



Power and Cooling

This chapter describes the Cisco NCS 6000 Series Routers power and cooling systems. It also provides the power, grounding, and cooling requirements for the installation site to help you plan the site facilities for the system.

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Chassis Power System

The Cisco NCS 6000 Series chassis can be either AC-powered or DC-powered. Each type of power system supports N+N redundancy for all feeds and power system components.

The Cisco NCS 6008 LCC has six AC or DC power trays. The Cisco NCS 6000 FCC has four AC or DC power trays. The AC power tray has three slots for power modules (PMs). The DC power tray has four slots for PMs.

The power modules (PMs) will load-share across input power feeds. The load is balanced across all input feeds.

Each AC PM requires its own single-phase AC input power feed. If you have 3-phase AC-Delta or AC-Wye at your equipment, a *Cisco NCS 3-Phase AC PDU* is required to convert a 3-phase AC input power feed to three single-phase AC input power feeds. See the [Converting 3-Phase AC to Single-Phase AC, on page 15](#).

General Power and Grounding Requirements

This section describes the power and grounding requirements to consider when planning the site facilities for the routing system. In addition, see the [DC Power Systems, on page 5](#) or the [AC Power Systems, on page 9](#) for information about the power requirements for your chassis type.

**Note**

A qualified 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.

- Installation of the routing system 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 N+N redundancy for system power. Each power source requires its own circuit breaker.
- Each power source must provide clean power to the site (free of spikes and noise). If necessary, install a power conditioner.
- The 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:
 - AC-powered systems require chassis grounding. A grounding-type AC power outlet is required.
 - DC-powered systems require chassis grounding only.
- When planning the power for the site, be sure to 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 Network Convergence System 6000 Series Routers](#) before installing the routing system.

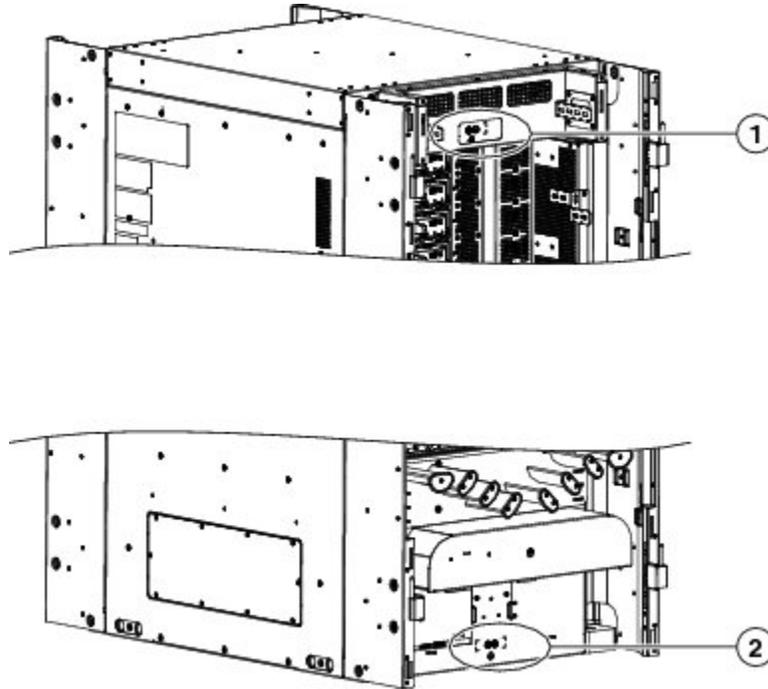
Bonding and Grounding Guidelines

The Cisco NCS 6008 LCC and Cisco NCS 6000 FCC have two safety earth ground connections. These grounding points are also referred to as Network Equipment Building System (NEBS) bonding and grounding points, and are provided to satisfy the Telcordia NEBS safety requirements.

You can connect the central office ground system or interior equipment grounding system to either of the two grounding points on the rear side of the chassis. Threaded ground inserts are located on a rear panel

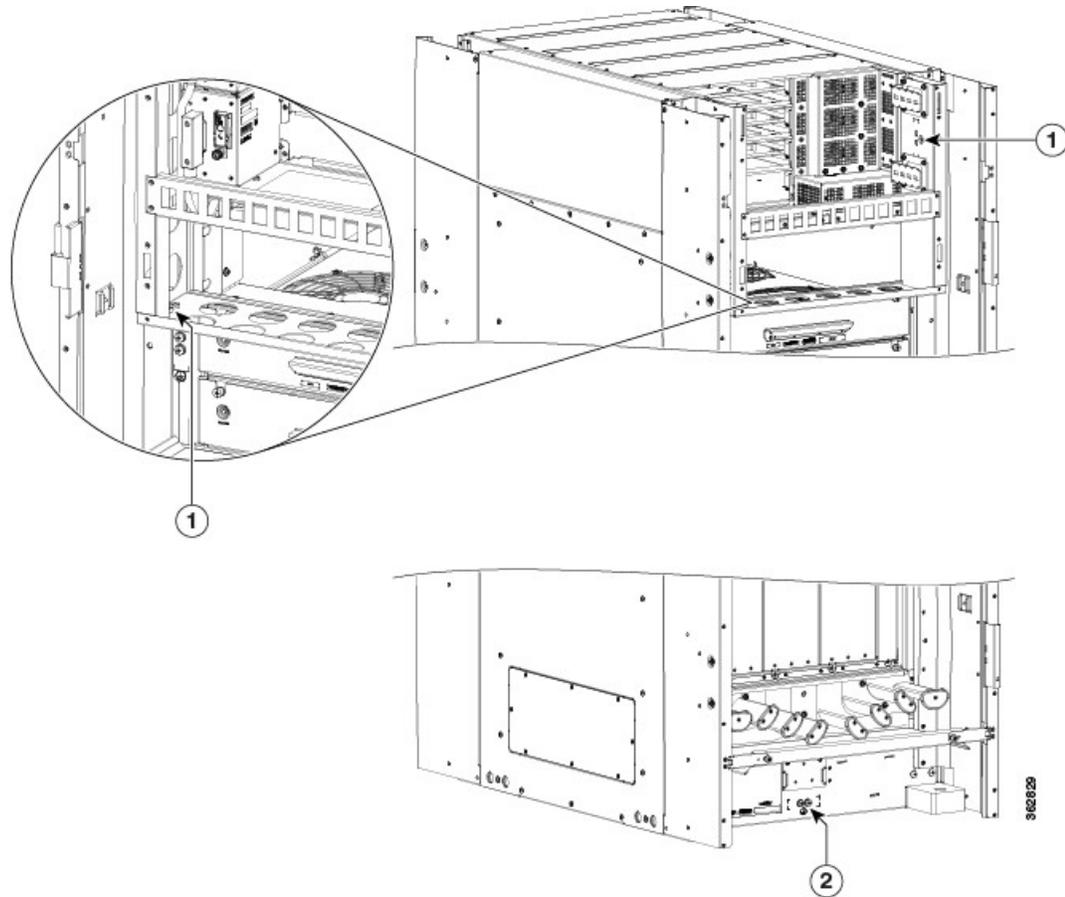
near the top of the chassis and near the bottom of the chassis on both the LCC and FCC (see the following figures).

