Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Site Planning Guide

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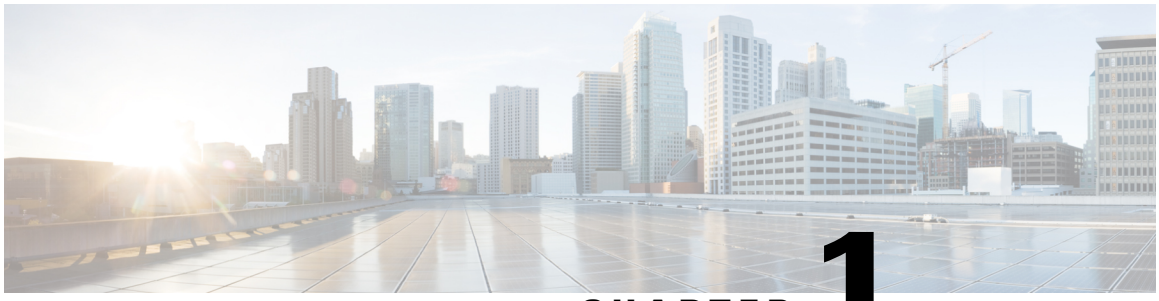


CHAPTER 1

Preface

This preface explains the objectives, intended audience, and organization of this Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Site Planning Guide, referred to in this document as the site planning guide , and describes the conventions used in the document.

Objectives

This guide describes the basic facilities requirements, such as floor space, power requirements, environmental requirements, and so on, for the Cisco CRS 16-Slot Line Card Chassis (LCC). This guide is intended to help you in planning the site where the chassis will be installed. It should be used with Cisco Systems, Inc. site planning coordinators and site inspectors, well in advance of the delivery of the chassis.

Audience

This guide is intended for anyone who plans the facilities, including space, rack-mounting, power, cooling, cabling, delivery, and storage, for the delivery and installation of a Cisco CRS 16-Slot LCC.

Organization

This document contains the following chapters and appendices:

Title	Description
Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Overview	Describes the Cisco CRS routing system and presents an overview of the steps required to prepare the site for the installation of a LCC.
Space Planning	Provides information about chassis space requirements and other site preparation details (for example, floor loading and securing the chassis to the floor).
Power and Cooling Requirements	Describes the power and cooling requirements for the chassis.
Shipping and Receiving	Describes the things to consider as you plan for the shipment of the chassis and transport to the installation site.
System Planning Considerations	Provides information about system planning considerations, such as high availability.
Product IDs	Provides the product identifiers (IDs) for orderable chassis components.
Preliminary Site Survey	Contains a sample preliminary site survey in which to enter information about the installation site and site-preparation process.
Cisco CRS Series Carrier Routing System 16-Slot Line Card Chassis Specifications	Lists the chassis specifications and provides information about wire gauges and resistances for DC power cabling.

Documentation Conventions

This document uses the following conventions:

Convention	Description
bold font	Commands and keywords and user-entered text appear in **bold** font.
Italic font	Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font.
[ ]	Elements in square brackets are optional.
{x | y | z}	Required alternative keywords are grouped in braces and separated by vertical bars.

Convention	Description
[x | y | z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
`courier` font	Terminal sessions and information the system displays appear in `courier` font.
	Indicates a variable for which you supply values, in context where italics cannot be used.
< >	Nonprinting characters such as passwords are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Note *Means reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Tip *Means the following information will help you solve a problem*. The tips information might not be troubleshooting or even an action, but could be useful information, similar to a Timesaver.

Caution *Means reader be careful*. In this situation, you might perform an action that could result in equipment damage or loss of data.

Warning IMPORTANT SAFETY INSTRUCTIONS

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. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.

SAVE THESE INSTRUCTIONS

Warning Statements using this symbol are provided for additional information and to comply with regulatory and customer requirements.

Related Documentation

This section refers you to other documentation that contains complete planning, installation, and configuration information.

The documentation listed below is available online.

- *Cisco CRS Carrier Routing System 16-Slot Line Card Chassis System Description*
- *Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Installation Guide*
- *Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Unpacking, Moving, and Securing Guide*
- *Cisco CRS Carrier Routing System Ethernet Physical Layer Interface Module (PLIM) Installation Note*
- *Cisco CRS Carrier Routing System Packet-over-SONET/SDH Physical Layer Interface Module Installation Note*
- *Cisco CRS Fiber-Optic Cleaning Kit Quick Start Guide*
- *Cisco CRS Carrier Routing System Hardware Documentation Guide*
- *Cisco CRS Carrier Routing System Regulatory Compliance and Safety Information*

Changes to This Document

This table lists the technical changes made to this document since it was first created.

Table 1: Changes to This Document

Date	Summary
July 2014	Added support for new 2x100GE-FLEX-40 PLIM. Added updates to support the Cisco CRS-X back-to-back and multishelf systems, which include new CRS-16-FC400/M switch fabric card.
January 2014	Added updates to support the Cisco CRS-X, which includes new line cards, switch fabric cards, and PLIMs.
September 2011	Updated Appendix A, *Product IDs* and Appendix C, *Cisco CRS Series Carrier Routing System 16-Slot Line Card Chassis Specifications*.
May 2011	Updated the *Shipping and Receiving* with information about moving the chassis using the dolly supplied by Cisco.

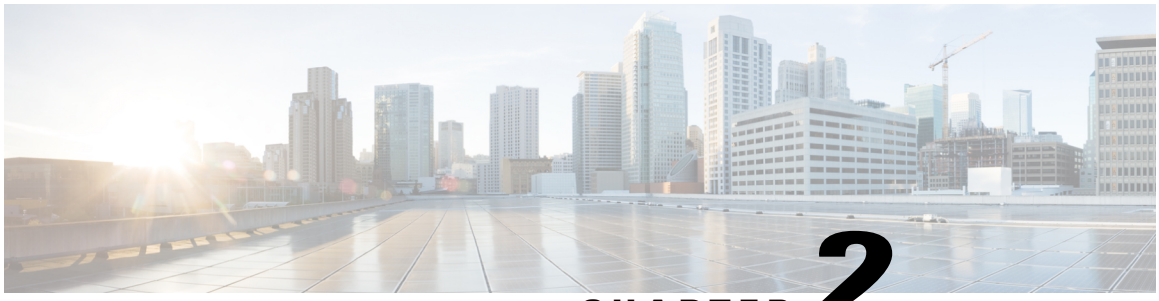
Date	Summary
April 2011	Added information about new CRS-16-PRP-6G and CRS-16-PRP-12G Performance Route Processor (PRP) cards. Technical updates and minor editorial changes were also made.
March 2011	Added information about new modular configuration AC and DC power systems. Added product IDs for the modular configuration power components.
October 2010	Added information about new MSC140 and FP140 line cards; 4-port, 8-port, 14-port, and 20-port 10-GE XFP PLIMS; and 1-port 100-GE CFP PLIM. Technical updates and minor editorial changes were also made.
January 2010	Updated weight and floor loading values.
February 2008	Updated the document with technical corrections.
August 2007	Revision includes technical corrections and other updates throughout the document.
June 2007	Updated the two-pole DC power requirements.
September 2006	Revision includes general technical corrections.
April 2006	Changed document title.
December 2005	Reorganized the document to more closely align with the steps in the site preparation process. Updated the *Space Planning*, and *Shipping and Receiving* chapters, with information about chassis dimensions and weight, required aisle clearances, and floor loading. Updated the *Power and Cooling Requirements* chapter, with new information on general power and grounding requirements and DC power requirements, and a few clarifications were made in the AC power section. Updated the *System Planning Considerations* chapter, with information about high availability. Added several new product IDs to Appendix A *Product IDs*. Updated chassis specifications in Appendix C *Cisco CRS Series Carrier Routing System 16-Slot Line Card Chassis Specifications*. Added the *DC Wire Gauge and Resistance* section.

Date	Summary
July 2004 December 2004	The document was released in July and updated with technical corrections in December.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see *What's New in Cisco Product Documentation*, at: http://www.cisco.com/c/en/us/td/docs/general/whatsnew/whatsnew.html.

Subscribe to *What's New in Cisco Product Documentation*, which lists all new and revised Cisco technical documentation as an RSS feed and delivers content directly to your desktop using a reader application. The RSS feeds are a free service.



CHAPTER 2

Cisco CRS 16-Slot Line Card Chassis Overview

This guide describes how to plan and prepare your facilities for the installation of a Cisco CRS Carrier Routing System 16-Slot Line Card Chassis (LCC). Because the installation of a line card chassis may require space, floor loading, power, and cooling modifications to a facility, the site planning should be done well in advance of the scheduled delivery of the system.

Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Overview

This guide describes how to plan and prepare your facilities for the installation of a Cisco CRS Carrier Routing System 16-Slot Line Card Chassis (LCC). Because the installation of a line card chassis may require space, floor loading, power, and cooling modifications to a facility, the site planning should be done well in advance of the scheduled delivery of the system.

Note If you are already familiar with Cisco CRS routers and components, go straight to the *Overview of the Site Planning Steps* section and the Appendix *Preliminary Site Survey*

This chapter describes the Cisco CRS 16-slot LCC and its main components. It contains the following sections:

Overview

The Cisco CRS 16-slot LCC is a highly scalable routing platform designed for efficient service-provider point-of-presence (POP) evolution as the IP network grows into a multiservices network. The Cisco CRS 16-slot LCC, in the initial release, is constructed from a single line card chassis, a mechanical enclosure that contains 16 slots for modular services cards (MSCs) or forwarding processor (FPs) cards and associated physical layer interface modules (PLIMs), and eight slots for the complete or partial switch fabric.

The LCC supports 40G, 140G, and 400G fabric cards, as follows:

- The Cisco CRS-1 Carrier Routing System uses fabric cards designed for 40 G operation (CRS-16-FC/S or CRS-16-FC/M cards).

- The Cisco CRS-3 Carrier Routing System uses fabric cards designed for 140G operation (CRS-16-FC140/S or CRS-16-FC140/M cards).
- The Cisco CRS-X Carrier Routing System uses fabric cards designed for 200G operation (CRS-16-FC400/S or CRS-16-FC400/M in cards in 200G mode).

A mixture of 40G, 140G, and 400G fabric cards is not supported except during migration.

Note Throughout this document, the generic term Cisco CRS Carrier Routing system refers to the Cisco CRS-1, Cisco CRS-3, and Cisco CRS-X Carrier Routing Systems, unless otherwise specified.

The chassis is bolted to the facility floor and does not require an external rack. The chassis contains its own power and cooling systems. Two types of power systems are available: fixed or modular configuration. Both power configurations use either AC or DC power.The chassis also contains route processor cards (RPs) that perform routing-protocol calculations. The RPs distribute forwarding tables to the MSCs and FPs, provide a control path to each MSC or FP for system monitoring functions, and contain hard disks for system and error logging. RPs plug into two dedicated slots in the LCC.

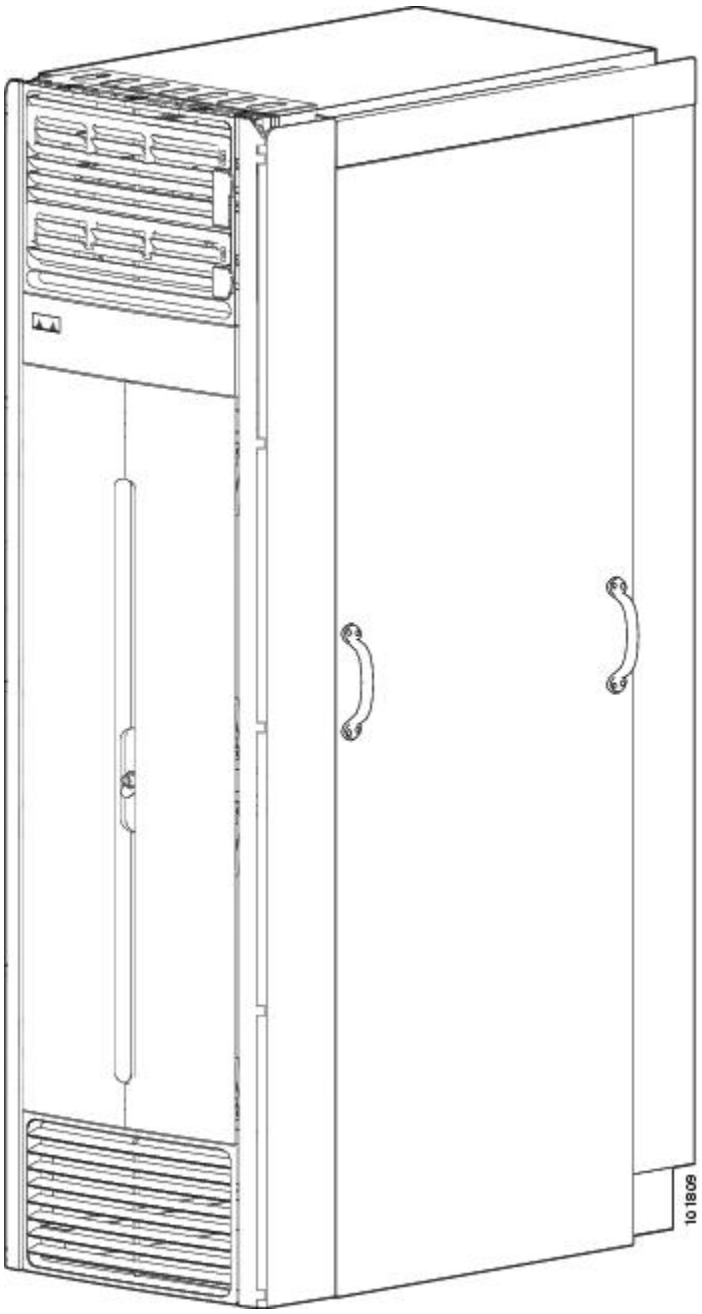
The Cisco CRS 16-slot LCC has 16 MSC slots, each with a capacity of up to 200 gigabits per second (Gbps) ingress and 200 Gbps egress, for a total routing capacity per chassis of 6.4 terabits. (A terabit is 1 x 1012 bits or 1000 gigabits.)

The router is built around a scalable, distributed three-stage Benes switch fabric and a variety of data interfaces. The data interfaces are contained on PLIMs that are mated, in the line card chassis, to an associated MSC or FP. MSCs, and FPs (also referred to as line cards) are cross-connected to each other through the switch fabric.

Note The Cisco CRS router is described in greater detail in Cisco CRS Carrier Routing System 16-Slot Line Card Chassis System Description.

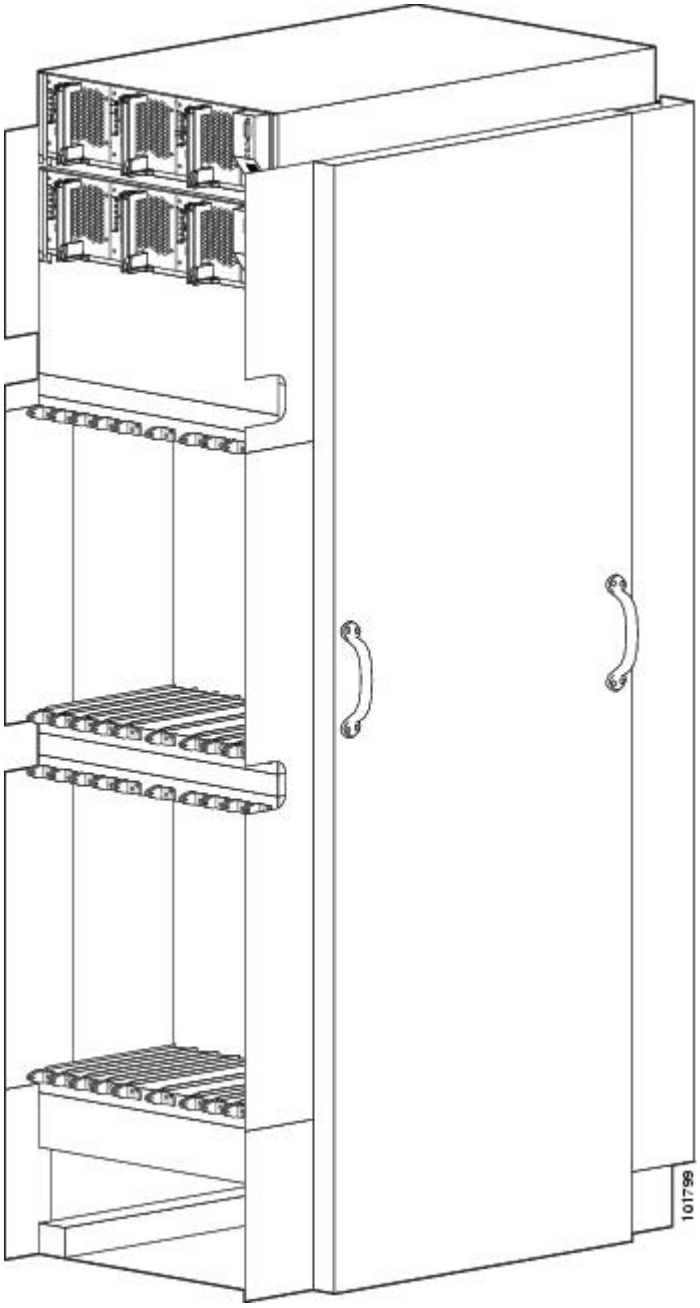
The figure below shows a Cisco CRS single-shelf (standalone) system.

Figure 1: Cisco CRS Single-Shelf (Standalone) Router



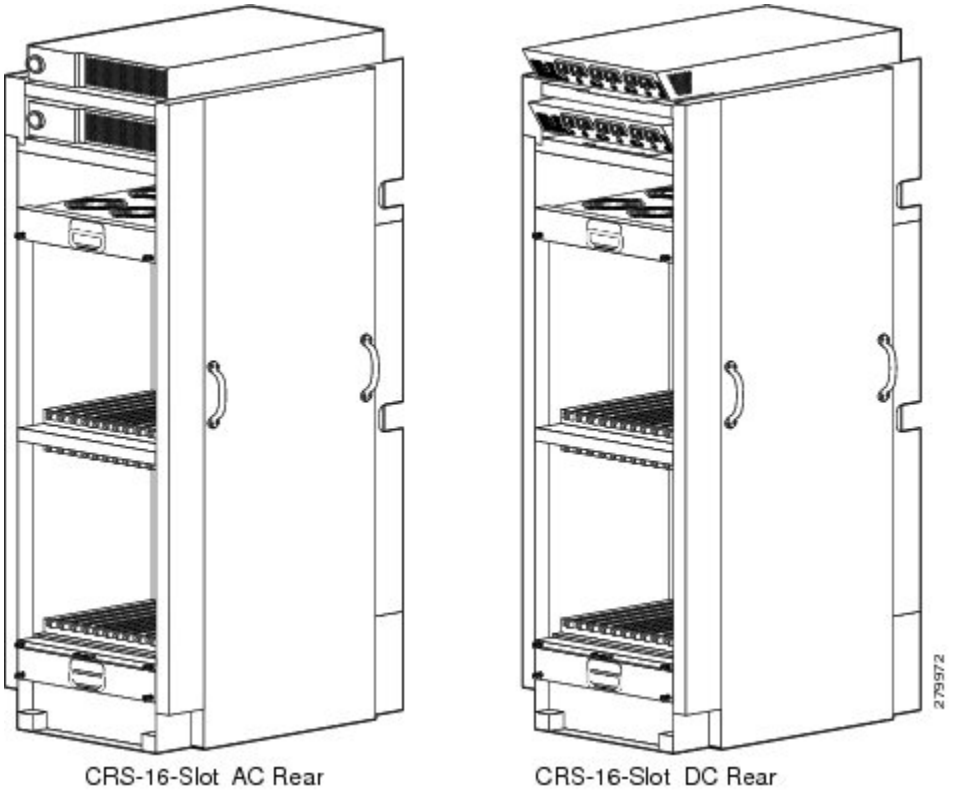
The figure below shows the front view of a Cisco CRS 16-slot line card chassis with a fixed configuration AC power system installed. The front view of a Cisco CRS 16-slot line card chassis with a fixed configuration DC power system installed is similar.

