



# Power and Cooling Requirements

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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, page 1](#)

## 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 7](#) or the [AC Power System, on page 13](#) 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**

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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.

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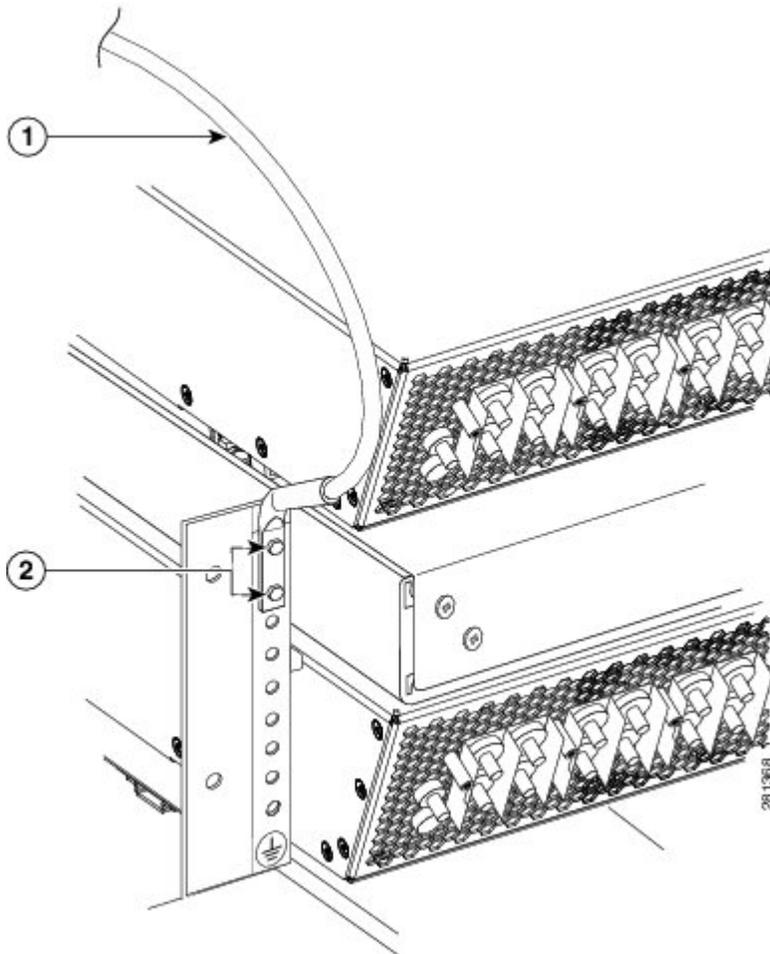
## Bonding and Grounding Guidelines

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 1: NEBS Bonding and Grounding Points—Modular Configuration DC Power Shelf Shown**



1	Chassis ground cable	2	NEBS bonding and grounding points
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**Note**

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

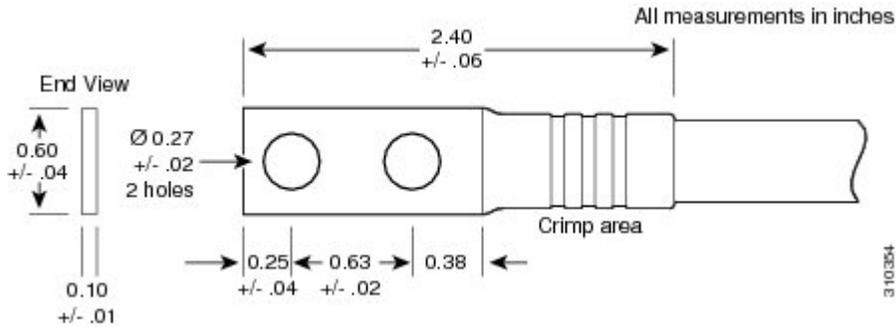
The grounding points are hidden by a cover plate. When the cover plate is removed, you can easily see the labels indicating the location of the grounding points. Two grounding points are provided; use the top grounding point for NEBS grounding purposes.

