



Cisco CRS 16-Slot Chassis Power Systems

This chapter includes the following sections:

Power specifications are provided in [Technical Specifications](#)

- [Power Systems Overview, on page 1](#)
- [Power Component Information Common to the Two Types of Power Systems, on page 2](#)
- [Fixed Configuration Power Supply, on page 7](#)
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- [Cisco CRS 3-Phase Power Distribution Unit, on page 36](#)

Power Systems 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:

Fixed configuration power system—consists of two power shelves, AC rectifiers or DC power entry modules (PEMs), and alarm modules. 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 power 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. 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, refer to http://www.cisco.com/en/US/docs/routers/crs/crs1/mux_box/installation/quick_start/guide/crs_pdu_qs.html 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 W (13.9 kW) of DC input power when the chassis is fully loaded (95% efficiency).
- AC-powered chassis requires up to a maximum of 15,000 W (15.0 kW) of AC input power when the chassis is fully loaded (88% efficiency).

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 14,667 watts (14.7 kW) of DC input power when the chassis is fully loaded (88% efficiency).
- 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 (92% efficiency).



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.

Power Component Information Common to the Two Types of Power Systems

This section introduces information shared by the fixed configuration power components and the modular configuration power components in the following topics:

Basic Chassis Power Details

The Cisco CRS 16-Slot line card chassis can be configured with either an AC-input power subsystem or a DC-input power subsystem. Site power requirements differ, depending on the source voltage used. Follow these precautions and recommendations when planning power connections to the router:

- Check the power at your site before installation and periodically after installation to ensure that you are receiving clean power. Install a power conditioner, if necessary.

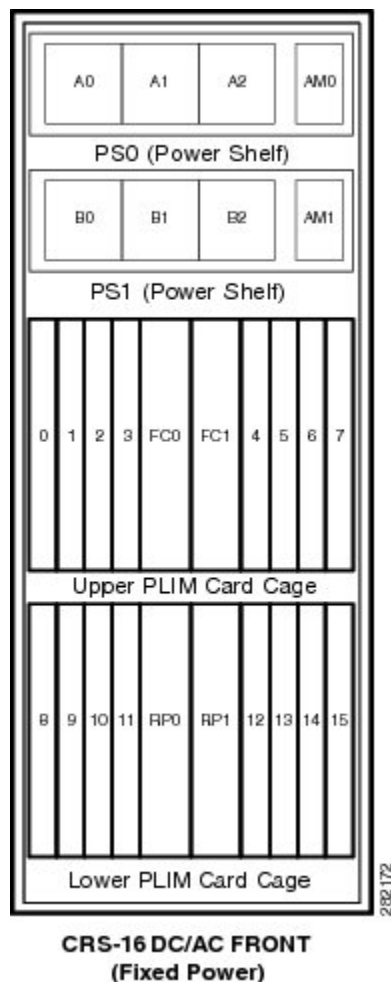
- Install proper grounding to avoid damage from lightning and power surges.

The Cisco CRS 16-slot line card chassis requires that at least one power shelf and its components be installed to operate properly; however, if you install only one power shelf and its components, your system will not be 2N redundant.

Two types of power shelves exist in fixed and modular configurations:

- Fixed configuration—AC shelf and a DC shelf. A fixed configuration AC power shelf houses the AC rectifiers, while a fixed configuration DC power shelf houses the DC PEMs. The following figure shows the fixed configuration power supply shelves and alarm modules.

Figure 1: Line Card Chassis DC/AC Fixed Configuration Power—Slot Numbering



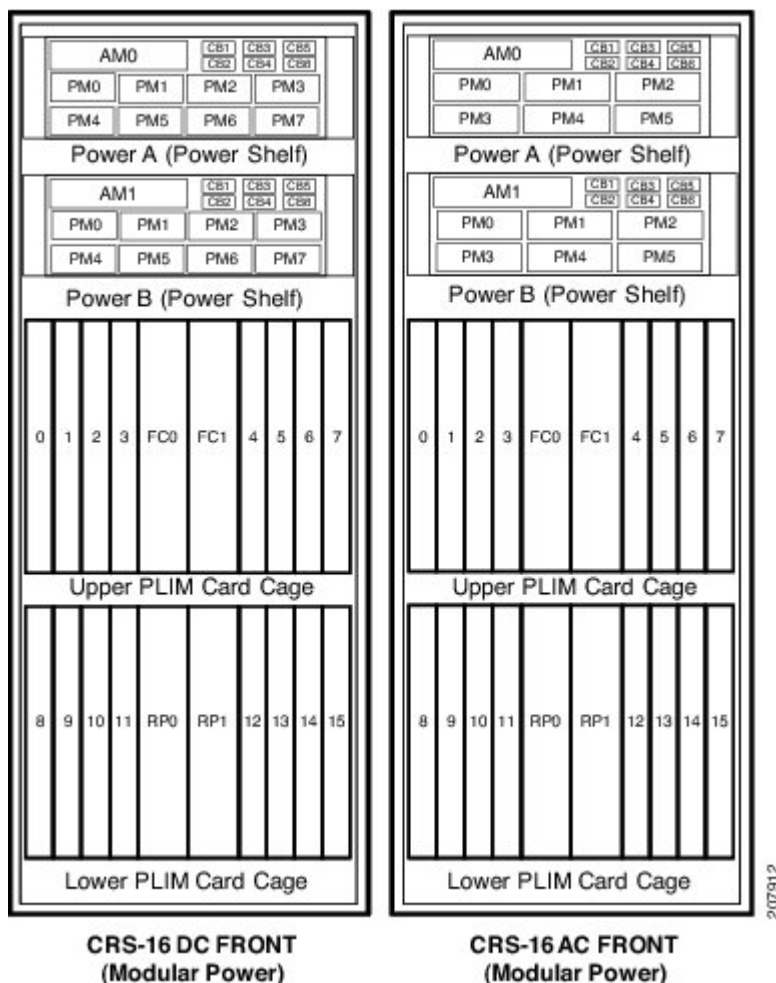
- Modular configuration—AC power shelf houses the AC PMs, while a modular configuration DC power shelf houses the DC PMs. It is required that you use only one type of power shelf in a chassis at a time.



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

The following figure shows the DC and AC power modular numbering in a modular power configuration.

Figure 2: Line Card Chassis DC and AC Modular Configuration Power—Slot Numbering



Chassis Grounding Guidelines

The 16-slot 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.

DC Power Systems

Each DC powered chassis contains two DC power shelves for 2N redundancy. The 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. Each DC PEM has its own circuit breaker.

- In the modular configuration power system, each shelf can accept up to eight DC PMs. The power shelves and DC PMs are field replaceable.



Note Depending on the hardware deployed at your site, your system may not consume, or be capable of consuming the maximum power supplied by the power system.

Fixed Configuration DC Power

The Cisco CRS 16-slot line card chassis fixed configuration DC power system provides 13,200 watts to power the chassis. Due to its power zones, the Cisco CRS 16-slot line card chassis using fixed configuration power requires a total of 12 dedicated 60 A DC input power connections, two for each DC PEM, to provide redundant DC power to all six power zones of Cisco CRS 16-slot line card chassis midplane. We recommend that you have two separate, redundant –48/-60 VDC power battery sources to provide power to the Cisco CRS 16-slot line card chassis. Connect the six 60 A DC inputs to the upper power shelf (PS0) to one battery, and the other six inputs to the lower power shelf (PS1) to the other battery.

At sites where the Cisco CRS 16-slot line card chassis is equipped with a DC-input power supply shelf and DC PEMs, observe the following guidelines:

- All power connection wiring should follow the rules and regulations in the National Electrical Code (NEC) and any local codes.
- Each DC-input PEM connection is rated at 60 A maximum. A dedicated, commensurately rated DC power source is required for each PEM connection.
- For DC power cables, we recommend that you use commensurately rated, high-strand-count copper wire cable. Each DC PEM requires two –48/-60 VDC inputs, which means twelve cables in total (six pairs) for each power shelf, plus the grounding wire. The length of the cables depends on the router location. These cables are not available from Cisco Systems; they are available from any commercial vendor.

Modular Configuration DC Power

The Cisco CRS 16-slot line card chassis modular configuration DC power system can provide up to 16,800 watts to power the chassis. However, by default, the power capability of a system when shipped, with 6 PMs per power shelf, is 12,600 watts.

At sites where the Cisco CRS 16-slot line card chassis is equipped with a DC-input power supply shelf and DC PMs, observe the following guidelines:

- All power connection wiring should follow the rules and regulations in the National Electrical Code (NEC) and any local codes.
- Each DC-input PM connection is rated at 60 A maximum. A dedicated, commensurately rated DC power source is required for each PM connection.
- Each PM requires one –48/-60 VDC input, which leads to twelve wires in total (six pairs) for each power shelf and one shelf grounding wire.
- For DC power cables, we recommend that you use commensurately rated, high-strand-count copper wire cable. Each DC PM requires two –48/-60 VDC inputs, which means sixteen cables in total (eight pairs) for each power shelf, plus the grounding cable. The length of the cables depends on the router location. These cables are not available from Cisco Systems; they are available from any commercial vendor.



Note Depending on the hardware deployed at your site, your system may not consume, or be capable of consuming the maximum power supplied by the power system.

Each modular configuration DC power shelf supports up to eight DC PMs. The power shelves and DC PMs are field replaceable.



Note Although each modular configuration DC power shelf can support up to eight DC PMs, the modular configuration DC power shelf is shipped with six DC PMs per shelf.

AC Power Systems

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

- Fixed configuration power system—each shelf contains three AC power rectifiers. The power shelves and AC power rectifiers are field replaceable. Each shelf and AC power rectifier has its own circuit breaker.
- Modular configuration power system—each shelf can contain up to six AC PMs. The power shelves and the AC PMs are field replaceable.



Note Depending on the hardware deployed at your site, your system may not consume, or be capable of consuming the maximum power supplied by the power system.

Fixed Configuration AC Power

The Cisco CRS 16-slot line card chassis fixed configuration AC power system provides 13,200 watts to power the chassis. Two versions of the 3-phase AC power shelf are available to provide either an AC Delta or an AC Wye input configuration. Each of the AC power shelf versions has a different Cisco part number to distinguish the Wye from the Delta configuration. The AC connections to the Cisco CRS 16-slot line card chassis are made to terminal blocks on the AC power shelves that have been hard wired for a Wye or Delta configuration. All chassis should have two power shelves of the same type, that is, two Delta or two Wye AC power shelves.

In the fixed configuration power system, each shelf supports three AC-to-DC rectifiers that are field replaceable. The AC-to-DC rectifiers convert 200-to-240 VAC power to -54 VDC used by the Cisco CRS 16-slot line card chassis.

The AC Wye power shelf has a Wye 3-phase, 5-wire connection: 200 to 240 (L-N)/346 to 415 (L-L) VAC, 3W+N+PE, 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 is required for each power shelf.

The AC Delta power shelf has a Delta 3-phase, 4-wire connection: 200 to 240 VAC, 3-phase, 3W+PE, 50 to 60 Hz, 42 A. For redundant operation, two 3-phase Delta 60-A branch circuits are required. One power connection is required for each power shelf.



Note The power cables for the power shelves are shipped unattached and need to be installed.

Modular Configuration AC Power

The Cisco CRS 16-slot line card chassis modular configuration AC power system can provide up to 18,000 watts to power the chassis. However, by default, the power capability of a system when shipped, with 5 AC PMs per power shelf, is 15,000 watts.

Each modular configuration power shelf supports up to six PMs. The power shelves and PMs are field replaceable.



Note Although the system is capable of delivering this level of power, depending on the hardware deployed at your site, your system may not consume, or be capable of consuming, this much power.

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 PDU* will be required to convert 3-phase AC input power to single-phase AC input power for the power shelf. For further information, see the [Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide](#).

Each modular configuration AC PM has the following input power requirements:

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

Each power shelf contains six IEC-320-C22 receptacles which can accept up to six IEC-320-C21 connector cords, depending on how many AC PMs are installed in the shelf.



Note In order to maintain a balanced 3-phase power load, six AC PMs are required to be installed in a Cisco CRS 16-slot line card chassis AC modular configuration power shelf.



Note If single-phase AC power is available at your site, we recommend that you use appropriate short-circuit protection in compliance with national and local electrical codes.