Figure 1: LCC NEBS Bonding and Grounding Points—Rear Side of Chassis



1	NEBS bonding and grounding points (upper)	2	NEBS bonding and grounding point (lower)
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Figure 2: FCC NEBS Bonding and Grounding Points—Rear Side of Chassis



1	NEBS bonding and grounding points (upper)	2	NEBS bonding and grounding point (lower)
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To connect the chassis to a NEBS-compliant bonding and grounding system at your site, you must have the following:

- One 180-degree angle (straight) grounding lug that has two M6 bolt holes with 0.63 inch spacing center to center between them, and a wire receptacle able to accept a 6-AWG copper wire (see the following figure).
- Four M6 bolts with integrated square cone locking washers (shipped pre-installed on the chassis, two at each grounding point).



Note

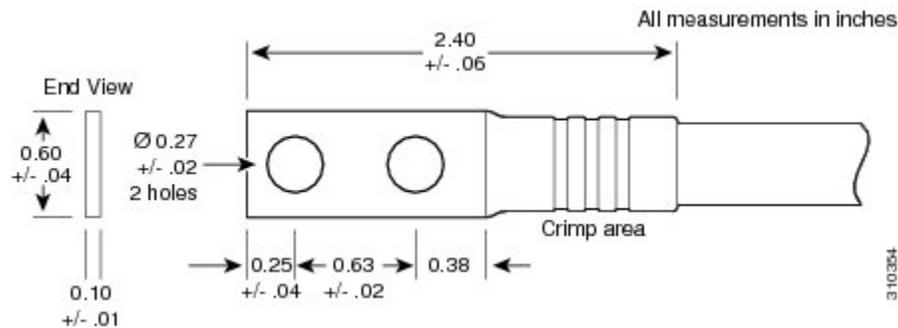
The chassis ground wire connectors have a torque value of 30 in-lb (3.39 N-m).

- Cisco recommends 2-6-AWG multistrand copper ground cable. This cable is not available from Cisco; it is available from any commercial cable vendor. The cable should be sized according to local and national installation requirements.

**Caution**

The DC Return of the Cisco NCS 6000 Series chassis should remain isolated from the system frame and chassis (DC-I: Isolated DC Return).

Figure 3: 180-Degree Angle Straight Barrel Grounding Lug



DC Power Systems

The DC input power system provides the necessary power for all chassis components. Site power requirements differ, depending on the source voltage used.

DC Power Requirements

The Cisco NCS 6008 LCC and Cisco NCS 6000 FCC each contain DC power trays.

- The LCC has six DC power trays.

The upper three DC power trays (0–2) are contained within power shelf 0 (PS0), and the lower three DC power trays (3–5) are contained within power shelf 1 (PS1). Each power shelf has a power control module (PCM) with its own I/O power switch. Each DC power tray has four slots for DC PMs.

- The FCC has four power trays.

The upper two power trays (0–1) are contained within power shelf 0 (PS0), and the lower two power trays (2–3) are contained within power shelf 1 (PS1). Each set of power trays has a power control module (PCM) with its own I/O power switch. Each DC power tray has four slots for DC PMs.

**Note**

The DC power trays for the LCC and FCC are field-replaceable. The PMs are hot-swappable.

In addition to the requirements described in the [General Power and Grounding Requirements](#), on page 2, DC input power requirements are as follows:

- Each DC power tray requires up to four DC input feeds of either –48 VDC (nominal), 50 A or –60 VDC (nominal), 40 A. The power tray accepts input DC power in the range –40 to –72 VDC.
- To operate the system with N+N DC power redundancy requires access to the "A" and "B" power busses at the Central Office (CO). This dual connectivity provides N+N power redundancy in case a power source fails.
 - CO "A" power connected to power trays 0, 1, and 2, with up to four –48/–60 VDC inputs per power tray.
 - CO "B" power connected to power trays 3, 4, and 5, with up to four –48/–60 VDC inputs per power tray.
- Required input current is as follows:
 - 50 A at –48 VDC nominal input voltage.
 - 40 A at –60 VDC nominal input voltage.
 - 60 A at minimum input voltage (–40 VDC).
- An "allpole" separation of the power source is not required. The DC PM is an isolated DC/DC converter with no galvanic connection between "L+" and the chassis. In addition, the "L+" potentials of each PM are isolated from each other.
- All power connection wiring must 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.

DC Input Power Cables

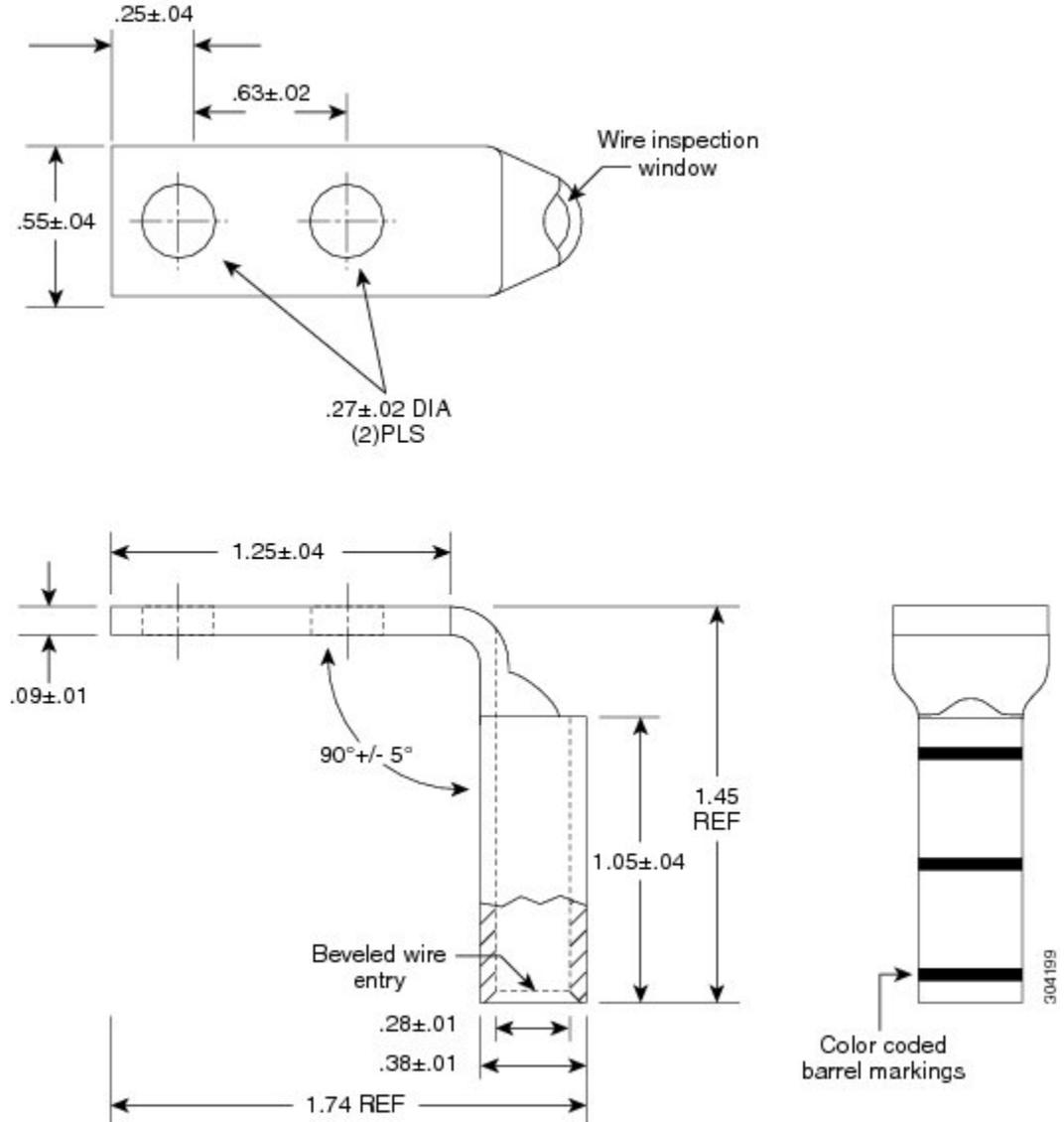
Each power tray contains four pairs of double-stud terminals (RTN, –48V/–60V) for connecting DC input power. Each power tray contains up to four PMs.