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

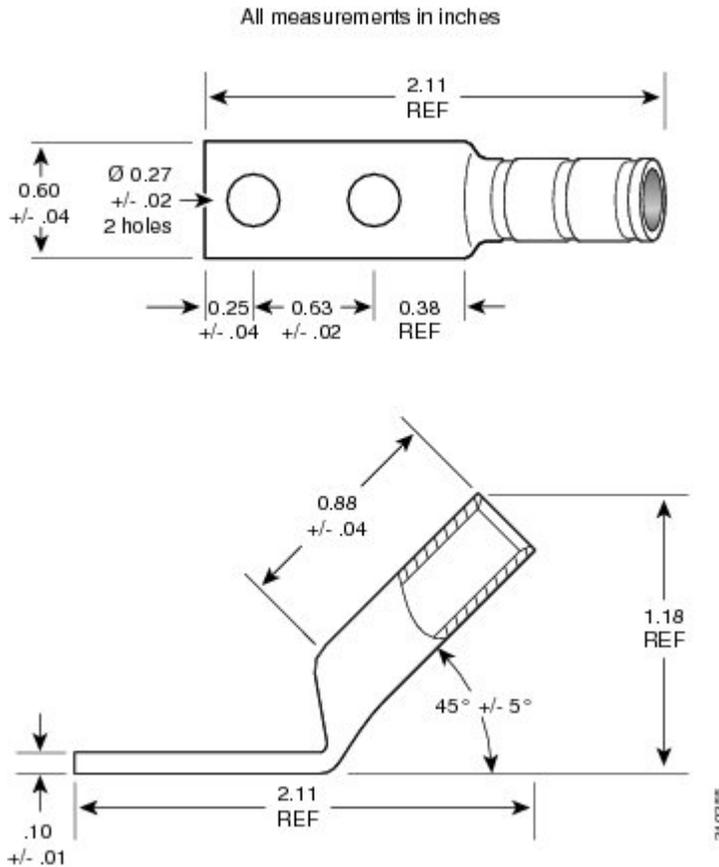
- One grounding lug that has two M6 bolt holes with 0.63 inch (5/8 inch) (1.60 cm) of spacing between them and a 6-AWG or larger multistrand copper cable.

- 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 3: 45-Degree Chassis Ground Lug](#), on page 6

**Figure 2: 180-Degree (Straight) Chassis Ground Lug**



**Figure 3: 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 2](#).

- 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 1: 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.)

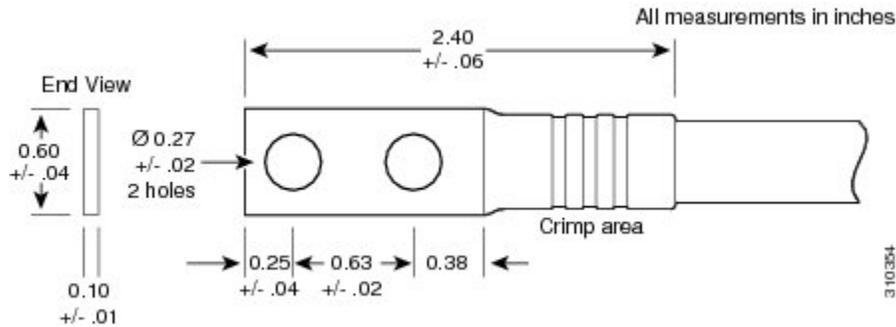


### Note

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 4: 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**