Fixed Configuration Power Supply

This section contains the following topics:

- [AC Fixed Configuration Power Systems, on page 16](#)
- [Alarm Module for Fixed Configurations, on page 21](#)

The fixed configuration power includes the following major components:

- Two (redundant) AC or DC power shelves
- Three AC rectifiers or three DC power entry modules (PEMs) per power shelf

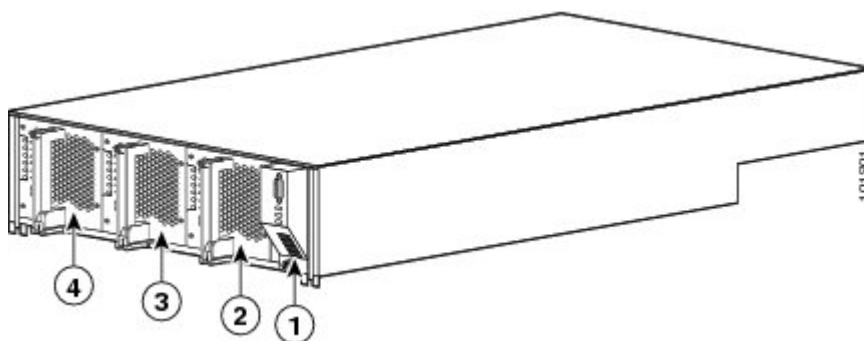
- Alarm modules, one per power shelf

In the fixed configuration power system, different power shelves are used for DC, AC Wye, and AC Delta input power. Each power shelf contains three AC rectifiers or three DC PEMs and an alarm module. The following figure shows a front view of a fixed configuration AVC Wye power shelf with AC rectifiers and alarm module installed. The front view of a fixed configuration AC Delta power shelf with AC rectifiers and alarm module installed and a fixed configuration DC power shelf with DC PEMs and alarm module installed are similar.



Note Although differences exist among the different power shelf types (AC Wye, AC Delta, and DC), they are installed in the same manner.

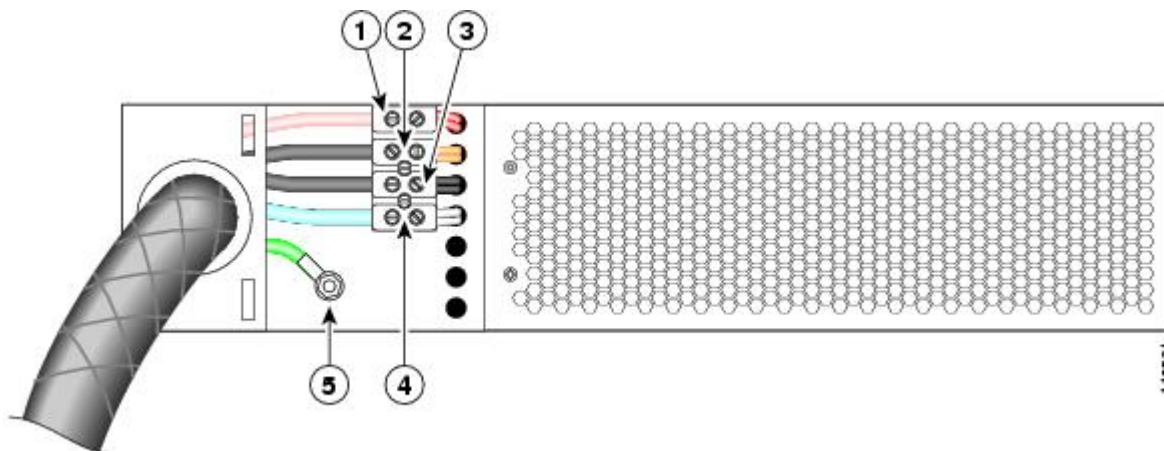
Figure 3: AC Wye Power Shelf with AC Rectifiers Installed - Front View



1	Alarm module	3	AC rectifier 1
2	AC rectifier 2	4	AC rectifier 0

The following figure shows the AC Wye power shelf with a 5-wire Wye cord and an IEC 60309 plug rated 415 V/32 A, IP44, 3W+N+PE; it is 4 meters long. The power shelf has five corresponding leads: three active (hot), one neutral, and one ground.

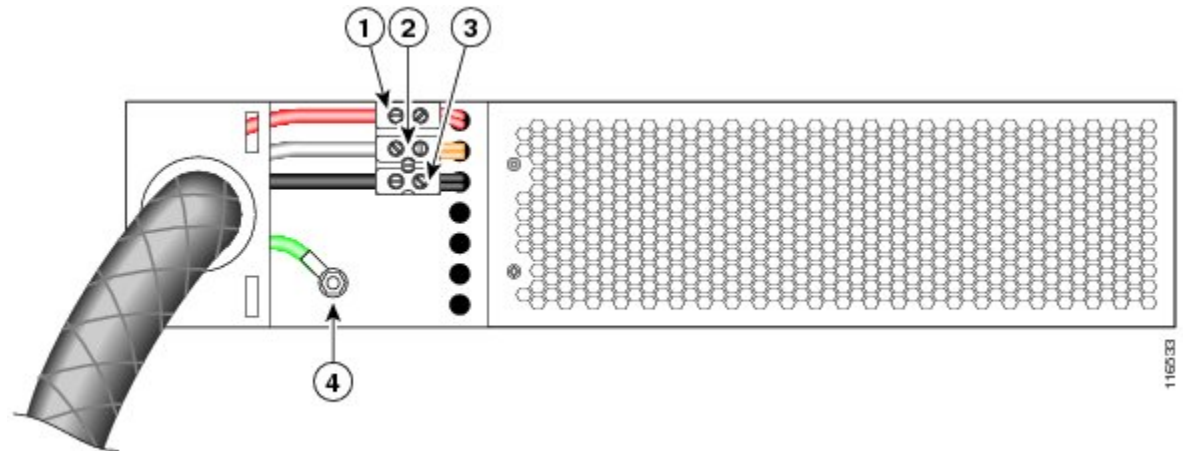
Figure 4: Fixed AC Wye Power Shelf - Rear View



1	Lead 1 (L1)	4	Lead 4 (L4, neutral)
2	Lead 2 (L2)	5	Ground
3	Lead 3 (L3)		

The following figure shows the Delta power shelf. The power cord has a 4-pin 460P9W plug (3W+PE) that plugs into a 460R9W power receptacle.

Figure 5: Fixed Delta Power Shelf - Rear View



1	Lead 1 (L1)	3	Lead 3 (L3)
2	Lead 2 (L2)	4	Ground

Fixed Configuration Power Architecture

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

For details showing the CRS 16-slot line card chassis power routing distribution for a fixed DC configuration, see [Figure 8: CRS 16-Slot Line Card Chassis Power Distribution - Fixed DC Configuration](#) and for an AC fixed configuration, see [Figure 11: Cisco CRS 16-Slot Line Card Chassis Power Distribution - Fixed AC Configuration](#).

Input power enters the chassis through the two power shelves and is distributed to the A or B power bus. Both bus bars distribute power through the midplane to the MSC, PLIM, switch fabric, RP, and fan controller card slots.

- The A power shelf supplies –54 VDC to the A bus bar.
- The B power shelf supplies –54 VDC to the B bus bar.

Because chassis components are powered by both A and B power inputs, the Cisco CRS 16-slot line card chassis can continue to operate normally if:

- One AC PEM or DC PEM fails
- One entire power shelf fails
- One bus bar fails

It takes two failures for the system to be degraded. In addition, the failures must occur in both the A and B sides of the power architecture to affect the same power zone for the degradation to occur.

Individual chassis components have power-related devices (OR-ing diodes, inrush control circuits, and EMI filters) that are part of the chassis power architecture. These power-related devices form part of the dual power source (A and B bus) architecture, and enable online insertion and removal (OIR) of the component, also called hot-swapping.

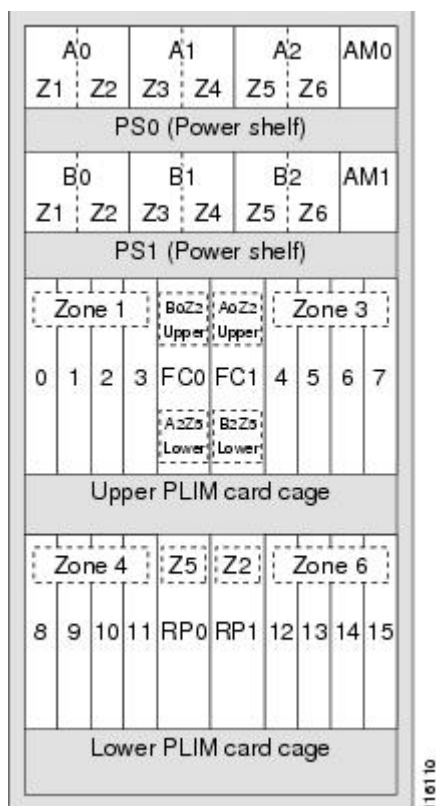
Fixed Configuration Chassis Power Zones

Chassis power zones distribute power throughout the chassis and provide redundant power to chassis slots. In the fixed configuration power system, each power zone is powered by a set of power modules (one module from each power shelf). In each set of power modules (A0 and B0, A1 and B1, and A2 and B2) each power module is considered a backup for the other. Each set of power modules provides power to the same set of chassis power zones. If either power module fails, the other continues to provide power to those slots.

The AC or DC fixed configuration power system distributes power in the chassis through six power zones, which provide power redundancy and reliability. Each power zone receives power from both bus bars (A and B), which ensures that each card and module in the chassis is powered by both power shelves.

A Cisco CRS 16-slot line card chassis can lose a single power module or an entire power shelf and still have the power to operate for a fixed configuration. For a power zone to lose complete power, a power module in each power shelf would have to fail. The following figure shows the power zones on the PLIM side of the chassis with a fixed configuration power system installed.

Figure 6: Line Card Chassis Power Zones—(PLIM Side) Fixed Configuration Power



As shown in the figure, each power module (DC PEM or AC rectifier) powers two power zones:

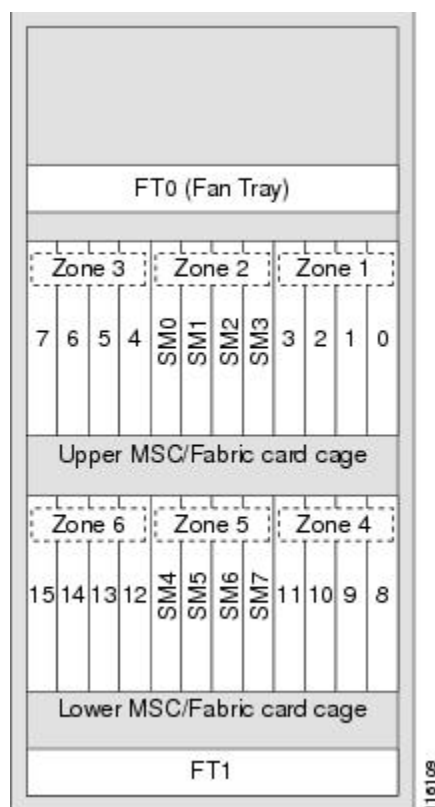
- Power module A0 powers power zones 1 and 2 (Z1 and Z2)
- Power module A1 powers power zones 3 and 4 (Z3 and Z4)
- Power module A2 powers power zones 5 and 6 (Z5 and Z6)
- Power module B0 powers power zones 1 and 2 (Z1 and Z2)
- Power module B1 powers power zones 3 and 4 (Z3 and Z4)
- Power module B2 powers power zones 5 and 6 (Z5 and Z6)
- The upper fan tray is powered by power zone 2 (A0Z2 and B0Z2) and the lower fan tray is powered by power zone 5 (A2Z5 and B2Z5) through the fan controller cards.
- Alarm module AM0 is assigned to the upper power shelf PEM A0, A1, A2
- Alarm module AM1 is assigned to power shelf B, for B0, B1, B2

The figure also shows which power zones power which chassis slots:

- Power zone 1 (Z1) powers chassis slots 0, 1, 2, and 3
- Power zone 2 (Z2) powers chassis slots FC0 (upper), FC1 (upper) and RP1
- Power zone 3 (Z3) powers chassis slots 4, 5, 6, and 7
- Power zone 4 (Z4) powers chassis slots 8, 9, 10, and 11
- Power zone 5 (Z5) powers chassis slots FC0 (lower), FC1 (lower) and RP0
- Power zone 6 (Z6) powers chassis slots 12, 13, 14, and 15

The following figure shows the six power zones on the MSC side of the Cisco CRS 16-slot line card chassis.

Figure 7: Line Card Chassis Power Zones—(MSC Side) Fixed Configuration Power



The above figure shows which power zones power which chassis slots on the MSC side of the chassis:

- Power zone 1 (Z1) powers chassis slots 0, 1, 2, and 3
- Power zone 2 (Z2) powers chassis slots SM0, SM1, SM2, and SM3
- Power zone 3 (Z3) powers chassis slots 4, 5, 6, and 7
- Power zone 4 (Z4) powers chassis slots 8, 9, 10, and 11
- Power zone 5 (Z5) powers chassis slots SM4, SM5, SM6, and SM7
- Power zone 6 (Z6) powers chassis slots 12, 13, 14, and 15

The fan trays (FT0 and FT1) receive their operating power from the fan controller cards (FC0 and FC1).