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

- For DC input power cables, select the appropriate wire gauge based on the National Electrical Code (NEC) and local codes for –48 VDC (nominal), 50 A DC input voltage, or –60 VDC (nominal), 40 A DC input voltage. Up to four pairs of cable leads, source DC (–) and source DC return (+), are required for each power tray, depending on the number of DC PMs installed. These cables are available from any commercial cable vendor. All input power cables for the chassis should have the same wire gauge and cable lengths should match within 10 percent of deviation.
- Each DC input power cable is terminated at the power tray by a 90 degree cable lug. The terminal block lug opening width is 0.62 inches (15.75 mm). The terminal posts are centered 0.63 inches (16 mm) apart and are 1/4-20 thread.

We recommend that you use a 90-degree angle, industry-standard, dual-hole, standard barrel compression lug. See figure below.

Figure 4: 90-Degree DC Input Power Cable Lug



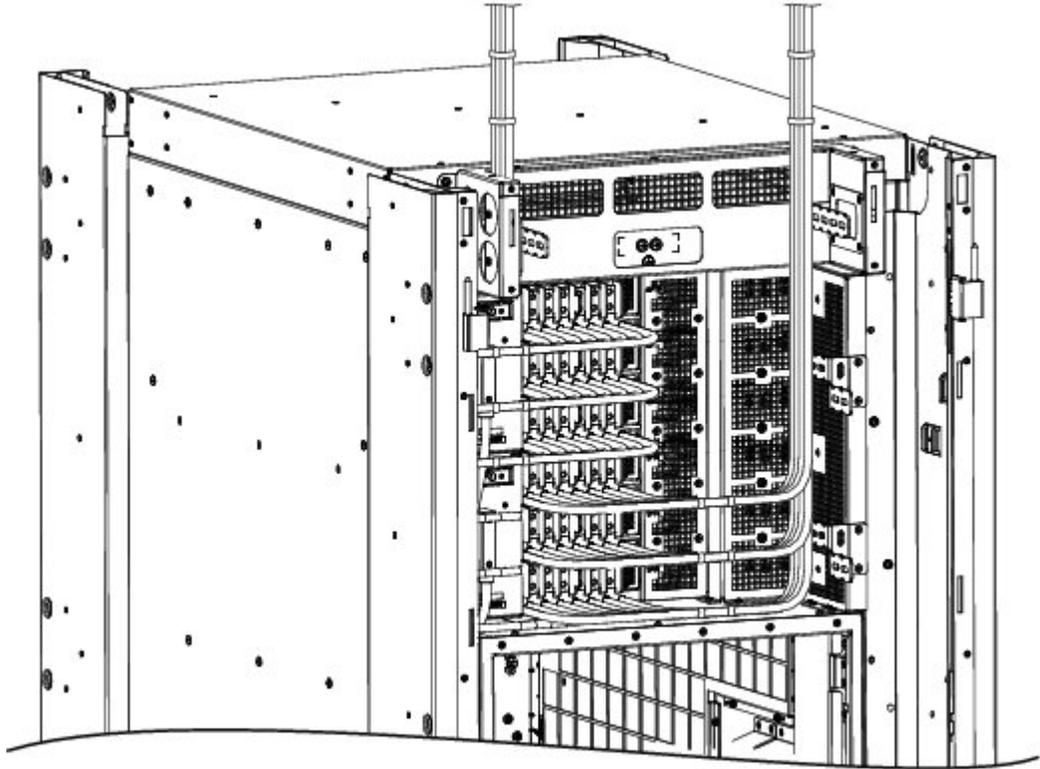
Note Use local electrical codes for clearance requirements when using power lugs to ensure safe operation.



Note In the DC power system, the power wire connectors have a torque value of 45 to 55 in-lb (5.1 to 6.2 N-m).

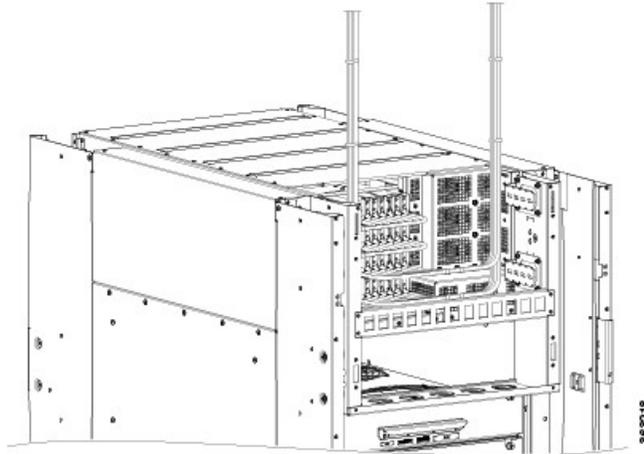
The following figure shows the DC input power cables connected to the DC power tray terminal block on the LCC.

Figure 5: DC Power Tray Power Cable Connections (LCC)



The following figure shows the DC input power cables connected to the DC power tray terminal block on the FCC.

