



Cisco CRS 8-Slot Line Card Chassis Enhanced Router Power Systems

This chapter describes the power systems of the Cisco CRS 8-Slot Line Card Chassis.

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Cisco CRS 8-Slot Chassis Power Systems

This chapter describes the power systems of the Cisco CRS 8-Slot Line Card Chassis. It contains the following topics:

- [Enhanced Router Modular Configuration Power System, on page 4](#)
- [Cisco CRS 3-Phase AC Power Distribution Unit, on page 16](#)



Note Specifications for power components are provided in [Appendix A, “Technical Specifications.”](#)

Power Systems Overview

- Modular configuration power system—consists of two power shelves and either AC or DC power modules (PMs). However, the AC version of the modular configuration power system requires single-phase AC input power to power the shelves. If you have 3-phase AC-Delta or AC-Wye at your equipment, a Cisco CRS 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 PDU that converts 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, refer to [Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide](#).

Power Component Information Common to Two Types of Power System

This section contains information shared by the modular configuration power components in the following topics:

Basic Chassis Power Details

The Cisco CRS 8-slot Line Card Chassis Enhanced router can be configured with either a DC-input power system or an AC-input power system. The chassis power system provides the necessary power for chassis components. Input power availability is site dependent and may be DC, AC Delta, or AC Wye.

A modular configuration AC power shelf houses up to 3 AC PMs, while a modular configuration DC power shelf houses up to 4 DC PMs. It is required that you use only one type of power shelf in a chassis at a time.



Note In a modular configuration power system, both AC and DC power supplies are referred to as power modules (PMs).



Note This unit might have more than one power module connection. All connections must be removed to de-energize the unit. **Statement 1028**

Power System-Modular Configuration

Modular configuration power system consists of two power shelves and either AC or DC power modules (PMs). However, the AC version of the modular configuration power system requires single-phase AC input power to power the shelves. If you have 3-phase AC-Delta or AC-Wye at your equipment, a Cisco CRS 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.



Note In a modular configuration AC power system, PDU refers to the Cisco CRS PDU that converts 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, refer to Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide.



Caution Use only one type of modular configuration power shelf—AC or DC—and its mating AC or DC PMs in a chassis at one time.

Precautions and Recommendations

Follow these precautions and recommendations when planning power connections to the router:

- For the modular configuration power system, although power shelves may be installed or removed without powering down the system, for safety purposes we recommend that you power down the system before you install or remove a power shelf.

Grounding Guidelines

Modular configuration supports chassis grounding only. The chassis allows you to connect the central office ground system or interior equipment ground system to the bonding and grounding receptacles on the router chassis, when a modular configuration power system is installed.

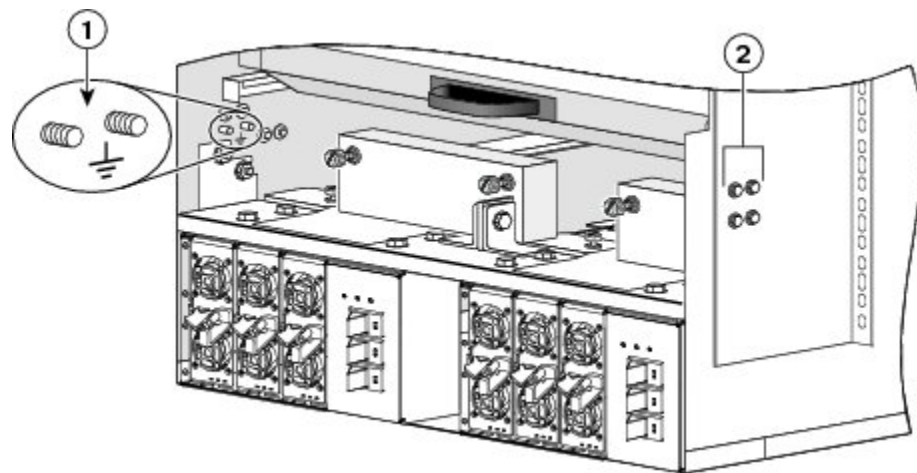
Each side of the chassis has one pair of threaded ground studs located on the inside of the chassis and two sets of grounding receptacles located on the outside of the chassis. These ground points are also called the network equipment building system (NEBS) bonding and grounding points.



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

The following figure shows six chassis grounding points that are provided at the rear (MSC) side of the chassis.

Figure 1: NEBS Bonding and Grounding Points (Rear of Chassis) -



1	NEBS bonding and grounding points (inside chassis)
2	NEBS bonding and grounding points (outside chassis)



Caution Do not remove the chassis ground wire unless the chassis is being replaced.

See [Cisco CRS Carrier Routing System 8-Slot Line Card Chassis Enhanced Router Installation Guide](#) for additional grounding and bonding details and installation instructions.

DC Power Systems

Each DC powered chassis contains two modular configuration power shelves for 2N redundancy.



Note Depending on the hardware deployed at your site, your system may not consume the maximum power supplied by the power system.

AC Power Systems

Each AC powered chassis contains two AC power shelves for 2N redundancy. The shelves contain the input power connectors. In the Cisco CRS 8-Slot Line Card Chassis Enhanced router, each power shelf can contain up to three AC PMs. The power shelves and the AC PMs are field replaceable. See [Enhanced Router Modular Configuration Power System, on page 4](#).



Note Depending on the hardware deployed at your site, your system may not consume the maximum power supplied by the power system.

Enhanced Router Modular Configuration Power System

This section describes the Cisco CRS 8-Slot Line Card Chassis Enhanced router modular configuration power system and contains the following topics:

Overview-Modular Power Configuration

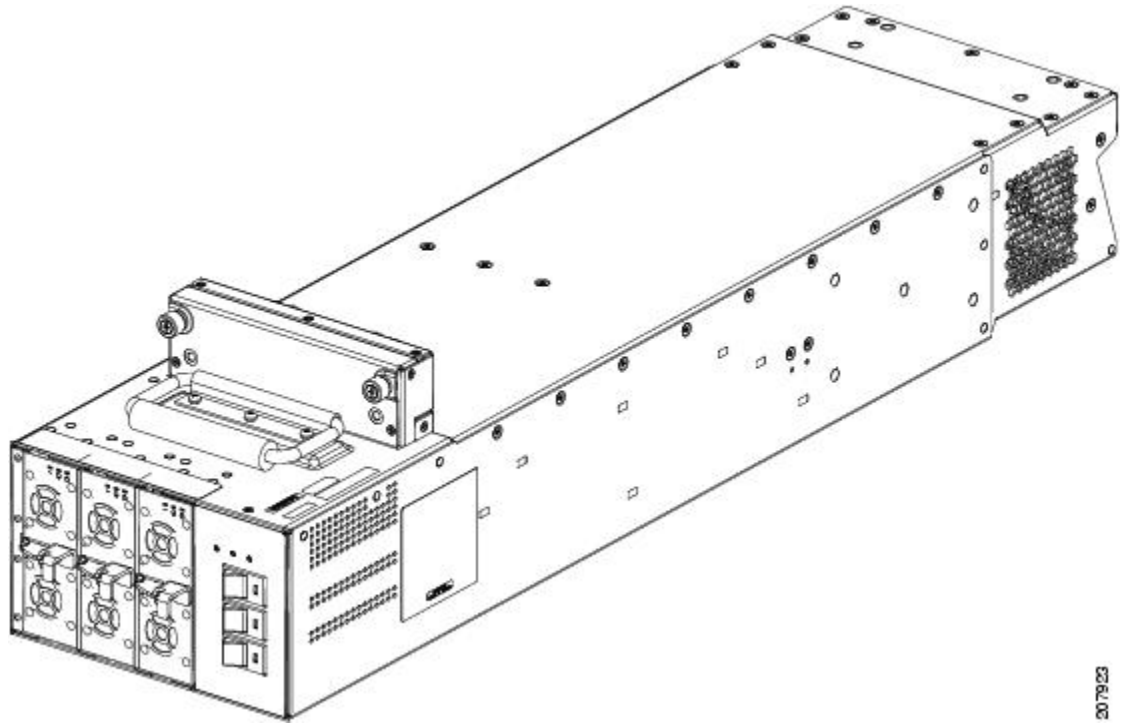
This section describes the Cisco CRS 8-Slot Line Card Chassis Enhanced router modular configuration power system. The modular configuration power solution is configurable. It includes the following components:

- Two (redundant) AC or DC power shelves
- Up to three AC power modules or four DC power modules per power shelf
- Each DC power module provides 2100 Watts, with potential growth up to 8.4KW DC power per power shelf
- Each AC power module provides 3000 Watts, with potential growth up to 9KW DC power per power shelf



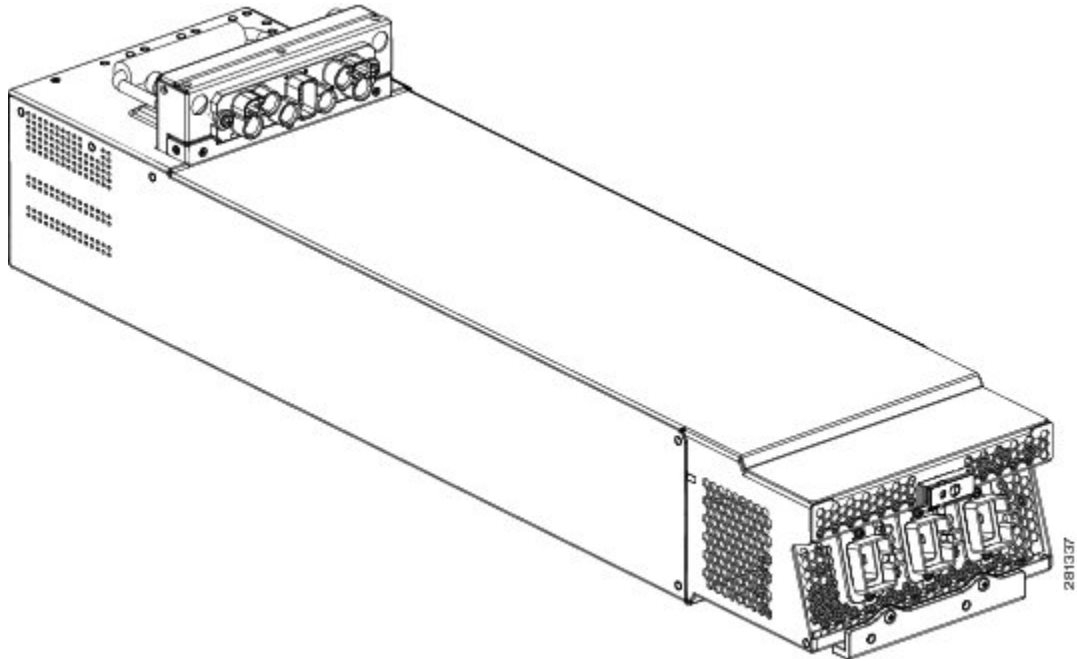
Note The default modular configuration power system may not ship with the maximum number of power modules configured. Additional power modules can be added at any time, depending on the system's power requirements.

Figure 2: Modular Configuration AC Power Shelf—Front View



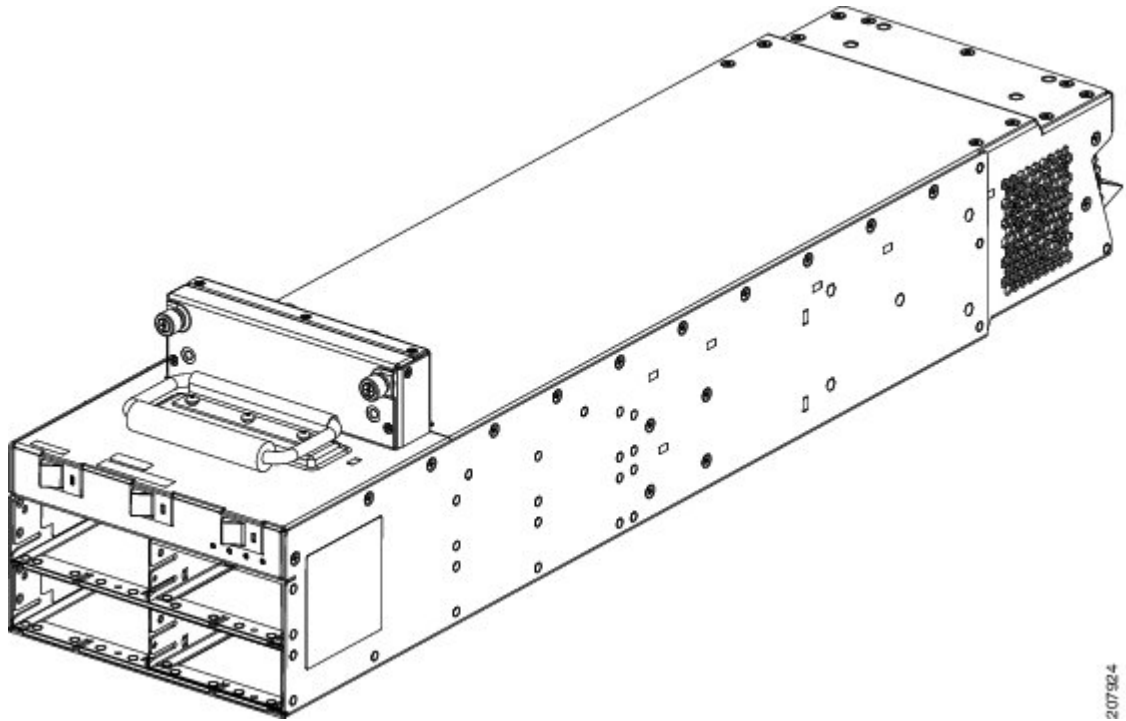
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Figure 3: Modular Configuration AC Power Shelf—Rear View