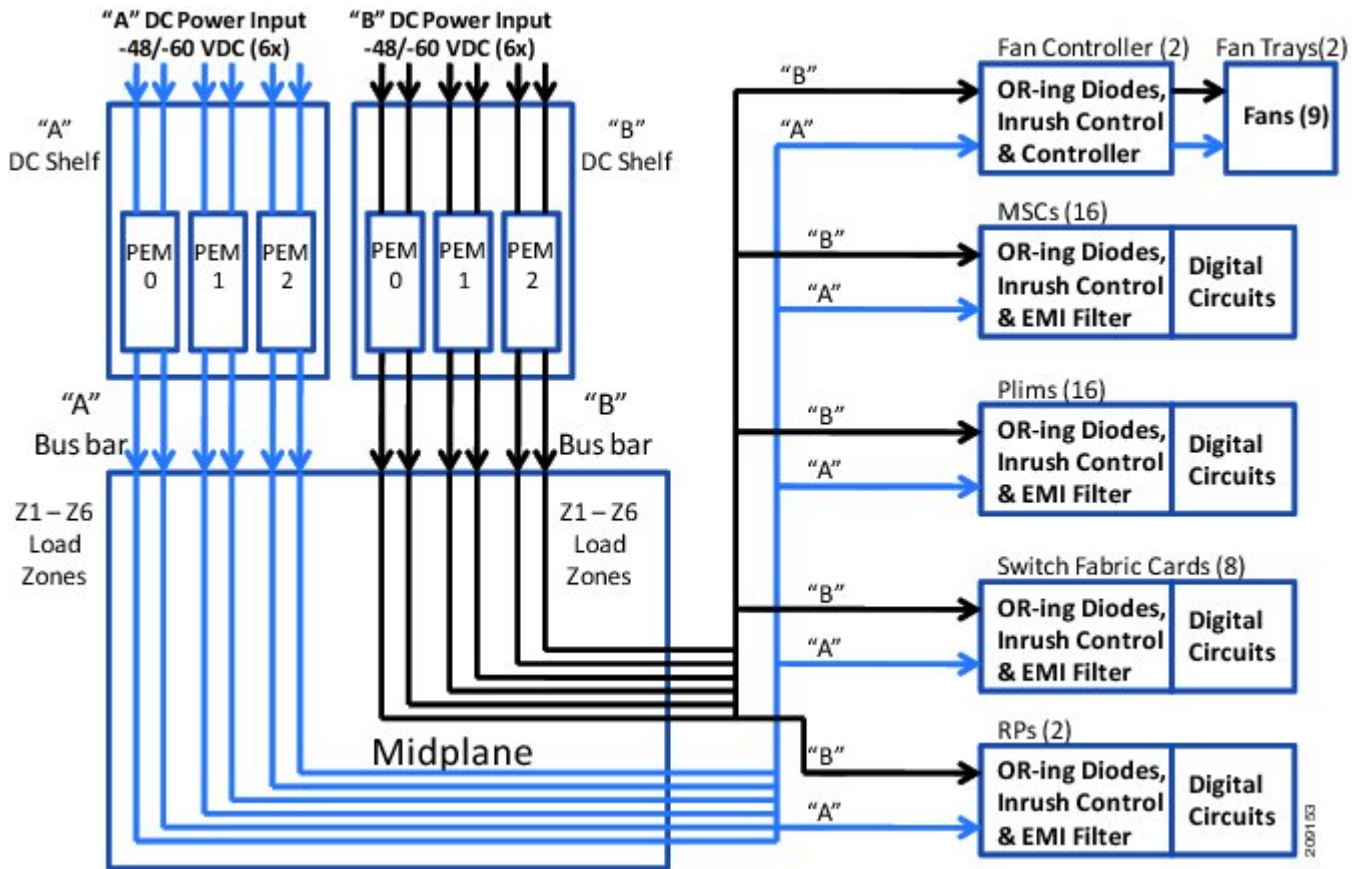
DC Fixed Configuration Power Systems

The Cisco CRS 16-slot line card chassis DC fixed configuration power system provides 13,200 Watts to power the Cisco CRS 16-slot line card chassis. The DC power system, which provides 2N power redundancy for the routing system, contains the following components:

- Two DC power shelves—Contain the input DC power connectors and house the DC power entry modules (PEMs).
- Three DC PEMs (per power shelf)—Take input DC power from the power shelf, provide filtering and surge protection, and pass the power to either the A or B bus bar. Each PEM is field replaceable.
- Each power shelf has its own circuit breaker, and each PEM has its own circuit breaker.
- Each AC or DC power shelf contains an alarm module that monitors the health of the entire system including the power system and provides an external interface for system alarms.

The following figure shows the 16-slot line card chassis power routing distribution for a fixed DC configuration.

Figure 8: CRS 16-Slot Line Card Chassis Power Distribution - Fixed DC Configuration



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

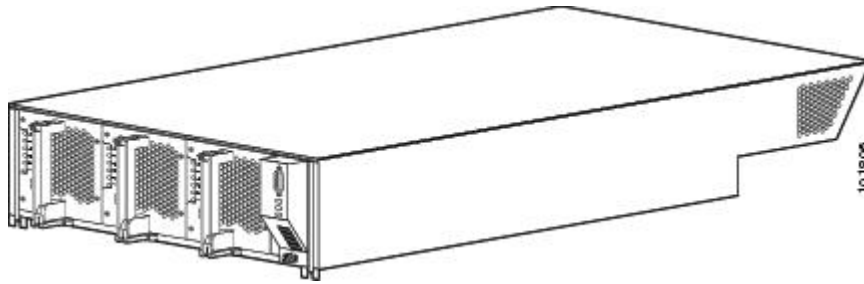
Input power enters the chassis through the two power shelves and is distributed to the A or B power bus. Both bus bars distribute power through the midplane to the MSC, PLIM, switch fabric, RP, and fan controller card slots.

- The A power shelf supplies -54 VDC to the A bus bar.
- The B power shelf supplies -54 VDC to the B bus bar.

Fixed Configuration DC Power Shelf

The fixed configuration DC power shelf is the enclosure that houses three DC PEMs, the alarm module, and power distribution connections and wiring. The power shelf installs in the Cisco CRS 16-slot line card chassis from the front and plugs into the chassis power interface connector panel.

Figure 9: DC Fixed Configuration Power Shelf)



Each power shelf has six pair of input power terminals and each $-48/-60$ VDC (nominal), 60 A service return. Each connector consists of two terminals ($-$ and $+$). Each terminal consists of two M6 threaded studs, 0.6 inches long, and centered 0.6 inches apart. The terminals have a safety cover and there is strain relief on the power shelf to secure the input power cables.

The power shelf also has a service processor that monitors the condition of each PEM and provides status signals that indicate the health of the power supplies.

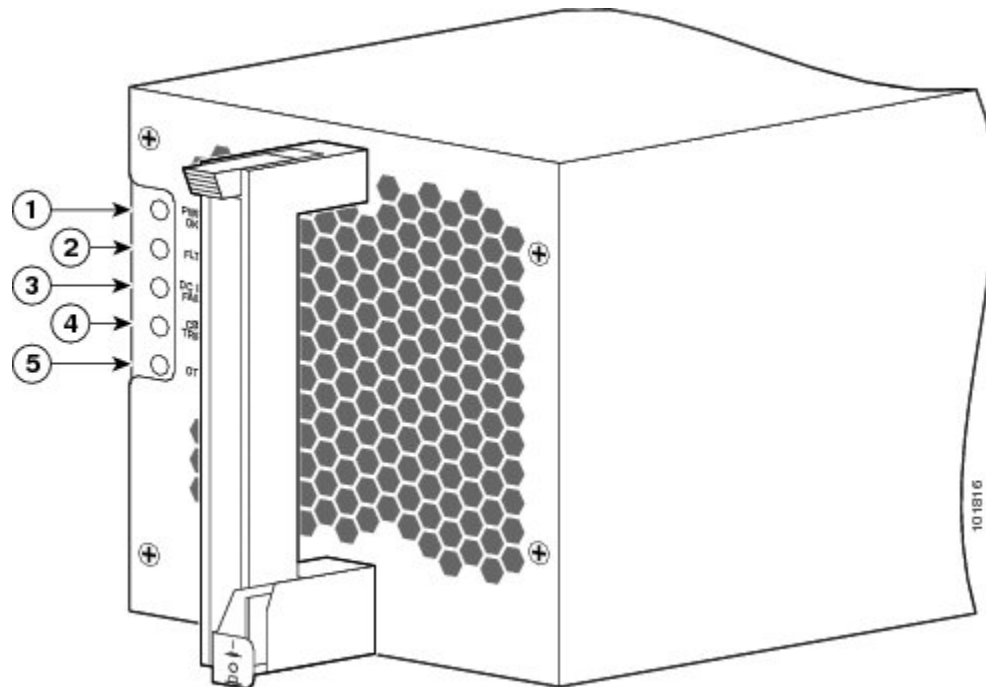
Each DC power shelf supports three PEMs, and accepts two 60A battery feeds. Input DC power enters the power shelf and is processed by the PEMs before being distributed to the chassis midplane. The PEMs perform inrush current limiting, EMI filtering, surge protection, and circuit isolation on the input DC power, and then distribute the power to either the A or B bus bar in the chassis midplane.

To provide 2N redundancy, one DC power shelf powers the A bus and the other shelf powers the B bus. Power zones in the chassis midplane provide power from both the A and B bus to each card and module in the chassis. For detailed information about how power is distributed through the chassis, see [Figure 8: CRS 16-Slot Line Card Chassis Power Distribution - Fixed DC Configuration](#).

Fixed Configuration DC Power Entry Module

The fixed configuration DC PEM, shown in the following figure, processes input power from the power shelf and passes the power to the A or B bus bar. DC PEMs are field-replaceable.

Figure 10: Fixed Configuration DC Power Entry Module



1	PWR OK	4	BREAKER TRIP
2	FAULT	5	OT
3	DC INPUT FAIL		

Two $-48/-60$ VDC inputs enter the PEM at the rear of the power shelf through a connector on the power shelf midplane. The PEM performs inrush current limiting, EMI filtering, surge protection, and circuit isolation to process the power before it exits the PEM and is distributed to the chassis midplane.

A service processor module (in the power shelf) monitors each PEM and reports the status to the system controller function on the route processor. The service processor detects whether the PEM is present, and monitors PEM output voltages and current, and fault and alarm conditions (see the next section).

Each PEM 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). The system software reads the EEPROM of each FRU in the system to determine if it is the correct FRU.

Fixed Configuration PEM Indicators

Each fixed configuration DC PEM has power and status indicators. DC PEM indicators are powered by both DC power shelves; therefore, the indicators are operational even when the DC PEM is not being powered from its input voltage. The following table lists the DC PEM status indicators and their functions.

Table 1: DC PEM Status Indicators

Name	Color	Function
PWR OK	Green	PEM is operating normally with power.

Name	Color	Function
FAULT	Yellow	A PEM fault was detected (for example, failed bias supply, over-temperature or over-current, or DC output out of range).
DC INPUT FAIL	Yellow	No DC input to the PEM, or DC input is out of range.
OT	Yellow	PEM is overheated and has been shut down.
BREAKER TRIP	Yellow	Circuit breaker has tripped and is in the off position.

The following table lists the conditions of the LEDs under certain failure conditions.