Figure 6: DC Power Tray Power Cable Connections (FCC)



AC Power Systems

The AC input power system provides the necessary power for all chassis components. Site power requirements differ, depending on the source voltage used.

AC Power Requirements

An AC-powered LCC has six AC power trays. The upper three AC power trays (0–2) are contained within power shelf 0 (PS0), and the lower three AC power trays (3–5) are contained within power shelf 1 (PS1). Each power shelf has a PCM with its own I/O power switch. Each AC power tray has three slots for PMs.

An AC-powered FCC has four power trays. The upper two power trays (0–1) are contained within power shelf 0 (PS0), and the lower two power trays (2–3) are contained within power shelf 1 (PS1). Each AC power tray has three slots for PMs.

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 to provide N+N power redundancy in case a power source fails.
- Each AC PM requires its own single-phase AC input power feed, with 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.

◦ Each AC power tray contains three IEC-320-C22 receptacles, which can accept up to three IEC-320-C21 connector female plugs, depending on how many AC PMs are installed in the tray.

- The AC power system requires single-phase AC input power to each PM. If you have 3-phase AC Delta or AC Wye at your equipment, a *Cisco NCS 3-phase AC PDU* is required to convert 3-phase AC input power to single-phase AC input power (Cisco PID NCS-PDU-DELTA or NCS-PDU-WYE). For more information, refer to the [Cisco 3-Phase AC Power Distribution Unit Installation Guide](#) on Cisco.com.

**Note**

If you have a 3-Phase AC PDU installed, we recommend you install three AC PMs in each AC power tray to maintain a balanced 3-phase power load.

For detailed AC power specifications, see the [“LCC Power Specifications” section](#) and the [“FCC Power Specifications” section](#).

AC Power Tray Wiring

The AC power tray is shipped with AC power cords. Each AC power tray accepts up to three power cords. Each AC power cord has a different plug type, depending on locale. AC power cords are available for the locales listed in the table.

Table 1: AC Input Power Cord Options

Locale	Cisco PID	Plug Rating	Reference Illustration
North America	PWR-CAB-AC-USA=	20 A/250 VAC	<i>North America-AC Input Power Cord</i>
Europe	PWR-CAB-AC-EU=	16 A/250 VAC	<i>Europe-AC Input Power Cord</i>
United Kingdom	PWR-CAB-AC-UK=	16 A/250 VAC	<i>United Kingdom-AC Input Power Cord</i>
Italy	PWR-CAB-AC-ITA=	16 A/250 VAC	<i>Italy-AC Input Power Cord</i>
Australia	PWR-CAB-AC-AUS=	15 A/250 VAC	<i>Australia-AC Input Power Cord</i>
Japan	PWR-CAB-AC-JPN=	20 A/250 VAC	<i>Japan-AC Input Power Cord</i>
Switzerland	PWR-CAB-AC-SUI=	16 A/250 VAC	<i>Switzerland-AC Input Power Cord</i>
South Africa	PWR-CAB-AC-SA=	16 A/250 VAC	<i>South Africa-AC Input Power Cord</i>
Israel	PWR-CAB-AC-ISRL=	16 A/250 VAC	<i>Israel-AC Input Power Cord</i>
China	PWR-CAB-AC-CHN=	16 A/250 VAC	<i>China-AC Input Power Cord</i>
Brazil	PWR-CAB-AC-BRA=	20 A/250 VAC	<i>Brazil-AC Input Power Cord</i>