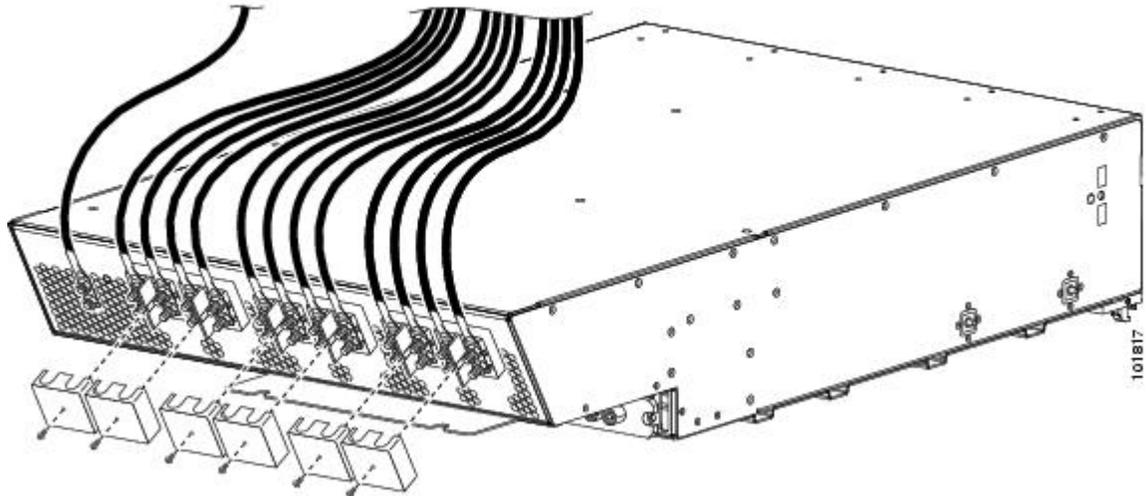
If reverse polarity occurs, the DC power module circuit breaker trips. No damage should occur because of reverse polarity protection, but you should correct the situation immediately.

The figure 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 5: 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 2.

- 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 2: 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.



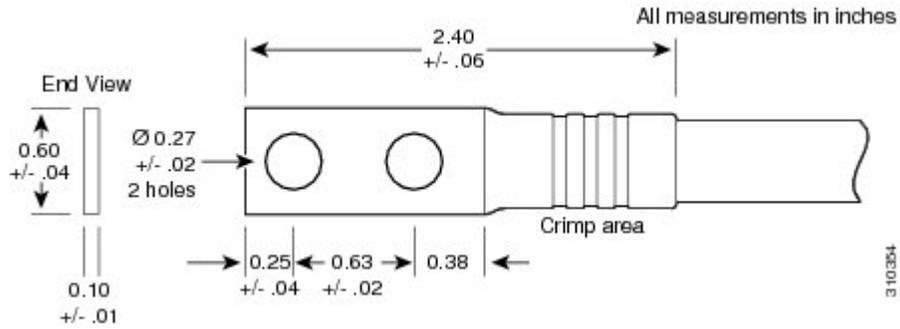
### Caution

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

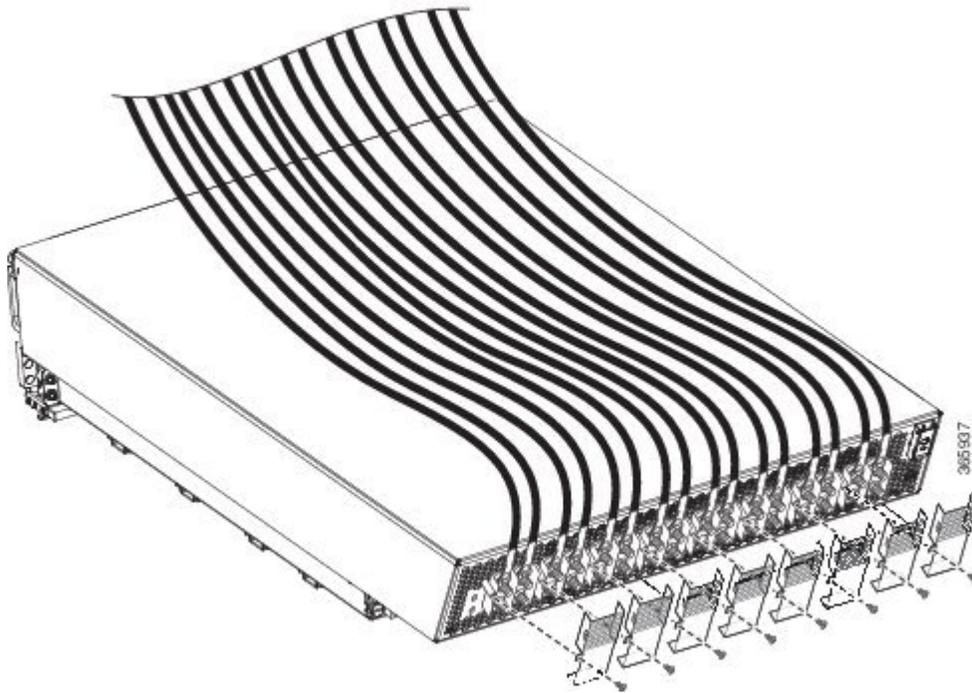
terminate a 6-AWG power cable with a cable lug such as Panduit part number LCD2-14A-Q or equivalent. See the figure below.

