure A-1   *Compliance Information Label*
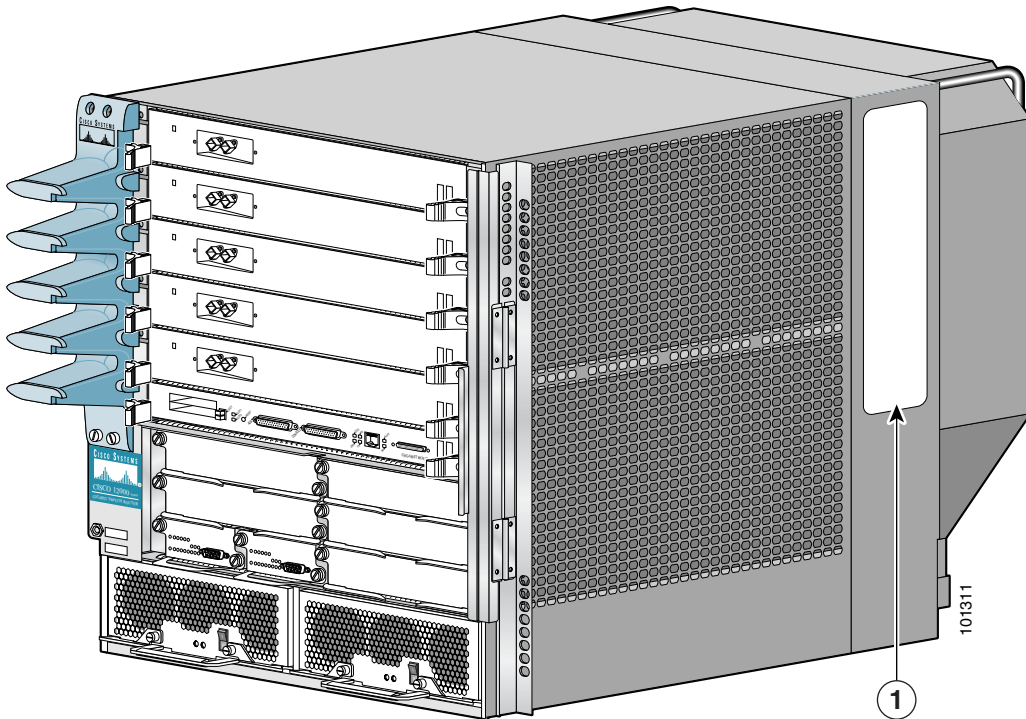
1	Compliance information label

Router Performance Upgrades and Model Identification

The compliance information label on the side of the chassis also identifies the Cisco XR 12000 Series Router by its model number. The model number indicates the router is in the Cisco XR 12000 Series, the maximum switching capacity the router supports, and the number of line card and RP slots in the chassis.

For example, the Cisco XR 12406 router features 120 Gbps switching capacity in a 6-slot, 10-Gigabit per slot chassis. Table A-11 shows the Cisco XR 12406 Router model comparison information based on chassis slot counts, maximum switching capacity, and switch fabric type.

Table A-11   Cisco XR 12406 Router Model Comparison

Model	Chassis Slots	Switching Capacity	Switch Fabric Identification
12406	6	120 Gbps	SFC and CSC

On Cisco XR 12000 series routers that support switching capacity increases through switch fabric upgrades, observe the following administrative considerations after you perform the upgrade and verify its installation:

- The switch fabric upgrade does not include a new label that identifies the router by the new model number. The compliance label on the router chassis does not change. This could confuse technicians who might service the router in the future. We recommend that the upgrade technician take any required administrative steps to make the new, post-upgrade router identity outwardly obvious.

- If steps are not taken to identify a router with upgraded switch fabric, the alternative methods for identifying an upgraded router are through either Cisco IOS XR software commands or the Cisco identification labels on the switch fabric cards (SFCs and CSCs) installed in the router. Table A-11 lists the router models and their corresponding switch fabric card identification labels.

APPENDIX **B**

Repacking the Router

To repack your Cisco XR 12406 router for shipment, use the following repacking information and procedures:

Transporting and Storing the Router

The shipping package for the Cisco XR 12406 router is engineered to reduce the potential of product damage associated with routine material handling experienced during shipment. To minimize potential damage to the product, transport these products in their Cisco packaging. Failure to do so may result in damage to the router or degradation of its performance. Do not remove the router from its shipping container until you are ready to install it. Keep the router in the shipping container until you have determined where you will install it. The router should always be transported or stored in an upright position.