Table 2: DC PEM LED Conditions

Condition	PWR OK LED	Fault LED	DC Input Fail LED	OT LED	Breaker Trip LED
No fault (power is on)	On	Off	Off	Off	Off
Failed DC power	Off	Off	On	Off	Off
Overheated temperature	Off	On	Off	On	Off
Tripped breaker	Off	Off	Off	Off	On

AC Fixed Configuration Power Systems

The fixed configuration AC power system provides 13,200 watts to power the Cisco CRS 16-slot line card chassis. The AC power system, which provides 2N power redundancy for the routing system, contains the following components:

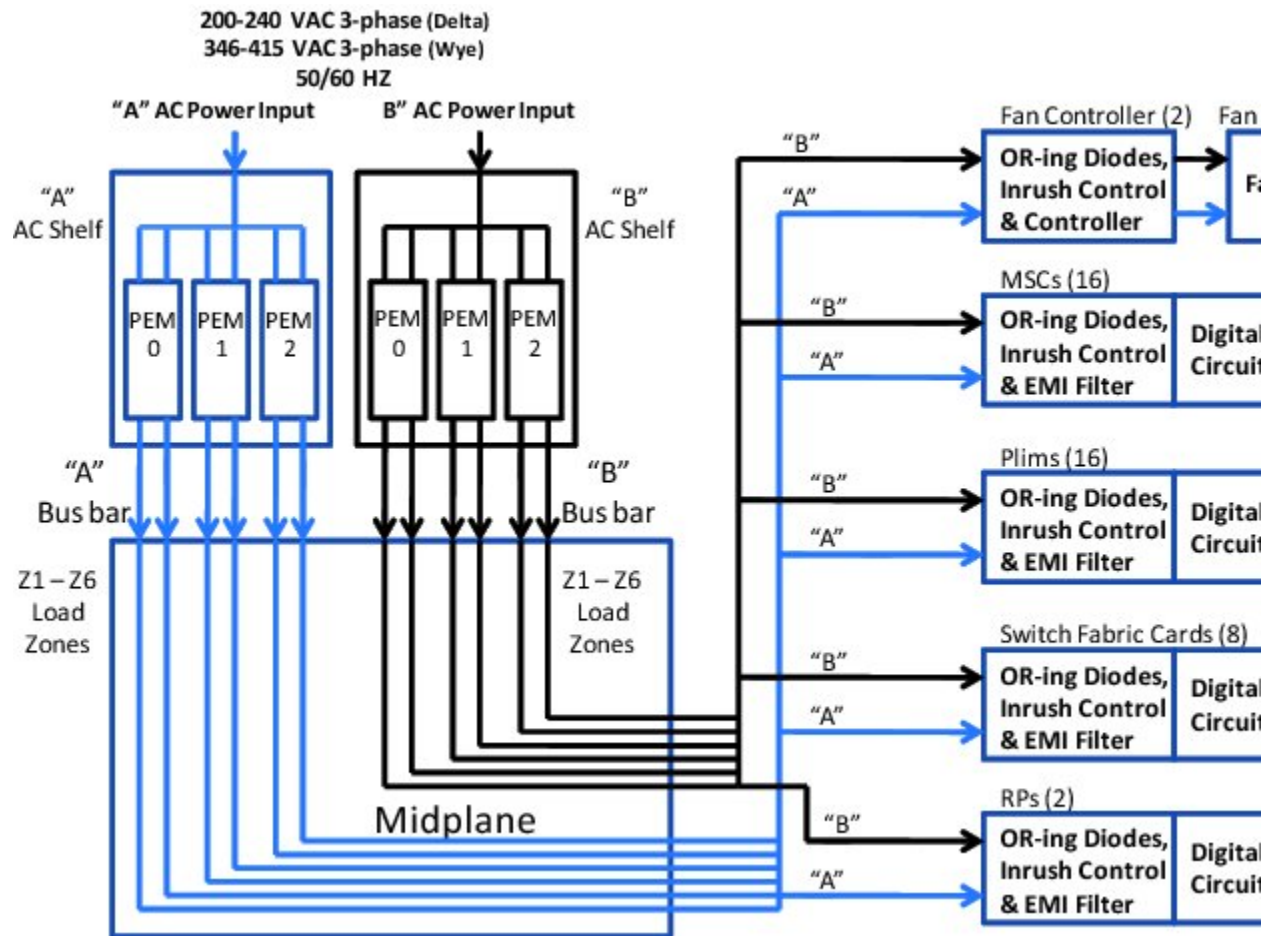
- Two AC power shelves (per chassis)—Contain the input AC power connectors and hold the AC rectifier modules. The power shelves are available in either AC Delta or AC Wye configurations. The chassis requires two power shelves of the same type (Delta or Wye).
- Three AC rectifier modules (per power shelf)—Convert 200- to 240-VAC input power to 54 VDC used by the Cisco CRS 16-slot line card chassis. Each AC rectifier is field replaceable.
- Each power shelf has its own circuit breaker and each AC rectifier has its own circuit breaker.

Two versions of the 3-phase AC power shelf are available to support AC Delta or AC Wye input configurations. Each version of the AC power shelf has a different part number. The input AC power for each type of power shelf is as follows:

- The AC Wye power shelf has a Wye 3-phase, 5-wire connection: 200 to 240(L-N)/346 to 415(L-L) VAC, 3W+N+PE, 50-60 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 AC Delta power shelf has a Delta 3-phase, 4-wire connection: 200 to 240 VAC, 3-phase, 3W+PE, 42 A, 50 to 60 Hz. For redundant operation, two 3-phase Delta 60-A branch circuits are required. One power connection goes to each power shelf.

The following figure shows the Cisco CRS 16-slot line card chassis power routing distribution for a fixed AC configuration.

Figure 11: Cisco CRS 16-Slot Line Card Chassis Power Distribution - Fixed AC Configuration



Input AC power enters the power shelf and is distributed to the three AC rectifiers in the shelf. The AC rectifiers convert AC power into DC power, provide filtering, and then pass the DC power to either the A or B bus bar in the chassis midplane. For redundancy, one AC power shelf powers the A bus and the other shelf powers the B bus. Power zones in the chassis midplane provide power from both the A and B bus to each card and module in the chassis.

The power shelf also has a service processor module that monitors the condition of each AC rectifier and provides status signals that indicate the health of the power supplies ([Fixed Configuration AC Rectifier Indicators, on page 21](#)).



Note The same AC rectifier is used in both the AC Delta and AC Wye power shelves. See [Fixed Configuration AC Rectifier, on page 19](#).

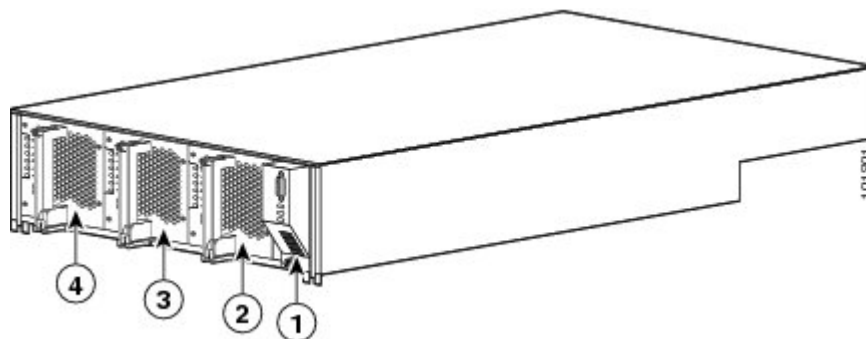


Note The power cables for the fixed configuration AC power shelves are not shipped pre-attached.

Fixed Configuration AC Delta Power Shelf

The AC Delta power shelf is the enclosure that houses three AC rectifier modules, an alarm module, and power distribution connections and wiring. The AC Delta power shelf, shown in the following figure, is installed in the Cisco CRS 16-slot line card chassis from the front and plugs into the chassis power interface connector panel.

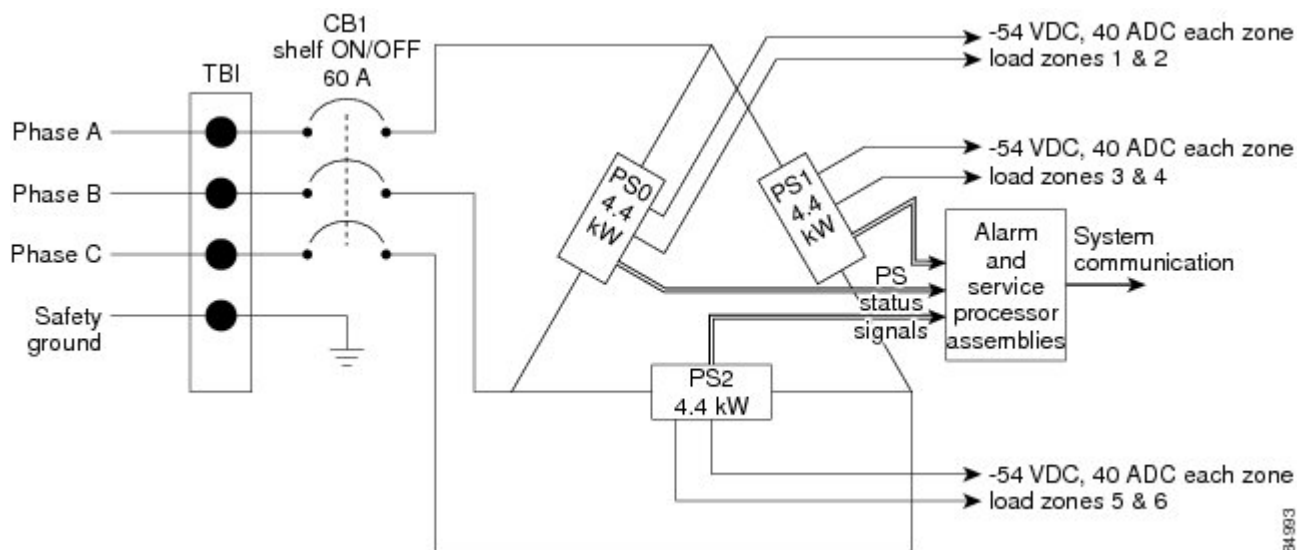
Figure 12: AC Wye Power Shelf with AC Rectifiers Installed - Front View



1	Alarm module	3	AC rectifier 1
2	AC rectifier 2	4	AC rectifier 0

The following figure shows the wiring of an AC Delta power shelf. As shown, four-wire AC Delta 3-phase power is wired into the AC Delta power shelf at a terminal block (TB1). The 3-phase power is then routed through the shelf circuit breaker to the three AC rectifiers (PS0, PS1, and PS2) in the power shelf. The AC rectifiers convert the AC power into 54 VDC power for the chassis. Each AC rectifier powers two of the chassis power zones.

Figure 13: AC Delta Power Wiring



Fixed Configuration AC Wye Power Shelf

The AC Wye power shelf is the enclosure that houses three AC rectifier modules, an alarm module, and power distribution connections and wiring. The power shelf (see the above figure) is installed in the Cisco CRS 16-slot line card chassis from the front and plugs into the chassis power interface connector panel.

Input AC power enters the power shelf and is distributed to the three AC rectifiers in the power shelf. The AC rectifiers convert AC power into DC power, provide filtering, and then pass the DC power to either A or B bus bar in the chassis midplane. For redundancy, one AC power shelf powers the A bus and the other shelf powers the B bus. Power zones in the chassis midplane provide power from both the A and B bus to each card and module in the chassis. For details on power routing distribution for the CRS 16-slot line card chassis for a fixed AC configuration, see [Figure 11: Cisco CRS 16-Slot Line Card Chassis Power Distribution - Fixed AC Configuration](#).

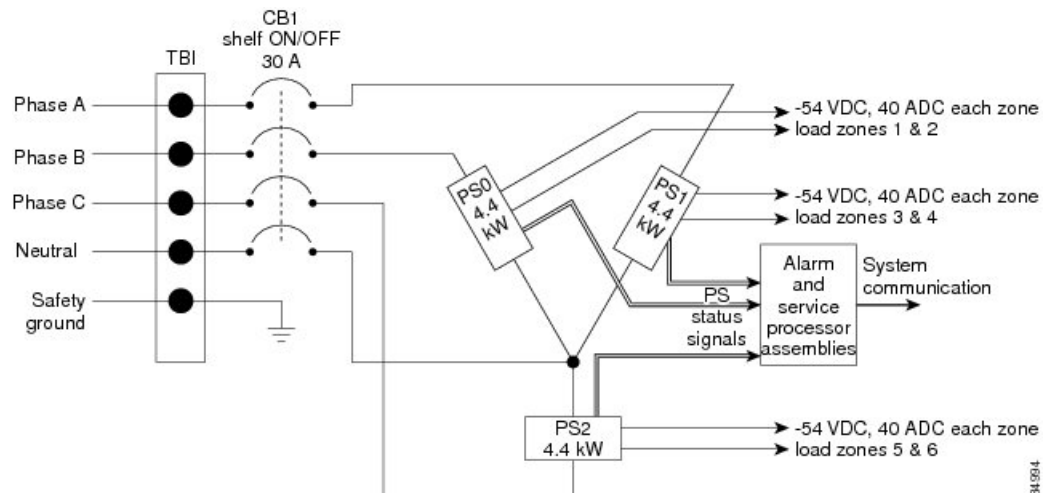
The power shelf also has a service processor module that monitors the condition of each AC rectifier and provides status signals that indicate the health of the power supplies.



Note The same AC rectifier is used in AC Delta and AC Wye power shelves. See the next section for more information.

The following figure shows the wiring of an AC Wye power shelf. As shown in the previous figure, 5-wire AC Wye 3-phase power is wired into the AC Wye power shelf at a terminal block (TB1). The 3-phase power is then routed through the shelf circuit breaker to the 3 AC rectifiers in the power shelf. The AC rectifiers (PS0, PS1, and PS2) convert the AC power into the DC (54 VDC) power. Each AC rectifier powers two of the chassis power zones. The DC power is distributed to the FRUs in the various power zones through the bus bar and the chassis midplane.