Figure 2: Line Card Chassis Front (PLIM) Side View - Fixed Configuration Power



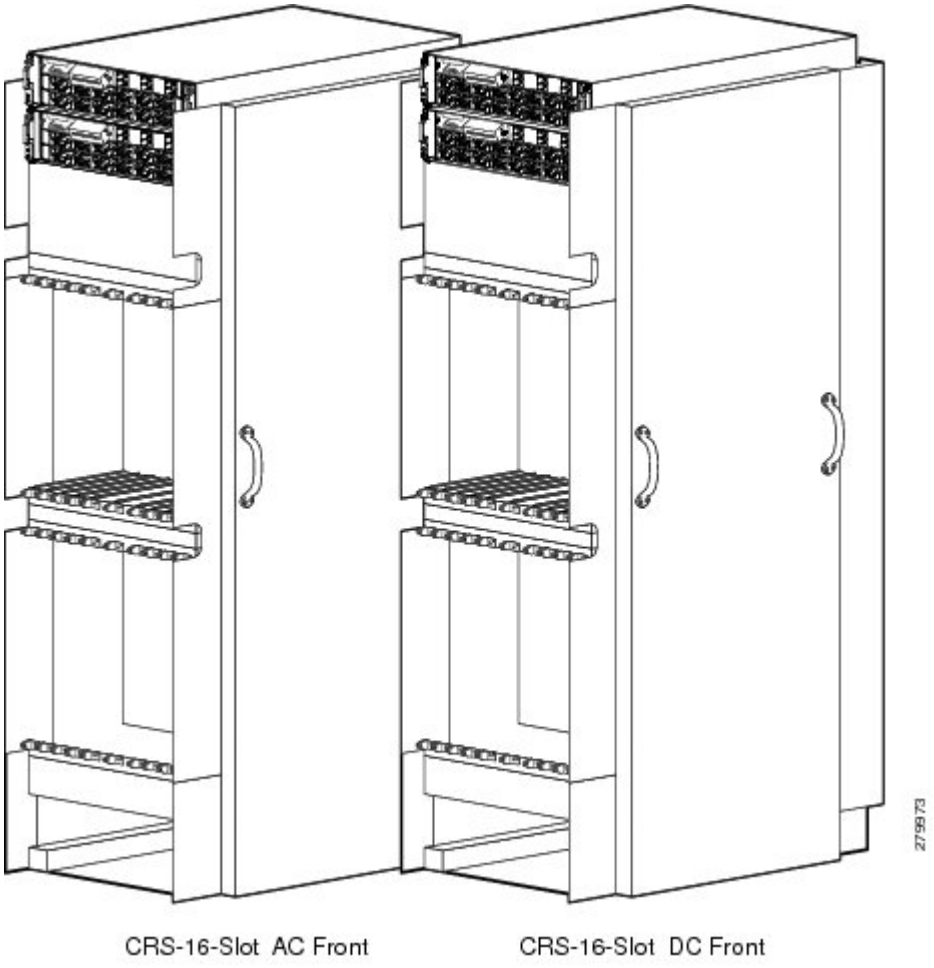
The figure below shows the rear view of a Cisco CRS 16-slot line card chassis with a fixed configuration AC and DC power system installed.

Figure 3: Line Card Chassis Rear (MSC) Side View - Fixed Configuration Power



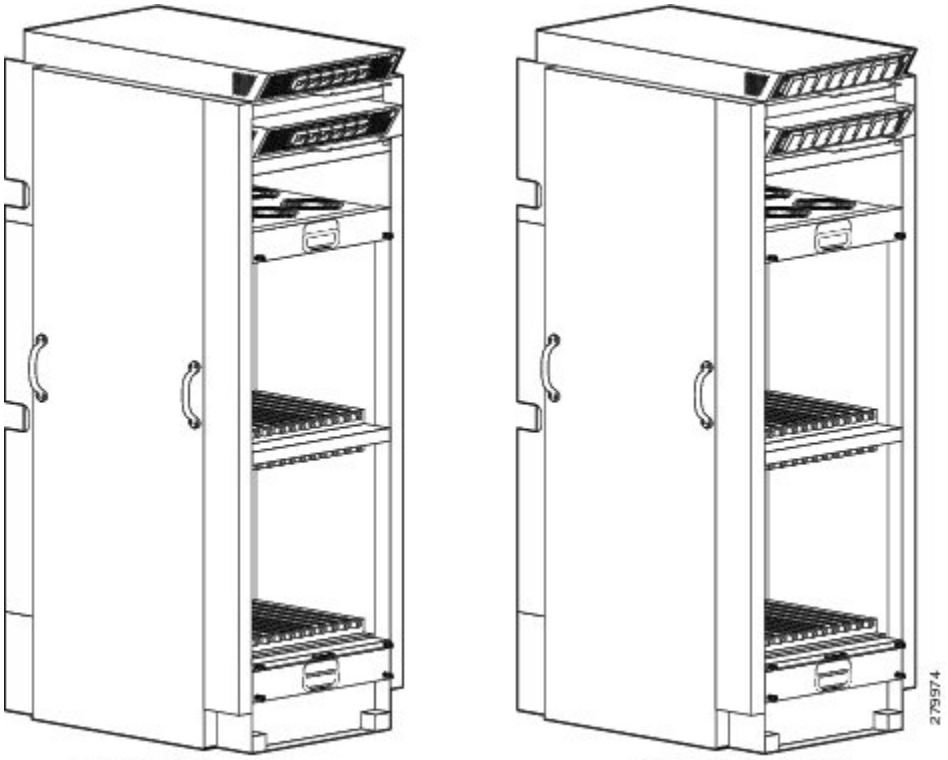
The below figure shows the front view of a Cisco CRS 16-slot line card chassis with a modular configuration AC and DC power system installed.

Figure 4: Line Card Chassis Front (PLIM) Side View - Modular Configuration Power



The figure below shows the rear view of a Cisco CRS 16-slot line card chassis with a modular configuration AC and DC power system installed.

Figure 5: Line Card Chassis Rear (MSC) Side View - Modular Configuration Power



Line Card Chassis Components

The main building block of the Cisco CRS router is the 16-slot line card chassis. The line card chassis is secured to the floor and has locking front and rear doors. No external racks are required for the installation of the chassis.

This section lists the main components of a LCC. It primarily identifies the components that are considered field-replaceable units (FRUs), but where additional detail is useful, identifies subassemblies that are not field replaceable.

The line card chassis contains:

- As many as 16 modular services cards (MSCs) or forwarding processor (FP) cards (also called line cards), and 16 physical layer interface modules (PLIMs). An MSC (or FP) and a PLIM are an associated pair of cards that mate through the chassis midplane. The MSC or FP provides the forwarding engine for Layer 3 routing of user data, and the PLIM provides the physical interface and connectors for the user data.

Note For a complete list of available PLIMs, consult your Cisco sales representatives. or visit http://www.cisco.com/

- ◦ The MSC card is available in the following versions: CRS-MSC (end-of-sale), CRS-MSC-B, CRS-MSC-140G, and CRS-MSC-X (200G mode).
  - ◦ The FP card is available in the following versions: CRS-FP140, CRS-FP-X (200G mode).
  - ◦ The LSP card is: CRS-LSP.
- Each line card can be associated with different types of PLIMs, which provide different interface speeds and technologies. Note the following:
  - ◦ The CRS-MSC-B card is compatible with both 40G CRS-1 and 140G CRS-3 fabric cards.
  - ◦ The CRS-MSC-140G card is only compatible with the 140G CRS-3 fabric card.
  - ◦ The CRS-MSC-X card is only compatible with the 400G CRS-X fabric card.
- Chassis midplane. The midplane connects MSCs and FPs to their associated PLIMs and allows an MSC or FP to be removed from the chassis without having to disconnect the cables that are attached to the associated PLIM. The midplane distributes power, connects the MSCs and FPs to the switch fabric cards, and provides control plane interconnections. The midplane is not field replaceable by the customer.
- Two route processor cards (RPs). The RPs provide the intelligence of the system by functioning as the line card chassis system controller and performing route processing. Only one RP is active at a time. The second RP acts as a "standby" RP, serving as a backup if the active RP fails.

The RP also monitors system alarms and controls the system fans. LEDs on the front panel indicate active alarm conditions.

A Performance Route Processor (PRP) is also available for the Cisco CRS 16-slot line card chassis. Two PRPs perform the same functions as two RPs, but provide enhanced performance for both route processing and system controller functionality.

- (Optional) One or more distributed route processor cards (DRPs), each with a corresponding PLIM. Each DRP and DRP PLIM function as an additional route processor (RP) in the system, providing additional route processing for the Cisco CRS router. By offloading processor-intensive tasks (such as BGP speakers and ISIS) from the RP to the DRP, you can improve system performance.
- Eight switch fabric cards. These fabric cards provide a three-stage Benes switch fabric for the system. The switch fabric receives user data from one MSC (or FP) and PLIM pair and performs the switching necessary to route the data to the appropriate egress MSC (or FP) and PLIM pair.
  - ◦ As a single-shelf (standalone) system, the line card chassis contains switch fabric cards that provide all three stages of the three-stage Benes switch fabric.
  - ◦ As part of a multishelf system, the LCC contains S13 fabric cards that provide Stage 1 and Stage 3 of the switch fabric. S2 fabric cards in the FCCs provide Stage 2 of the fabric, and fabric cables connect the fabric cards to each other.

Note The LCC supports either 40G fabric cards (FC/S cards), 140G fabric cards (FC-140/S cards), or 400G fabric cards (FC-400/S cards in 200G mode). An LCC with a mix of 40G, 140G, and 400G fabric cards is not a supported mode of operation. Such a mode is temporarily allowed only during the upgrade process.

- A power system that provides redundant power to the chassis. Two types of power systems are available: fixed configuration power and modular configuration power. Both power configurations use either AC or DC power and are fully redundant.
- Two alarm modules. The alarm modules provide external alarm system connections. The alarm modules are located in the AC or DC power shelves.
- Two fan controller cards. These cards control the chassis fans, varying their speed to adjust the airflow for ambient conditions.
- Upper and lower fan trays. The upper and lower fan trays are identical and are interchangeable within the chassis. A removable air filter is also located above the lower fan tray.
- Front and rear cosmetics with cable management features. The front (PLIM) side of the chassis has horizontal cable management brackets above both card cages. The rear (MSC) side of the chassis has one cable management bracket located in the middle of the chassis above the lower card cage. The rear cable management bracket is mandatory when the LCC is being installed as part of a multishelf system.

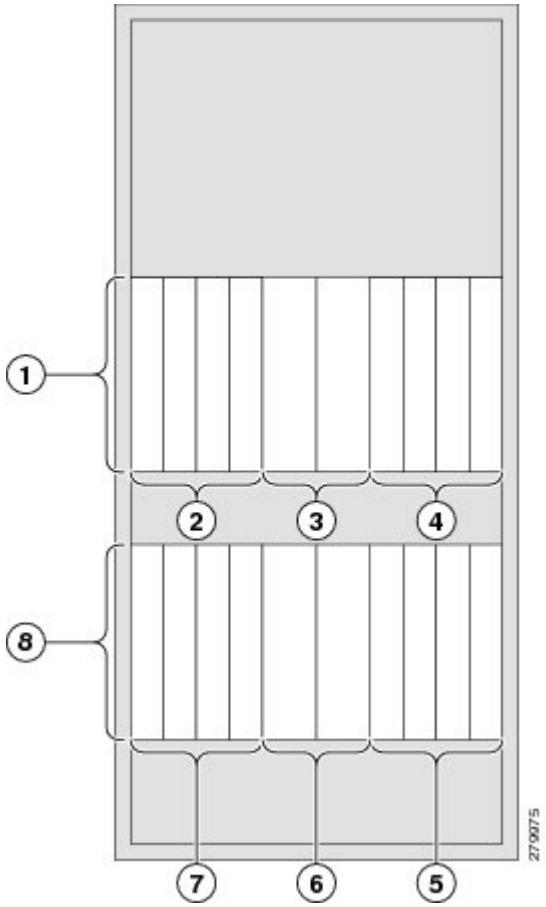
The PLIM side of the chassis is considered the front of the chassis—this is where user data cables attach to the PLIMs and where cool air enters the chassis. The MSC side, which is where warm air is exhausted, is considered the rear of the chassis.

Chassis Slot Numbers

This section identifies the locations of and slot numbers for major cards that plug into the chassis.

The figure below shows the chassis slot numbers on the PLIM side of the Cisco CRS 16-slot line card chassis.

Figure 6: Line Card Chassis Front (PLIM) Side Slot Numbers



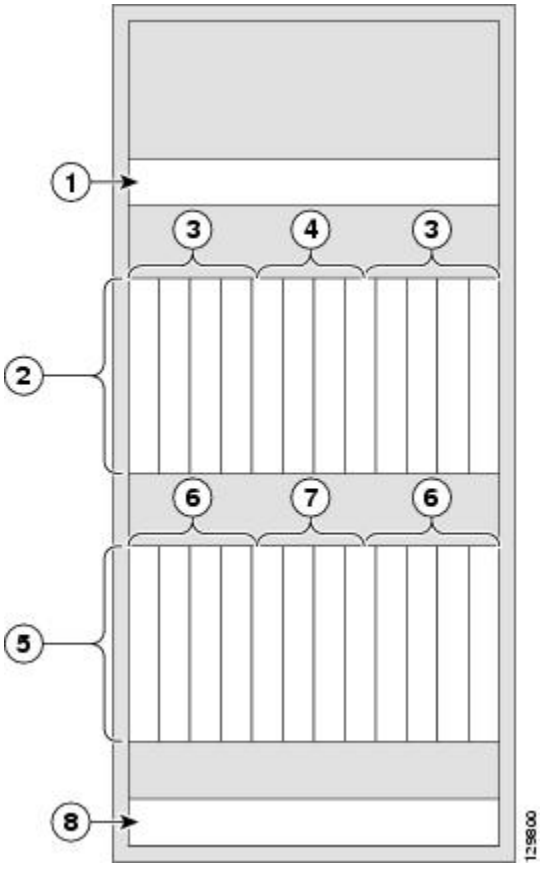
1	Upper PLIM card cage	5	Lower PLIM card slots (12 to 15, left to right)
2	Upper PLIM card slots (0 to 3, left to right)	6	RP card slots (RP0 and RP1)
3	Fan controller card slots (FC0 and FC1)	7	Lower PLIM card slots (8 to 11, left to right)
4	Upper PLIM card slots (4 to 7, left to right)	8	Lower PLIM card cage

As shown in the above figure, the components on the front (PLIM) side of the chassis include:

- Upper PLIM card cage with eight PLIM slots (left to right: 0, 1, 2, 3, 4, 5, 6, 7) spaced around two double-width fan controller card slots, FC0 and FC1. (These thicker-width slots accept only the two fan controllers.)
- Lower PLIM card cage with eight PLIM slots (left to right: 8, 9, 10, 11, 12, 13, 14, 15) and two double-width route processor card slots, RP0 and RP1. (These thicker-width slots accept only the RPs.)

The figure below shows the chassis slot numbers on the rear (MSC) side of the Cisco CRS 16-slot line card chassis.

Figure 7: Rear (MSC) Side Slot Numbers



1	Upper fan tray (FT0)	5	Lower card cage
2	Upper card cage	6	Lower MSC slots (15 to 8, left to right)
3	Upper MSC slots (7 to 0, left to right)	7	Lower switch fabric card slots (SM4 to SM7, left to right)

4	Upper switch fabric card slots (SM0 to SM3, left to right)	8	Lower fan tray (FT1)

As shown in the above figure, the components on the rear (MSC) side of the chassis include:

- Top fan tray (FT0)
- Upper card cage, eight MSC slots (left to right: 7, 6, 5, 4, 3, 2, 1, 0) spaced around four switch fabric card slots (SM0, SM1, SM2, and SM3)
- Lower card cage, eight MSC slots (left to right: 15, 14, 13, 12, 11, 10, 9, 8) spaced around four switch fabric card slots (SM4, SM5, SM6, and SM7)
- Lower fan tray (FT1)

The MSC slot numbers are reversed from the PLIM slot numbers on the other side of the chassis. Because an MSC is associated and actually mates through the midplane with a PLIM, MSC slot 0 is on the far right side of the chassis looking at it from the rear (MSC) side; PLIM slot 0 is on the far left side of the chassis looking at it from the front (PLIM) side. MSC slot 0 and PLIM slot 0 mate with each other through the midplane, and so do all other MSC and PLIM slots (2 through 15).

Overview of Site Planning Steps

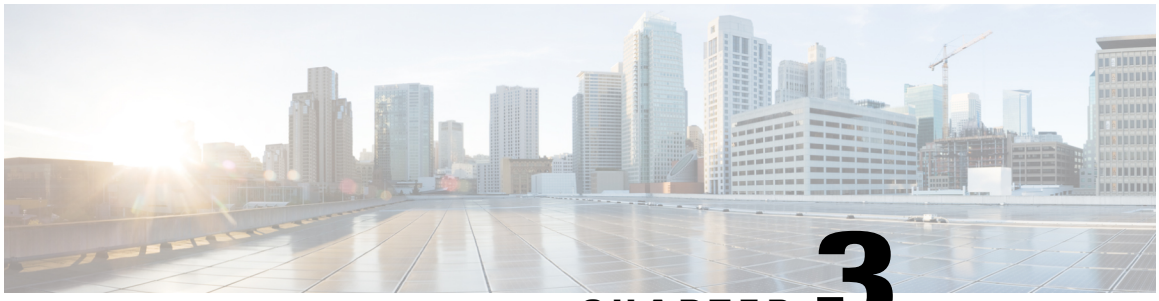
The following table lists the steps to prepare your site for the installation of a Cisco CRS line card chassis. Use the table as a checklist for all aspects of the installation. For information about a particular task, see the appropriate section of this site planning guide. After completing the checklist, you should consult your Cisco installation coordinator for a site readiness inspection.

See the Appendix *Preliminary Site Survey* for a sample of the preliminary site survey that you should complete before you prepare a detailed site survey.

Table 2: Cisco CRS 16-Slot Line Card Chassis Installation Checklist

Site Planning Steps	See	Check
1. Determine where to install the chassis. Ensure that the installation site meets the necessary requirements, including space.	Basic Cisco CRS Routing System Floor Plans, on page 21 Chassis Floor Loading, on page 25 Anchoring the Chassis to the Floor, on page 26	
2. Plan for power (fixed or modular configuration, AC or DC) and grounding.	General Power and Grounding Requirements, on page 30 DC Power System, on page 35 AC Power System, on page 41 Bonding and Grounding Guidelines, on page 31	

Site Planning Steps	See	Check
3. Consider cooling and airflow requirements.	Line Card Chassis Airflow, on page 51 Line Card Chassis Environmental Specifications, on page 92	
4. Consider equipment arrival, storage, and transport to the installation site.	Receiving and Storing Routing System Components, on page 55 Transport to the Installation Site, on page 60	
5. Check if system planning requirements, such as high availability and cable management, have been met.	Planning for High Availability, on page 65 Power Redundancy and Card Placement for High Availability, on page 66 Cable Management, on page 69	



CHAPTER 3

Space Planning

This chapter provides information to help you determine where to install the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis and to plan and prepare the site for the installation of the chassis. It describes the amount of space required for the chassis and provides information about floor loading and drill hole locations for securing the chassis to the floor. This chapter contains the following sections.

Space Planning

This chapter provides information to help you determine where to install the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis and to plan and prepare the site for the installation of the chassis. It describes the amount of space required for the chassis and provides information about floor loading and drill hole locations for securing the chassis to the floor. This chapter contains the following sections:

Basic Cisco CRS Routing System Floor Plans

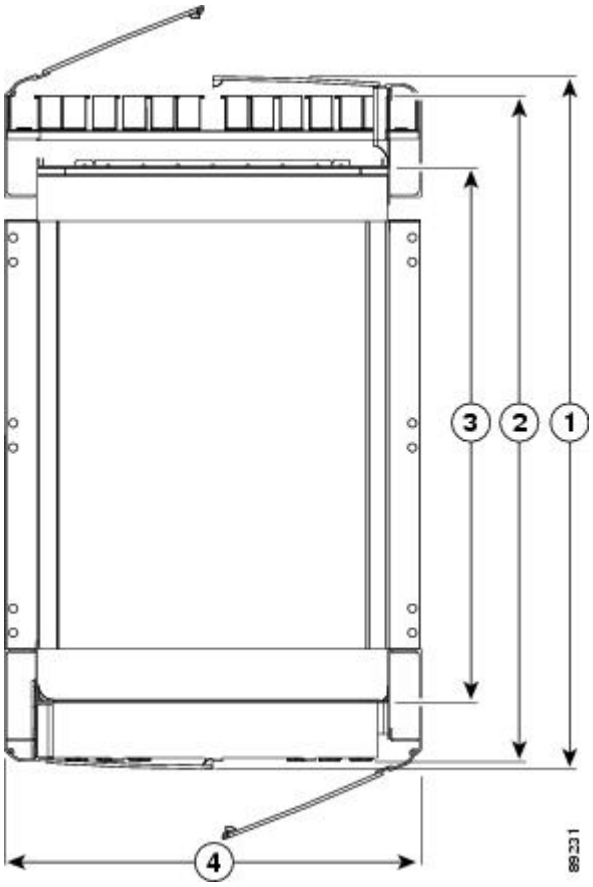
As part of the site planning process, you must decide where to install the Cisco CRS 16-slot line card chassis. As you consider where to install the system, consider the following:

- Installation site floor plan must include:
  - Enough free space for the chassis (see the Line Card Chassis Footprint, on page 22).
  - Adequate space for airflow and enough room to access chassis components for maintenance (see the Aisle Spacing and Maintenance Access Floor Plan, on page 23).
  - Additional free space for potential expansion of the system (see the Planning for Future Expansion, on page 25).
- Floor at the installation site must support the weight of the chassis (see the Chassis Floor Loading, on page 25).
- Chassis must be bolted to the floor, which means that you must drill holes in the floor for the mounting bolts that secure the chassis to the floor (see the Anchoring the Chassis to the Floor, on page 26).