Figure 7: North America—AC Input Power Cord

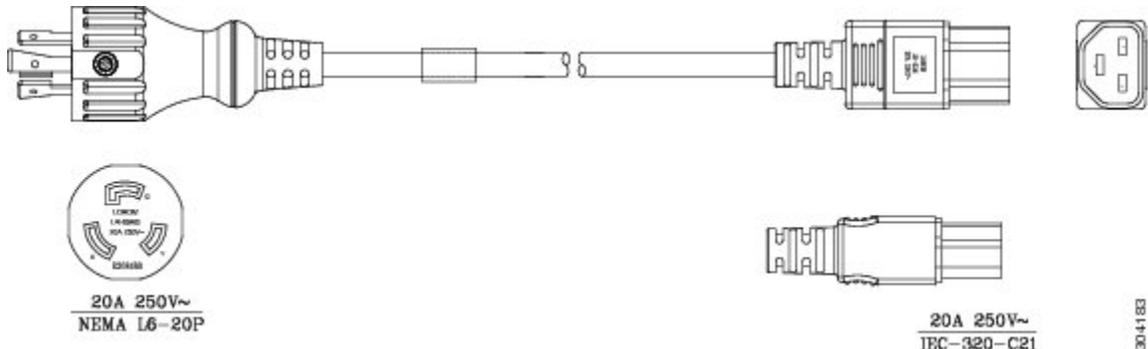


Figure 8: Europe—AC Input Power Cord

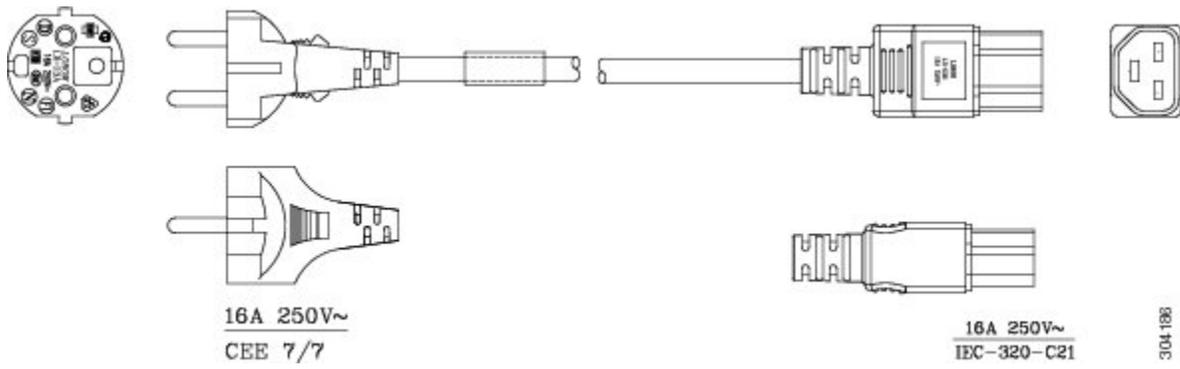


Figure 9: United Kingdom—AC Input Power Cord

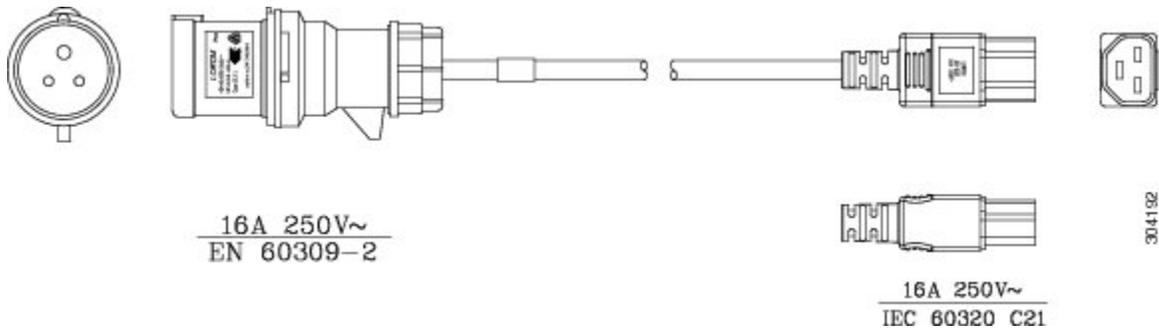


Figure 10: Italy—AC Input Power Cord

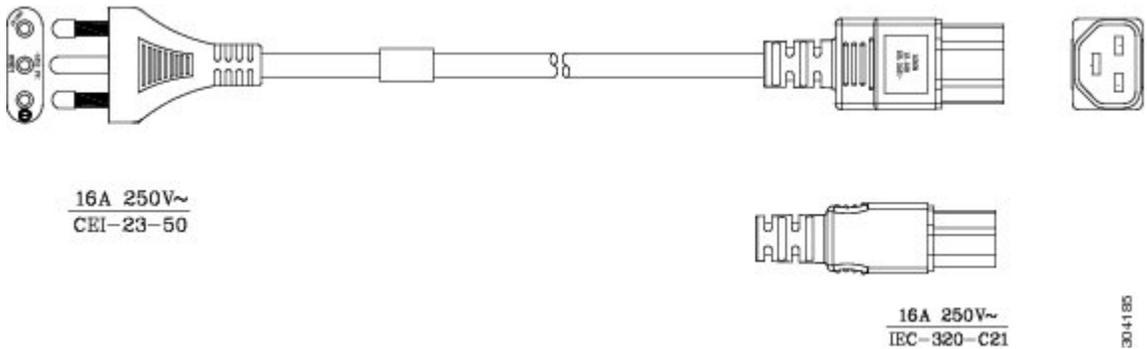
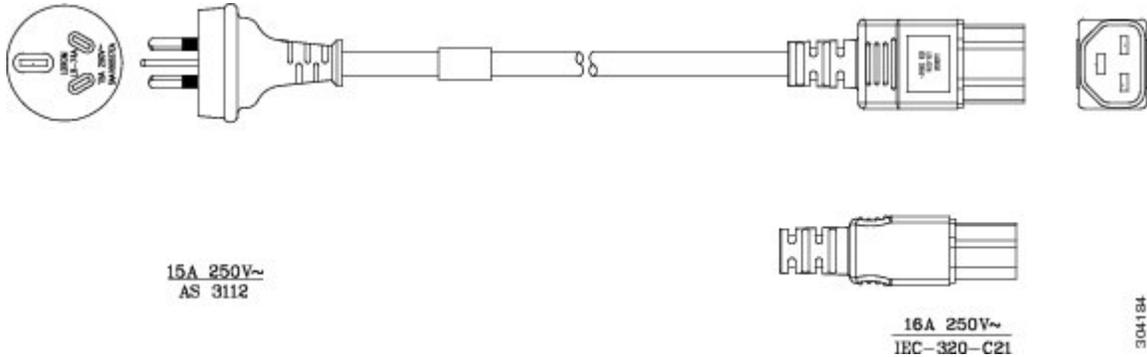


Figure 11: Australia—AC Input Power Cord





Note

The AS 3112 standard rates cord sets up to a maximum of 15 A, 250 VAC for the C21 plug. Therefore the building circuit breaker must be 15-A maximum. Installation of the Cisco NCS 6000 Series chassis must follow national and local electrical codes.