Figure 14: AC Wye Power Wiring

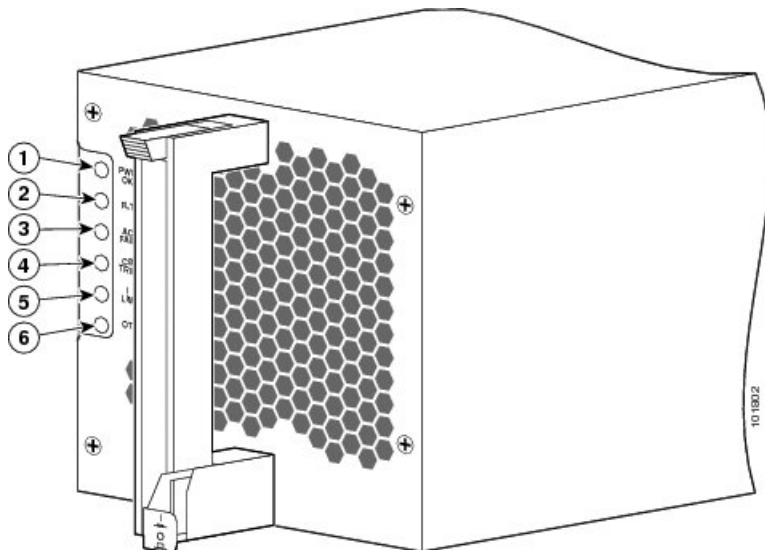


Fixed Configuration AC Rectifier

The fixed configuration AC rectifier, shown in the following figure, is an AC power supply that converts input AC power into the DC power necessary to power chassis components. The same rectifier is used for both AC Wye and AC Delta power shelves.

The rectifier takes input AC power from the power shelf, rectifies the AC into DC, provides filtering and control circuitry, provides status signaling, and passes the DC power to either the A or B bus bar in the chassis midplane. Each AC rectifier has a self-contained cooling fan that draws air through the module.

Figure 15: Fixed Configuration AC Power Rectifier



1	PWR OK	4	OT
2	FAULT	5	BREAKER TRIP
3	DC INPUT FAIL	6	ILIM

As shown in [Figure 14: AC Wye Power Wiring](#), a single phase of the 3-phase AC input power (200 to 240 VAC or 346 to 415 VAC) is routed to each AC power rectifier in the AC power shelf. The AC power enters the AC rectifier at the rear of the power shelf through a connector located on the power shelf midplane.

After the power enters the AC rectifier, internal circuits rectify the AC into DC, filter and regulate it. The conversion from AC to DC is done in two stages:

- The first stage is for power factor correction (PFC). The PFC process converts the AC to 350 VDC power. The PFC maintains the AC input current to be sinusoidal and in-phase with the AC input. The result is near unity power factor.
- The second stage is DC-to-DC conversion. The DC-to-DC process converts the 350 VDC primary side power to 54 VDC isolated secondary power.

A microprocessor in the AC rectifier monitors the status of each AC rectifier. The microprocessor communicates with the system controller on the route processor (RP). The microprocessor circuitry monitors the following AC rectifier fault and alarm conditions:

- Fault—Indicates a failure in an AC rectifier, such as failed bias supply, over temperature or current limit. It includes a warning that the DC output is out side the allowable output range.
- AC Input Fail—Indicates that the AC input voltage is out of range.
- Circuit Breaker Trip—Indicates that the AC rectifier circuit breaker has tripped.
- Over temperature—Indicates that the AC rectifier has exceeded the maximum allowable operating temperature.
- AC Rectifier Present—Indicates that the rectifier is present and seated properly in the power shelf.

- Voltage and Current Monitor signals (Vmon, Imon)—Indicates that the output voltages and currents provided by the AC rectifier are within range.

Each AC rectifier 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). The system software reads the EEPROM of each FRU in the system to determine if it is the correct FRU.

Fixed Configuration AC Rectifier Indicators

Each AC rectifier has power and status indicators. The AC rectifier indicators receive power from both AC power shelves; therefore, the indicators are operational even when the AC rectifier is not powered from its input voltage.

The following table lists the AC rectifier status indicators and their functions.

Table 3: Fixed Configuration AC Rectifier Status Indicators

Name	Color	Function
PWR OK	Green	AC rectifier is operating normally with power.
FAULT	Yellow	A fault has been detected in the AC rectifier.
AC INPUT FAIL	Yellow	AC input is out of range or is not being provided to the AC rectifier.
OT	Yellow	AC rectifier is overheated and it has been shut down.
BREAKER TRIP	Yellow	Input circuit breaker is off (in the off position).
ILIM	Yellow	AC rectifier is operating in a current limiting condition.

The following table lists the LED readings during failure conditions.

Table 4: Fixed Configuration AC Rectifier LED Conditions

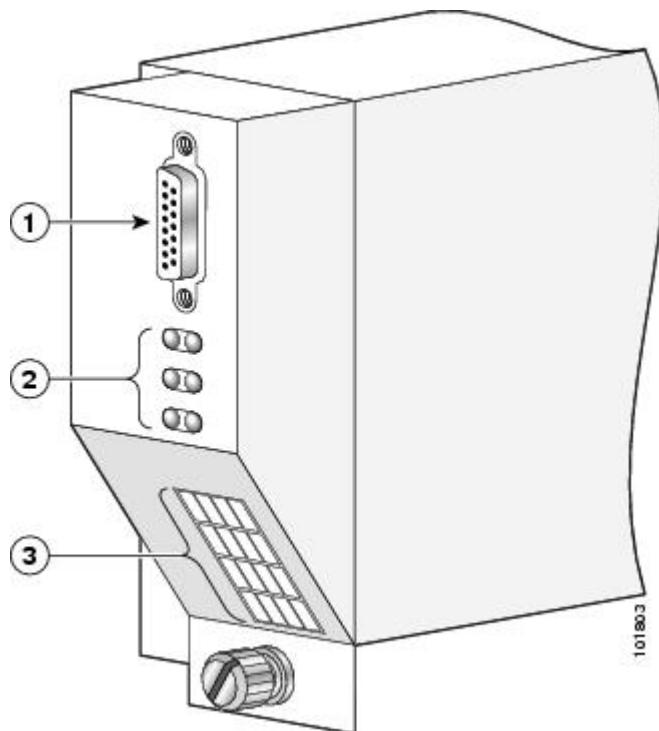
Condition	PWR OK LED	Fault LED	AC Input Fail LED	OT LED	Breaker Trip LED	ILIM LED
No fault (power is on)	On	Off	Off	Off	Off	Off
Failed AC power	Off	Off	On	Off	Off	Off
Overheated temperature	Off	On	Off	On	Off	Off
Tripped breaker	Off	Off	Off	Off	On	Off
Current limit	Off	Off	Off	Off	Off	On

Alarm Module for Fixed Configurations

This section describes an alarm module in a fixed configuration power supply in the Cisco CRS 16-slot line card chassis. An alarm module can be installed only in the far right slot of the power shelf (as you are facing the front [PLIM] side of the chassis).

Each AC or DC power shelf contains an alarm module, which monitors the status of the power shelf and provides an external interface for system alarms. A dedicated alarm module slot exists on the right side of every power shelf. The same alarm module is used in all power shelves.

Figure 16: Fixed Configuration Alarm Module



1	External alarm connector	3	LED display
2	Alarm LEDs		

The alarm module performs the following functions:

- Alarm outputs, both relay and LEDs:
 - Alarm LEDs—Three large LEDs (Critical, Major, and Minor) indicate the status of the chassis. The LEDs are controlled by software on the RP system controller. For redundancy, each alarm indicator has two LEDs (to ensure that alarm status is visible even if one of the LEDs fails).
 - Relay—The alarm module output function consists of a relay and its associated driver. As directed by the system controller (on the RP or the switch controller/fan controller (SCFC), depending on the chassis type), the microprocessor on the alarm module activates the relay. The alarm relay connector is a standard DA-15S connector.
- PEM or AC rectifier status monitoring—The alarm module monitors the performance and status of the AC rectifiers or DC PEMs. The module monitors Circuit Breaker Tripped conditions, Power Good, Power Fail, Internal Fault, Over Temp conditions, AC rectifier or PEM presence, and voltage and current output levels. Since it receives power from both power shelves, the alarm module can report the status of an unpowered shelf.
- Alarm monitoring—An LED display provides information about the status of the chassis.
 - If the system is operating properly, “IOS-XR” appears in the LED display.

- If an alarm occurs, this LED indicates the card or component that is experiencing a problem. For example, if a fan tray is missing, the display indicates which fan tray is missing. A display such as “0 1 SP” indicates that the MSC in rack 0, slot 1 is experiencing a problem.

The following table lists the pin outs for the alarm relay connector.

Table 5: Alarm Relay Connector Pin Outs

Signal Name	Pin	Description
Alarm_Relay_NO	1	Alarm relay normally open contact
Alarm_Relay_COM	2	Alarm relay common contact
Alarm_Relay_NC	9	Alarm relay normally closed contact

Only Pins 1, 2, and 9 are available for customer use. The remaining pins are for Cisco manufacturing test, and should not be connected. Use a shielded cable for connection to this port for EMC protection.

Modular Configuration Power Supply

This section includes the following topics:

- [AC Modular Configuration Power Systems, on page 31](#)
- [Alarm Module for Modular Configurations, on page 35](#)

The modular configuration power system includes the following major components:

- Two (redundant) AC or DC power shelves
- Up to six AC power modules (PMs) or eight DC PMs per power shelf
- Removable alarm module, one per power shelf
- Each DC PM provides 2100 Watts, with potential growth up to 16,800 Watts per power shelf
- Each AC PM provides 3000 Watts, with potential growth up to 18,000 Watts per power shelf

In the modular configuration power system, different power shelves are used for AC and DC power. The AC power solution requires single phase input power. If you have AC Delta or AC Wye at your site, a *Cisco CRS 3-Phase Power Distribution Unit* may be required to convert 3-phase input power to single phase output power for the power shelf. For more information, see [Cisco CRS 3-Phase Power Distribution Unit, on page 36](#).

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.

For details showing the CRS 16-slot line card chassis power routing distribution for a modular DC configuration, see [Figure 22: CRS 16-Slot Line Card Chassis Power Distribution - Modular DC Configuration](#) and for the AC modular configuration, see [Figure 24: CRS 16-Slot Line Card Chassis Power Distribution - Modular AC Configuration](#).

If you have 3-phase AC Delta or AC Wye at your equipment, a Cisco CRS 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 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 the [Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide](#).

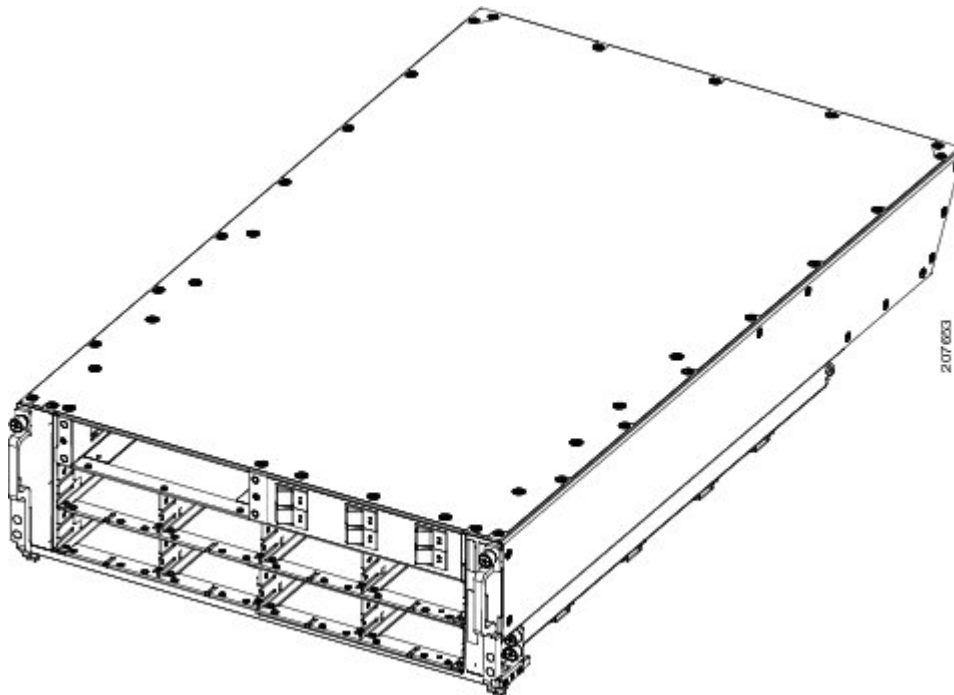
Each modular power solution can contain up to eight DC PMs or six AC PMs. For details on power routing distribution for the CRS 16-slot line card chassis with a modular AC configuration, see [Figure 24: CRS 16-Slot Line Card Chassis Power Distribution - Modular AC Configuration](#).