Line Card Chassis Footprint

The figure below is a top view of the line card chassis footprint (with optional front and rear cosmetics installed). The front of the chassis is at the top of the figure.

Figure 8: Top View of Line Card Chassis



1	40.236 in. (102.199 cm)	3	32.766 in. (83.226 cm)
2	38.264 in. (97.191 cm)	4	23.546 in. (59.807 cm)

1	40.236 in. (102.199 cm), depth of LCC with doors attached and closed,
2	38.264 in. (97.191 cm), depth of front cable management to rear cable management, excluding doors

3	32.766 in. (83.226 cm), distance from front surface to rear surface of the chassis, excluding cable management and doorS
4	23.546 in. (59.807 cm), width of chassis

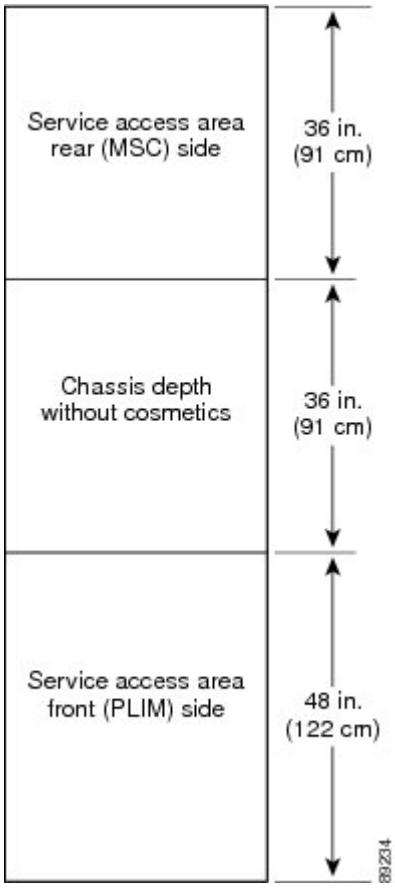
Note A single-shelf (single chassis) system does not require chassis interconnect cabling; therefore, the rear door is optional.

Aisle Spacing and Maintenance Access Floor Plan

Make sure that enough space exists at the installation site to install the line card chassis and allow sufficient airflow. The floor plan must also provide enough room to access chassis components for maintenance (for example, to remove fan trays, power modules, cables, and air filters). We recommend 48 in. (122 cm) clearance

to install the chassis and 36 in. (91.4 cm) clearance to allow for access to chassis components. The below figure shows a typical floor plan.

Figure 9: Cisco CRS 16-Slot Line Card Chassis Floor Plan



Cisco provides two layout templates to help you determine where to install the system:

- Aluminum plate template (CRS-LCC-DRILLTEMP) shows the chassis footprint and the pattern of holes that must be drilled into the floor for the mounting brackets that secure the chassis to the floor. See the Anchoring the Chassis to the Floor, on page 26.
- Mylar template (CRS-LCC-FLOORTEMP) shows the chassis footprint, door swings, and required clearances to remove and replace chassis components. Use this template to plan the aisle space required for the installation and maintenance of a line card chassis.

Note For front-to-front row alignment and back-to-back row alignment, we recommend that adjacent rows of chassis align the front intake to front intake or rear exhaust to rear exhaust.

Planning for Future Expansion

When planning the installation of the Cisco CRS-1 routing system, consider potential expansion of the system, such as adding additional line card chassis (single-shelf systems).

When planning for expansion, consider:

- Floor space for additional chassis
- Power and cooling requirements for additional chassis
- Cable management for additional interconnection cables and line card interface cables
- System management for the larger systems

Chassis Floor Loading

Whether you plan to install the chassis on slab concrete or raised floors, ensure that the floor is level and that it can support the weight of the chassis. The table below lists the chassis weight and floor loading for the line card chassis.

Table 3: Chassis Weight and Floor Loading

Chassis Configuration	Chassis Weight	Floor Loading
Chassis with cards, power components, and front and rear cosmetics (doors, panels, and grilles)	1753 lb (795 kg) (estimated maximum)	371 lb per sq ft(0.18 kg per sq cm)

If you have 3-phase AC Delta or AC Wye at your equipment, a Cisco CRS 3-phase AC power distribution unit (PDU) will be required to convert 3-phase AC input power to single-phase AC input power for the power shelf. The table below lists the weight of two individual PDUs required to be installed for system redundancy, including cables and chassis-mounting brackets.

Table 4: Power Distribution Unit Weight

PDU Type	Weight
CRS-16 Delta PDU (including two PDUs, cables and brackets)	77 lb (35 kg)
CRS-16 Wye PDU (including two PDUs, cables and brackets)	51 lb (23 kg)

For more information about the Cisco CRS 3-Phase AC PDU, refer to the *Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide.*

Anchoring the Chassis to the Floor

The Cisco CRS chassis must be anchored (bolted) to the floor at the installation site. To assist with this task, an aluminum plate template (CRS-LCC-DRILLTEMP) can be ordered. The template provides drill bushings for the chassis mounting-hole locations.

The template shows the chassis footprint and the pattern of holes that must be drilled into the floor for the mounting brackets that secure the chassis to the floor (see the figure below). The template includes several mounting-hole locations:

- Primary—Use these mounting-hole locations whenever possible.
- Secondary—Use these locations if it is not possible to use the Primary locations.
- Aux—Use these locations when there is an obstruction at both the primary and secondary locations (for example, rebar in a concrete floor or a structure beneath a raised floor). For this situation, Cisco provides an outrigger kit (CRS-16-LCC-ALTMNT) that attaches to the chassis to anchor the chassis to the floor. See the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Unpacking, Moving, and Securing Guide for instructions on installing the outrigger kit.

Slab Concrete Floors

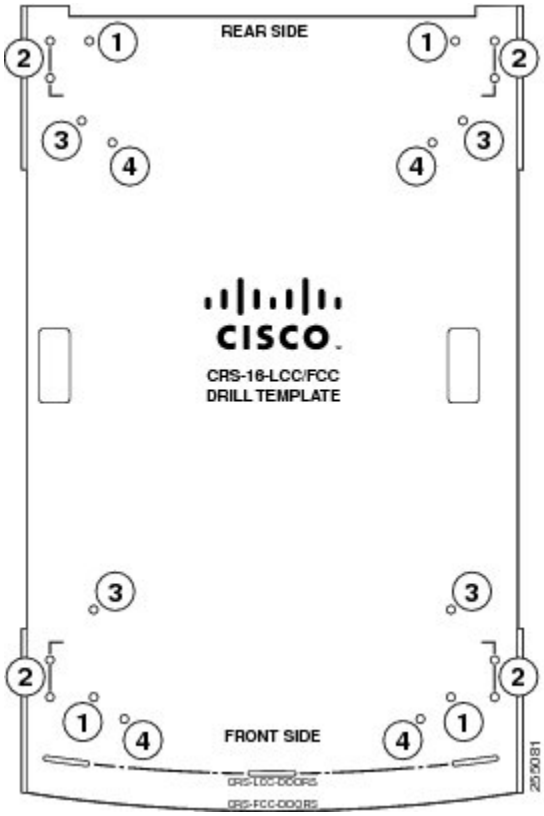
Cisco has contracted with Hilti Corporation to provide a kit for installation of the Cisco CRS chassis on concrete floors. The kit contains instructions, fasteners, and washers. In addition, a nonstandard 18-mm concrete drill is required to install the studs. This drill can be ordered from Hilti.

Raised Floors

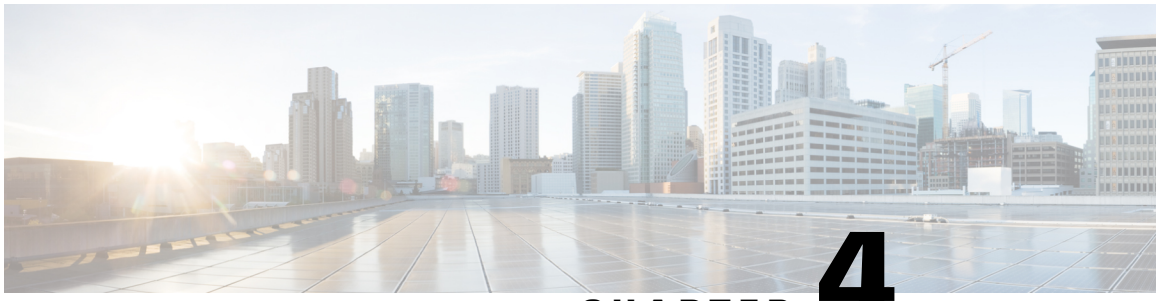
If you plan to install the line card chassis on a raised floor or you need to reinforce the floor to support the weight of the chassis, be sure to follow the instructions from the raised-floor manufacturer.

The figure below shows the drill hole template with the mounting hole locations, which are marked in each of the four corners of the template.

Figure 10: Drill Hole Template



1	Primary LCC/FCC mount location (preferred)	3	Secondary LCC/FCC mount location
2	Aux LCC mount location (requires CRS-16-LCC-ALTMNT kit)	4	Aux FCC mount location (requires CRS-16-FCC-ALTMNT kit)



CHAPTER 4

Power and Cooling Requirements

This chapter describes the power and cooling requirements for the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis. It contains the following sections:

Power and Cooling Requirements

This chapter describes the power and cooling requirements for the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis. It contains the following sections:

Line Card Chassis Power System Overview

The chassis power system provides power to chassis components and is made up of two power shelves that contain power modules. Each power shelf is connected to a separate and independent power source. Input power enters the power shelves and is processed by the power modules before being distributed to the components in the chassis.

The line card chassis can be either DC or AC powered. There are two options for power systems: the fixed configuration power system and the modular configuration power system.

Fixed configuration power system consists of two power shelves, AC rectifiers or DC power entry modules (PEMs), and alarm modules. It is available in versions for DC and AC power supplies. The AC version requires either 3-phase AC-Delta or 3-phase AC-Wye input power to the power shelves. In redundant configuration, the fixed configuration power system provides power sharing per load zone. The fixed configuration power system includes SNMP MIBS and XML support.

Modular configuration power system consists of two power shelves, AC or DC power modules (PMs), and alarm modules. It is available in versions for DC and AC power supplies. However, unlike the fixed configuration power system, the AC version of the modular configuration power system requires single-phase AC input power to the power shelves; there is no 3-phase AC-Wye or AC-Delta. If you have 3-phase AC Delta or AC Wye at your equipment, a *Cisco CRS 3-phase AC power distribution unit (PDU)* will be required to convert 3-phase AC input power to single-phase AC input power for the power shelf. At the shelf level, the power system provides 2N redundancy; the PMs themselves provide load-share redundancy. The modular configuration power system also includes SNMP MIBS and XML support.

Note In a modular configuration AC power system, PDU refers to the *Cisco CRS 3-phase AC PDU* which is required to convert 3-phase AC-Wye or AC-Delta input power to single-phase AC input power for the modular configuration AC power shelf. For further information, see *Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide* .

Maximum input power requirements for line card chassis with a fixed configuration power system installed are as follows:

- DC-powered chassis requires up to a maximum of 13,895 watts (13.9 kW) of DC input power when the chassis is fully loaded.
- AC-powered chassis requires up to a maximum of 15,000 watts (15.0 kW) of AC input power when the chassis is fully loaded.

Maximum input power requirements for line card chassis with a modular configuration power system installed are as follows:

- DC-powered chassis requires up to a maximum of 14,667watts (14.7 kW) of DC input power when the chassis is fully loaded.
- AC-powered chassis requires up to a maximum of 14,348 watts (14.4 kW) of AC input power when the chassis is fully loaded.

Note If you have a *Cisco CRS 3-phase AC PDU* installed, six AC PMs are required to be installed in each modular configuration AC power shelf to maintain a balanced 3-phase power load.

Note These power requirements are for a fully loaded chassis with sixteen PLIMs. A chassis with fewer PLIMs uses slightly less power. However, it is a good idea to allocate this much power for each chassis to ensure that enough power is available for future system expansion.

See *Cisco CRS Carrier Routing System 16-Slot Line Card Chassis System Description* for detailed information about how each power system operates and distributes power to the components in the chassis.

General Power and Grounding Requirements

This section describes the power and grounding requirements you must consider when planning the site facilities for the line card chassis. In addition, see the DC Power System, on page 35 or the AC Power System, on page 41 for additional power requirements.

Note A certified electrician should review the information in these sections to ensure that the installation site meets these requirements. For larger system configurations, consult a facilities electrical expert to understand the load that the routing system may put on the facility power plant.

General power and grounding requirements are:

- Installation of the line card chassis must follow national and local electrical codes:

  - In the United States—United States National Fire Protection Association (NFPA) 70 and United States National Electrical Code (NEC)
  - In Canada—Canadian Electrical Code, part I, CSA C22.1
  - In other countries—International Electrotechnical Commission (IEC) 60364, parts 1 through 7

- Two separate and independent AC or DC power sources are needed to provide 2N redundancy for system power. Each power source requires its own circuit breaker.
- Each power source must provide clean power to the site. If necessary, install a power conditioner.
- Site must provide short-circuit (over-current) protection for devices.
- Proper grounding is required at the site to ensure that equipment is not damaged by lightning and power surges. In addition:
  - For fixed and modular configuration AC-powered systems, a grounding-type AC power outlet is required. In addition, fixed and modular configuration AC-powered systems also require chassis grounding.
  - Chassis grounding is required for fixed and modular configuration DC-powered systems.
  - For fixed configuration DC-powered systems, each DC power shelf requires a connection to earth ground.
  - For modular configuration DC-powered systems, each DC power shelf is grounded by installing an external grounding bracket between the power shelves and attached to the chassis.
- Site power planning must include the power requirements for any external terminals and test equipment you will use with your system.

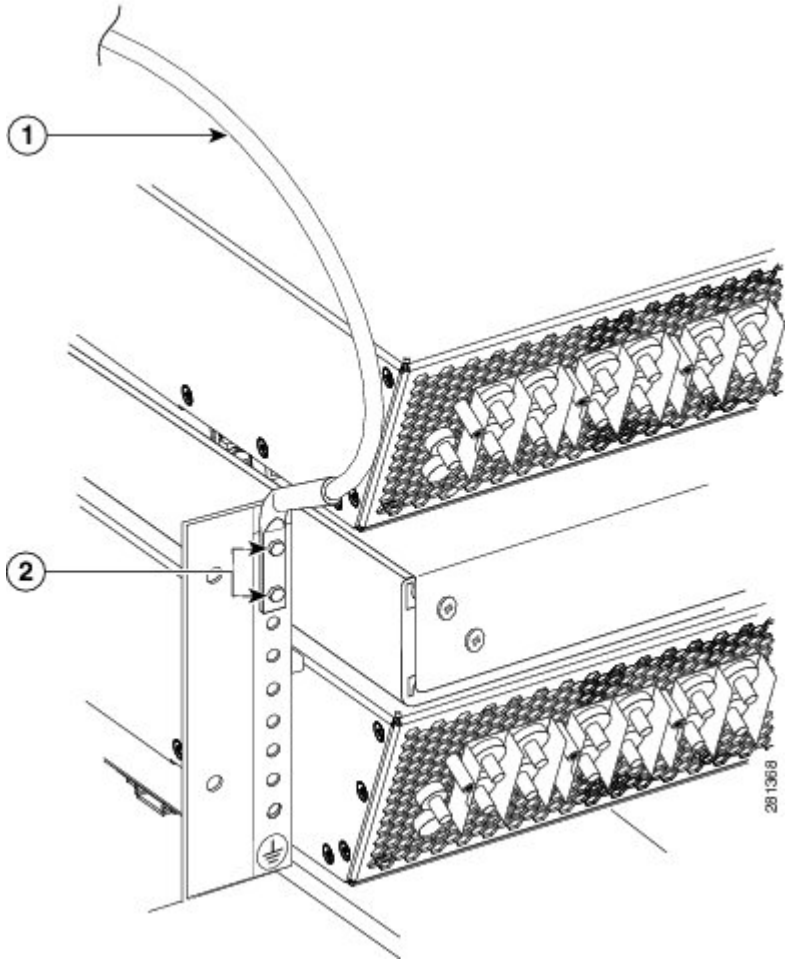
Note Be sure to review the safety warnings in Regulatory Compliance and Safety Information for the Cisco CRS-1 Carrier Routing System before attempting to install the routing system.

Bonding and Grounding Guidelines

The router chassis has a safety earth ground connection in conjunction with power cabling to the fixed configuration power shelves. The chassis allows you to connect the central office ground system or interior equipment grounding system to the bonding and grounding receptacles on the router chassis, when either a fixed or modular configuration power system is installed. Two threaded ground inserts are located on top of the chassis rear (MSC) side panel to the left of the lower power shelf. The figure below shows the NEBS and grounding points on the rear (MSC) side of the chassis with a modular configuration DC power shelf installed. This grounding point is also referred to as the network equipment building system (NEBS) bonding and grounding stud. The location of the grounding points on the Cisco CRS 16-slot line card chassis is the same for both fixed and modular configuration power systems.

Note These bonding and grounding receptacles are provided to satisfy the Telcordia NEBS requirements for bonding and grounding connections.

Figure 11: NEBS Bonding and Grounding Points—Modular Configuration DC Power Shelf Shown



1	Chassis ground cable	2	NEBS bonding and grounding points

Note A 45-degree grounding lug is shown in the figure above. A 180-degree (straight) grounding lug can also be used.

The grounding points are hidden by a cover plate. When the cover plate is removed, you can easily see the labels indicating the location of the grounding points. Two grounding points are provided; use the top grounding point for NEBS grounding purposes.

To connect the chassis to a ground connection, you must have the following:

- One grounding lug that has two M6 bolt holes with 0.63 inch (5/8 inch) (1.60 cm) of spacing between them and a 6-AWG or larger multistrand copper cable.

- The grounding lug used can be either a 180 degree (straight) lug, as shown in the figure below, or a 45-degree lug, as shown in Figure 13: 45-Degree Chassis Ground Lug , on page 34

Figure 12: 180-Degree (Straight) Chassis Ground Lug

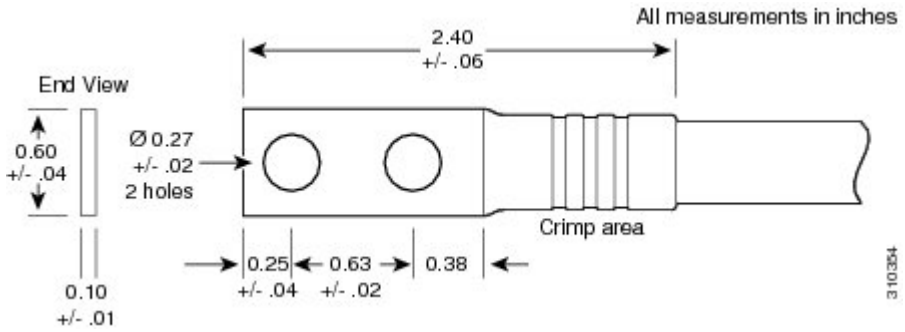
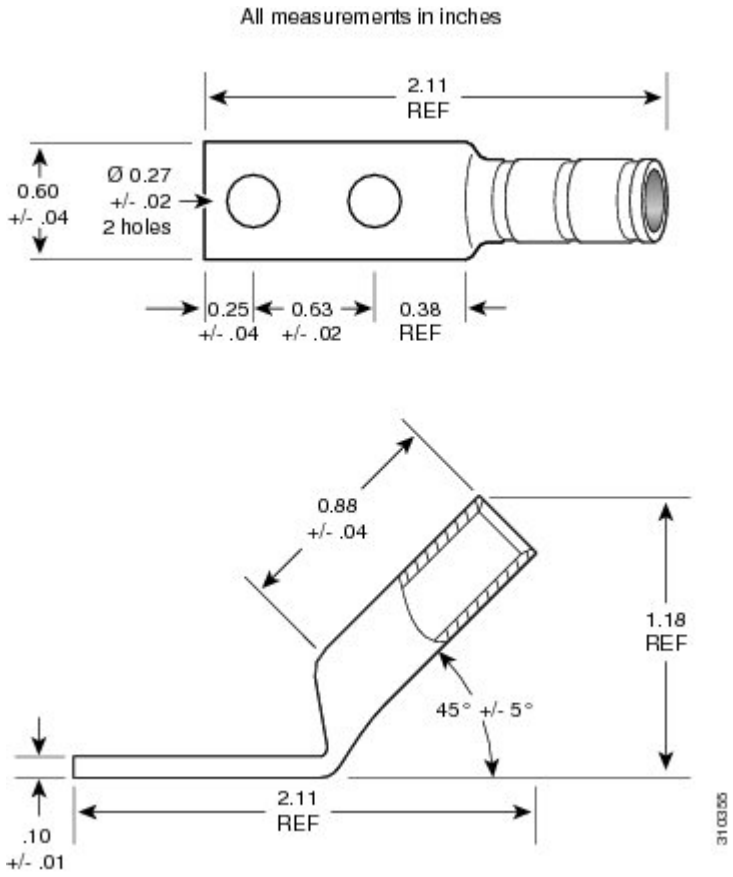


Figure 13: 45-Degree Chassis Ground Lug



- Two M6 or equivalent hex head bolts and integrated locking washers are pre-installed on the chassis.
- Ground cable routed upwards. Although we recommend at least 6 AWG multistrand copper cable, the actual cable diameter and length depend on the router location and site environment. This cable is not

available from Cisco Systems; it is available from any commercial cable vendor. The cable should be sized according to local and national installation requirements.