Figure 12: Japan—AC Input Power Cord

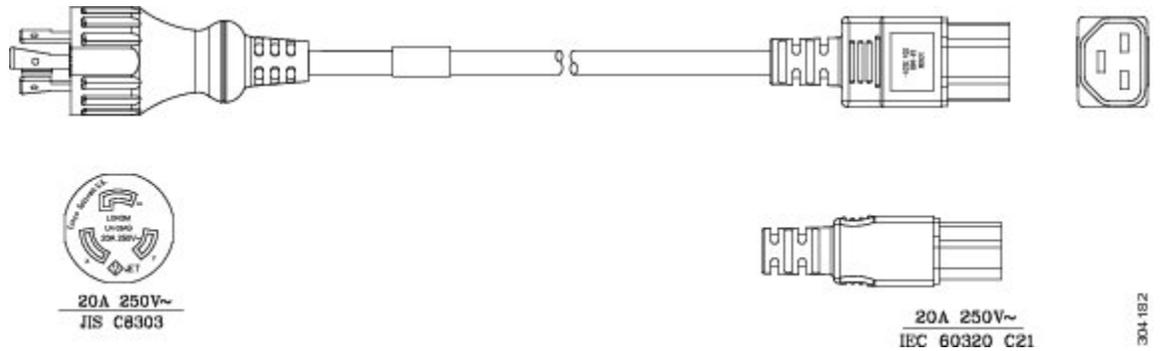


Figure 13: Switzerland—AC Input Power Cord

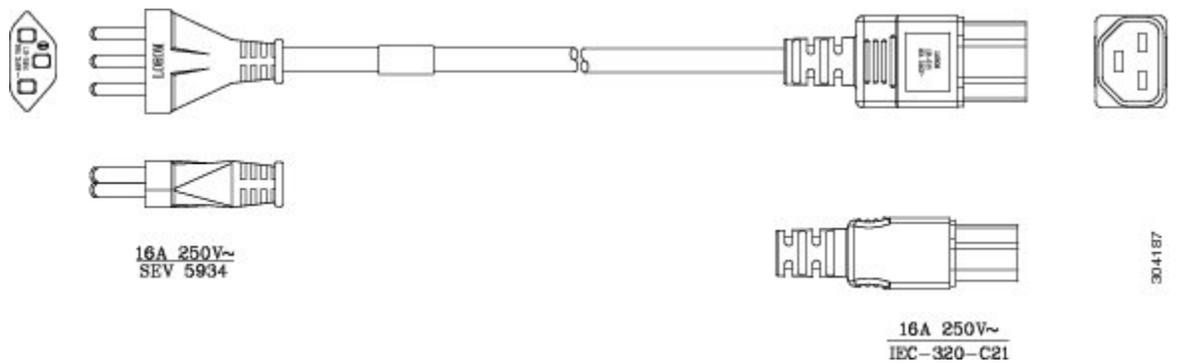


Figure 14: South Africa—AC Input Power Cord

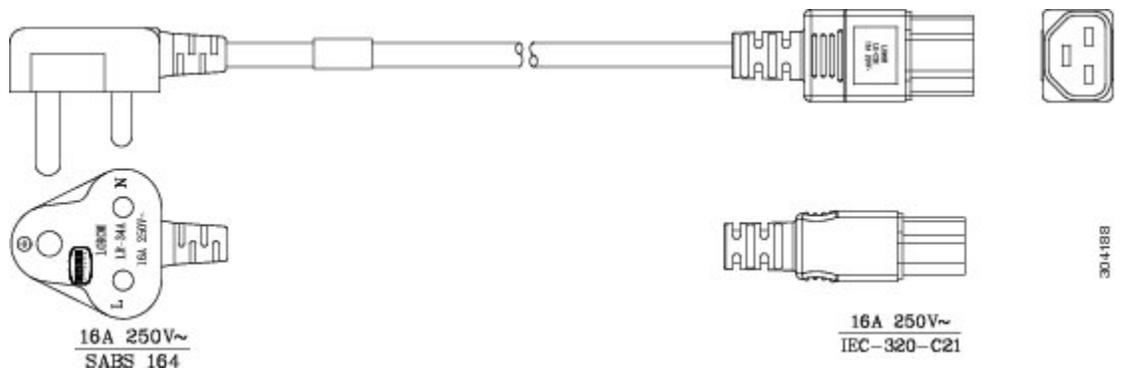


Figure 15: Israel—AC Input Power Cord

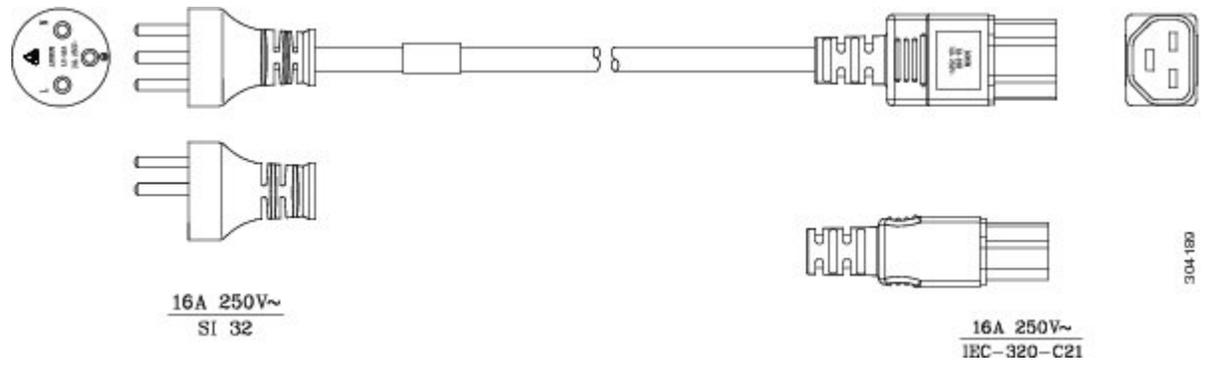


Figure 16: China—AC Input Power Cord

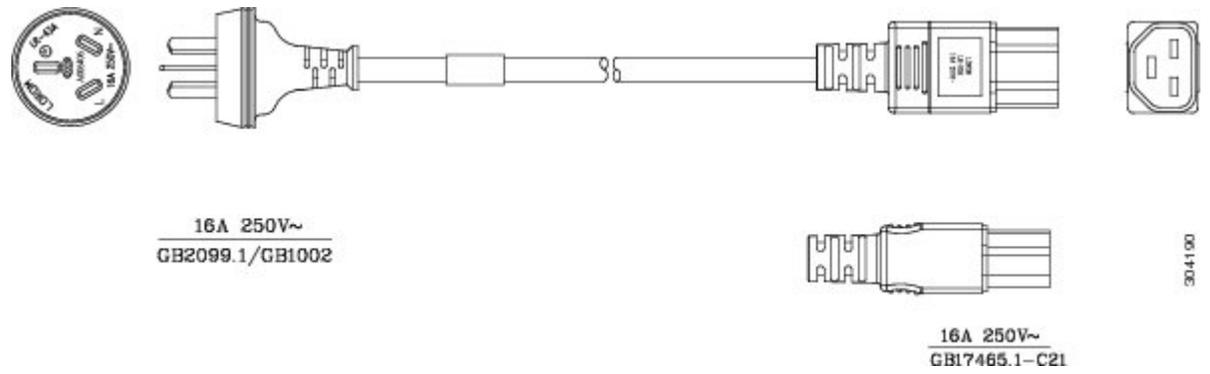
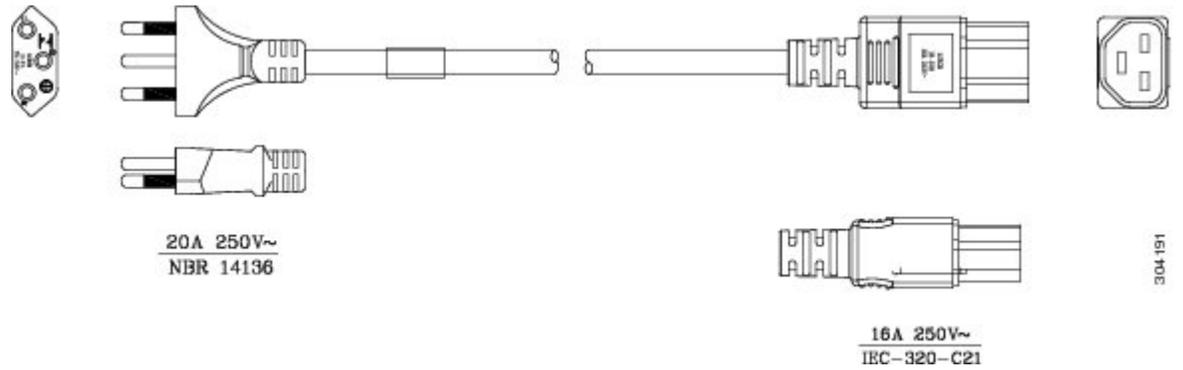
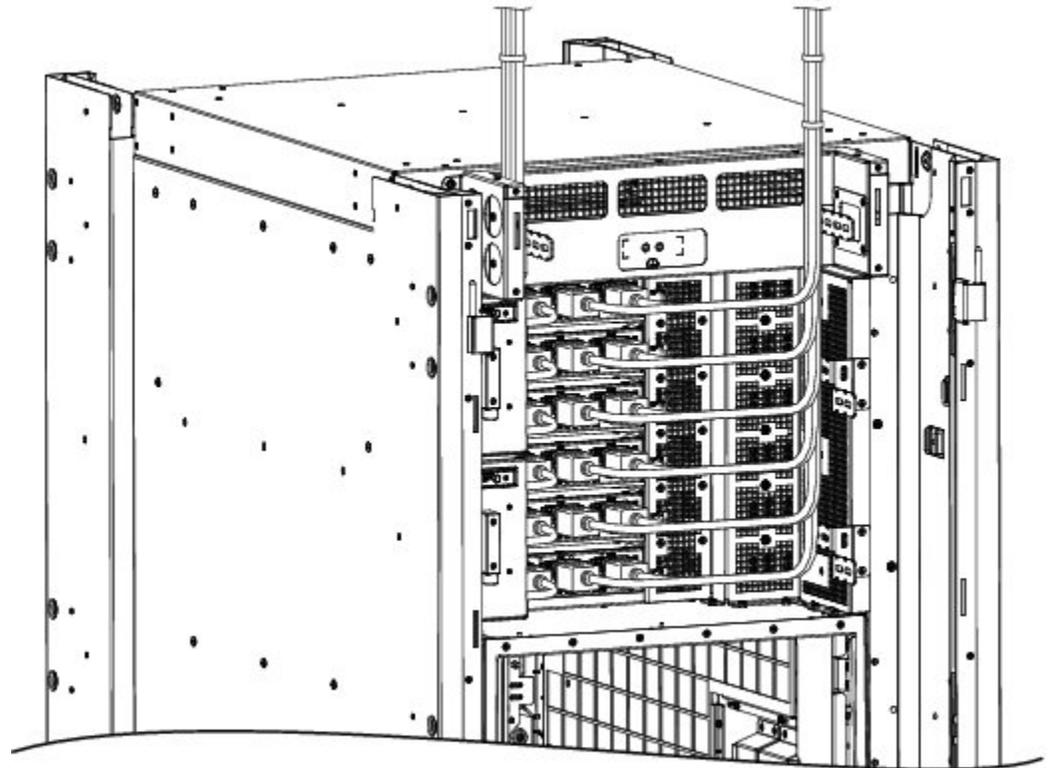