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

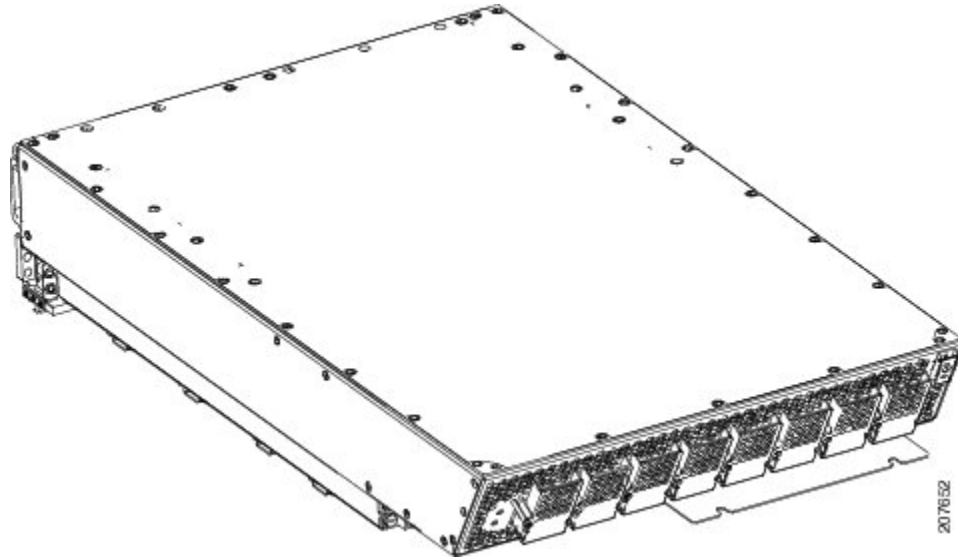
The following figure shows the front view of the modular configuration DC power shelves.

Figure 17: DC Modular Configuration Power Shelf - Front View



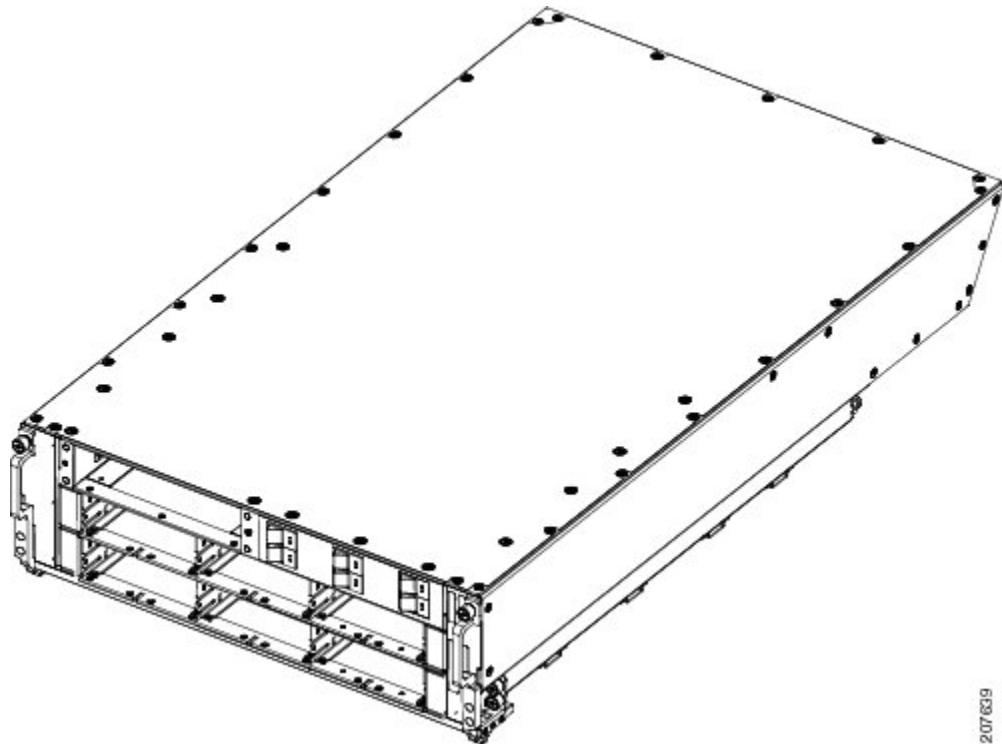
The following figure shows the rear view of the modular configuration DC power shelves.

Figure 18: DC Modular Configuration Power Shelf - Rear View



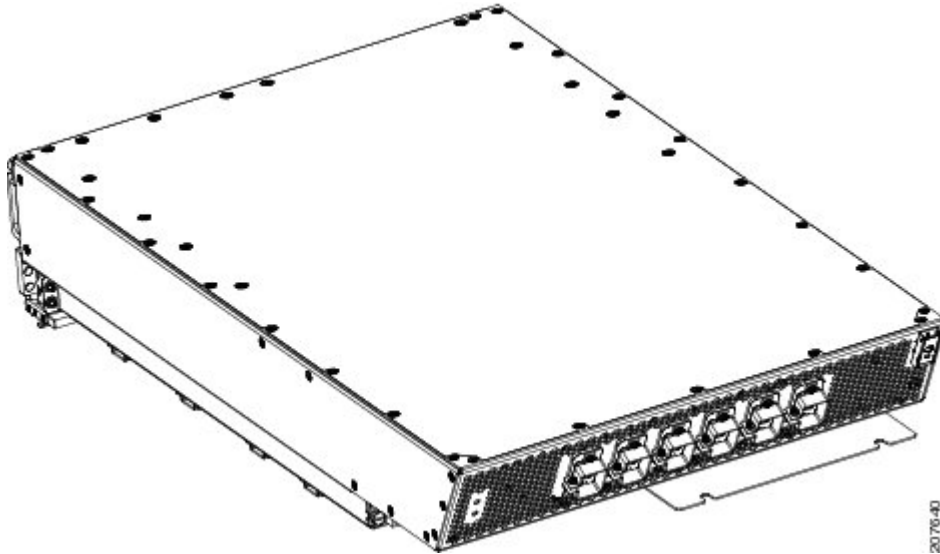
The following figure shows the front view of the modular configuration AC power shelves.

Figure 19: AC Modular Configuration Power Shelf - Front View



The following figure shows the rear view of the modular configuration AC power shelves

Figure 20: AC Modular Configuration Power Shelf - Rear View



Modular Configuration Power Architecture

The modular configuration power supply for the Cisco CRS 16-slot line card chassis provides the following features:

- AC or DC power shelf redundancy
- N+N power module redundancy
- Elimination of power zone distribution, while maintaining zone protection
- Capacity for future growth

The modular AC and DC power systems use A or B power shelves to provide reliable, 2N redundant power to all chassis components. All PMs in the modular power shelf power all zones as long as the zone circuit breaker is not tripped. In addition, the modular power supplies work in parallel with each other, and they can monitor power consumption, performance, analysis, and power management concurrently.

The AC or DC PM distributes power and passes PM status signals to the system. A separate alarm module provides all PM status monitoring and handles alarm functions. Each PM has its own integrated fuse to protect the system, and each PM is plugged into its own power outlet.

For details showing the CRS 16-slot line card chassis power routing distribution for a modular DC configuration, see [Figure 22: CRS 16-Slot Line Card Chassis Power Distribution - Modular DC Configuration](#) and for the AC modular configuration, see [Figure 24: CRS 16-Slot Line Card Chassis Power Distribution - Modular AC Configuration](#).

Each PM provides 2 voltages:

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

The Cisco CRS 16-slot line card chassis can continue to operate normally if:

- One AC or DC PM fails
- One entire power shelf fails
- One internal bus bar fails

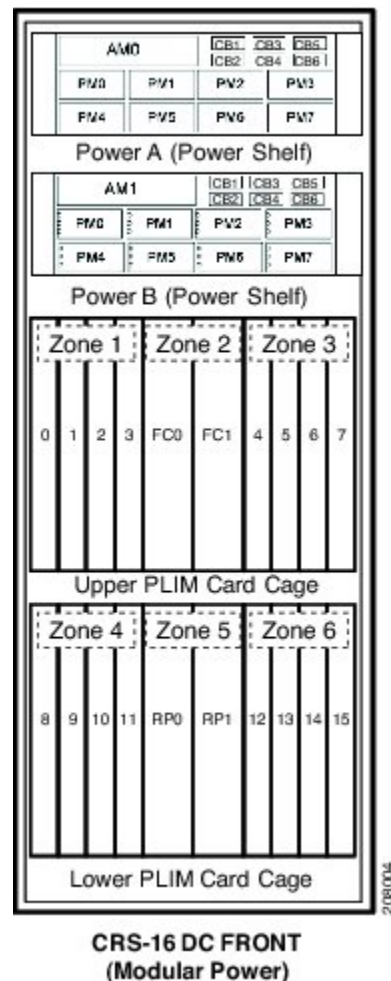
- PMs are added to or removed from the power shelf

The AC or DC power system distributes power in the chassis through six power zones, which provide power redundancy and reliability. Each power zone receives power from both bus bars (A and B), which ensures that each card and module in the chassis is powered by both power shelves as shown in [Figure 22: CRS 16-Slot Line Card Chassis Power Distribution - Modular DC Configuration](#) for modular DC configuration and [Figure 24: CRS 16-Slot Line Card Chassis Power Distribution - Modular AC Configuration](#) for modular AC configuration.

Because no exact redundancy exists across the PMs, individual PMs can be installed or 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 each PM 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.

A Cisco CRS 16-slot line card chassis can lose any single PM or an entire power shelf and still have the power to operate. The following figure shows the front (PLIM) side of the Cisco CRS 16-slot line card chassis power shelf location in a modular configuration. The Cisco CRS 16-slot line card chassis will continue to operate, even if one or more PMs across multiple power shelves fails, provided it receives enough power to meet the system requirements.

Figure 21: CRS 16-Slot Chassis Front (PLIM) Side Power Shelf Location—Modular Configuration



The figure shows chassis power zones on the MSC side of the chassis:

- Power shelf A supports everything in it. PM 0-7 supports everything in the entire chassis that needs power which are cards, fans, alarm modules. CB1 supports Z1, CB2 supports Z2 ... CB6 supports Z6
- Power shelf B supports everything in it. PM 0-7 supports everything in the entire chassis that needs power which are cards, fans, alarm modules. CB1 supports Z1, CB2 supports Z2 ... CB6 supports Z6
- Power zone 1 supports chassis slots 0, 1, 2, and 3
- Power zone 2 supports chassis slots FC0 and FC1
- Power zone 3 supports chassis slots 4, 5, 6, and 7
- Power zone 4 supports chassis slots 8, 9, 10, and 11
- Power zone 5 supports chassis slots RP0 and RP1
- Power zone 6 supports chassis slots 12, 13, 14, and 15

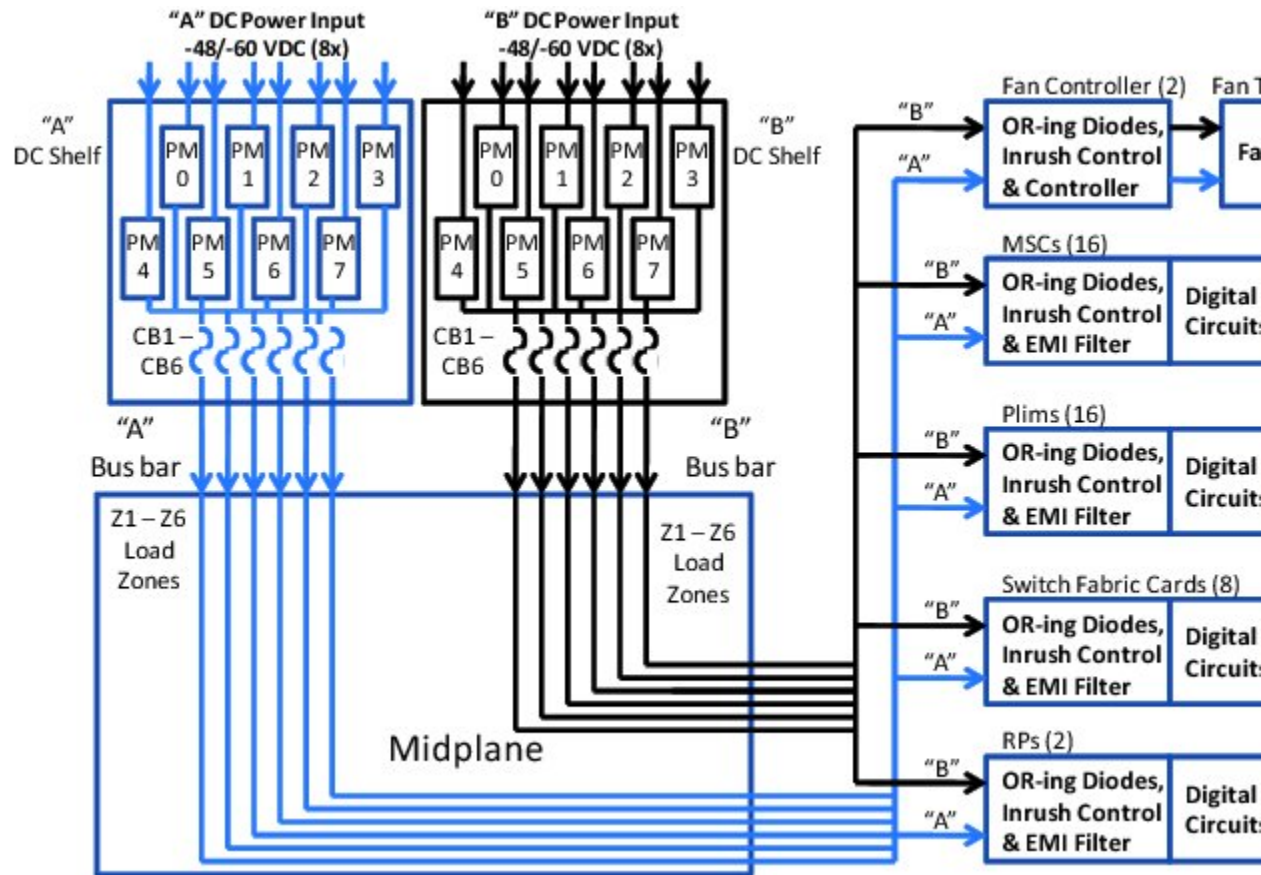
DC Modular Configuration Power Systems

The DC modular configuration power system provides up to 16,800 watts DC power to the Cisco CRS 16-slot line card chassis. The DC modular power system contains the following components:

- Two DC power shelves. Each power shelf contains the DC input power connections and houses the DC PMs and alarm Module. The chassis requires two power shelves for redundancy.
- Up to eight field-replaceable DC PMs per shelf.