> **Note** If the original packing material has been lost or is damaged, order a replacement packaging kit (Product Number: GSR6-PKG=).

Shipping Package Overview

Figure B-1 shows a Cisco XR 12406 router in an exploded view of the router shipping package.

Figure B-1   Cisco XR 12406 Router Packing Components
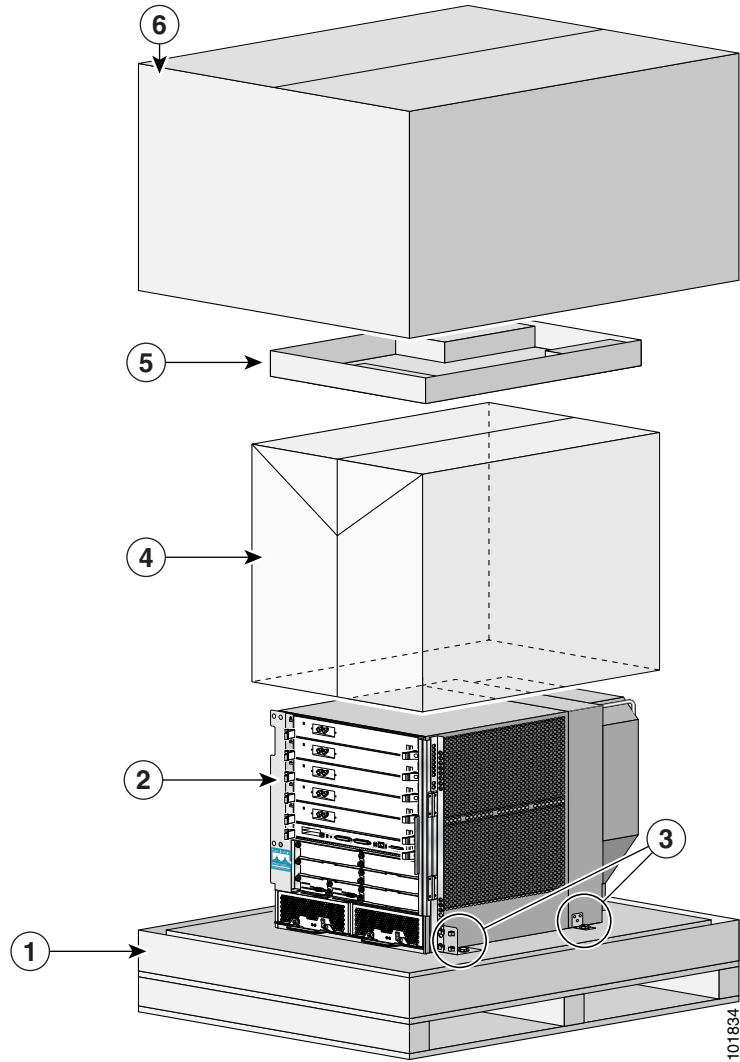
1	Pallet base	**4**	Plastic bag
2	Router	**5**	Accessory kit tray
3	Hold-down brackets with bolts	**6**	Outer shipping carton

Tools and Equipment

You will need the following tools and equipment to repack the router for shipping:

- Router packaging kit
- ESD-preventive wrist strap
- Number 1 and Number 2 Phillips screwdrivers
- 9/16-inch wrench
- 10-mm wrench (either open-end or socket)
- Plastic carton straps and strap installation tools

Safety Recommendations

Before you begin the router repacking procedures, review the following safety information:

- The safety recommendations listed in the "Safety and Compliance" section on page 2-2 of this guide.
- The safety warnings listed in the Cisco publication *Regulatory Compliance and Safety Information for the Cisco XR 12000 Series Router* (Document Number 78-4347-19) that accompanied your router.

Repacking the Router

Repacking the Cisco XR 12406 router into the shipping container is presented in the following procedure. This procedure assumes you have repacked the accessory kit and have the anchor clips and angle brackets, bolts, screws, and carton that were removed when the chassis was unpacked.