**Figure 6: DC Power Cable Lug**



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

**Figure 7: 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 2](#), 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 9: AC Delta Power Cord Plug](#), on page 14.)

**Figure 8: AC Wye Power Cord Plug**



**Figure 9: 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.

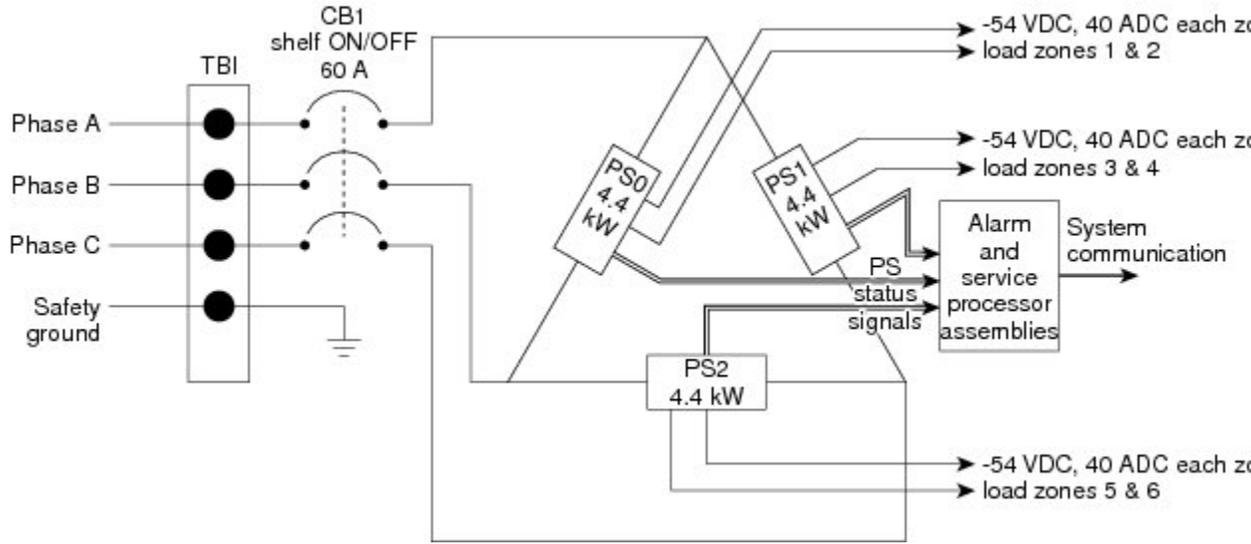
- AC Delta configuration is typically used in the United States, Japan, and other countries where the phase-to-phase voltage is approximately 208 VAC. The power supplies are wired between the phases (see [Figure 11: AC Wye Power Shelf Wiring](#), on page 16) and a neutral is not required.
- AC Wye configuration 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 11: AC Wye Power Shelf Wiring](#), on page 16.)