Figure 17: Brazil—AC Input Power Cord



This figure shows the AC input power cables plugged into the AC power trays.

Figure 18: AC Power Tray Power Cable Connections—LCC Shown



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 NCS 3-phase AC PDU* is 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 each PM. The Cisco NCS PDU includes either an AC Delta (Cisco PID NCS-PDU-DELTA) or AC Wye (Cisco PID NCS-PDU-WYE) power interface, and has power input and power output cords entering and exiting the box (*Single AC PDU—Front and Rear*). An optional mounting bracket is available for mounting the PDUs on both sides of the chassis.



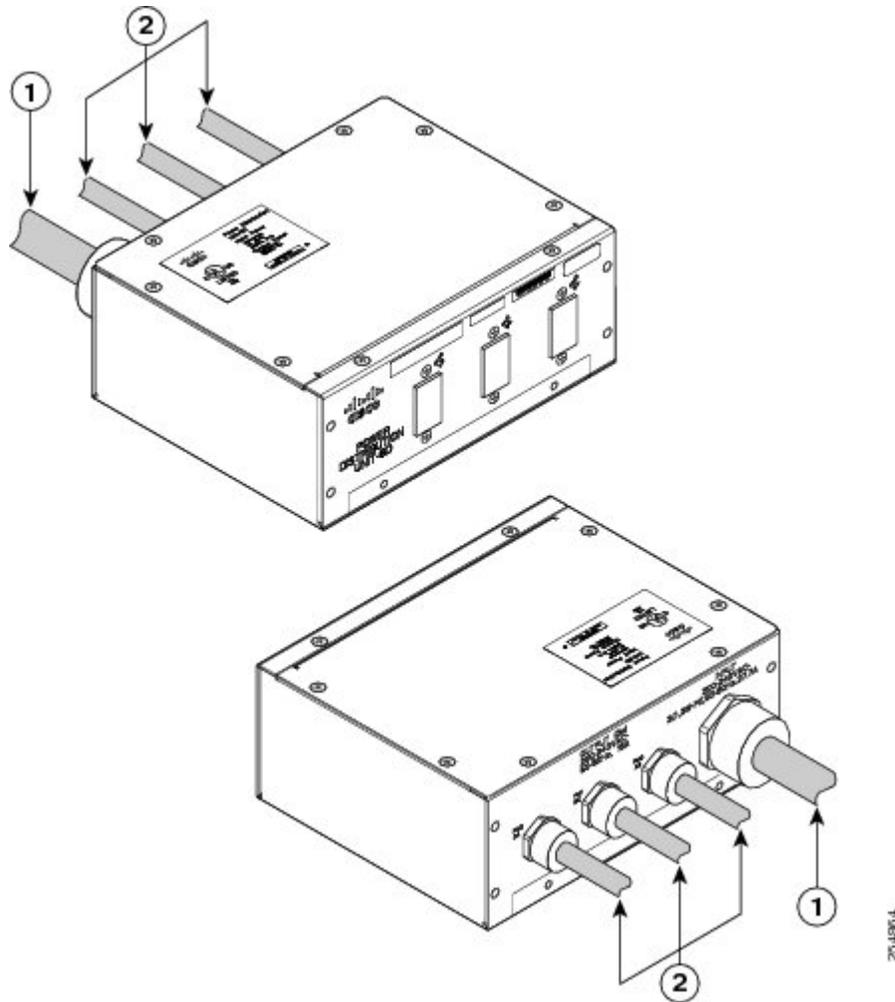
Note

The overall width of both the LCC and FCC with the AC PDU brackets installed is 35.3 in. (89.7 cm).

For more information on AC PDUs, refer to the [Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide](#) on Cisco.com.

This figure shows a single AC Delta PDU. The single AC Wye PDU is similar.

Figure 19: Single AC PDU—Front and Rear



1	3-phase AC input cord	2	Single-phase AC output cords
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AC Input Power Requirements

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 to provide N+N power redundancy. One, two, or three 3-phase feeds can be used from that source according to how many PMs are being powered; one feed for one PDU, which feeds up to three PMs. The first three power trays are fed from the first AC power source (through the AC PDUs), and the other three power trays are fed from the other AC power source (through the other AC PDUs).

- Each 3-phase AC power source must provide its own circuit breakers.
- AC Delta input:
 - 3-phase, 200 to 240 VAC (phase-to-phase), 50 to 60 Hz.
 - Input current: 27.7 A.
 - The Delta input power cord has 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.
- AC Wye input:
 - 3-phase, 200 to 240 VAC (phase-to-neutral), 50 to 60 Hz.
 - Input current: 16 A (International) or 20 A (North America). The PDU is rated for 16-A service.
 - The 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 three single-phase output cords, each with a 90-degree IEC-320-C21 plug that plugs into an IEC-320-C22 inlet on the rear of the AC power tray.
- A 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.

These figures show the plugs for the power cords on the AC Delta and Wye PDUs.