Note The DC return of this system should remain isolated from the system frame and chassis (DC-I: Isolated DC Return).

DC Power System

The Cisco CRS 16-slot line card chassis can be configured with either a fixed or modular configuration DC-input power subsystem. The chassis power system provides the necessary power for chassis components. Site power requirements differ, depending on the source voltage used.

Each DC powered chassis contains two fixed or modular configuration DC power shelves for 2N redundancy. The power shelves contain the input power connectors.

- In the fixed configuration power system, each power shelf contains three DC PEMs. The power shelves and DC PEMs are field replaceable.
- In the modular configuration power system, each shelf can contain up to eight DC PMs. The power shelves and DC PMs are field replaceable.

Fixed Configuration DC Power Requirements

A fixed configuration DC-powered LCC contains two DC power shelves and six DC PEMs. Each power shelf contains three DC PEMs. Input power connections from the DC power source are made to terminals at the rear of each power shelf. The power shelves and power modules are field replaceable. Each power shelf and power module has its own circuit breaker.

Observe the following guidelines for DC-powered chassis. In addition, be sure to review the requirements in the General Power and Grounding Requirements, on page 30.

- Each DC-powered chassis requires up to a maximum of 13,900 watts (13.9 kW) of DC input power when the chassis is fully loaded.
- Two separate and independent power sources are required, each providing nominal –48/-60 VDC, 60 A service.
- All power connection wiring should conform to the rules and regulations in the National Electrical Code (NEC) and any local codes. In addition, make sure that the wiring conforms to any internal requirements at the installation site.
- Each DC power source must comply with the safety extra-low voltage (SELV) requirements in UL 60950-1, CSA-C22.2 No. 60950-1, EN60950-1, AS/NZS 60950, and IEC60950-1.
- A DC-powered system should be installed in a restricted access area in accordance with the National Electric Code, ANSI/NFPA 70.
- All components in the area where DC input power is accessible must be properly insulated.
- If it is not possible to rely on the identification of the earthed conductor in the DC mains supply, whereby the equipment is not provided with a two-pole disconnect device, then a two-pole disconnect device is to be provided external to the equipment.

The below table lists the fixed configuration DC input current and voltage specifications.

Table 5: DC Input Current and Voltage Information

Nominal input voltage	–48 VDC North America–60 VDC European Community(range: –42 VDC to –75 VDC)
Input line current	50 A maximum at –48 VDC40 A maximum at –60 VDC

Fixed Configuration DC Power Shelf Wiring

Each wiring block on the DC power shelf contains two pairs of terminals, one positive and one negative, and is covered by a plastic block cover that snaps onto the power shelf and is secured by a screw.

The requirements for the DC input power and ground connections are as follows:

- Each PEM requires two DC inputs of nominal –48/–60 VDC, 60 A service. Because each DC input consists of two pairs of cable leads, source DC (–) and source DC return (+), you need four cables (two pairs) for each PEM or 12 total cables (six pairs) for each power shelf. In addition, each power shelf requires one grounding cable.
- All input power cables for the chassis should have the same wire gauge, and cable lengths should match within 10 percent of deviation.
- For DC input power cables, use the appropriate wire gauge for –48/–60 VDC, 60 A service. We recommend that you use a commensurately rated, high-strand-count copper cable. This cable is not available from Cisco Systems; it is available from any commercial vendor. The length of the input power cables depends on the chassis location. The cables must be long enough to reach the chassis from the A and B power bus access points.

Caution A certified electrician must select the appropriate DC input power cable based on standard electrical practices, such as derating factors, wiring type, operating temperatures, and so on. The electrician must verify that the cable complies with the National Electrical Code (NEC) and local codes and any guidelines in effect at the installation site. At minimum, DC input power cables must be 6-AWG or heavier and rated for 90°C (194°F) temperature or higher.

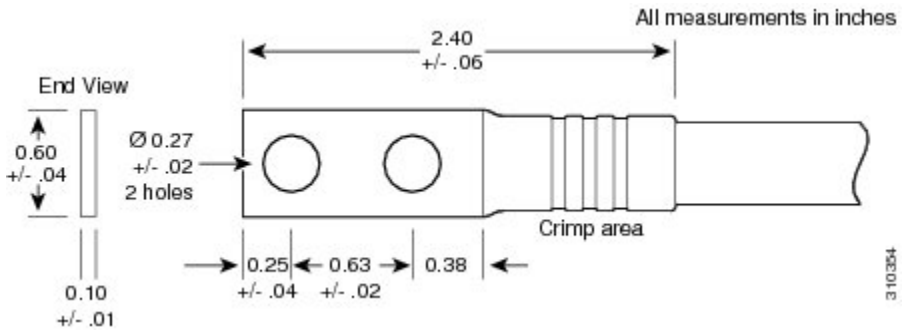
- Earth ground cable is required for each fixed configuration DC power shelf. We recommend that you use at least 6-AWG multistrand copper cable, which is available from any commercial cable vendor.

The ground cable lug should be dual hole and able to fit over M6 terminal studs at 0.63-inch (1.60 cm) centers (for example, Panduit part number LCD2-14A-Q or equivalent). The cable lug is similar to the cable lug for the input power cable. (See the figure below.)

Note When wiring the fixed configuration DC power shelf, be sure to attach the ground cable first. When removing the wiring, be sure to remove the ground cable last.

- Each DC input power cable must be terminated by a cable lug at the power shelf. The cable lug must be dual hole and able to fit over M6 terminal studs at 0.63-inch (1.60 cm) centers. For example, you could terminate a 6-AWG power cable with a cable lug such as Panduit part number LCD2-14A-Q or equivalent. (See the figure below.)

Figure 14: DC Input Power Cable Lug



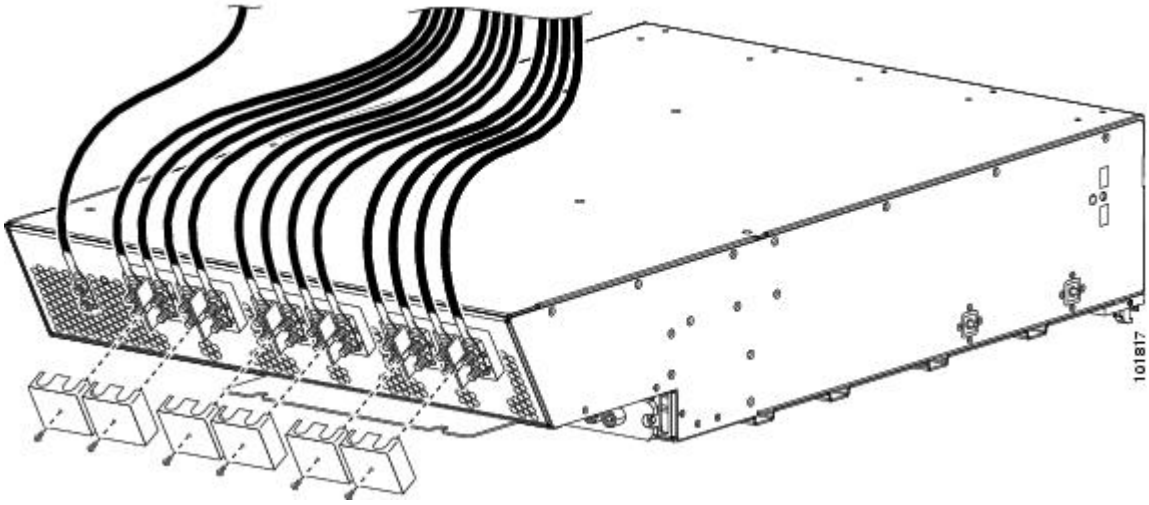
The color-coding of the DC input power cables depends on the color-coding of the site DC power source. Typically, green or green and yellow indicates that the cable is a ground cable. Because no color-coding standard for the source DC wiring exists, you must ensure that the power cables are connected to the DC-input power shelf terminal studs in the proper positive (+) and negative (–) polarity.

Note If reverse polarity occurs, the DC power module circuit breaker trips. No damage should occur because of reverse polarity protection, but you should correct the situation immediately.

The figire below shows the DC input power connections at the rear of the power shelf. The ground cable is located on the far left on the shelf. When wiring the fixed configuration DC power shelf, be sure to attach the ground cable first. When removing the wiring, be sure to remove the ground cable last.

Note The maximum DC current allowed is 60 A. Cisco provides 65 A circuit breaker. Size the circuit breaker appropriately based on local laws and standards.

Figure 15: DC Power Shelf Input Power Wiring



Modular Configuration DC Power Requirements

A modular configuration DC-powered LCC contains two DC power shelves. Each modular configuration DC power shelf is connected to up to eight DC power inputs and contains up to eight DC PMs that are field replaceable.

Observe the following guidelines for DC-powered chassis. In addition, be sure to review the requirements in the General Power and Grounding Requirements, on page 30.

- Two separate and independent power sources are required, each providing nominal –48/-60 VDC, 60 A service.
- Power shelf grounding is accomplished by installing an external ground bracket between the power shelves and attached to the chassis.
- All power connection wiring should conform to the rules and regulations in the National Electrical Code (NEC) and any local codes. In addition, make sure that the wiring conforms to any internal requirements at the installation site.
- Each DC power source must comply with the safety extra-low voltage (SELV) requirements in UL 60950-1, CSA-C22.2 No. 60950-1, EN60950-1, AS/NZS 60950, and IEC60950-1.
- A DC-powered system should be installed in a restricted access area in accordance with the National Electric Code, ANSI/NFPA 70.
- All components in the area where DC input power is accessible must be properly insulated.
- If it is not possible to rely on the identification of the earthed conductor in the DC mains supply, whereby the equipment is not provided with a two-pole disconnect device, then a two-pole disconnect device is to be provided external to the equipment.

The figure below lists the modular configuration DC input current and voltage specifications.

Table 6: DC Input Current and Voltage Information

Nominal input voltage	–48 VDC North America–60 VDC European Community(range: –40 VDC to –72 VDC)
Input line current	40 A maximum at –48 VDC30 A maximum at –60 VDC50 A maximum at -40 VDC

Modular Configuration DC Power Shelf Wiring

Each modular configuration DC power shelf contains eight pairs of double-stud terminals, covered by a plastic terminal block cover. To provide 2N power redundancy, one power shelf should be connected to the central office "A" power bus and the other power shelf should be connected to the "B" power bus.

The requirements for the modular configuration DC input power connections are as follows:

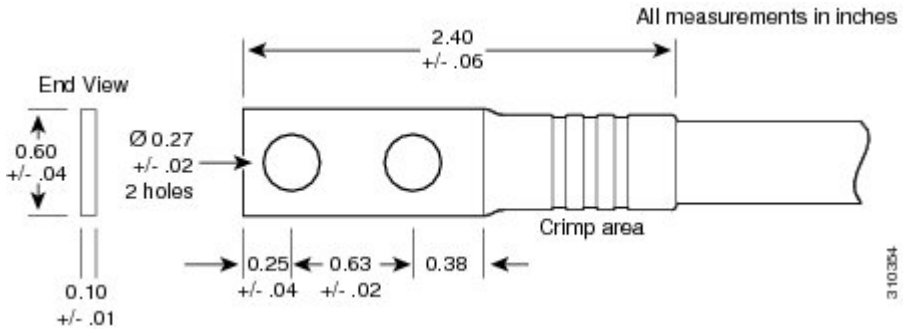
- Each power shelf requires up to eight pairs of cable leads, source DC (–) and source DC return (+).
- All input power cables for the chassis should have the same wire gauge, and cable lengths should match within 10 percent of deviation.
- For DC input power cables, use the appropriate wire gauge for –48/-60 VDC, 60 A service. We recommend that you use a commensurately rated, high-strand-count copper cable. This cable is not available from Cisco Systems; it is available from any commercial vendor. The length of the input power cables depends on the chassis location. The cables must be long enough to reach the chassis from the A and B power bus access points.

Caution A certified electrician must select the appropriate DC input power cable based on standard electrical practices, such as derating factors, wiring type, operating temperatures, and so on. The electrician must verify that the cable complies with the National Electrical Code (NEC) and local codes and any guidelines in effect at the installation site. At minimum, DC input power cables must be 6-AWG or heavier and rated for 90°C (194°F) temperature or higher.

- Each DC input power cable is terminated at the power shelf by a cable lug. The cable lug must be dual hole and able to fit over M6 terminal studs at 0.63-inch (1.60 cm) centers. For example, you could

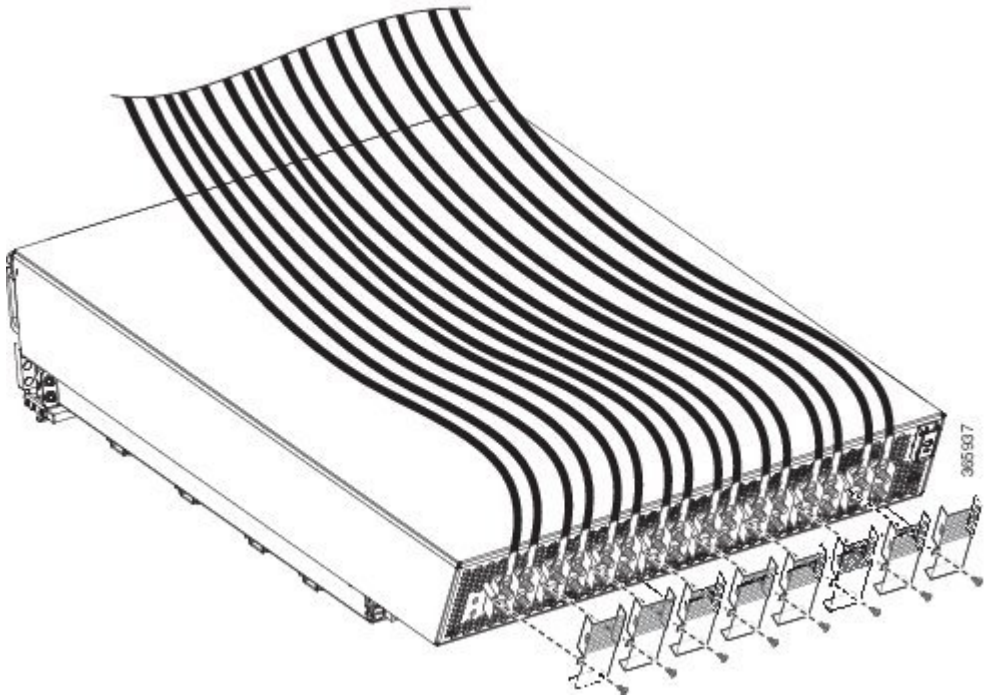
terminate a 6-AWG power cable with a cable lug such as Panduit part number LCD2-14A-Q or equivalent. See the figure below.

Figure 16: DC Power Cable Lug



The figure below shows the DC input power cables connected to the modular configuration DC power shelf terminal studs.

Figure 17: Modular Configuration DC Power Shelf Cable Connections



AC Power System

The Cisco CRS 16-slot line card chassis can be configured with either a fixed or modular configuration AC-input power subsystem. The chassis power system provides the necessary power for chassis components. Site power requirements differ, depending on the source voltage used.

Each AC powered chassis contains two AC power shelves for 2N redundancy. The power shelves contain the input power connectors.

- In the fixed configuration power system, each power shelf contains three AC-to-DC rectifiers. The power shelves and AC-to-DC rectifiers are field replaceable.
- In the modular configuration power system, each shelf can contain up to six AC PMs. The power shelves and AC PMs are field replaceable.

Fixed Configuration AC Power Requirements

Each fixed configuration AC-powered line card chassis requires up to 14,600 watts (14.6 kW) of AC input power when the chassis is fully loaded. Although the AC power system provides slightly less power (13.2 kW) to chassis components, the additional input power is required to accommodate the 90% efficiency of the power system.

In addition to the requirements in the General Power and Grounding Requirements, on page 30, AC input power requirements are as follows:

- Each fixed configuration AC-powered chassis contains two AC power shelves for 2N redundancy. The shelves contain the input power connectors.
- Each power shelf supports three AC-to-DC rectifiers that are field replaceable. The AC-to-DC rectifiers convert 200 to 240 VAC power to 54.5 VDC used by the line card chassis.
- Each power shelf and each AC-to-DC rectifier has its own circuit breaker.
- Two separate and independent AC power sources are required, one for each power shelf.
- If it is not possible to rely on the identification of the earthed conductor in the AC mains supply, whereby the equipment is not provided with a two-pole disconnect device, then a two-pole disconnect device is to be provided external to the equipment.

Two versions of the AC power shelf are available for AC input power in either the Delta or Wye configuration. Each power shelf has a different Cisco part number to distinguish it from the other. All chassis have two power shelves of the same type; that is, two AC Delta or two AC Wye power shelves.

- AC Wye power shelf has a Wye 3-phase, 5-wire connection: 200 to 240 (L-N)/346 to 415 (L-L) VAC, 50 to 60 Hz, 25 A. For redundant operation, two 3-phase Wye branch circuits are required: 40 A (North America) or 32 A (International). One power connection to each power shelf. The 5-wire connection is 3 wire + neutral + protective earthing, or ground wire (3W+N+PE).
- AC Delta power shelf has a Delta 3-phase, 4-wire connection: 200 to 240 VAC, 42 A, 50 to 60 Hz. For redundant operation, two 3-phase Delta 60-A branch circuits are required. One power connection to each power shelf. The 4-wire connection is 3 wire + protective earthing, or ground wire (3W+PE).

Cable accessory packages for the AC power shelves contain AC power cables for the power shelves. The power cables, which are 13 feet (4 meters) long, are not shipped preattached to the power shelves.

- The Wye power cord is rated for 415 VAC, 40 A (North America) or 32 A (International). The power cord has a 5-pin 532P6W plug (3W+N+PE) that plugs into a similarly rated 532R6W power receptacle. (See the figure below.)
- The Delta power cord is rated for 250 VAC, 60 A. The power cord has a 4-pin 460P9W plug (3W+PE) that plugs into a 460R9W power receptacle. (See the Figure 19: AC Delta Power Cord Plug, on page 42.)

Figure 18: AC Wye Power Cord Plug

Figure 19: AC Delta Power Cord Plug

For additional power system details, see Cisco CSR Carrier Routing System 16-Slot Line Card Chassis System Description.

Fixed Configuration AC Power Shelf Wiring

The Cisco CRS line card chassis can be ordered with AC power shelves in either the Delta or Wye configuration. Each type of power shelf has a different Cisco part number to distinguish it from the other. Both types of power shelves require 3-phase, 220-to-240 VAC input power.

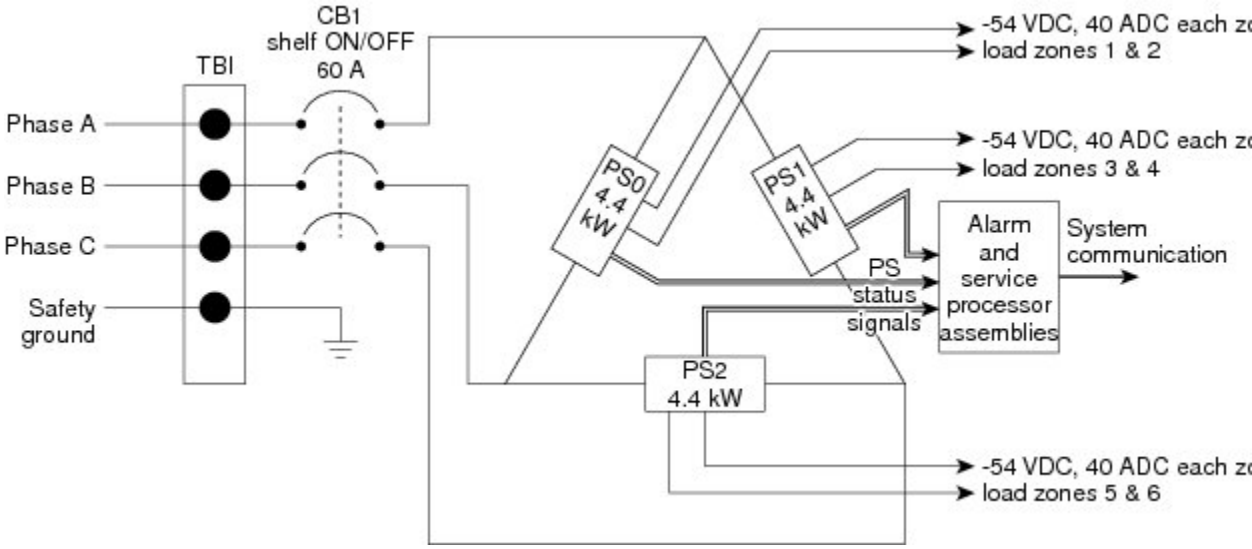
- AC Delta configuration is typically used in the United States, Japan, and other countries where the phase-to-phase voltage is approximately 208 VAC. The power supplies are wired between the phases (see Figure 21: AC Wye Power Shelf Wiring, on page 44) and a neutral is not required.
- AC Wye configuration is typically used in Europe and countries where each phase-to-neutral voltage is approximately 220 VAC. The power supplies are wired between each phase and neutral. (See Figure 21: AC Wye Power Shelf Wiring, on page 44.)