## 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 10: AC Delta Power Shelf Wiring**

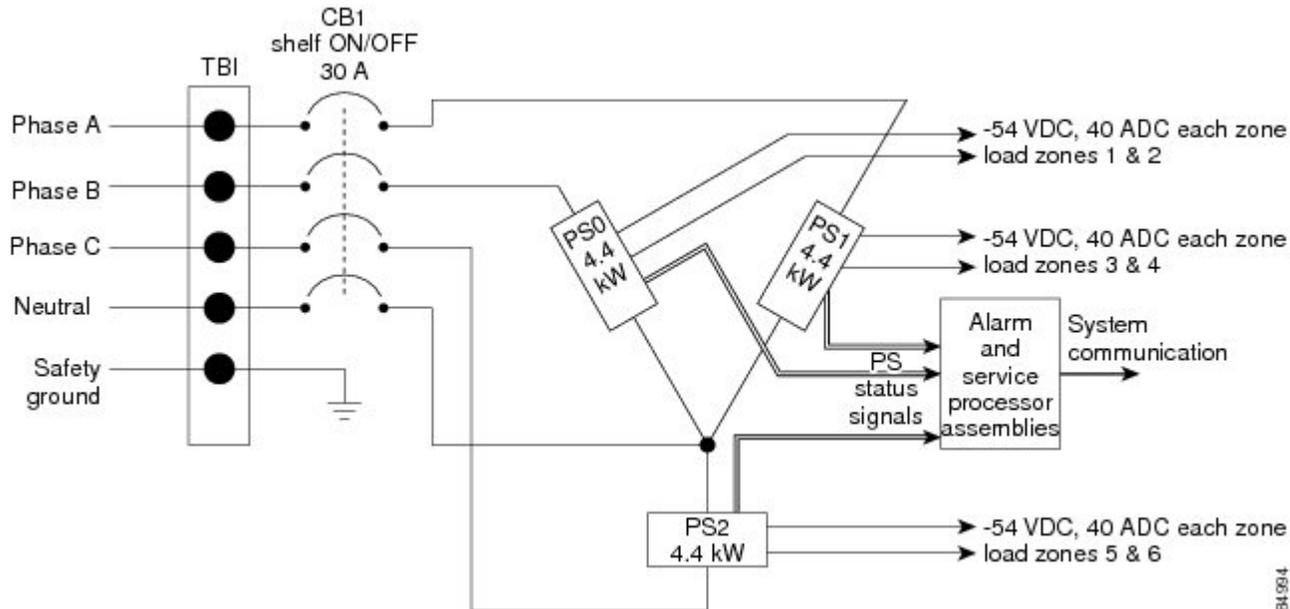


### AC Wye Power Shelf Wiring

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.

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

**Figure 11: AC Wye Power Shelf Wiring**



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## 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 2, 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](#).

## 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

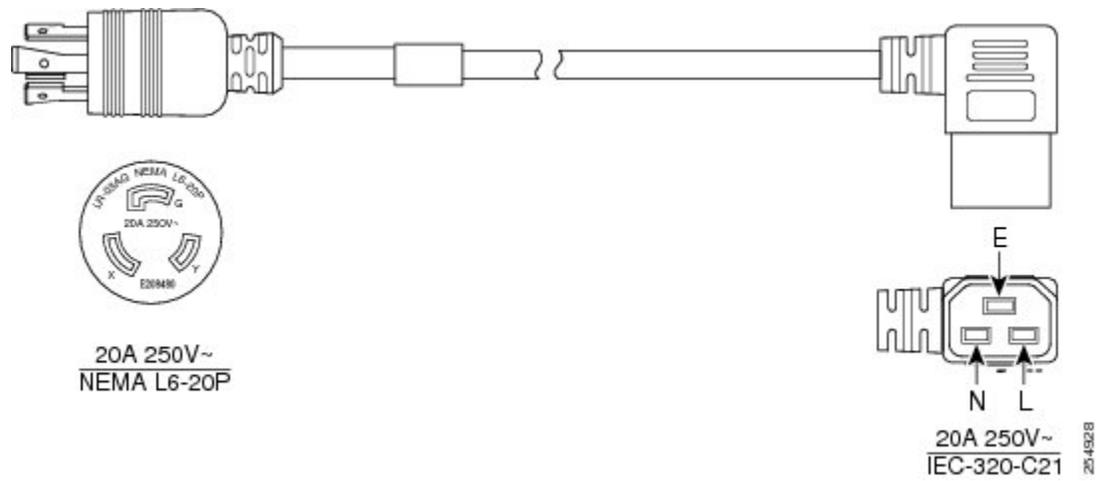
The table below lists the single-phase AC-input cord power options and Cisco product numbers for the Cisco CRS 16-slot LCC with a modular configuration AC power shelf installed. The table below also references power cord illustrations.