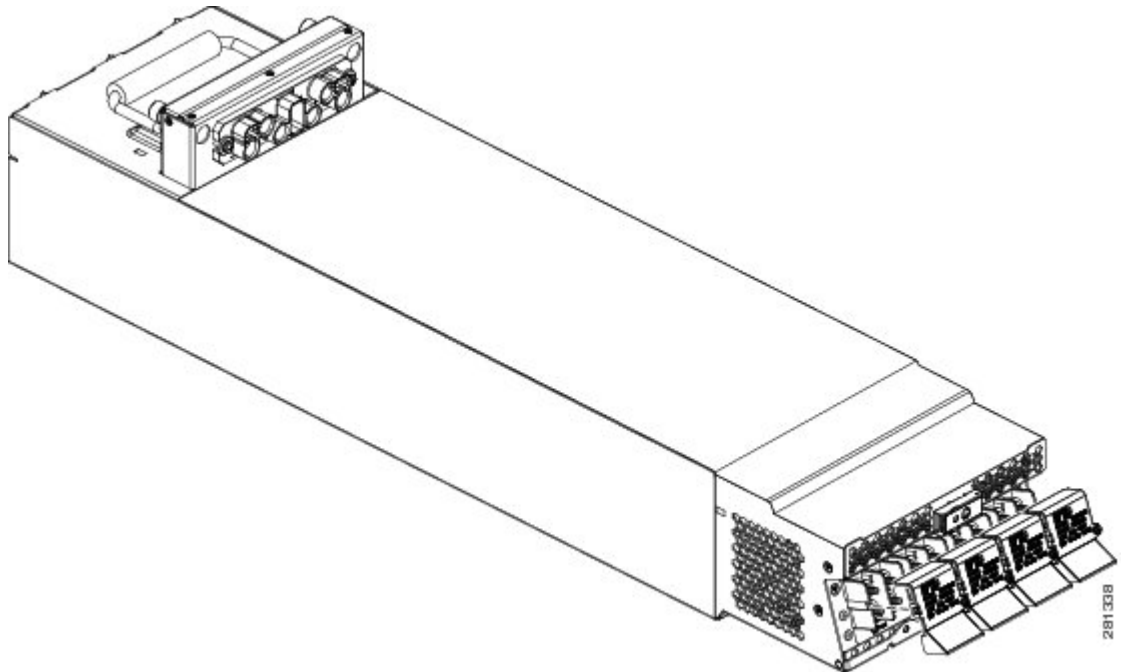
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Figure 4: Modular Configuration DC Power Shelf —Front View



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Figure 5: Modular Configuration DC Power Shelf —Rear View



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Modular Configuration Power Architecture

In the modular configuration power system, each DC power shelf accepts up to four PMs (power modules) and each AC power shelf accepts up to 3 PMs. The power shelves and PMs are field replaceable. The power shelves contain the input power connectors.



Note Depending on the hardware deployed at your site, your system may not consume the maximum power supplied by the power system.

The modular configuration power module provides the following features:

- AC or DC power shelf redundancy
- PM load-share redundancy
- Elimination of power zone restriction, while maintaining zone protection
- Capacity for future growth

The modular AC and DC power systems use A and B power shelves to provide reliable, 2N redundant power to all chassis components. See [#con_1237669/fig_1270022](#) for the 8-slot chassis power routing distribution with a modular DC configuration and [#con_1241429/fig_1294667](#) for the power routing distribution with a modular AC configuration.

All power modules in the modular power shelf power all zones. In addition, the modular power supplies work in parallel with each other, and they can monitor power consumption, performance, analysis, and power management concurrently.

Unlike the Cisco CRS 16-slot Line Card Chassis Enhanced router, the power shelf on the Cisco CRS 8-slot Line Card Chassis Enhanced router does not contain an alarm module. Instead, alarm functionality is integrated into the Route Processor (RP). The DC power module monitors power module status and processes alarm functions. The AC or DC power module distributes power and passes power module status signals to the system. Each power module has its own integrated fuse to protect the system, and each power module is plugged into its own power outlet.

The Cisco CRS 8-Slot Line Card Chassis requires 8.0 kW of DC input power and 8.75 kW of AC input power from the building supply.

Modular Configuration DC Power

The Cisco CRS 8-slot Line Card Chassis Enhanced router modular configuration DC power system can provide up to 8,400 W to power the Line Card Chassis Enhanced router. The modular configuration DC power system uses A and B power shelves to provide reliable, 2N redundant power to all chassis components.



Note Depending on the hardware deployed at your site, your system may not consume the maximum power supplied by the power system.

If DC power to one modular configuration power shelf fails, the other power shelf provides enough power for the chassis. This 2N power redundancy enables the routing system to operate in spite of single power failure.