The following figure shows the Cisco CRS 16-slot line card chassis power routing distribution for a modular DC configuration.

Figure 22: CRS 16-Slot Line Card Chassis Power Distribution - Modular DC Configuration



Note Although each modular configuration DC power shelf can support up to eight DC PMs, the modular configuration DC power shelf is shipped with six DC PMs per shelf.

Modular Configuration DC Power Shelf

The DC modular power shelf is the enclosure that houses the DC PMs, the alarm module, and power distribution connections and wiring. The power shelf installs in the Cisco CRS 16-slot line card chassis from the front and plugs into the chassis power interface connector panel. [Figure 17: DC Modular Configuration Power Shelf - Front View](#) shows the front view of the modular configuration DC power shelves and [Figure 18: DC Modular Configuration Power Shelf - Rear View](#) shows the rear view of the modular configuration DC power shelves.

Each PM has its own power connector to connect input DC power -48/-60 VDC (nominal), 60 A service. Each connector consists of two terminals (- and +). The terminals have a safety cover.

See [Figure 22: CRS 16-Slot Line Card Chassis Power Distribution - Modular DC Configuration](#) for a diagram of the Cisco CRS 16-slot line card chassis power routing distribution for a modular DC configuration.

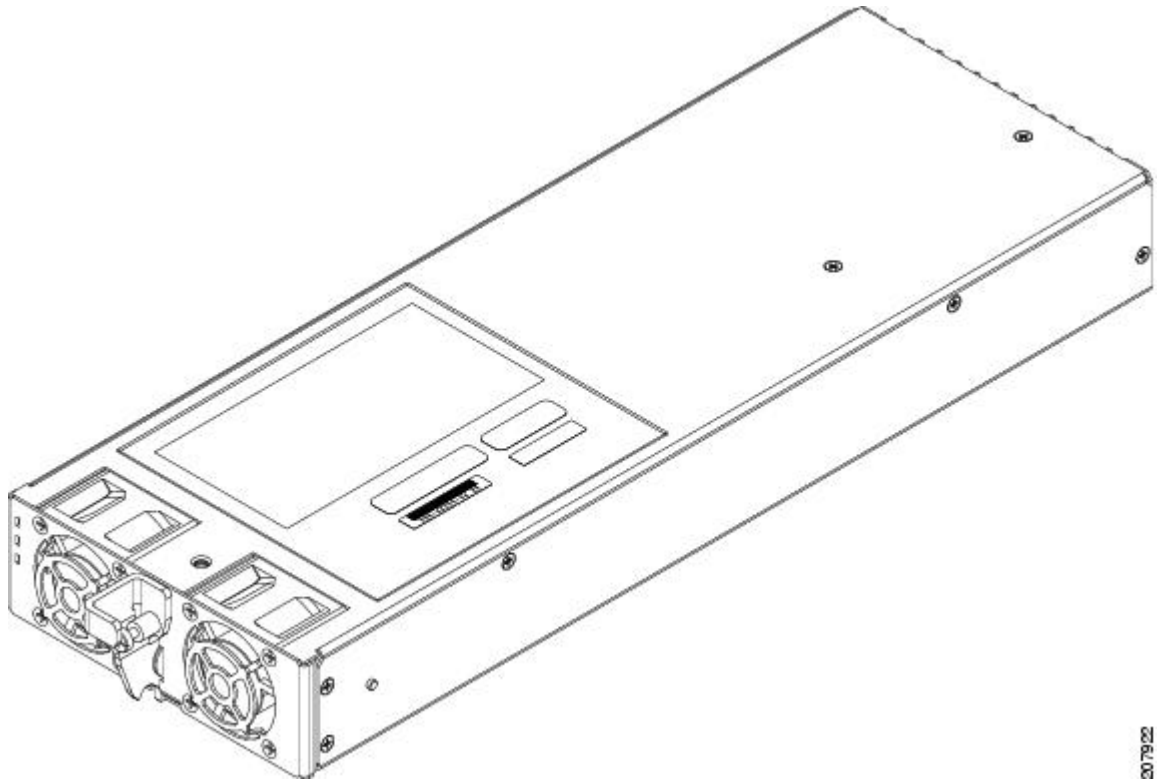
Each DC power shelf supports up to eight power modules and accepts one 60 A battery feed per PM. Input DC power enters the power shelf and is processed by the PMs before being distributed to the chassis midplane.

The PMs 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 PM provides 2100 Watts. The DC PM, shown in the following figure, passes the power via the internal bus bar to the system. PMs are field-replaceable.

Figure 23: Modular Configuration DC Power Module



Two $-48/-60$ VDC inputs enter the PM at the rear of the power shelf, and exits the PM and is distributed to the chassis midplane.

Each PM 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). The system software reads the EEPROM of each FRU in the system to determine if it is the correct FRU.

Modular Configuration DC Power Module Indicators

The following three LED status indicators are located on the front of each DC PM:

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

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

The following table lists the PM status indicators and their functions.

Table 6: DC PM Status Indicators

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

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

- 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 supply is operating normally, the Internal Fault LED is turned off.

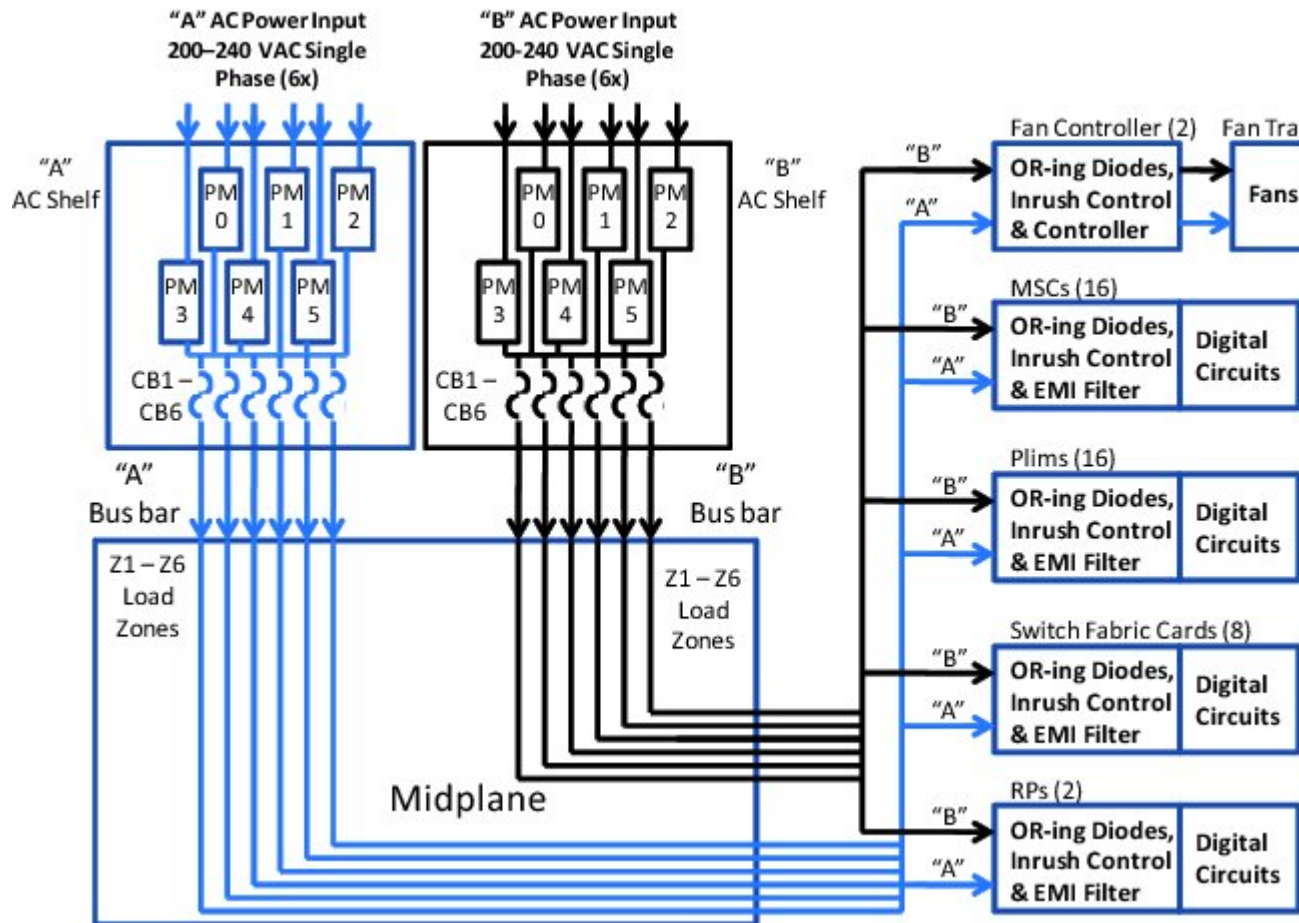
AC Modular Configuration Power Systems

The modular configuration AC power system provides up to 18,000 watts to power the Cisco CRS 16-slot line card chassis. The AC power system, which provides 2N power redundancy for the routing system, contains the following components:

- Two AC power shelves (per chassis)—Each power shelf contains the input AC power connectors and holds the AC PMs. The chassis requires two power shelves for redundancy.
- Up to six field-replaceable AC PMs per power shelf.

The following figure shows the Cisco CRS 16-slot line card chassis power routing distribution for a modular AC configuration.

Figure 24: CRS 16-Slot Line Card Chassis Power Distribution - Modular AC Configuration



Note Although each modular configuration AC power shelf can support up to six AC PMs, the modular configuration power shelf is shipped with five PMs per shelf.

Modular Configuration AC Power Shelf

The AC power shelf is the enclosure that houses the AC PMs, the alarm module, and power distribution connections and wiring. The AC power shelf, shown in [Figure 19: AC Modular Configuration Power Shelf - Front View](#), is installed in the Cisco CRS 16-slot line card chassis from the front and plugs into the chassis power interface connector panel.



Note The power cables for the modular configuration AC power shelves are not shipped pre-attached.

Each AC power shelf supports up to six AC PMs. The AC PMs convert AC power into DC power, provide filtering, and then distribute the DC power to the chassis midplane. For details about power routing distribution for a modular AC configuration, see [Figure 24: CRS 16-Slot Line Card Chassis Power Distribution - Modular AC Configuration](#)

The power shelf also has a microprocessor that monitors the condition of each AC PM and provides status signals that indicate the health of the power supplies (see [Modular Configuration AC Power Module Indicators](#), on page 34).