**Table 3: Modular Configuration Single-Phase AC-Input Power Cord Options**

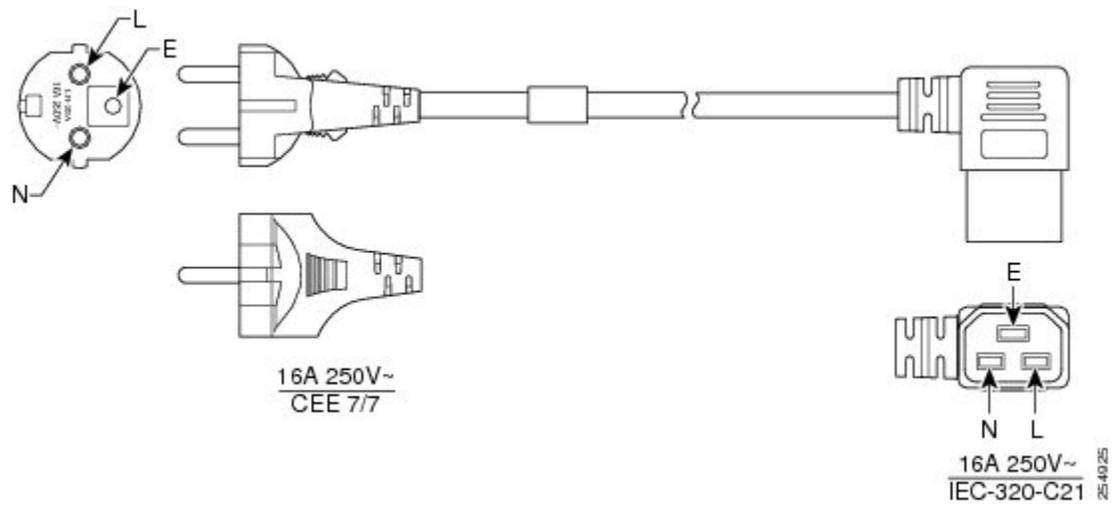
Locale	Cisco Product Number	Plug Rating	Reference Illustration
North America	CRS-AC-CAB-NA(=)	20 A/250 VAC	<a href="#">Figure 12: North America—Modular Configuration AC-Input Power Cord, on page 19</a>
Europe	CRS-AC-CAB-EU(=)	16 A/250 VAC	<a href="#">Figure 13: Europe—Modular Configuration AC-Input Power Cord, on page 19</a>

<b>Locale</b>	<b>Cisco Product Number</b>	<b>Plug Rating</b>	<b>Reference Illustration</b>
United Kingdom	CRS-AC-CAB-UK(=)	13 A/250 VAC	<a href="#">Figure 14: United Kingdom—Modular Configuration AC-Input Power Cord, on page 19</a>
Italy	CRS-AC-CAB-IT(=)	16 A/250 VAC	<a href="#">Figure 15: Italy—Modular Configuration AC-Input Power Cord, on page 21</a>
Australia	CRS-AC-CAB-AU(=)	15 A/250 VAC	<a href="#">Figure 16: Australia—Modular Configuration AC-Input Power Cord, on page 21</a>