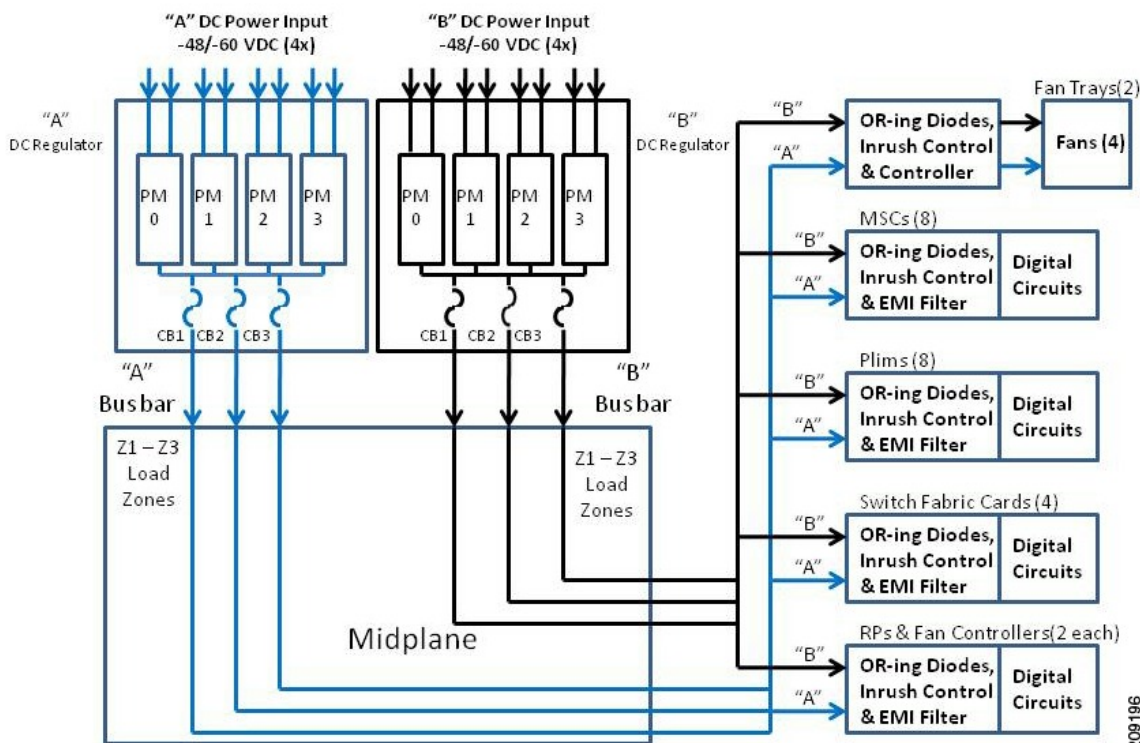
The following table summarizes the DC power system specifications for the Cisco CRS 8-Slot Line Card Chassis.

Table 1: DC Power System Specifications

DC Power Component	Specifications
Power Shelf	Two DC power shelves DC Power Shelf: Supports up to four DC power modules
Power Redundancy	Two DC Power Shelves each containing up to four DC power modules—2N redundancy
DC Input	Required input current is as follows: <ul style="list-style-type: none"> • 50 amps at -48 VDC nominal input voltage. • 40 amps at -60 VDC nominal input voltage • 60 amps at low input voltage (-40 VDC) Required lugs: 45° angled industry standard 2-hole compression lugs with holes on 5/8- inch centers (for example, for AWG no. 2 wire: Panduit part number LCC2-14AH-Q or equivalent).
Ground Lug	Industry standard 2-hole compression lug with holes on 5/8- inch centers (Panduit part number LCD6-14A-L, or equivalent)

The following figure shows the 8-slot chassis power routing distribution for a modular DC configuration.

Figure 6: CRS 8-Slot Chassis Power Distribution- Modular DC Configuration



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Modular Configuration DC Power Shelf

The DC modular configuration power shelf is the enclosure that houses the DC power modules and power distribution connections and wiring. The power shelf (see [#con_1282820/fig_1274839](#) for front view and [#con_1282820/fig_1274845](#) for rear view) installs in the Cisco CRS 8-slot Line Card Chassis Enhanced router from the front and plugs into the chassis power interface connector panel.

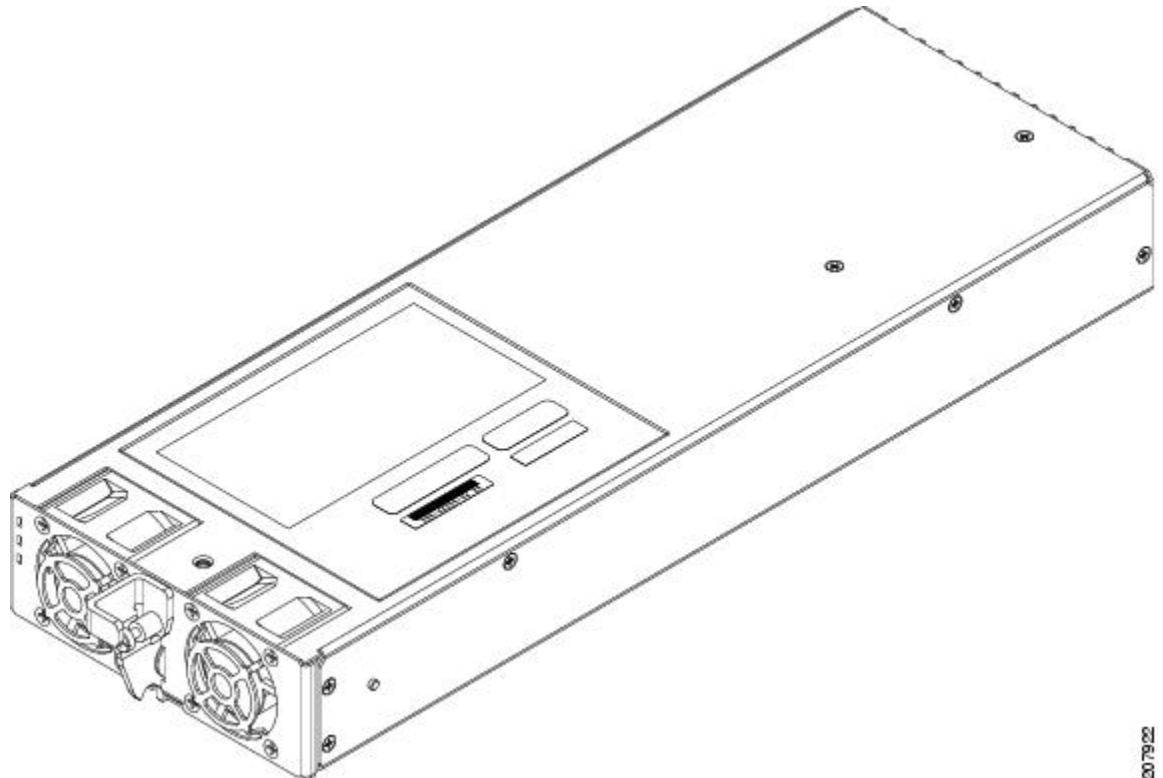
Each modular configuration DC power shelf requires up to four DC input feeds of either –48 VDC (nominal), 50 A or –60 VDC (nominal), 40 A. The power shelf accepts input DC power in the range –40 to –72 VDC. Each terminal consists of two M6 threaded studs, 0.6 inches long, and centered 0.625 inches apart. The terminals have a safety cover.