AC Delta Power Shelf Wiring

The figure below shows an example of how AC Delta power is wired to the power shelf. As shown, AC Delta has four wires (three phases and a safety ground) wired into a terminal board (TB1) on the power shelf. The

input-AC power is routed through a circuit breaker (CB1) to the three 4.4-kW AC rectifiers (PS0, PS1, and PS2), where it is converted into DC power (nominal 54.5 VDC, 37 ADC) and routed to the six load zones of the chassis. The load zones distribute power to the various components in the chassis through the backplane. Power supply status signals are also routed to an alarm and service processor for system communication.

Figure 20: AC Delta Power Shelf Wiring

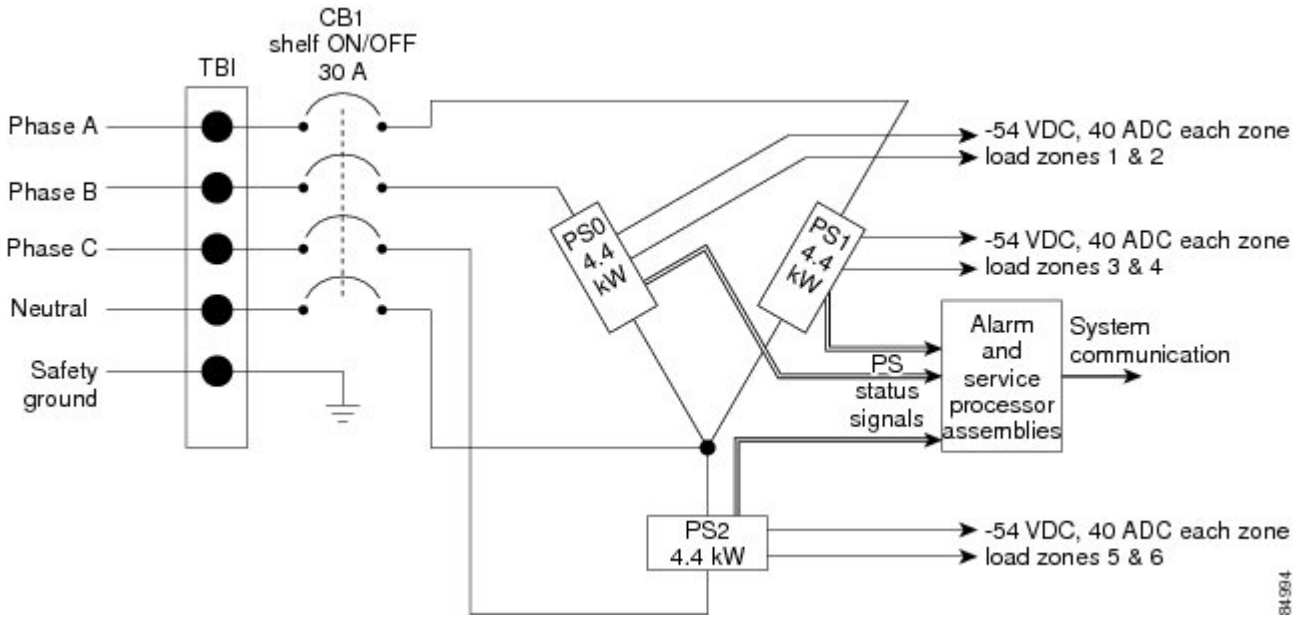


AC Wye Power Shelf Wiring

The figure below shows an example of how AC Wye power is wired to the power shelf. As shown, the AC Wye configuration has five wires (three phases, neutral, and a safety ground) wired into a terminal board (TB1) on the power shelf. The input-AC power is routed through a circuit breaker (CB1) to the three 4.4-kW AC rectifiers (PS1, PS2, and PS3), where it is converted into DC power (nominal 54.5 VDC, 37 ADC) and routed to the six load zones of the chassis. The load zones distribute power to the various components in the

chassis through the backplane. Power supply status signals are also routed to an alarm and service processor for system communication.

Figure 21: AC Wye Power Shelf Wiring



Modular Configuration AC Power Requirements

A modular configuration AC-powered LCC contains two AC power shelves and up to six AC PMs per power shelf.

In addition to the requirements in the General Power and Grounding Requirements, on page 30, AC input power requirements are as follows:

- An AC-powered chassis requires up to a maximum of 14,348 watts (14.4 kW) of AC input power when the chassis is fully loaded.
- Two separate and independent AC power sources are required, one for each power shelf. Each power shelf should be connected to a different power source to provide 2N power redundancy in case a power source fails.
- Each AC power source must provide single-phase AC power, and have its own circuit breaker.
- The AC power receptacles used to plug in the chassis must be the grounding type. The grounding conductors that connect to the receptacles should connect to protective earth ground at the service equipment.
- AC single-phase input:
  - Single-phase, 200 to 240 VAC nominal, 50 to 60 Hz, 16 A International and 20 A North America.
  - Each AC power shelf contains six IEC-320-C22 receptacles which can accept up to six IEC-320-C21 connector female cords, depending on how many AC PMs are installed in the shelf.

- If it is not possible to rely on the identification of the earthed conductor in the AC mains supply, whereby the equipment is not provided with a two-pole disconnect device, then a two-pole disconnect device is to be provided external to the equipment.
- Unlike the fixed configuration AC power system, which requires 3-phase AC Delta or AC Wye input power, the modular configuration AC power system requires single-phase AC input power. If you have 3-phase AC Delta or AC Wye at your equipment, a *Cisco CRS 3-phase AC PDU* will be required to convert 3-phase AC input power to single-phase AC input power for the power shelf. For further information, refer to *Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide.*

Note If you have a *Cisco CRS 3-phase AC PDU* installed, six AC PMs are required to be installed in each modular configuration AC power shelf to maintain a balanced 3-phase power load.

For detailed modular configuration AC power specifications, see the Line Card Chassis Specifications, on page 87.

Modular Configuration AC Power Shelf Wiring

The modular configuration AC power shelf is shipped with AC power cords. Each modular configuration AC power shelf accepts up to six power cords. Each power cord is 4.25 m in length and different plug types (pre-attached) are available, depending on the locale. AC cords are available for the following locales:

- North America
- Europe
- United Kingdom
- Italy
- Australia

The table below lists the single-phase AC-input cord power options and Cisco product numbers for the Cisco CRS 16-slot LCC with a modular configuration AC power shelf installed. The table below also references power cord illustrations.

Table 7: Modular Configuration Single-Phase AC-Input Power Cord Options

Locale	Cisco Product Number	Plug Rating	Reference Illustration
North America	CRS-AC-CAB-NA(=)	20 A/250 VAC	Figure 22: North America—Modular Configuration AC-Input Power Cord, on page 47
Europe	CRS-AC-CAB-EU(=)	16 A/250 VAC	Figure 23: Europe—Modular Configuration AC-Input Power Cord, on page 47

Locale	Cisco Product Number	Plug Rating	Reference Illustration
United Kingdom	CRS-AC-CAB-UK(=)	13 A/250 VAC	Figure 24: United Kingdom—Modular Configuration AC-Input Power Cord, on page 47
Italy	CRS-AC-CAB-IT(=)	16 A/250 VAC	Figure 25: Italy—Modular Configuration AC-Input Power Cord, on page 49
Australia	CRS-AC-CAB-AU(=)	15 A/250 VAC	Figure 26: Australia—Modular Configuration AC-Input Power Cord, on page 49

Figure 22: North America—Modular Configuration AC-Input Power Cord

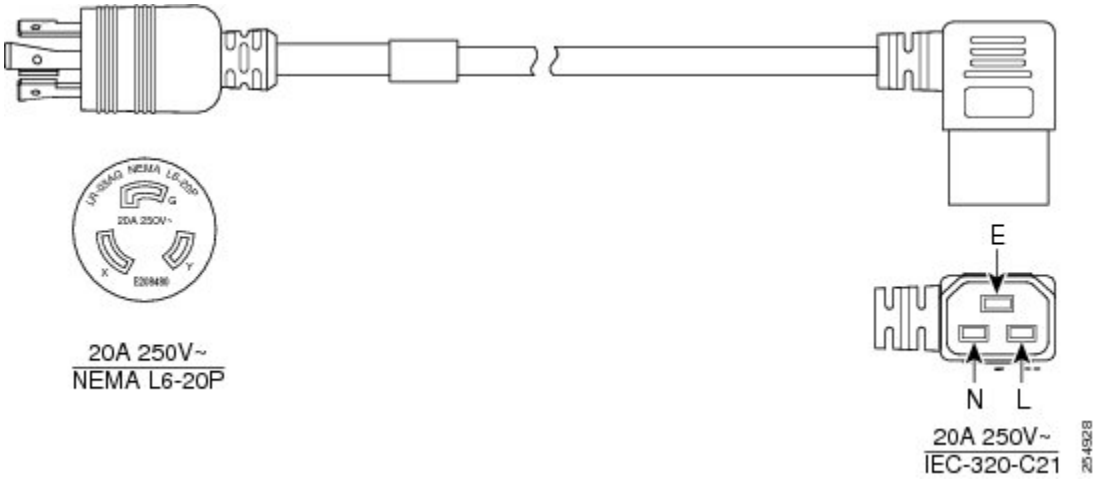


Figure 23: Europe—Modular Configuration AC-Input Power Cord

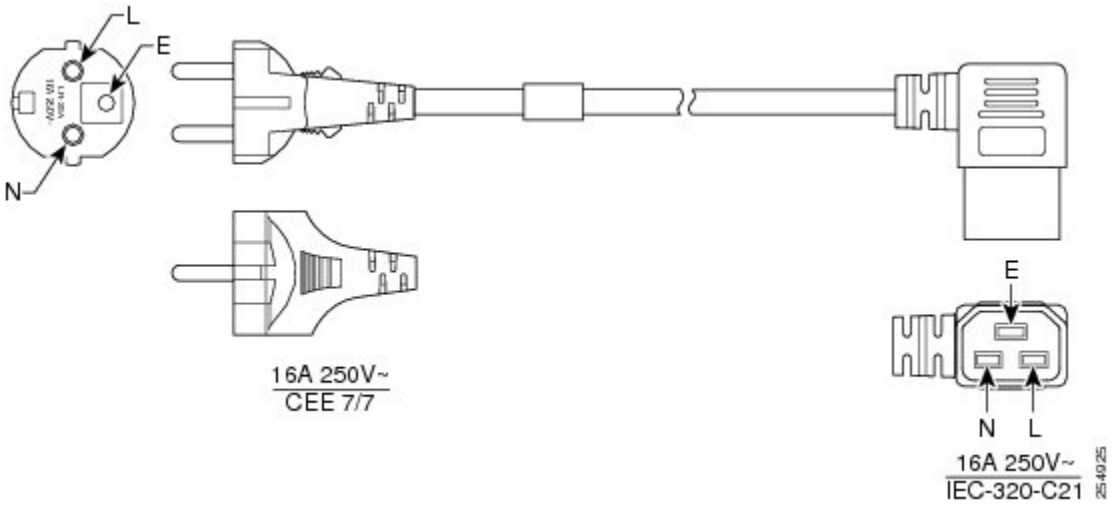
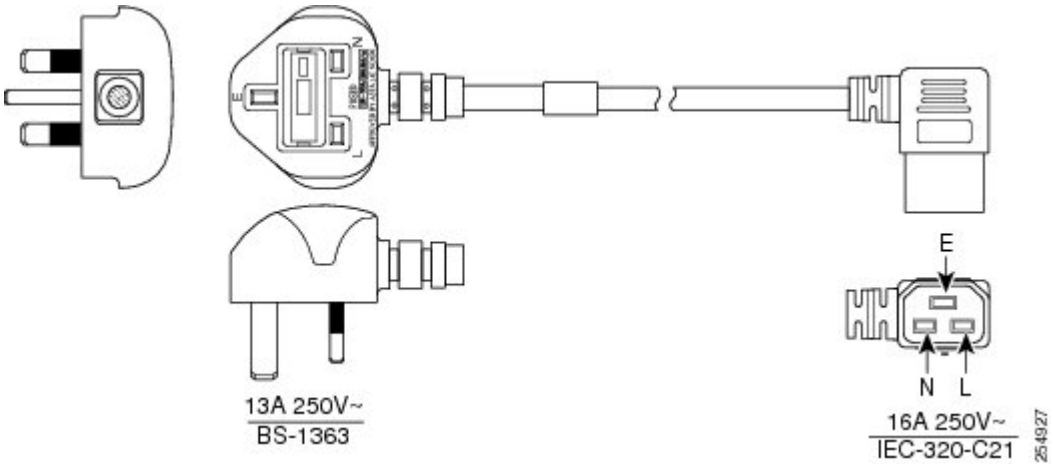


Figure 24: United Kingdom—Modular Configuration AC-Input Power Cord


E
N
L
13A 250V~
BS-1363
E
N L
16A 250V~
IEC-320-C21
254927

Note The BS-1363 standard rates cord sets up to a maximum of 13 A, 250 VAC for the C-21 plug. Therefore, the building circuit breaker must be 13 A maximum. Installation of the Cisco CRS 16-slot line card chassis must follow national and local electrical codes.

Figure 25: Italy—Modular Configuration AC-Input Power Cord

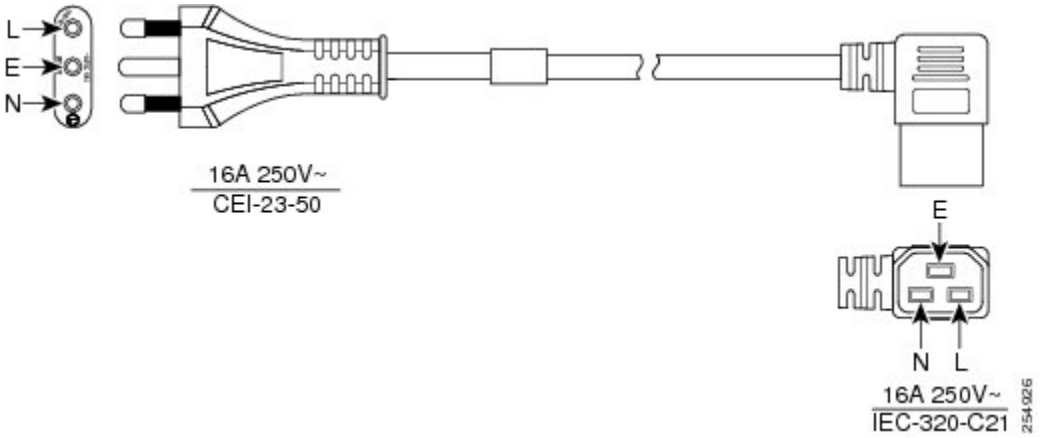
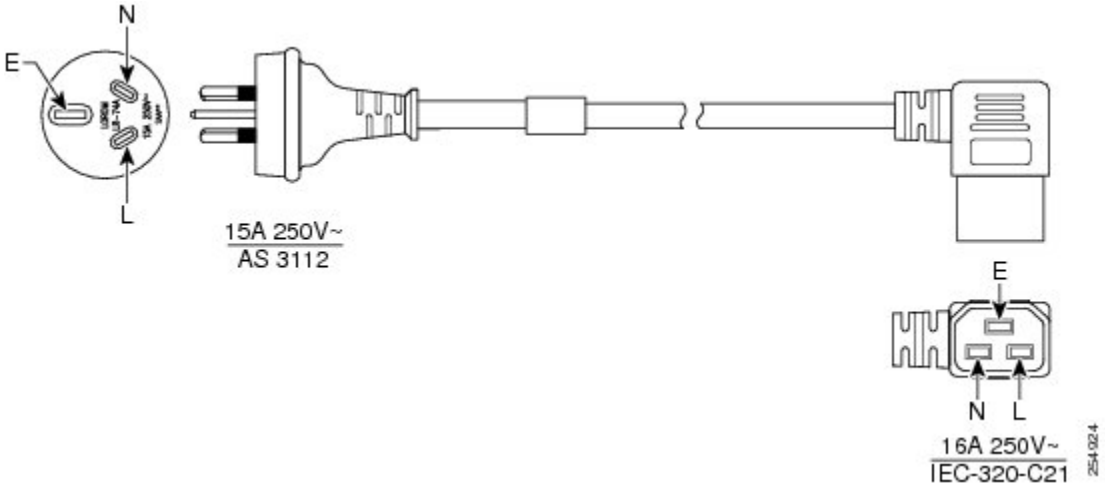


Figure 26: Australia—Modular Configuration AC-Input Power Cord



Note The AS 3112 standard rates cord sets up to a maximum of 15 A, 250 VAC for the C-21 plug. Therefore the building circuit breaker must be 15 A maximum. Installation of the Cisco CRS 16-slot line card chassis must follow national and local electrical codes.

Converting 3-Phase AC to Single-Phase AC

If you have 3-phase AC Delta or AC Wye input power at your equipment, a *Cisco CRS 3-phase AC PDU* will be required to convert 3-phase AC Delta or AC Wye input power to single-phase AC input power that connects directly to the rear of the modular configuration AC power shelf. The Cisco CRS PDU includes either an AC Delta or AC Wye power interface, and has power input and power output cords entering and exiting the box.

In addition to the requirements in the General Power and Grounding Requirements, on page 30, AC input power requirements are as follows:

- Two separate and independent AC power sources are required, one for each PDU. Each PDU should be connected to a different power source to provide 2N power redundancy in case a power source fails.
- Each AC power source must provide 3-phase VAC power, and have its own circuit breaker.
- AC Delta input:
  - 3-phase, 200 to 240 VAC (phase-to-phase), 50 to 60 Hz.
  - Input current: 2 x 27.7A.
  - Each PDU has two Delta input power cords, each with a 4-pin IEC 60309 plug (3 wire + protective earthing [3W+PE]). The power cord is rated for 250 VAC, 60 A, and plugs into a similarly rated IEC 60309 receptacle.
  - Each PDU has six single phase output cords, each with a 90 degree IEC-320-C21 plug that plugs into a IEC-320-C22 inlet on the rear of the modular configuration AC power shelf.
- AC Wye input:
  - 3-phase, 200 to 240 VAC (phase-to-neutral), 50 to 60 Hz.
  - Input current: 32 A.
  - Wye power cord has a 5-pin IEC 60309 plug (3 wire + neutral + protective earthing conductor (ground wire) [3W+N+PE]). The cord is rated for 415 VAC, 16 A, and plugs into a similarly rated IEC 60309 receptacle.
  - Each single PDU has six single phase output cords, each with a 90 degree IEC-320-C21 plug that plugs into a IEC-320-C22 inlet on the rear of the modular configuration AC power shelf.
- Grounding-type AC power outlet is required. The PDUs are shipped with AC power cords that have a grounding-type plug. As a safety feature, the plugs fit only a grounding-type AC power outlet.

The figures below show the plugs for the power cords on the AC Delta and AC Wye PDUs respectively .

Figure 27: AC Delta Power Cord Plug

Figure 28: AC Wye Power Cord Plug

For detailed Cisco CRS Power Distribution Unit AC power specifications, see the *Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide.*

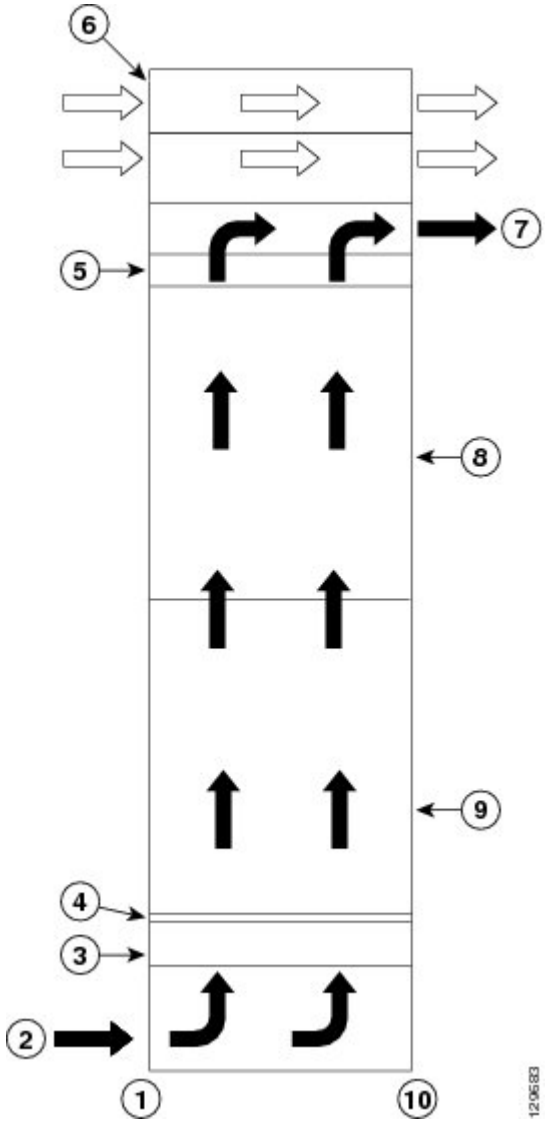
Line Card Chassis Airflow

The airflow through the line card chassis is controlled by a push-pull configuration. As shown in the following figure, ambient air flows in at the bottom front of the line card chassis and up through the card cages until it exhausts at the top rear. The bottom fan tray pulls ambient air in from the bottom front of the chassis; the top fan tray pushes warm air out the back of the chassis. The power modules in the power shelves have their own self-contained cooling fans.