Figure 20: AC Delta Power Cord Plug

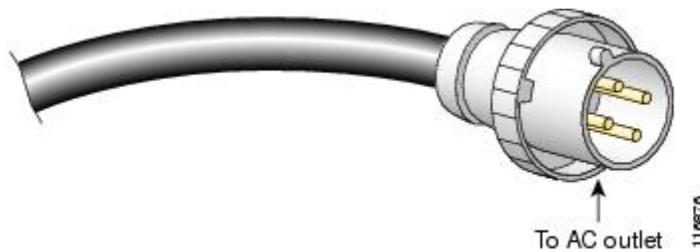


Figure 21: AC Wye Power Cord Plug



Chassis Cooling System

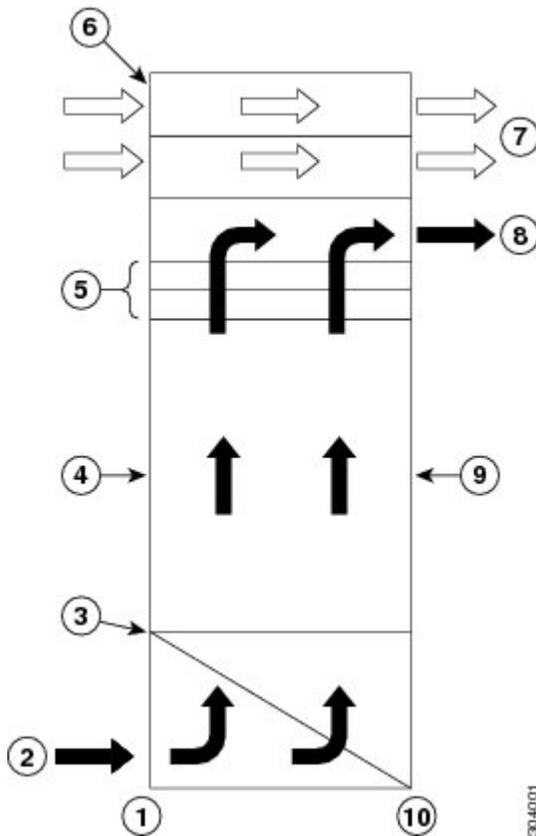
The Cisco NCS 6000 Series Routers have two fan trays, with six variable-speed fans each, that cool the chassis card cages. Cool air flows in at the bottom front of the chassis, up through the chassis card cages, through the fans in the fan trays, and exhausts out the top rear of the chassis. In addition, each AC or DC PM at the top of the chassis has self-contained fans that pull in cool air from the front of the chassis and exhaust warm air out the rear.

A replaceable air filter is located on the front of the LCC and FCC. We recommend that you check the air filter once a month. How often you should replace the air filter depends on the facility environment. In a dirty environment, or if frequent temperature alarms occur, always check the intake grills for debris, and then check the air filter to see if it needs to be replaced.

Line Card Chassis Airflow

This figure shows the airflow through the LCC.

Figure 22: Airflow Through the Cisco NCS 6008 LCC



1	Front side of chassis	6	Air flow through PMs
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2	Air inlet plenum	7	Exhaust air from PMs
3	Air filter	8	Air exhaust plenum
4	Front cage for LCs	9	Rear cage for FCs and RP cards
5	Fan trays	10	Rear side of chassis

LCC Airflow Volumes

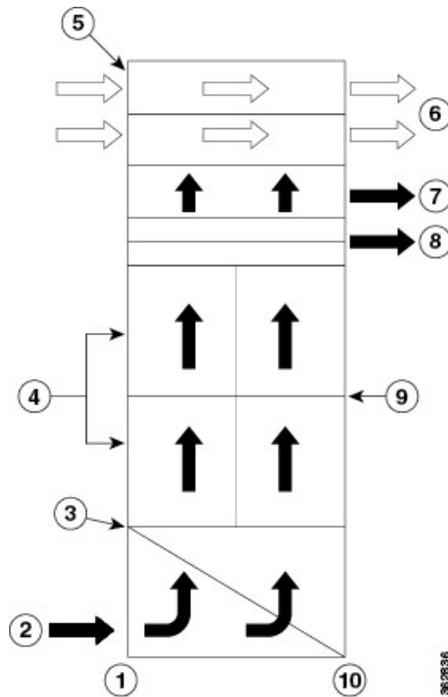
The airflow volumes for a fully loaded Cisco NCS 6008 LCC are as follows:

- Chassis airflow: Up to 2500 cubic feet (70,792 liters) per minute
- DC power system airflow: Up to 240 cubic feet (6796 liters) per minute
- AC power system airflow: Up to 180 cubic feet (5097 liters) per minute

Fabric Card Chassis Airflow

This figure shows the airflow through the FCC.

Figure 23: Airflow Through the Cisco NCS 6000 FCC



1	Front side of the FCC	6	Exhaust air from PMs
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2	Air inlet plenum	7	Air exhaust plenum
3	Air filter	8	Fan trays (rear)
4	Upper and lower card cages	9	Upper and lower card cages
5	Air flow through PMs	10	Rear side of the FCC

FCC Airflow Volumes Airflow

The airflow volumes for a fully loaded Cisco NCS 6000 FCC are as follows:

- Chassis airflow: Up to 1980 cubic feet (56,6000 liters) per minute
- DC power system airflow: Up to 120 cubic feet (3400 liters) per minute
- AC power system airflow: Up to 88 cubic feet (2500 liters) per minute

Facility Cooling Requirements

The Cisco NCS 6000 Series Routers consume considerable power, which dissipates much heat.

When there is one or more fan failures, the system monitors the temperature sensors mounted on the critical components within the various boards and increases fan throughput to hold temperatures below their critical threshold. The system does this monitoring even when all the fans are operating correctly (so that it protects the components if the air intake is blocked for example). If temperatures exceed the critical threshold, the associated cards are shut down to avoid permanent damage.

If either fan tray is removed from the chassis, the other fan tray will immediately spin up to maximum speed in order to provide sufficient cooling performance. Although the system can operate indefinitely at full capacity with just one operational fan tray up to an ambient room temperature of 104°F (40°C) without overheating, there is no longer any redundancy offered, so immediate replacement of the missing fan tray is advised.

When both fan trays are removed, a critical alarm is generated along with a system message warning you to install a fan tray or the entire chassis will shutdown in approximately 45 seconds.

To ensure that the site provides the proper air circulation for the system:

- Make certain that the site is as dust free as possible. Dusty environments can clog the air filter or power supply intake vents, reducing the cooling airflow through the system.
- Allow sufficient airflow by maintaining a minimum of 6 inches (15.2 cm) of clearance at both the inlet and exhaust openings on the chassis and PMs. If airflow is blocked or restricted, or if inlet air is too warm, an over-temperature condition can occur. Under extreme conditions, the environmental monitoring system shuts down the power to protect the routing system components.