Each DC power shelf supports up to four power modules, and accepts one 60 A battery feed per power module. Input DC power enters the power shelf and is processed by the power modules before being distributed to the chassis midplane. The power modules perform inrush current limiting, EMI filtering, surge protection, and circuit isolation on the input DC power, and then distribute the power via the internal bus bar in the chassis midplane.

Modular Configuration DC Power Module

Each DC power module provides 2100 Watts. The DC power module, shown in [Figure 7: Modular Configuration DC Power Module](#), passes the power via the internal bus bar to the system and is similar to the AC power module. Power modules are field-replaceable.

Figure 7: Modular Configuration DC Power Module.



One –48/–60 VDC input enters the power module at the rear of the power shelf, and exits the power module and is distributed to the chassis midplane.

Unlike the Cisco CRS 16-slot Line Card Chassis Enhanced router, the power shelf on the Cisco CRS 8-slot Line Card Chassis Enhanced router does not contain an alarm module. The DC power module monitors power module status and processes alarm functions. A microprocessor in the DC power module monitors the status of each DC power module. The microprocessor communicates with the system controller on the route processor (RP) card. The microprocessor circuitry monitors the following DC power module fault and alarm conditions:

- **Fault:** Indicates a failure in an DC power module, such as failed bias supply, or over temperature. It includes a warning that the DC output voltage is outside the allowable output range.
- **DC Input Fail:** Indicates that the DC input voltage is out of range.
- **Over Temperature:** Indicates that the DC power module has exceeded the maximum allowable operating temperature.
- **DC Power Module Present:** Indicates that the power module is present and seated properly in the system chassis.
- **Voltage and Current Monitor signals (Vmon, Imon):** Indicates how much output voltage and current are provided by the DC power module.

Each DC power module contains an ID EEPROM that stores information used by the control software (for example, part number, serial number, assembly deviation, special configurations, test history, and field traceability data).

Modular Configuration DC Power Module Indicators

Each DC power module has power and status indicators. The DC power module indicators receive power from both DC power modules; therefore, the indicators are operational even when the DC power module is not powered from its input voltage. The following three LED status indicators are located on the front of each DC power module:

- Input OK - Green
- Output OK - Green
- Internal Fault - Red

The power module LED status indicators are not visible when the front grille is installed.

The following table lists the power module status indicators and their functions.

Table 2: Power Module Status Indicators

Name	Color	Function
Input OK	Green	Input OK LED turns on continuously when input voltage is present and within the regulation range. Input OK LED flashes when input voltage is present but not within the regulation range. Input OK LED is off when input voltage is not present. Input OK LED flashes when hot-unplugging the power module from the power shelf to indicate that there is energy in the power module until the input bulk capacitor is completely discharged or the housekeeping circuit is shut down.
Output OK	Green	Output OK LED turns on continuously when power module output voltage is on. Output OK LED flashes when power module output voltage is in a power limit or an overcurrent situation.

Name	Color	Function
Internal Fault	Red	Internal Fault LED turns on continuously when there is an internal fault in the power module.

The Internal Fault LED on the DC power module is turned on continuously to indicate that one or more of the following internal faults is detected inside the power module:

- 5V out of range
- Output Stage OT
- Fan Fault
- OR-ing fault (Output voltage less than bus voltage)
- OC shutdown
- OT shutdown
- OV shutdown
- Input stage OT
- Fault induced shutdown occurred
- Thermal sensor fault
- Vout out of range
- Boost Vbulk fault

Once all of the faults have been removed and the power module is operating normally, the Internal Fault LED is turned off.

Modular Configuration AC Power

The Cisco CRS 8-slot Line Card Chassis Enhanced router modular configuration AC power system can provide up to 9,000 W to power the Cisco CRS 8-Slot Line Card Chassis Enhanced router.



Note Depending on the hardware deployed at your site, your system may not consume the maximum power supplied by the power system.

The modular configuration power system provides the following features:

- AC power shelf redundancy
- PM load-share redundancy
- Elimination of power zone distribution, while maintaining zone protection
- Capacity for future growth

The modular configuration AC power systems use A and B power shelves to provide reliable, 2N redundant power to all chassis components.

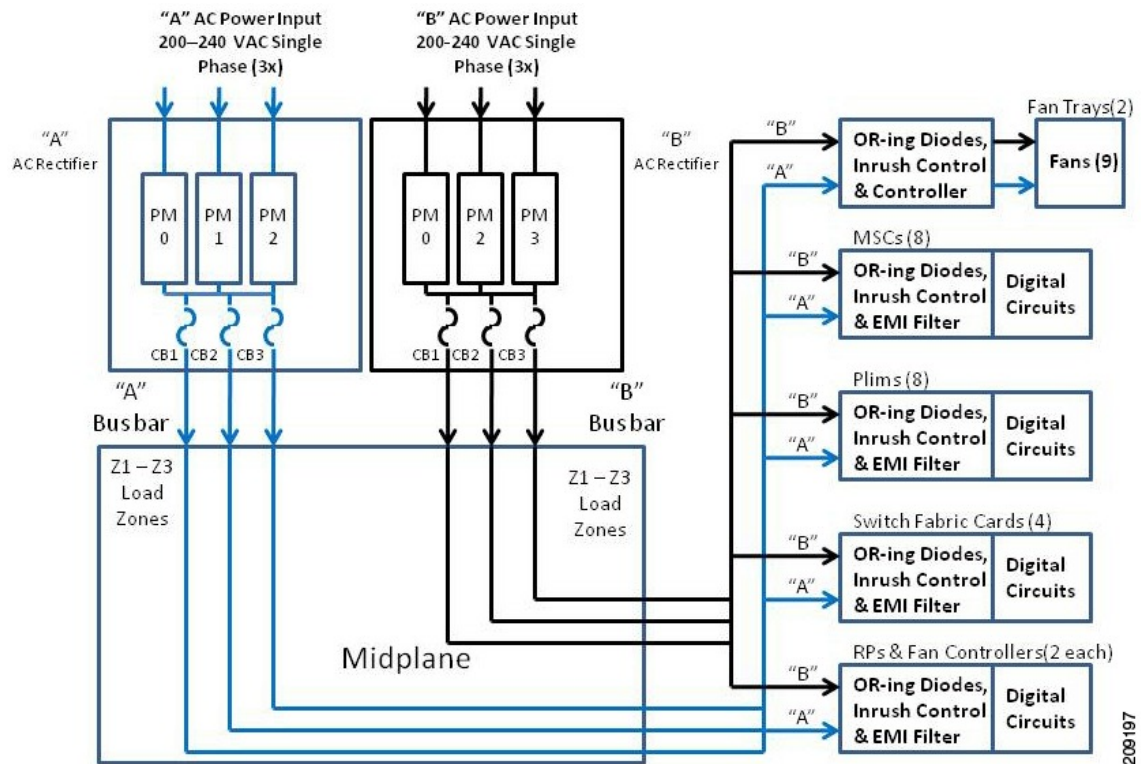
The Cisco CRS 8-slot Line Card Chassis Enhanced router does not contain an alarm module. The AC PM monitors PM status and processes alarm functions. The AC PM distributes power and passes PM status signals to the system. Each PM has its own integrated fuse to protect the system, and each PM is plugged into its own power outlet. Alarms are processed through the RP. LEDs on the front panel of the RP indicate active alarm conditions.