A replaceable air filter is positioned above the lower fan tray. How often the air filter should be replaced depends on the facility environment. In a dirty environment, or when you start getting frequent temperature alarms, you should always check the intake grills for debris, and then check the air filter to see if it needs replacement.

Before removing the air filter for replacement, you should have a spare filter on hand; then, when you remove the dirty filter, install the spare filter in the chassis.

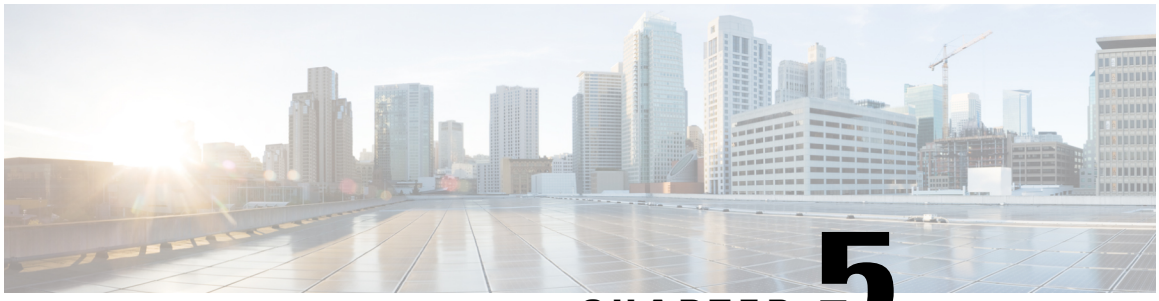
Figure 29: Airflow Through Line Card Chassis



1	Front (PLIM) side of chassis	6	Power shelves (two installed)
2	Air intake	7	Air exhaust
3	Lower fan tray	8	Upper card cage
4	Air filter	9	Lower card cage

5	Upper fan tray	10	Rear (MSC) side of chassis

The line card chassis has a maximum airflow of 2050 cubic feet per minute.



CHAPTER 5

Shipping and Receiving

This chapter describes the issues to consider as you prepare to receive shipment of the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis and transport the chassis components to the installation site.

Shipping and Receiving

This chapter describes the issues to consider as you prepare to receive shipment of the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis and transport the chassis components to the installation site.

It includes the following sections:

Receiving and Storing Routing System Components

When planning your Cisco CRS 16-slot line card chassis installation, you must consider how the routing system components will be moved from the shipping dock to the site where the chassis is to be installed. This section, and the sections that follow, provide information about the things to consider as you plan on how to transport the system components from the loading dock to the installation site.

The line card chassis is shipped in several crates that reduce the potential for product damage during routine material handling and shipment. To protect the chassis:

- Always store the chassis in its original packaging in an upright position.
- If you plan to store chassis components before the installation, be sure to store the components carefully and in their original shipping containers to prevent accidental damage.

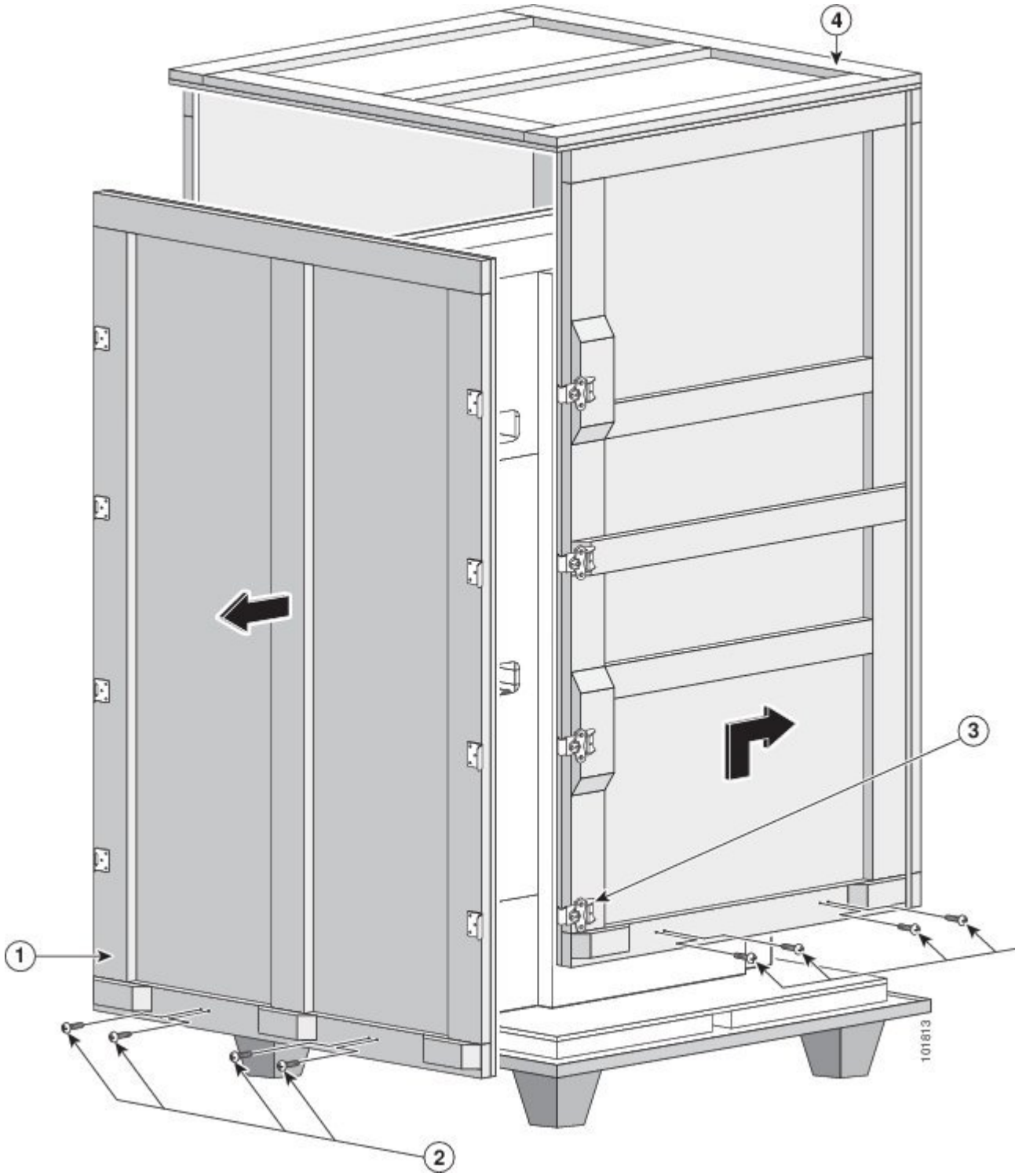
Note When you are planning the transportation route and storage area, consider the shipping pallet and crate dimensions. (Table 8: Line Card Chassis Shipping Crate and Pallet Weight and Dimensions, on page 59)

Shipping Crates and Pallets

Depending on the number of options you ordered, the Cisco CRS router arrives packaged in several shipping crates and pallets. The line card chassis is shipped on a pallet by itself and arrives inside a polyethylene bag enclosed in a plywood box, held in place by steel clips (see the table below). Other system components are shipped in separate crates. For complete details on the contents of each crate, see the shipping and parts identification label on the crate.

Caution Do not stack the Cisco CRS shipping crates, because serious damage to the system components can occur.

Figure 30: Cisco CRS 16-Slot Line Card Chassis in Original Packaging



1	Lock latches	3	Four-sided plywood box
2	Large side panel		

The table below lists the physical characteristics of the chassis shipping crate.

Table 8: Line Card Chassis Shipping Crate and Pallet Weight and Dimensions

Weight (Est. max.)	**1497 lb (679 kg)—Chassis in shipping crate with pallet**
Dimensions	Height: 92 in. (233.7 cm)
	Width: 45 in. (114.3 cm)
	Length: 48 in. (121.9 cm)

Unpacking and Storage of Chassis and Chassis Components

Consider the following as you plan for the unpacking and storage of chassis components:

- Make sure that enough room exists at the loading dock or installation site to unpack the system components. If you plan to store the components before installation, make sure that you have an area large enough in which to store the system components. Note that you should store components in their shipping crates until you are ready to install them.
- You should unpack the chassis and chassis components in the following order:
  - Chassis
  - Power System
  - Exterior cosmetics
  - MSCs and PLIMs
- Will you unpack the chassis components from their shipping crates at the loading dock or installation site? Consider the following:
  - Are corridors and aisles from the loading dock to the installation site wide enough for the moving device and the chassis and components in their crates or pallets?
  - To use the dolly supplied by Cisco to transport the chassis to the installation site, you must unpack the chassis to attach the dolly.
  - If aisles are not wide enough, you might want to unpack components at the loading dock. Of course, you must make sure that there is enough room.
  - Is there enough room at the installation site to unpack chassis components? If not, can system components be unpacked at the loading dock?
- Consider how you will move the chassis components from the shipping dock to the installation site. See the Transport to the Installation Site, on page 60.

Transport to the Installation Site

This section describes the things to consider as you plan the route to use to move the chassis from the loading dock to the installation site. See Figure 31: Recommended Turning Diameter of Dolly, on page 62 for the minimum hallway, aisle, and doorway clearances required to accommodate the chassis.

Before you attempt to move the chassis to the installation site, we recommend that you check the proposed transport route and note any areas of concern. It might also be useful to create a diagram of the route you plan to take from the loading dock to the installation site.

Note We recommend that at least two people move the chassis from the shipping dock to the installation site.

- Is the installation site on a different floor than the loading dock? If so, are there freight elevators that can be used to transport the system components?
  - Can freight elevators support the weight of the system chassis and the moving device?
  - Are elevators tall and wide enough for system components (with or without shipping crates)?
- Are there any ramps in the transport route? If so, the following guidelines apply:
  - We recommend 1 inch of rise for every 12 inches of run.
  - Maximum limit of 1 inch of rise for every 6 inches of run. If the ramp exceeds the maximum limit, consult with Cisco Technical Staff.
- Are there any raised floors in the transport route or at the installation site that need to be protected while you move the chassis?
- Make sure that hallways, aisles, and doorways are high and wide enough to accommodate the chassis and moving device.
- Make sure that corners are wide enough for the chassis and moving device.
- Make sure that no obstacles exist in the transport route (for example, boxes or equipment in hallways, hanging wires, or items on the floor).
- Ensure that the dolly supplied by Cisco is available to transport the uncrated chassis from the shipping dock to the chassis final location.

Important Notice About Transporting the Chassis

Either a fork lift or pallet jack can be used to transport a crated chassis only.

Throughout this chapter we refer to the dolly (supplied by Cisco) as the required means to transport the uncrated chassis from the shipping dock to the chassis final location.

Note In the event that the dolly supplied by Cisco is not the appropriate method of transportation, consult Cisco Technical Staff to determine a method of transportation appropriate for the site. Ensure that the alternate lifting device is capable of moving the chassis safely, supporting the weight of the chassis, and is capable of preventing the chassis from tipping.

Caution When using any type of device to transport the chassis, exercise extreme caution and follow proper safety practices.

Using the dolly supplied by Cisco to Move the Chassis—Things to Consider

If you plan to use the dolly supplied by Cisco to move the chassis, consider the following:

- Dolly is optimized to move the chassis on flat surfaces. It is not designed to move the chassis up stairs, over curbs, up ramps greater than 1 inch of rise for every 6 inches of run, or over bumps more than 1.5 inch (3.8 cm) high, such as door thresholds.
- Before attaching the dolly, ensure that the power shelves, power modules, MSCs and PLIMs have been removed from the chassis. Ensure that impedance carriers have been installed to prevent dust and debris from entering the card cage during movement and installation.
- Whenever possible, use the dolly in the 180-degree configuration to move the chassis. Hallways and aisles must be at least 52 inches (132 cm) wide to accommodate the combined dolly and chassis width. The dolly in its 90-degree configuration requires 32 inches (81 cm) of hallway and aisle clearance, but requires extra care to avoid tipping the chassis.

For instructions on assembling and using the dolly supplied by Cisco, see the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Unpacking, Moving, and Securing Guide.

Verifying the Move Path

Before moving the chassis, it is critical that you verify that the path that you are planning to use to move the chassis to its final location can accommodate the chassis size and weight and the restrictions of the chassis when using the dolly (see the Planning for Future Expansion, on page 25).

See the table below for a list of the restrictions for your move path, and verify that you have sufficient room for the *entire* move path before moving the chassis.

Table 9: Chassis Move Path Specifications

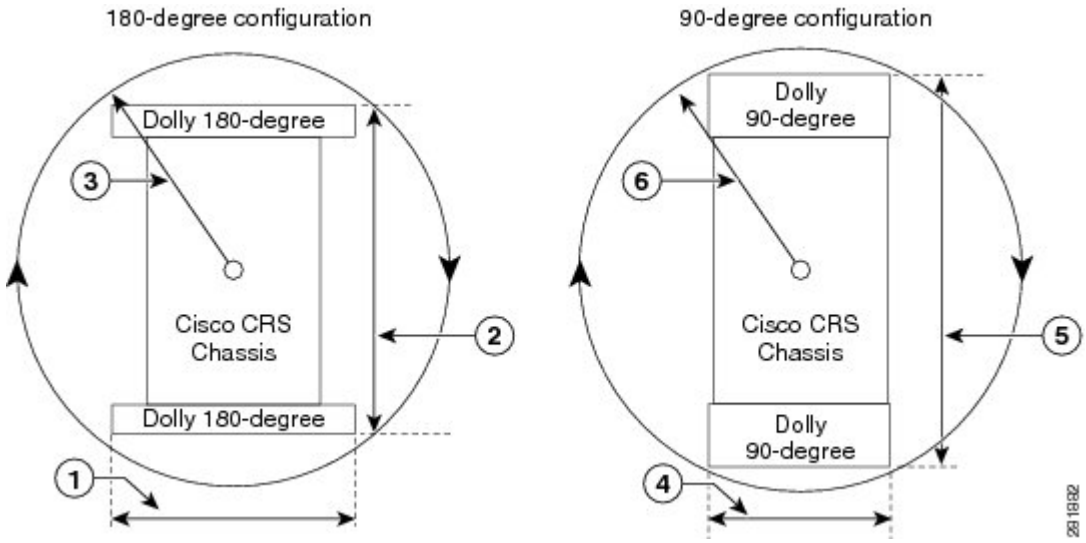
Specification	Value
Height (on dolly, with recommended 1 inch raise)	81 in. (205 cm)
Depth (on dolly, 90-degree dolly position)	70 in. (177 cm)
Depth (on dolly, 180-degree dolly position)	48 in. (121 cm)
Width (on dolly, 90-degree dolly position)	24 in. (60 cm)
Width (on dolly, 180-degree dolly position)	44 in. (112 cm)
Turning radius (on dolly, 90-degree dolly position)	37 in. (94 cm)
Turning radius (on dolly, 180-degree dolly position)	33 in. (83 cm)

Specification	Value
Weight of chassis (as shipped, configuration, packaging removed)	1175 lb (533 kg) (Estimated)
Maximum curb height (chassis on dolly)	1.5 in. (3.8 cm)

Note Allow a minimum gap of between 4 to 6 in. (10 to 15 cm) on each side of the combined chassis and dolly when moving it.

The figure below shows the recommended minimum space to turn the chassis on the dolly in its 90-degree and 180-degree configuration.

Figure 31: Recommended Turning Diameter of Dolly



1	Width (on dolly, 180-degree position) 44 in. (112 cm)	4	Width (on dolly, 90-degree position) 24 in. (60 cm)
2	Depth (on dolly, 180-degree position) 48 in. (122 cm)	5	Depth (on dolly, 90-degree position) 70 in. (178 cm)
3	Turn radius (on dolly, 180-degree position) 33 in. (83 cm)	6	Turn radius (on dolly, 90-degree position) 37 in. (94cm)

Then table below provides the dolly width and the recommended aisle width turning radius for the 90-degree and 180-degree dolly configuration.

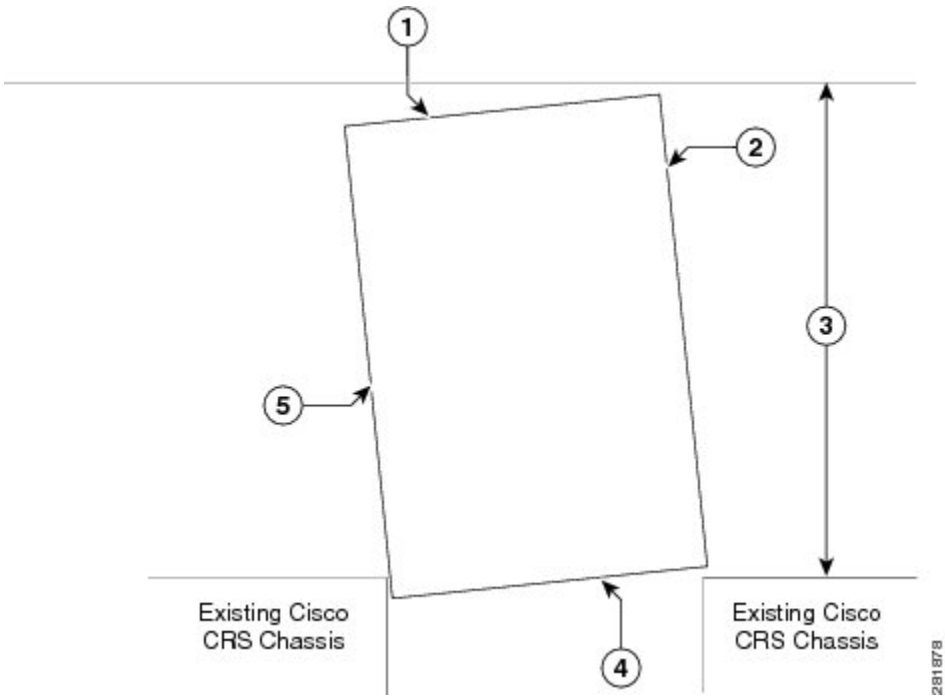
Table 10: Chassis Turning Recommendations

Dolly Configuration	Width of Combined Chassis and Dolly	Recommended Aisle Width Turning Radius
90-degree dolly position	24 in. (60 cm)	37 in. (94cm)[1]
180-degree dolly position	44 in. (112 cm)	33 in. (83 cm)

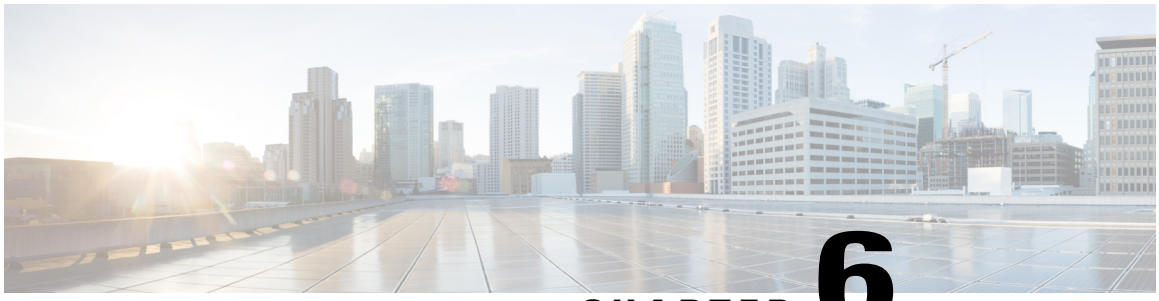
1 Aisle width may be different when transporting the chassis around a corner.

The figure below is a top view of the minimum aisle space required to install the Cisco CRS 16-slot line card chassis without using the dolly supplied by Cisco.

Figure 32: Minimum Aisle Space Requirements to Install Chassis—Top View (With Dolly Removed)



1	Chassis front	4	Chassis rear
2	Chassis side	5	Chassis side
3	Moving space requirement: 34.7 in. (95 cm)		



CHAPTER 6

System Planning Considerations

This chapter describes the system planning considerations for your Cisco CRS Carrier Routing System 16-Slot Line Card Chassis installation. It includes the following sections:

System Planning Considerations

This chapter describes the system planning considerations for your Cisco CRS Carrier Routing System 16-Slot Line Card Chassis installation. It includes the following sections:

Planning for High Availability

Following is a list of tasks to configure the line card chassis for high availability, which helps to ensure that service is not disrupted due to failures:

- Install a redundant line card chassis, whose user interface links mirror the links on the other line card chassis. This way, if something happens to one line card chassis, the links are still operational on the other line card chassis.