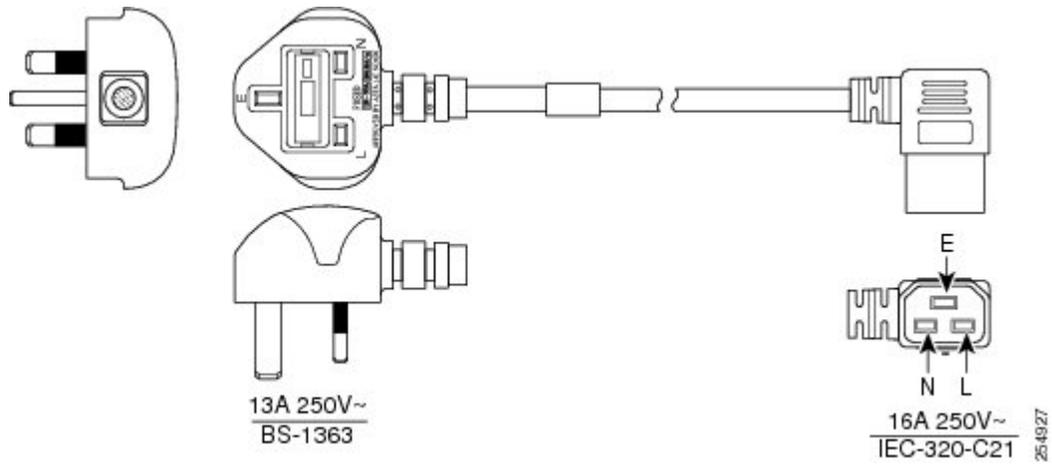
**Figure 12: North America—Modular Configuration AC-Input Power Cord**