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 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 the [Cisco CRS 3-Phase](#)

[AC Power Distribution Unit Installation Guide](#) or to the *Cisco CRS Carrier Routing System 8-Slot Line Card Chassis Enhanced Router Installation Guide*.

The following figure shows the power routing distribution of the 8-slot chassis with a modular AC configuration power system.

Figure 8: CRS 8-Slot Chassis Power Module - Modular AC Configuration



As shown in the figure, AC input power enters the chassis through the A and B power supplies and is distributed to the A or B power bus. Both buses distribute power through the midplane to the MSC, PLIM, switch fabric, and RP card slots.

Each AC power module provides 2 voltages:

- Output voltage 1 is -54 VDC
- Output voltage 2 is +5Vaux

Because chassis components are powered by both A and B power inputs, the Cisco CRS 8-slot Line Card Chassis Enhanced router can continue to operate normally if:

- One power module fails
- One input power (A or B) fails
- One internal bus bar fails
- One entire power shelf fails
- Power modules are added to, or removed from the power shelf

Due to the system power architecture design (no exact redundancy exists across the power modules), individual power modules can be removed without causing the chassis to lose power.

Individual chassis components have power-related devices, such as OR-ing diodes, inrush control circuits, and EMI filters. Because any power modules can power all chassis components, these devices can be inserted or removed (OIR) while the chassis is online. This component insertion and removal is also called *hot-swapping*.

The modular configuration AC power shelf has the following input VAC power requirements:

- Single-phase, 200 to 240 VAC nominal, 50 to 60 Hz, 16 A
- Each power shelf 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 shelf.



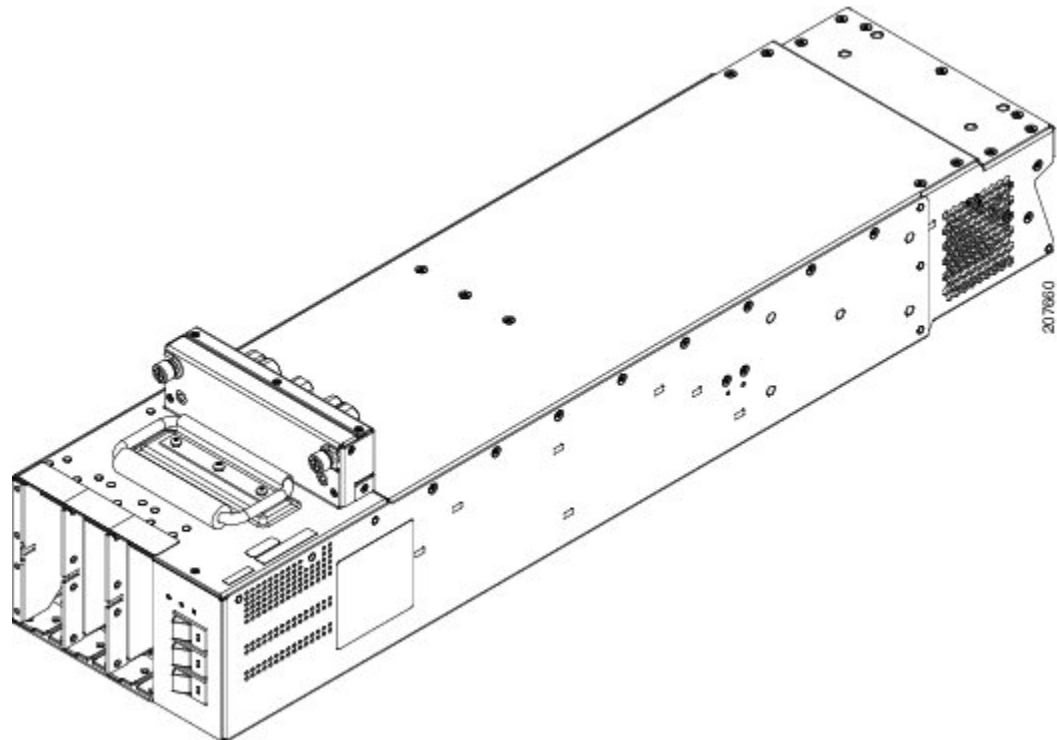
Note In order to maintain a balanced 3-phase power load, three AC PMs are required to be installed in a Cisco CRS 8-slot Line Card Chassis Enhanced router AC modular configuration power shelf.

For additional power details, see [Appendix A, “Technical Specifications.”](#)

Modular Configuration AC Power Shelf

The AC power shelf is the enclosure that houses the AC power modules and power distribution connections and wiring. The AC power shelf, shown in the following figure, is installed in the Cisco CRS 8-slot Line Card Chassis Enhanced router from the front and plugs into the chassis power interface connector panel.