There are three phases in the repacking process:

1. Securing the router to the pallet base (Figure B-2).

2. Reassembling the protective packaging around the router on the pallet base (see Figure B-1).

3. Strapping the entire package to the pallet base (Figure B-3).

Figure B-2   Securing the Router to the Pallet Base
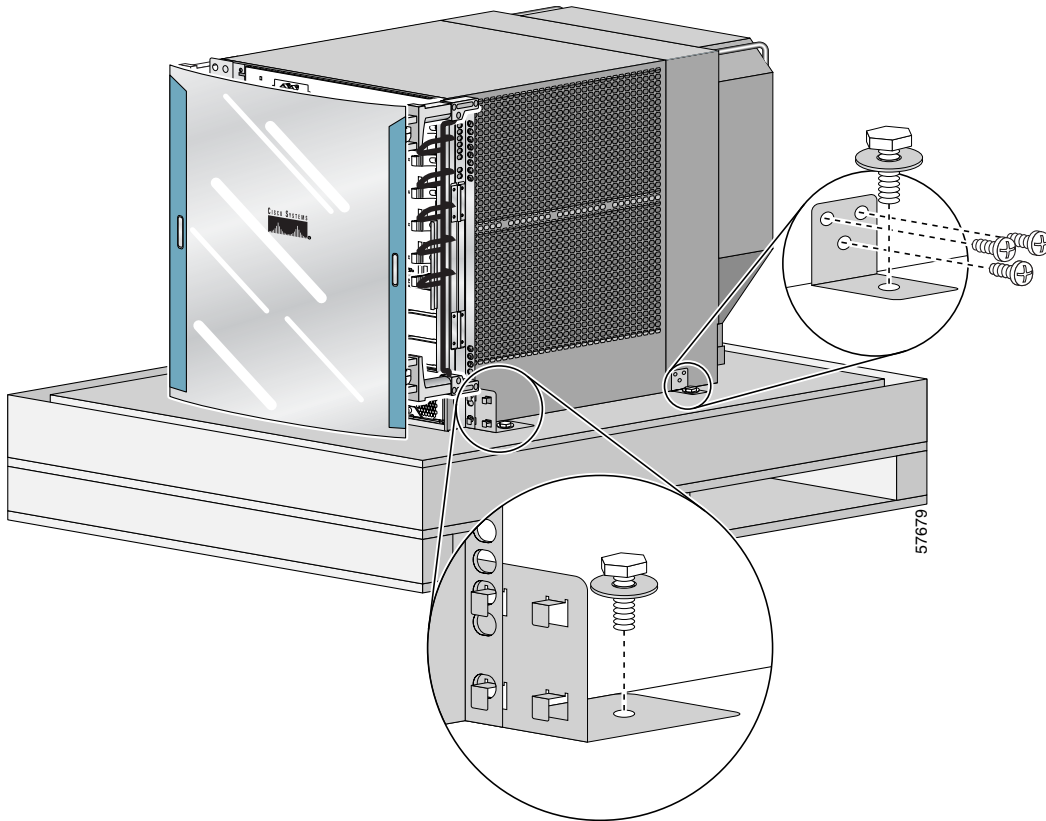
To repack the router, follow these steps:

Step 1   Place the router on the pallet base.

Step 2   Install the two anchor clips on the front of the chassis (see Figure B-2):

   a. Set the hold-down clips in the bottom holes of the rack-mounting flanges on either side of the chassis.

   b. Align the bolt holes in the anchor clips with the bolt holes in the pallet base.

   c. Insert and loosely tighten the bolts to secure the anchor clips to the pallet base.

Cisco XR 12406 Router Installation Guide

Step 3   Install the angle brackets on the sides of the chassis (see Figure B-2):

  a. Set the side of the bracket with the three screw holes against the side of the chassis and align the holes with the holes in the side of the chassis.

  b. Insert and loosely tighten the three screws you saved when the chassis was unpacked.

  c. Align the bolt holes in the angle brackets with the bolt holes in the pallet base.

  d. Insert and loosely tighten the bolts to secure the brackets to the pallet base.

Step 4   Place the plastic bag cover over the router (see Figure B-1).

Step 5   Place the accessory kit on top of the router (see Figure B-1).

Step 6   Place the cardboard carton over the accessory kit and router (see Figure B-1).

Step 7   Secure the cardboard carton to the pallet with plastic-type straps similar to the ones used to ship the router to you (see Figure B-3).

The router is ready for shipment.

Figure B-3   Packaged Router Secured to Pallet

Repacking the Router

I N D E X