To provide more high availability, also install each line card chassis in a different room, located in a different fire and power zone. This way, a problem in one room should not affect the operation of the other chassis.

- Run the power cables from each of the two power sources along different routes through the facility or at the installation site.
- Install PLIMs in specific line card chassis slots so that those links are not affected during a power failure. For example, you should distribute links to core and edge networks across PLIMs in different chassis slots so that a power failure does not affect the links. See the Line Card Chassis Load Zones and Card Placement for High Availability, on page 66 for more information.
- Run PLIM user interface cables along different routes.

See the following sections for information about the power redundancy features of the Cisco CRS routing system and information about how to install cards in the line card chassis to avoid the potential for service disruption during a power failure.

Power Redundancy and Card Placement for High Availability

This section describes the power redundancy features of the line card chassis. It describes the power load zones in the chassis and provides information about how to install cards to configure the chassis for high availability so that a power failure does not disrupt system operation.

The first several sections that follow provide information that applies to all chassis. The remaining sections describe specific features and considerations for individual chassis.

Redundant Power Systems and Chassis Load Zones

Each chassis power shelf is connected to a separate and independent power source (2N power redundancy). During normal operation when both power sources are operational, both sets of power shelves and power modules function together to power the chassis. If a power sources fails, the other power source provides enough input power to power the chassis. This 2N power redundancy enables the chassis to operate despite the power failure.

In addition, *chassis load zones* distribute power throughout the chassis and provide redundant power to chassis slots. In the modular configuration power system, all power modules power all chassis load zones, as long as the circuit breaker is not tripped. In the fixed configuration power system, each load zone is powered by a set of power modules (one module from each power shelf). In each set of power modules (A0 and B0, A1 and B1, and A2 and B2) each power module is considered a backup for the other. Each set of power modules provides power to the same set of chassis load zones. If *either* power module fails, the other continues to provide power to those slots.

Although it is rare, a double-fault power failure in a fixed configuration power system causes power to be lost to a load zone. A *double-fault failure* occurs when a power module **and** its backup module both fail. The failure results in **all** power being lost to a set of chassis slots, which means that the components or cards installed in those slots lose power and stop functioning until one of the failing power modules is replaced.

Note To avoid network connectivity disruption because of a double-fault power failure, you should carefully consider the best placement of cards in the chassis. See the Line Card Chassis Load Zones and Card Placement for High Availability, on page 66 for information about how to install cards to avoid a disruption in service.

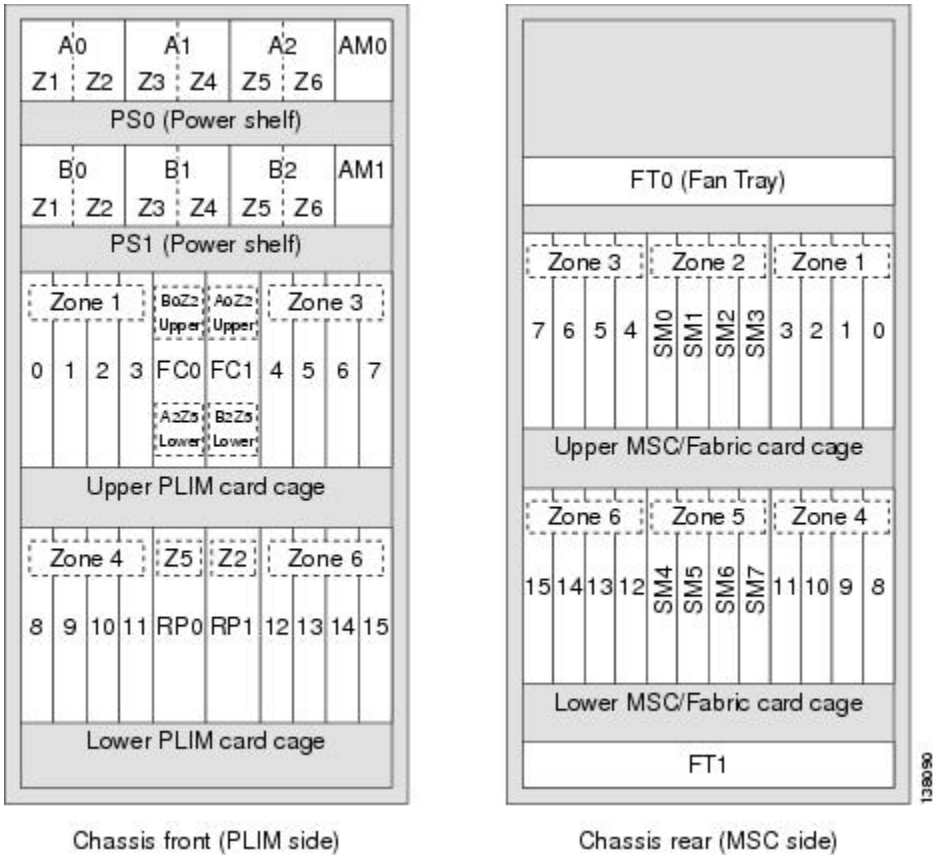
Figure 33: Line Card Chassis Power Load Zones—Fixed Configuration Power, on page 67 shows the load zones on the front (PLIM) and rear (MSC) side of the line card chassis.

Line Card Chassis Load Zones and Card Placement for High Availability

This section describes the power load zones in the line card chassis and provides information about how to install cards in the chassis so that a double-fault power failure does not disrupt service when a fixed

configuration power system is installed. The figure below shows the load zones on the front and rear of the chassis with a fixed configuration power system installed.

Figure 33: Line Card Chassis Power Load Zones—Fixed Configuration Power



To avoid service disruption because of a double-fault power failure in the line card chassis, consider the following to determine how to install modular services cards (MSCs), forwarding processor (FPs), and physical layer interface modules (PLIMs) in the chassis:

- Make sure that cards containing links to the core network are distributed across chassis load zones. For example, if all core-facing links are on cards in slots 0 through 3, a double-fault failure of power modules A0 and B0 would result in the Cisco CRS router not being able to communicate with other core routers in the network.
- In addition, make sure that cards containing links to downstream (edge) devices are distributed across chassis load zones. For example, if all edge-facing links are on cards in slots 12 through 15, a double-fault failure of power modules A2 and B2 would result in connectivity being lost to all downstream edge devices.
- Distribute cards across chassis load zones so that the loss of a load zone does not cause a single point of failure in the Cisco CRS router. For example, you want to ensure that the links to a particular system are not all lost if a double-fault failure occurs.

The table below shows an example of how you might install PLIMs in the line card chassis to avoid a single point of failure in the chassis. (This information is only an example. Your configuration may be different.)

Table 11: Example of Line Card Chassis Card Placement for High Availability

Load Zone	Slot	Card Type [2]	Card Connects to
1	0	4xOC-192	Core or Intra-POP
	1	16xOC-48	Edge
	2	1xOC-768	Intra-POP
	3	8x10-GE	Edge
3	4	1xOC-768	Core
	5	8x10-GE	Edge
	6	4xOC-192	Edge
	7	16xOC-48	Edge
4	8	1xOC-768	Core
	9	8x10-GE	Edge
	10	4xOC-192	Edge
	11	16xOC-48	Edge
6	12	4xOC-192	Core or Intra-POP
	13	16xOC-48	Edge
	14	1xOC-768	Intra-POP
	15	8x10-GE	Edge

2 Any PLIM can be inserted in the card slot. These card types are listed as examples of possible PLIM types.

Using DRPs and DRP PLIMs to Increase Routing Performance

The Cisco CRS distributed route processor (DRP) and its companion card (DRP PLIM) are optional components that can be installed in the line card chassis to provide enhanced routing capabilities for Cisco CRS routers. The DRP is installed in any MSC slot. The DRP PLIM is installed in the corresponding PLIM slot.

- The DRP contains two symmetric multiprocessors (SMPs), each of which performs routing functions. Processor-intensive tasks (such as BGP speakers and ISIS) can be offloaded from the route processors (RPs) to the DRPs to improve the routing performance of the Cisco CRS router.
- The DRP PLIM contains RJ-45 ports to connect the DRP to the system management console for configuration and management. The DRP has no ports.

Power

Before installing a Cisco CRS routing system, you must carefully plan the facility power required to support it. The power requirements are based on the number of line card chassis that you plan to install. When planning the power layout for a routing system, you should also include the power requirements of peripheral equipment (such as the external terminals), the network management equipment, and the test equipment you will use with your system.

For larger system configurations, it may be advisable to consult with a facilities electrical expert to understand the load that a routing system may put on the power plant of your facility. Always follow local electrical codes.

Note The chapter *Power and Cooling Requirements* provides detailed power and cooling requirements.

Cable Management

As the size of the routing system increases, the cabling required for the chassis increases. For example, a fully loaded chassis has more cables connected to it than a partially loaded chassis.

The cabling runs must be carefully planned. The basic configurations for various routing systems should be arranged to minimize the complexity and length of the cable runs. Precut and terminated cables are considered part of the basic configuration.

Physical Layer Interface Module Cables

You must provide the line card- PLIM interface cables and the cable management trays for these cables from the line card chassis to your facility interconnect.

Because the type and number of MSCs, FPs, and PLIMS vary with each routing system site, plan these data cable runs in advance of the system installation.

When planning the data cable runs, consider the:

- Number and type of interface connections to PLIMs and SPAs
- MSC horizontal cable management tray
- Line card chassis vertical cable management
- Termination at the other end of the cables (patch panel, optical transport equipment, and so on)
- Proper length and termination of cables

Noise Control

The line card chassis has built-in noise reduction, such as fan speed control. If the chassis is installed in an environment in which excessive noise could be harmful to personnel, some other noise-reduction options could be attempted. Passive noise reduction could include the installation of foam panels to insulate the surrounding area from the noise.

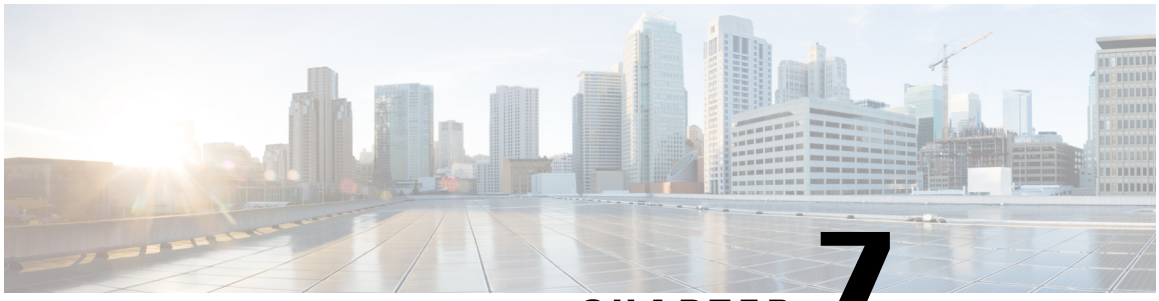
Additional noise-reduction measures have to be designed on an individual customer basis.

Cisco Installation Services

Cisco or a Cisco partner can provide a total installation, from planning to power up. For information about Cisco (or Cisco partner) installation services, contact Cisco Customer Advocacy.

System Testing, Certification, and Warranty

After a Cisco CRS routing system has been installed, it has to be tested and certified. Contact Cisco Customer Advocacy for information about testing, certification, and warranties.



CHAPTER 7

Product IDs

This appendix provides information about the product structure and product IDs. It contains the following tables:

Product IDs

This appendix provides information about the product structure and product IDs. It contains the following tables:

These tables list system components, their product IDs (the part numbers to use to order the component), and descriptions.

Note In the following tables, an equals sign (=) at the end of the product ID indicates that the component can be ordered as a spare. For those components, be sure to include the equals sign as part of the product ID.

Note Although this appendix provides product IDs for routing system components, the Cisco online ordering and pricing tool has the most up-to-date information on the routing system and product IDs: http://www.cisco.com CCO login is required. Enter a search term such as "CRS" to view a list of components.

Chassis Product IDs

The table below lists the high-level product IDs.

Table 12: Multishelf System Product IDs

Component	Product ID	Description
Multishelf System Components		

Component	Product ID	Description
CRS multishelf system	CRS-MC-FC24	Cisco CRS Multishelf System

The table below lists the PIDs for the fabric card chassis and its components.

Table 13: Cisco CRS Fabric Card Chassis Product IDs

Component	Product ID	Description
Fabric card chassis (complete)	CRS-FC24(=)	Cisco CRS FCC for a multishelf system(without switch fabric cards)
Fabric card chassis (chassis only)	CRS-FCC(=)	Cisco CRS routing system FCC (spare chassis)
Fan tray with fans	CRS-FCC-FAN-TR(=)	Cisco CRS FCC fan tray with fans (spare)(2 required for each chassis)
Cards and modules		
Switch fabric card (fabric chassis)	CRS-FCC-SFC(=) CRS-FCC-SFC-140(=)	S2 switch fabric cards for 40G system(8 required for each fabric chassis) S2 switch fabric cards for 140G system(8 required for each fabric chassis)
Switch fabric card blank	CRS-SFC-IMPEDANCE(=)	Blank card carrier for each switch fabric slot (used for shipment; must be replaced with fabric card)
22-port shelf controller card	CRS-FCC-SC-22GE(=)	22-port shelf controller Gigabit Ethernet (22-port SCGE) card(2 recommended for each fabric chassis)
OIM, single-width	CRS-FCC-OIM-1S(=)	Optical interconnect module (OIM)(1 required for each S2 fabric card in fabric chassis)
OIM blank	CRS-OIM-IMPEDANCE(=)	Blank carrier for each empty OIM slot
SFC and OIM eight pack bundle	CRS-FC24-SFC-8P(=)	Eight pack of S2 switch fabric cards and optional interconnect modules
FM-LED	CRS-FCC-LED(=)	Fiber module LED card (2 required for each fabric chassis)
FM-LED blank	CRS-FM-IMPEDANCE(=)	Blank carrier for each empty FM-LED slot(required for EMI compliance and cooling)

Component	Product ID	Description
Fixed Configuration Power		
AC Delta power system	CRS-FCC-ACD-KIT(=)	AC Delta power system for fabric chassis(includes 2 power shelves and 6 AC rectifiers)
AC Wye power system	CRS-FCC-ACW-KIT(=)	AC Wye power system for fabric chassis(includes 2 power shelves and 6 AC rectifiers)
DC power system	CRS-FCC-DC-KIT(=)	DC power system for fabric chassis(includes 2 power shelves and 4 power modules)
AC power rectifier	CRS-16-AC-RECT(=)	AC power rectifier for line card chassis(6 required for each chassis; 3 required for each AC power shelf)
DC PEM	CRS-16-DC-PEM(=)	AC power entry module for line card chassis(6 required for each chassis; 3 required for each DC power shelf)
Alarm module	CRS-16-ALARM(=)	Chassis alarm module(1 required for each power shelf)
Modular Configuration Power		
AC power system	CRS-FCC-ACKIT-M(=)	AC power system for fabric chassis(includes 2 power shelves and 6 AC PMs)
DC power system	CRS-FCC-DCKIT-M(=)	DC power system for fabric chassis(includes 2 power shelves and 8 DC PMs)
Alarm module	CRS-16-ALARM-C(=)	Chassis alarm module(1 required for each power shelf)
AC power cord	CRS-AC-CAB-NA CRS-AC-CAB-AU CRS-AC-CAB-UK CRS-AC-CAB-EU CRS-AC-CAB-IT	AC power cord—North America AC power cord—Australia AC power cord—United Kingdom AC power cord—Europe AC power cord—Italy Length of each power cord is 4.25 m.
Cable management and cosmetics		

Component	Product ID	Description
Front cosmetics	CRS-FCC-FRNT-CM(=)	Front cosmetics and cable management kit (front door not included)
Rear cosmetics	CRS-FCC-REAR-CM(=)	Rear cosmetics and cable management kit(rear door not included)
Front door	CRS-FCC-DRS-FR(=)	Front door for fabric chassis
Rear door	CRS-FCC-DRS-RR(=)	Rear door for fabric chassis
AC power grille	CRS-FCC-ACGRILLE(=)	Front grille for fixed configuration AC power shelves
DC power grille	CRS-FCC-DCGRILLE(=)	Front grille for fixed configuration DC power shelves
Modular power grille	CRS-16-PW-GRILL(=)	Front grille for modular configuration AC and DC power shelves
Chassis installation accessories (included with chassis)		
Drill hole template	CRS-LCC-DRILLTEMP(=)	Aluminum template showing where to drill the mounting holes to secure the chassis to the floor
Chassis access template	CRS-LCC-FLOORTEMP (=)	Mylar template showing chassis door swings and maintenance access area
Inrigger kit	CRS-FCC-ALTMNT(=)	Alternate mounting kit for anchoring chassis to floor

The table below lists the PIDs for the Cisco CRS 16-slot line card chassis and its components.

Table 14: Cisco CRS 16-Slot Line Card Chassis Product IDs

Component	Product ID	Description
Line card chassis(complete)	CRS-16-LCC/M CRS-16LCC140/M CRS-16/S	Cisco CRS-1 40G LCC(with 2 route processors [RPs], S13 fabric cards, and optical array cables) Cisco CRS-3 140G LCC(with 2 route processors [RPs], S13 fabric cards, and optical array cables) Cisco CRS LCC(with 2 route processors [RPs] and S123 fabric cards)

Component	Product ID	Description
Conversion Kit	CRS-16-MC-CONVCRS-16-MC140-CONV	Cisco CRS Multichassis conversion kit that converts a standalone Cisco CRS 16-Slot LCC into a Cisco CRS-1 Multichassis LCCCisco CRS Multichassis conversion kit that converts a standalone Cisco CRS 16-Slot LCC into a Cisco CRS-3 Multichassis LCC
Switch fabric cards		
Switch fabric card (single-shelf system)	CRS-16-FC/S(=) CRS-16-FC140/S(=) CRS-FCC-SFC400/S (=)	S123 switch fabric cards for CRS-1 system S123 switch fabric cards for CRS-3 system S123 switch fabric cards for CRS-X system (8 required for each line card chassis)
Switch fabric card (multi-shelf system)	CRS-16-FC/M(=) CRS-16-FC140/M(=) CRS-16-FC-400/M(=)	S13 switch fabric cards for CRS-1 system S13 switch fabric cards for CRS-3 system S13 switch fabric cards for CRS-X system (8 required for each line card chassis)
Route processors		
Route processor	CRS-16-RP(=)	Route processor(2 required for each line card chassis)
Performance route processor (PRP)	CRS-16-PRP-6G= CRS-16-PRP-12G=	Performance route processor (6GB memory) Performance route processor (12GB memory) (2 PRPs required for each line card chassis)
Distributed route processor (DRP)	CRS-DRP(=)	Additional route processor for the system (optional) (includes two cards, DRP CPU and DRP PLIM)
	To order DRP cards separately, use the following IDs (both cards are required for DRP operation):	
	CRS-DRP-B-CPU(=)	DRP card only (requires DRP PLIM)
	CRS-DRP-B-PLIM(=)	DRP PLIM only (requires DRP CPU)
Fixed Configuration Power		

Component	Product ID	Description
AC Delta power shelf	CRS-16-LCC-PS-ACD(=)	AC Delta power shelf for line card chassis (2 required for each chassis)
AC Wye power shelf	CRS-16-LCC-PS-ACW(=)	AC Wye power shelf for line card chassis (2 required for each chassis)
DC power shelf	CRS-16-LCC-PS(=)	DC power shelf for line card chassis (2 required for each chassis)
AC power rectifier	CRS-16-AC-RECT(=)	AC power rectifier for line card chassis(6 required for each chassis; 3 required for each AC power shelf)
DC PEM	CRS-16-DC-PEM(=)	AC power entry module for line card chassis(6 required for each chassis; 3 required for each DC power shelf)
Alarm module	CRS-16-ALARM(=)	Chassis alarm module(2 required for each chassis; 1 required for each power shelf)
Modular Configuration Power		
AC power system	CRS-16-ACKIT-M(=)	AC power system for fabric chassis(includes 2 power shelves and 10 AC PMs)
DC power system	CRS-16-DCKIT-M(=)	DC power system for fabric chassis(includes 2 power shelves and 12 DC PMs)
AC power module	CRS-PM-AC	Modular AC power module (Up to 6 required for each power shelf)
DC power module	CRS-PM-DC	Modular DC power module (Up to 8 required for each power shelf)
Alarm module	CRS-16-ALARM-C(=)	Modular power alarm module(1 required for each power shelf)
AC power cord	CRS-AC-CAB-NA CRS-AC-CAB-AU CRS-AC-CAB-UK CRS-AC-CAB-EU CRS-AC-CAB-IT	AC power cord—North America AC power cord—Australia AC power cord—United Kingdom AC power cord—Europe AC power cord—Italy Length of each power cord is 4.25 m.