Figure 9: Modular Configuration AC Power Shelf



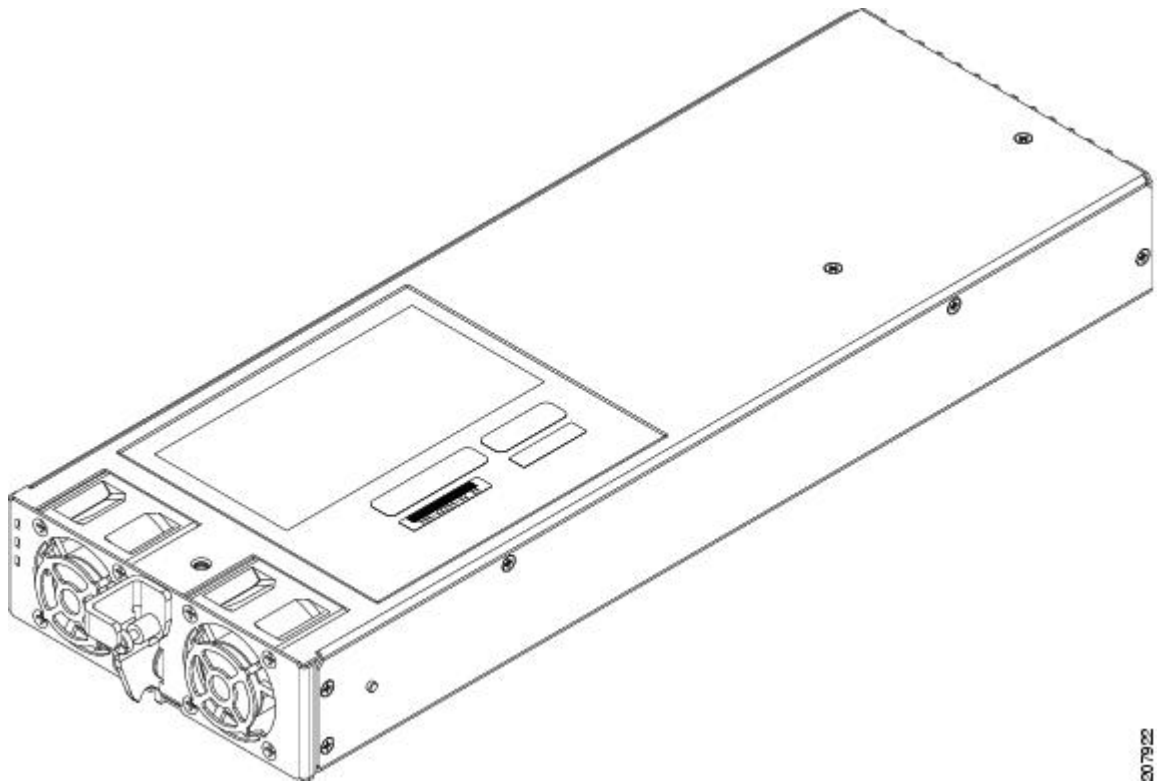
Note The power cables for the power shelves do not come pre-attached.

Modular Configuration AC Power Module

The AC power module is an AC power module that converts single phase input AC power into the DC power necessary to power chassis components.

The AC power module takes input AC power from the power shelf, converts the AC into DC, provides filtering and control circuitry, provides status signaling, and passes the DC power to the chassis midplane.

Figure 10: Modular Configuration AC Power Module



Each power module has its own power connector to connect input AC power. The input AC power for each power module is as follows:

- Each AC power module has a single-phase, 3-wire connection: Input: 200 to 240 VAC, 50 to 60 Hz, 16A. Tolerance: +/-10%(180 to 264) VAC, 50 to 60 Hz, 16A.
- A 3-pin IEC-320 C21 90 degree female plug is inserted into a 3-pin IEC-320 C22 male plug at the rear of each power module.

The AC power enters the AC power at the rear of the power shelf. Once the power enters the AC power module, internal circuits rectify the AC into DC, filter and regulate it. Each AC power module provides two output voltages, as follows:

- Output Voltage 1 is -54VDC at 55.5A
- Output Voltage 2 is +5V at 0.75A

Each AC power module contains an ID EEPROM that stores information used by control software (for example, part number, serial number, assembly deviation, special configurations, test history, and field traceability data).

[#con_1241429/fig_1294667](#) is a diagram of the connections between the modular configuration AC power shelves and the Cisco CRS 8-slot Line Card Chassis Enhanced router. See the http://www.cisco.com/en/US/docs/routers/crs/crs1/8_slot/installation/guide/hqlcc_install.pdf Cisco CRS Carrier Routing System 8-Slot Line Card Chassis Enhanced Router Installation Guide for detailed information about the input power connections to the AC power shelf.

Each AC power shelf supports up to three AC power modules. The AC power modules convert AC power into DC power, provide filtering, and then distribute the DC power to the chassis midplane. The power shelf also has a service processor module that monitors the condition of each AC power module and provides status signals that indicate the health of the power supplies.

Modular Configuration AC Power Module Indicators

The following three LED status indicators are located on the front of each AC power module:

- Input OK - Green
- Output OK - Green
- Internal Fault - Red

The following table lists the power module status indicators and their functions.

Table 3: AC Power Module Status Indicators

Name	Color	Function
Input OK	Green	Input OK LED turns on continuously when input voltage is present and within the regulation range. Input OK LED flashes when input voltage is present but not within the regulation range. Input OK LED is off when input voltage is not present. Input OK LED flashes when hot-unplugging the power module from the power shelf to indicate that there is energy in the power module until the input bulk capacitor is completely discharged or the housekeeping circuit is shut down.
Output OK	Green	Output OK LED turns on continuously when power module output voltage is on. Output OK LED flashes when power module output voltage is in a power limit or an overcurrent situation.
Internal Fault	Red	Internal Fault LED turns on continuously when there is an internal fault in the power module.

The Internal Fault LED on the AC power module is turned on continuously to indicate that one or more of the following internal faults is detected inside the power module:

- 5V out of range
- Output Stage OT
- Fan Fault
- OR-ing fault (Output voltage less than bus voltage)
- OC shutdown
- OT shutdown
- OV shutdown
- Input stage OT

- Fault induced shutdown occurred
- Thermal sensor fault
- Vout out of range
- Boost Vbulk fault

Once all of the faults have been removed and the power module is operating normally, the Internal Fault LED is turned off.

Cisco CRS 3-Phase AC Power Distribution Unit

This section describes the Cisco CRS Power Distribution Unit (PDU). The PDU converts 3-phase AC input power to single-phase AC output power that connects directly to the rear of the modular configuration AC power shelf.

The AC PDU includes either an AC Delta or AC Wye power interface, and has power input and power output cords entering and exiting the box. The PDU can be installed in a 19-inch rack or other locations, depending on the PDU type, by using chassis mounting brackets. In this section, single PDU refers to the individual PDU that converts 3-phase AC input power to single-phase AC output power.