**Figure 13: Europe—Modular Configuration AC-Input Power Cord**



**Figure 14: United Kingdom—Modular Configuration AC-Input Power Cord**

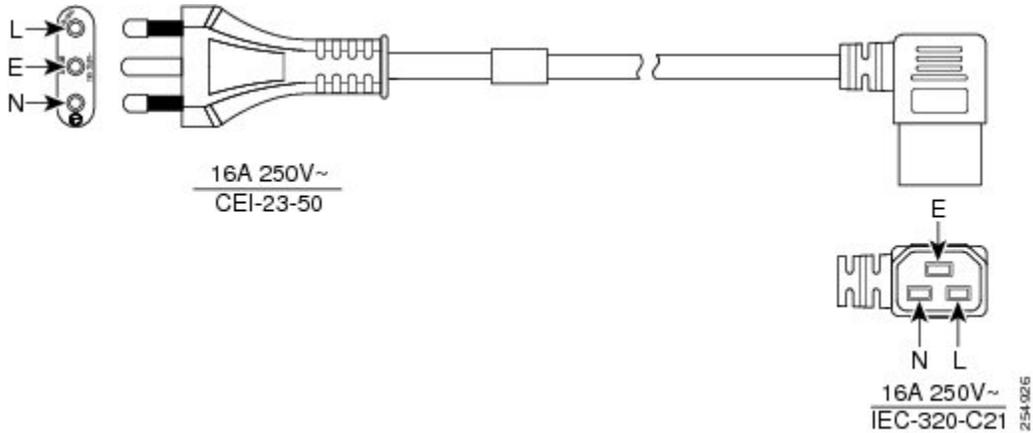




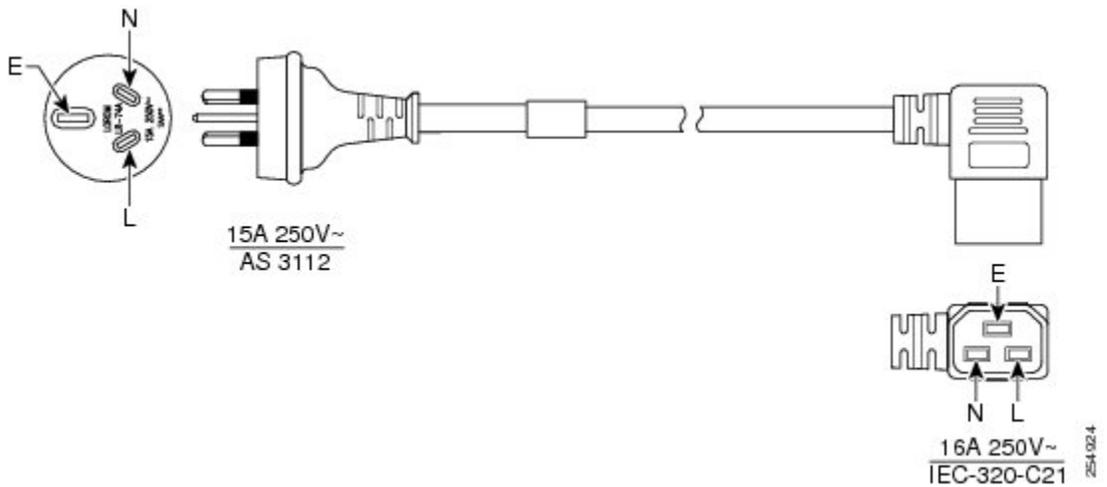
**Note**

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 15: Italy—Modular Configuration AC-Input Power Cord**



**Figure 16: 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 2, AC input power requirements are as follows:

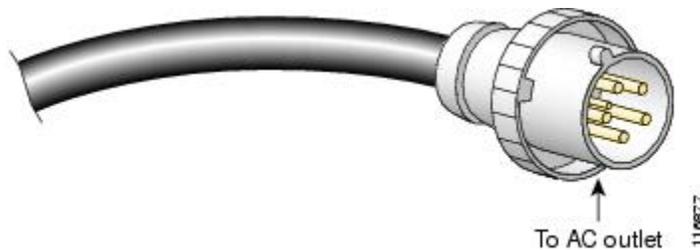
- Two separate and independent AC power sources are required, one for each PDU. Each PDU should be connected to a different power source to provide 2N power redundancy in case a power source fails.
- Each AC power source must provide 3-phase VAC power, and have its own circuit breaker.
- AC Delta input:
  - 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 17: AC Delta Power Cord Plug**



**Figure 18: 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*.

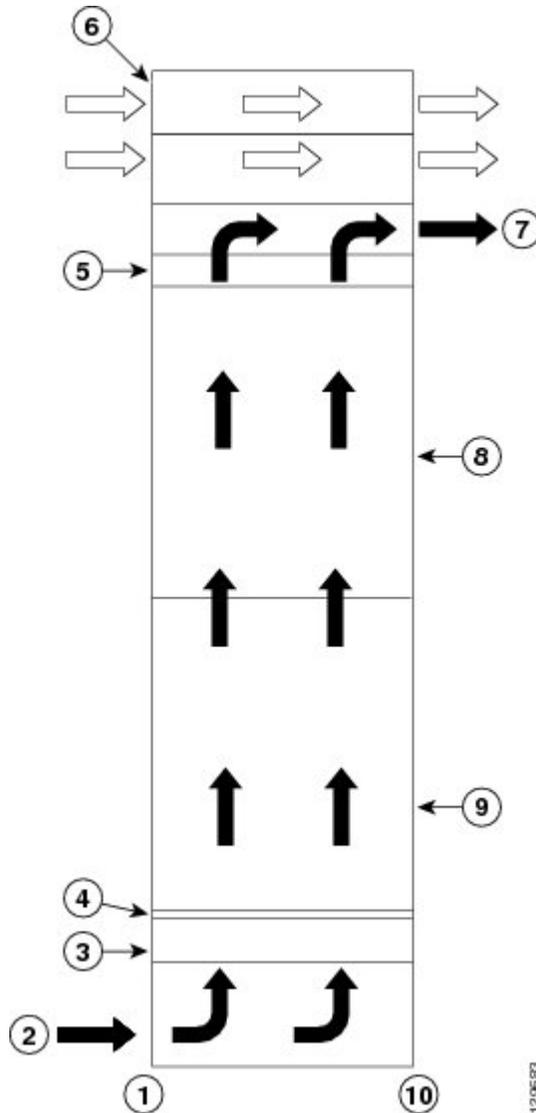
## Line Card Chassis Airflow

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 19: 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
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The line card chassis has a maximum airflow of 2050 cubic feet per minute.