Component	Product ID	Description
Cable management and cosmetics		
Front cosmetics	CRS-16-LCC-FRNT(=)	Front cosmetics and cable management kit
Rear cosmetics	CRS-16-LCC-BCK-CM(=)	Rear cosmetics and cable management kit
Front door	CRS-16-LCC-DRS-FR(=)	Front doors
Rear door	CRS-16-LCC-DRS-RR(=)	Rear doors
AC power grille	CRS-16-ACGRILLE(=)	Front grille for fixed configuration AC power shelves
DC power grille	CRS-16-DCGRILLE(=)	Front grille for fixed configuration DC power shelves
Modular power grille	CRS-16-PW-GRILL(=)	Front grille for modular configuration AC and DC power shelves
Chassis installation accessories (included with chassis)		
Drill hole template	CRS-LCC-DRILLTEMP(=)	Aluminum template showing where to drill the mounting holes to secure the chassis to the floor
Chassis access template	CRS-LCC-FLOORTEMP (=)	Mylar template showing chassis door swings and maintenance access area
Chassis floor mounting kit	CRS-16-LCC-ALTMNT(=)	Alternate mounting kit for anchoring chassis to floor
For detailed specifications for Cisco CRS routing system PLIMs, RPs and other components refer to the data sheet on: http://www.cisco.com/en/US/products/ps5763/index.html . CCO login is required.		
For additional information on Cisco CRS routing system SPA interface processor (SIP) and shared port adapters (SPAs), see *Cisco CRS SIP and SPA Hardware Installation Guide* .		

Fabric Cables

The table below lists the product ID numbers for Cisco CRS fabric cables. These cables, which are available in different lengths, connect the S13 fabric cards (in the line card chassis) to the S2 fabric cards (in the fabric chassis). Be sure to order enough cables for your system. The interconnection cables listed are shipped as a set of 24 in the meter length specified.

In the table below, the cable name *LCC/M-FC-FBR-XX* means the following:

- *LCC/M* is "Line Card Chassis/Multishelf System."
- *FC* is Fabric (Card) Chassis.
- *FBR* is Fiber.
- *xx* is the length of the cable in meters.

Note = symbol at the end of a product ID number indicates that the part is a *spare* , which means the part can be ordered.

Note R = symbol at the end of a product ID number indicates that the part is a riser-rated fiber cable.

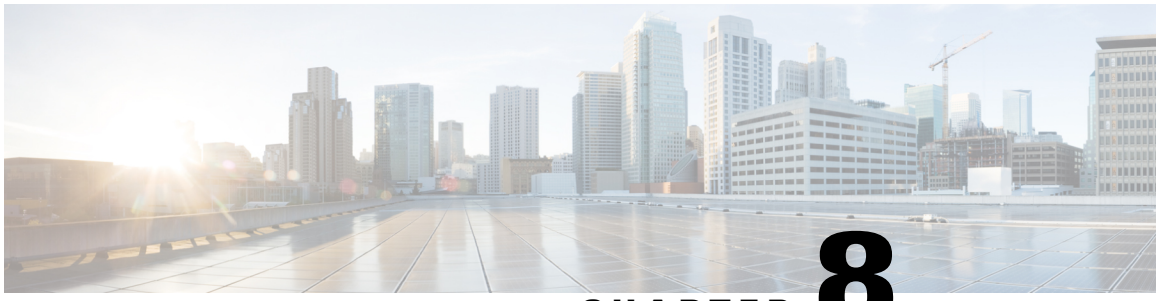
Table 15: Fabric Cables for the Cisco CRS-1 Multishelf System

Fabric Cable Product ID	Description and Length
LCC/M-FC-FBR-10=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 10 meters (32.8 feet)
LCC/M-FC-FBR-15=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 15 meters (49.2 feet)
LCC/M-FC-FBR-20=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 20 meters (65.6 feet)
LCC/M-FC-FBR-25=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 25 meters (82 feet)
LCC/M-FC-FBR-30=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 30 meters (98.43)
LCC/M-FC-FBR-40=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 40 meters (131.2 feet)
LCC/M-FC-FBR-50=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 50 meters (164 feet)

Fabric Cable Product ID	Description and Length
LCC/M-FC-FBR-60=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 60 meters (197 feet)
LCC/M-FC-FBR-70=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 70 meters (229.7)
LCC/M-FC-FBR-80=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 80 meters (262.5 feet)
LCC/M-FC-FBR-90=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 90 meters (295.3feet)
LCC/M-FC-FBR-100=	Cisco CRS Line Card Chassis-Fabric Chassis Fiber 100 meters (328 feet)
LCC/M-FC-FBR-10R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 10 meters (32.8 feet)
LCC/M-FC-FBR-15R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 15 meters (49.2 feet)
LCC/M-FC-FBR-20R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 20 meters (65.6)
LCC/M-FC-FBR-25R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 25 meters (82 feet)
LCC/M-FC-FBR-30R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 30 meters (98.43 feet)
LCC/M-FC-FBR-40R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 40 meters (131.2 feet)
LCC/M-FC-FBR-50R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 50 meters (164 feet)
LCC/M-FC-FBR-60R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 60 meters (197 feet)
LCC/M-FC-FBR-70R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 70 meters (229.7)
LCC/M-FC-FBR-80R=	Cisco CRS Line Card Chassis-Fabric Chassis Rise-rated r 80 meters (262.5 feet)
LCC/M-FC-FBR-90R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 90 meters (295.3feet)

Fabric Cable Product ID	Description and Length
LCC/M-FC-FBR-100R=	Cisco CRS Line Card Chassis-Fabric Chassis Riser-rated 100 meters (328 feet)

Note The Cisco CRS fiber-optic cleaning kit (CRS-FIBER-CLN-KIT=) includes a cleaning tool that advances a continuous roll of lint-free cleaning cloth across the face of the optic. For more information, see the *Cisco CRS-1 Carrier Routing System Fiber-Optic Cleaning Guide* .



CHAPTER 8

Prelimnary Site Survey

This appendix contains a sample preliminary site survey that you should complete before planning a detailed site survey. This preliminary survey ensures that the basic system requirements have been completed or are underway before detailed site plans are completed.

Preliminary Site Survey

This appendix contains a sample preliminary site survey that you should complete before planning a detailed site survey. This preliminary survey ensures that the basic system requirements have been completed or are underway before detailed site plans are completed.

The table below is a sample preliminary site survey.

Table 16: Sample Preliminary Site Survey

Preliminary Site Survey	
Order Information	
Sales order number:	
Estimated shipping date:	
Site ready date:	
Installation date:	
Site Location and Address	
Company name:	
Site address:	

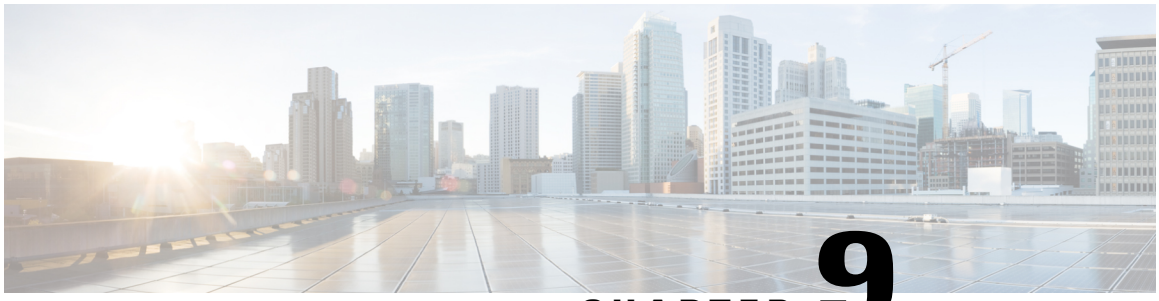
Preliminary Site Survey	
Shipping address:	
Building or computer room access:	
Special instructions:	
Hours and days of operation:	
Site Survey Contacts	
Primary Contact	
Name:	
Title:	
Phone number:	
Mobile phone number:	
Fax number:	
Pager number:	
E-mail address:	
Secondary Contact	
Name:	
Title:	
Phone number:	
Mobile phone number:	
Fax number:	
Pager number:	
E-mail address:	
Delivery and Installation Constraints	

Preliminary Site Survey	
Is there a loading dock available to unload the equipment at this site?	
Is the path to the installation area unobstructed? If not, can special arrangements be made to get the equipment to the installation area? Describe them.	
On what floor is the installation?	
If it is on a floor other than the ground floor, is there a freight elevator available? Note if the equipment will have to be brought up a flight of stairs.	
Is there someone on site during working hours to accept delivery of the materials? If not, list the times this person would be available.	
Floor Mounting	
How many line card chassis will be installed? Is there floor space available for all of the chassis?	
Does the floor meet the routing system floor-loading requirements?	
Can the primary or secondary chassis mounting locations be used to secure the chassis to the floor, or will an outrigger kit be required?	
Make a sketch of the area where the chassis is to be installed and note the chassis location.	
Power	
Is AC or DC power available for the chassis? Is there a connection point on the panel for the chassis?	

Preliminary Site Survey	
Is there a fuse access panel (FAP) available for the equipment? Provide a connection point on the fuse access panel for each chassis.	
Will a fuse access panel be installed in time for the routing system installation? Provide a date when the FAP will be installed.	
Is the FAP in the same room as the chassis?	
Is there an AC power outlet (220 V or 110 V) located within 10 feet of each chassis for PCs and test equipment?	
Is there proper grounding for the equipment? If not, when will the grounding be available? Provide a connection point for the grounding.	
Are there any restrictions when the equipment can be powered on or when electrical work can be done? If so, describe them.	
Are there special requirements for power or power cables (for example, a different wire gauge, and so on)? If so, describe them.	
Air conditioning	
Does the site have the air conditioning capacity to handle the routing system? If not, note what will be done to rectify the lack of adequate cooling.	
Describe the air conditioning at the site.	
System Interconnection Cabling	
Has the chassis-to-chassis interconnection cabling been considered?	
Control Plane, BITS, and Alarm Interfaces	

Preliminary Site Survey	
Will the facility building integrated timing source (BITS) be used? Has the cabling been considered?	
Will the chassis be connected to an external alarm system? Has the cabling been considered?	
Supported Data Interfaces	
Will the routing system be connected to OC-3/STM-1 POS circuits? How many ports?	
Will the routing system be connected to OC-48/STM-16 POS or DPT circuits? How many ports?	
Will the routing system be connected to OC-192/STM-64 POS or RPR XFP circuits? How many ports?	
Will the routing system be connected to OC-768/STM-256 POS circuits? How many ports?	
Will the routing system be connected to Gigabit Ethernet (GE) or 10-GE circuits? How many ports?	
Will the routing system be connected to 100-GE circuits? How many ports?	
Cable Plant	
Have the cables been pulled for all data interfaces? If not, list the outstanding cabling that needs to be installed and the scheduled completion dates.	
Are there connection points on the fiber distribution panel for all optical cables connecting to the routing system?	
Will fiber jumpers be provided? What length of fiber jumper is required to complete the installation?	

Preliminary Site Survey	
What type of fiber connector is used at the site?	
If attenuation is required, will attenuators be provided? If not, who will pay for the attenuators?	



CHAPTER 9

Cisco CRS 16-Slot Line Card Chassis System Specifications

This appendix contains tables that list the specifications for the main components of the Line Card Chassis.

Cisco CRS Series Carrier Routing System 16-Slot Line Card Chassis Specifications

This appendix contains tables that list the specifications for the main components of the Line Card Chassis.

Note For a complete list of cards supported in the Cisco CRS 16-slot line card chassis, go to the Cisco Carrier Routing System Data Sheets at: http://www.cisco.com/c/en/us/products/routers/carrier-routing-system/datasheet-listing.html

The appendix includes the following topics:

Line Card Chassis Specifications

The table below lists the specifications for the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis.

Table 17: Cisco CRS 16-Slot Line Card Chassis Specifications

Chassis Dimensions	
Height	80 in. (203.2 cm) as shipped84 in. (213.4 cm) as installed
Width	23.6 in. (60.0 cm) 26.1 in. (66.3 cm) with PDU and brackets

Depth	36 in. (91 cm) without doors and other cosmetics39.7 in. (101 cm) with front and rear doors
Floor space requirement	Chassis: 6 sq ft (0.56 sq m) Aisle spacing to install chassis (front): 48 in. (122 cm) Aisle spacing to service FRUs (front): 36 in. (91 cm) Aisle spacing to service FRUs (rear): 36 in. (91 cm)
Chassis	
Chassis shipping weight	1175 lb (532 kg) LCC with shipping crate and pallet
Chassis with power shelves only, no power modules	849 lb (385 kg)
Chassis with power shelves, power modules, alarm module	970 lb (440 kg)
Chassis, fully loaded with cards, without cosmetics	1585 lb (719 kg)
Chassis, fully loaded with cards and cosmetics (doors, panels, grilles, and so on)	1629 lb (739 kg)
Chassis, fully loaded with cards and cosmetics (doors, panels, grilles, and so on), AC Wye PDU, and brackets	1689 lb (766 kg)
Chassis, fully loaded with cards and cosmetics (doors, panels, grilles, and so on), AC Delta PDU, and brackets	1715 lb (778 kg)
Floor Loading	
Chassis footprint	4.72 sq ft (4385 sq cm)
Floor contact area	680 sq in. (4385 sq cm)
Maximum floor loading	Without cosmetics and doors: 1585 lb/4.72 sq. ft = 335 lb/sq. ft719 kg/4385 sq. cm = 0.164 kg/sq. cm With cosmetics and doors: 1695 lb/4.72 sq. ft = 359 lb/sq. ft769 kg/4385 sq. cm = 0.175 kg/sq. cm

Cards/Ports/Slots	1-port OC-768c/STM-256c packet over Synchronous Optical Network (POS) 4-port OC-192c/STM-64c POS/Dynamic Packet Transport (DPT) 16-port OC-48c/STM-16 POS/DPT 8-port 10 Gigabit Ethernet 4-port 10 Gigabit Ethernet CRS1-SIP-800 Carrier Card 4-Port OC-3/STM-1 POS SPA 8-Port 1 Gigabit Ethernet SPA 1-port OC-768c/STM-256c Tunable WDMPOS 4-port 10GE Tunable WDMPHY
Chassis Cooling	2 fan trays, push-pull configuration
Chassis airflow	Up to 2050 cubic ft (58,050 liters) per minute
Power shelf airflow	100 to 140 cubic ft (2832 to 3964 liters) per minute
AC power cord length	167 in. (4.25 m)

Fixed Configuration Power Specifications

The table below lists the fixed configuration power specifications for the LCC.

Table 18: Line Card Chassis Fixed Configuration Power Specifications

Description	Value
Power shelves	2 AC or 2 DC power shelves (Cannot mix AC and DC power shelves.)
DC power shelf	3 power entry modules (PEMs) per shelf
AC power shelf	3 PEMs per shelf
Maximum Input Power	
Fixed configuration DC, chassis fully loaded	13,895 W (13.9 kW) 95% efficiency
Fixed configuration AC, chassis fully loaded	15,000 W (15.0 kW) 88% efficiency
Maximum Output Power	

Description	Value
Chassis fully loaded (DC and AC)	12,744 W (12.7 kW)
Power Redundancy (2N)	
DC	2N: Requires 6 “A” battery plant feeds and 6 “B” battery plant feeds (up to 12 total)
AC, 3-phase	2N: Requires two independent 3-phase AC sources
DC Input	
Nominal input voltage	–48 VDC North America–60 VDC European Community(range –42 to –75 VDC)
Input current	50 A max at –48 VDC40 A max at –60 VDC
AC Input, Delta 3-phase	3W+PE (3 wire + protective earthing[3])
Nominal input voltage	3-phase 200 to 240 VAC, phase-to-phase(range 180 to 264 VAC, phase-to-phase)
Nominal line frequency	50/60 Hz (range 47 to 63 Hz)
Recommended AC service	60 A
AC Input, Wye 3-phase	3W+N+PE (3 wire + neutral + protective earthing1)
Nominal input voltage	3-phase 200-240/346-415 VAC(range 180 to 264 VAC, phase-to-neutral)(range 311 to 456 VAC, phase-to-phase)
Nominal line frequency	50/60 Hz (range 47 to 63 Hz)
Recommended AC service	40 A (North America)32 A (International)

3 Protective earthing conductor (ground wire).

Modular Configuration Power Specifications

The table below lists the modular configuration power specifications for the Cisco CRS 16-Slot Line Card Chassis.

Table 19: Line Card Chassis Modular Configuration Power Specifications

Description	Value
Power shelves	2 AC or 2 DC power shelves (Cannot mix AC and DC power shelves.)
DC power shelf	Supports up to 8 DC power modules (PMs) 6 PMs are shipped per shelf
AC power shelf	Supports up to 6 DC power modules (PMs) 5 PMs are shipped per shelf
Maximum Input Power	
Modular configuration, DC, chassis fully loaded	14,667 watts (14.7 kW) 88% efficiency
Modular configuration, AC, chassis fully loaded	14,348 watts (14.4 kW) 92% efficiency
Maximum Output Power	
Chassis fully loaded (DC and AC)	13,200 W (13.2 kW)
Power Redundancy	
DC	2N: Up to 8 “A” battery plant feeds and up to 8 “B” battery plant feeds
AC	2N: Up to 6 “A” AC single-phase power sources and up to 6 “B” single-phase AC power sources required.
DC Input	
Nominal input voltage	–48 VDC North America–60 VDC InternationalRange: 40 to –72 VDC
Input current	40 A max at –48 VDC30 A max at –60 VDC50 A at –40 VDC (maximum)
AC Input	Single-phase
Nominal input voltage	200 to 240 VAC (range 180 to 264 VAC)
Nominal line frequency	50/60 Hz (range 47 to 63 Hz)
Recommended AC service	20 A (North America) dedicated branch circuit16 A (International) dedicated branch circuit

Line Card Chassis Environmental Specifications

The table below lists the environmental specifications for the line card chassis.

Table 20: Line Card Chassis Environmental Specifications

Description	Value
Temperature	Operating, nominal: 41° to 104°F (5° to 40°C) Operating, short-term: 23° to 122°F (–5° to 50°C)[4] Nonoperating: –40° to 158°F (–40° to 70°C)
Humidity	Operating: 5 to 85% noncondensing Nonoperating: 5 to 90% noncondensing, short-term operation
Altitude	–197 to 5906 ft (–60 to 1800 m) at 122°F (50°C), short-term Up to 13,123 ft (4000 m) at 104°F (40°C) or below
Heat dissipation	47,408 BTU per hour (maximum) fixed configuration DC[5] 51,180 BTU per hour—(maximum) fixed configuration AC[6] 50,042 BTU per hour (maximum) modular configuration DC[7] 48,955 BTU per hour—(maximum) modular configuration AC[8]
Air exhaust temperature	129°F (54°C)—at room temperatures of 95 to 102°F (35 to 39°C) 149°F (65°C)—maximum exhaust temperature on a fully loaded system during worst-case operating conditions (50°C and 6000 ft altitude) Air temperature rise is 59°F (15°C) on a fully loaded system with fans running at maximum speed (5150 RPM). At room temperatures below 95°F (35°C), exhausted air is 66.2°F (19°C) higher than room temperature. At temperatures above 102°F (39°C), exhausted air is 59°F (15°C) higher than room temperature.

Description	Value
Air velocity (at exhaust)	1400 ft per minute (426.7 m per minute) at normal room temperature, low fan speed (4000 RPM) 1800 ft per minute (548.6 m per minute) at high temperature or altitude, maximum fan speed (5150 RPM) Software controls the speed of the fans based on measurements from the chassis thermal sensors.
Sound power level(fixed configuration power)	Room temp 27°C, sound power, 76.2dB with Arctic Room temp 40°C, sound power, 88 dB with Arctic Room temp 27°C, sound power, 82.2dB with TDI AC Room temp 27°C, sound power, 77.2dB with TDI DC Room temp 40°C, sound power, 89dB with TDI AC Room temp 40°C, sound power, 88dB with TDI
Sound power level(modular configuration power)	Fan speed 3300 RPM, temperature 80°F (27°C): 76.2 dB—modular configuration power Fan speed 5150 RPM, temperature 104°F (40°C): 88.0 dB—modular configuration power
Shock and vibration	Designed and tested to meet the NEBS shock and vibration standards defined in GR-63-CORE (Issue 2, April 2002).

4 Short-term refers to a period of not more than 96 consecutive hours and a total of not more than 15 days in 1 year. This refers to a total of 360 hours in any given year, but no more than 15 occurrences during that 1-year period.

5 Heat dissipation from the fixed configuration DC power system based on maximum output power capacity at 95% efficiency.

6 Heat dissipation from the fixed configuration AC power system based on maximum output power capacity at 88% efficiency.

7 Heat dissipation from the modular configuration DC power system based on maximum output power capacity at 90% efficiency.

8 Heat dissipation from the modular configuration AC power system based on maximum output power capacity at 92% efficiency. Depending on the hardware deployed at your site, your system may not consume or be capable of consuming the maximum power supplied by the power system.

Regulatory, Compliance, and Safety Specifications

For information about the regulatory, compliance, and safety standards to which the Cisco CRS Series system conforms, see *Regulatory Compliance and Safety Information for the Cisco CRS Carrier Routing System* .