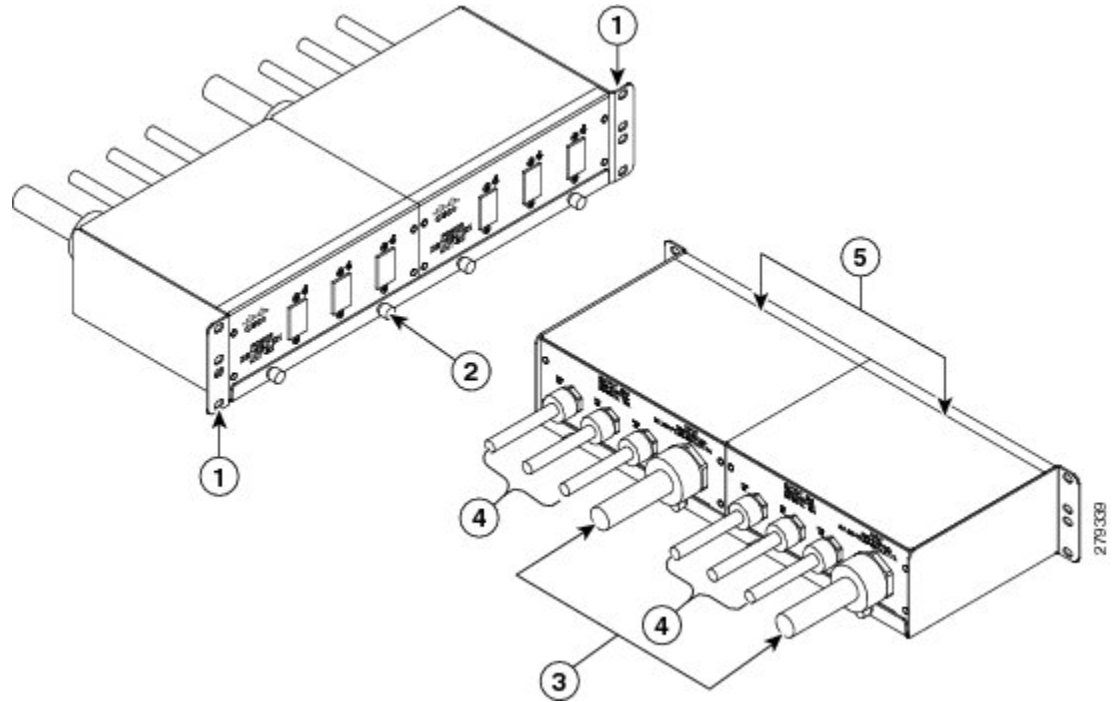
A PDU kit refers to all the components that are required to be installed in a redundant CRS system. A PDU kit contains 2 single PDUs and any necessary mounting brackets or hardware. When ordering an AC-powered Cisco CRS system, the appropriate PDU kit Product ID should also be ordered.

Cisco Product ID numbers for PDU kits are as follows:

- CRS-8-PDU-Delta—Redundant 3-phase to single-phase Delta PDU for Cisco CRS 8-slot Line Card Chassis Enhanced router, 2 input/6 output
- CRS-8-PDU-Wye—Redundant 3-phase to single-phase Wye PDU for Cisco CRS 8-slot Line Card Chassis Enhanced router, 2 input/6 output

The following figure shows the Power Distribution Unit 8D (Cisco product number PDU-321-3-Delta) that converts 3-phase AC Delta input power to single phase output power.

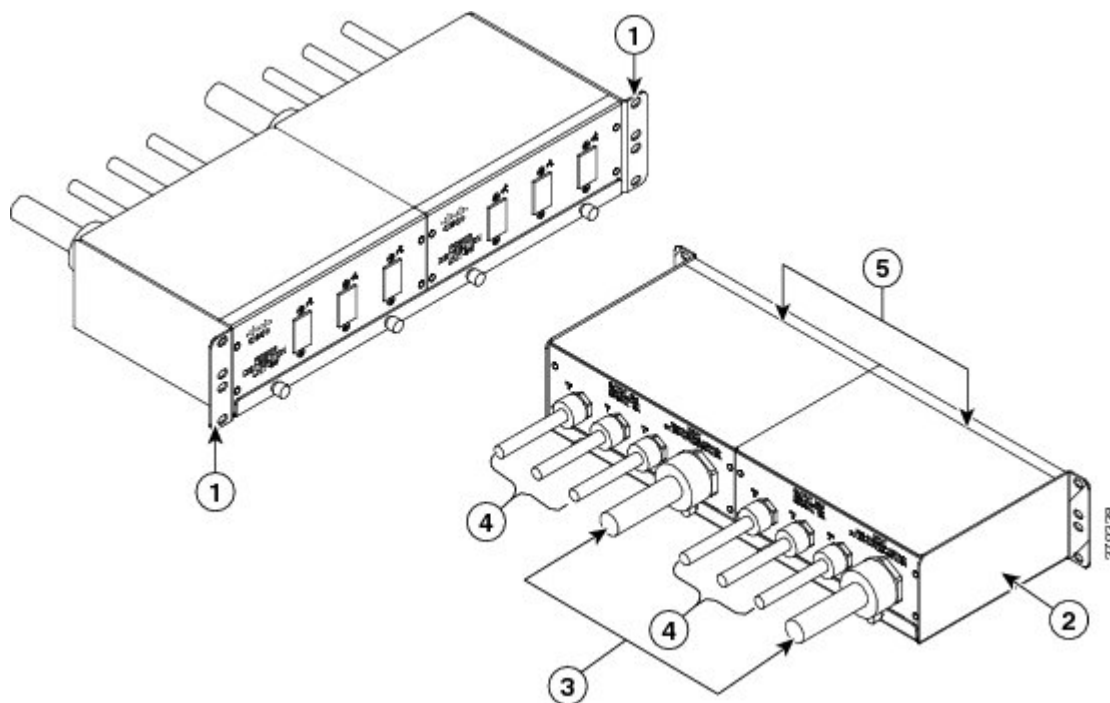
Figure 11: Cisco CRS-8-PDU-Delta



1	Rack mounting ears	2	Rack Tray
3	Input Cord	4	Output Cords
5	Face Plate		

The following figure shows the Power Distribution Unit 8W (Cisco product number PDU-321-3-Wye) that converts 3-phase AC Wye input power to single phase output power.

Figure 12: Cisco CRS-8-PDU-Wye



1	Rack mounting ears	2	Rack Tray
3	Input Cord	4	Output Cords
5	Face Plate		

The PDU for the CRS 8-slot Line Card Chassis Enhanced router is shipped with the following hardware for specific configurations:

- Two single AC Delta PDUs with 19 inch rack tray. Each AC Delta PDU has one power input and three outputs.
- Two single AC Wye PDUs with 19 inch rack tray. Each AC Wye PDU has one power input and three outputs.

For PDU specifications, see the [Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide](#), the section [Specifications](#). For information on installing the PDU, see the [Cisco CRS Carrier Routing System 8-Slot Line Card Chassis Enhanced Router Installation Guide](#).