Modular Configuration AC Power Module

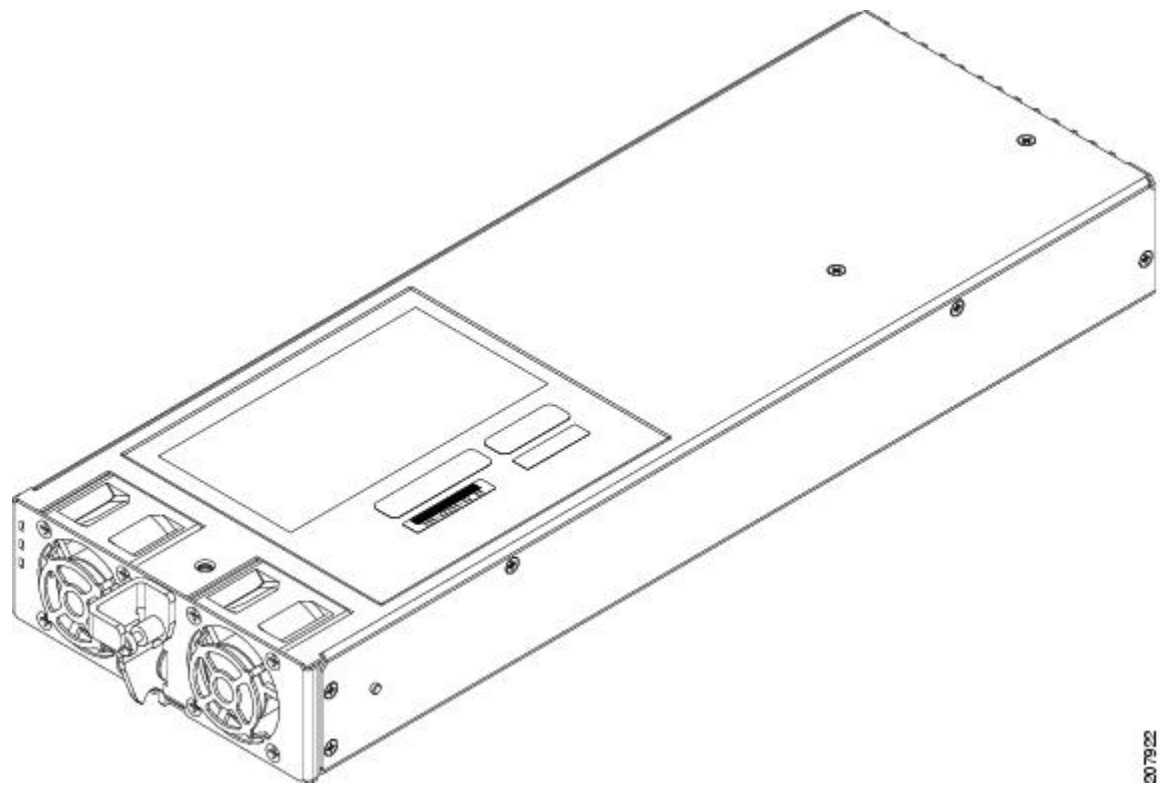
The AC PM is an AC power supply that converts single phase input AC power into the DC power necessary to power chassis components. The AC PM takes input AC power from the power shelf, converts the AC into DC, provides filtering and control circuitry, provides status signaling, and passes the DC power to the chassis midplane.

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

- Each AC PM has a single-phase, 3-wire connection: Input: 200 to 240 VAC nominal, 50 to 60 Hz, 16A Tolerance: +/-10%(180 to 264) VAC, 50 to 60 Hz, 16A

Each power shelf contains six IEC-320-C22 receptacles which can accept up to six IEC-320-C21 connector cords, depending on how many AC PMs are installed in the shelf. The following figure shows the AC modular configuration PM.

Figure 25: AC Modular Configuration Power Module



Each AC PM 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). The system software reads the EEPROM of each FRU in the system to determine if it is the correct FRU.

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

- Output Voltage 1 is -54 VDC at 55.5 A

- Output Voltage 2 is +5 Vaux at 0.75 A

Modular Configuration AC Power Module Indicators

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

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

The following table lists the PM status indicators and their functions.

Table 7: AC PM Status Indicators

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

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

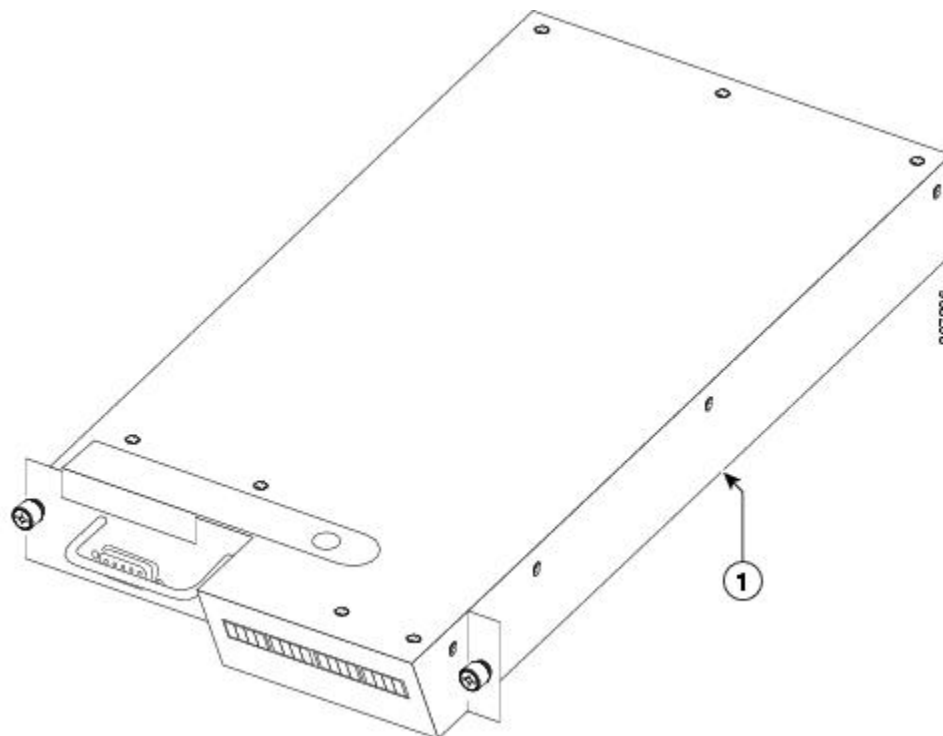
- 5V out of range
- Output Stage OT
- Fan Fault
- OR-ing fault (Output voltage less than bus voltage)
- OC shutdown
- OT shutdown
- OV shutdown
- Input stage OT
- Fault induced shutdown occurred
- Thermal sensor fault
- Vout out of range
- Boost Vbulk fault

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

Alarm Module for Modular Configurations

Each modular configuration power shelf contains an alarm module. It monitors the presence and performance of the modular PMs. It also monitors status of the power shelf and provides an external interface for system alarms. The following figure shows a modular configuration alarm module.

Figure 26: Modular Configuration Alarm Module



1	Side of alarm module to be installed on the right side of the opening
---	---

The alarm module receives power from both power shelves. As a result, it can report the status of an unpowered shelf as well as that of a powered shelf.

The alarm module performs the following functions:

- Alarm outputs, both relay and LEDs:
 - Alarm LEDs—Three large LEDs (Critical, Major, and Minor) indicate the status of the chassis. The LEDs are controlled by software on the RP system controller.
 - Relay—The alarm module output function consists of a relay and its associated driver. As directed by the system controller (on the RP or the switch controller/fan controller (SCFC), depending on the chassis type), the service processor module on the alarm module activates the relay. The alarm relay connector is a standard DA-15S connector.
- PM status monitoring—The alarm module monitors the performance and status of the PMs. The alarm module monitors Power Good, Power Fail, Internal Fault, Over Temp conditions, PM presence, and voltage and current output levels. The alarm module can report these statuses even for an unpowered shelf.
- Alarm monitoring—An alpha-numeric display provides information about the status of the chassis.

- If the system is operating properly, “RACKX IOS XR” appears in the alpha-numeric display, where X represents the rack number.
- If an alarm occurs, the alpha-numeric display indicates the card or component that is experiencing a problem. For example, if a fan tray is missing, the display indicates which fan tray is missing. A display such as “0 1 SP” indicates that the MSC in rack 0, slot 1 is experiencing a problem.

In the modular configuration power shelf, a service processor module monitors the status of each PM and communicates with the system controller of the Route Processor (RP). The service processor monitors the following PM faults and alarm conditions:

- Fault—Indicates a failure in a PM, such as failed bias supply, over temperature or current limit. It includes a warning that the DC output is outside the allowable output range.
- Input Fail—Indicates that the Input voltage is out of range.
- Over temperature—Indicates that the PM has exceeded the maximum allowable operating temperature.
- PM Present—Indicates that the PM is present and seated properly in the power shelf.
- Voltage and Current Monitor signals (Vmon, Imon)—Indicate that the output voltages and currents provided by the PM are within range.

The following table lists the pin outs for the alarm relay connector.

Table 8: Alarm Relay Connector Pin Outs

Signal Name	Pin	Description
Alarm_Relay_NO	1	Alarm relay normally open contact
Alarm_Relay_COM	2	Alarm relay common contact
Alarm_Relay_NC	9	Alarm relay normally closed contact

Only Pins 1, 2, and 9 are available for customer use. The remaining pins are for Cisco manufacturing test, and should not be connected. Use a shielded cable for connection to this port for EMC protection.

Cisco CRS 3-Phase Power Distribution Unit

This section describes the Cisco CRS 3-Phase AC Power Distribution Unit (PDU) for the CRS 16-slot line card chassis. 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 PDU includes either an AC Delta or AC Wye power interface to convert 3-phase input power to single phase output. The PDU has power input and power output cords entering and exiting the box. The PDU can be installed in a 19 inch rack or attached to the sides of the CRS 16-slot line card chassis by using custom mounting brackets.

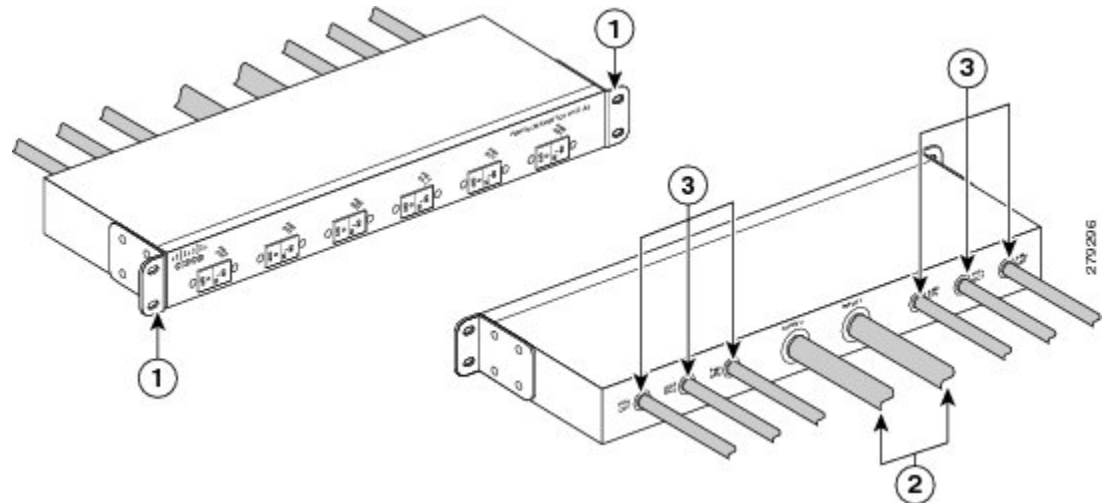
One PDU is required for each modular power shelf installed in the chassis for system redundancy. A PDU can be installed on either the left or right side of the chassis.

There are two versions of the CRS 16-slot line card chassis PDU:

- CRS-16-PDU-Delta—Redundant 3-phase to single-phase Delta PDU for Cisco CRS 16-slot line card chassis, 4 input/12 output
- CRS-16-PDU-Wye—Redundant 3-phase to single-phase Wye PDU for Cisco CRS 16-slot line card chassis, 2 input/12 output

The following figure shows the PDU that converts 3-phase AC Delta input power to single phase AC output power.

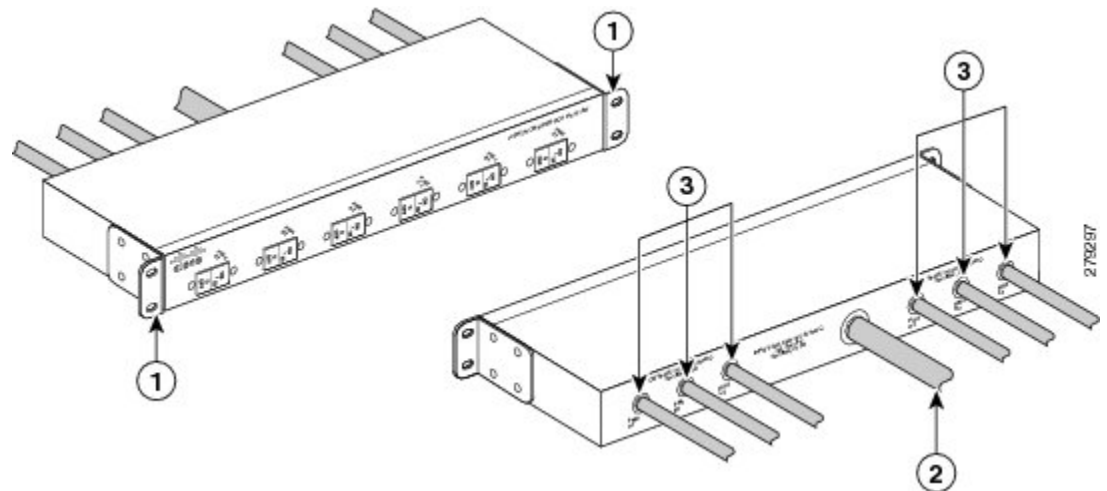
Figure 27: AC Delta Power Distribution Unit



1	Rack mounting ears	2	Input Cords
3	Output Cords		

The following figure shows the PDU that converts 3-phase AC Wye input power to single phase AC output power.

Figure 28: AC Wye Power Distribution Unit



1	Rack mounting ears	3	Output Cords
2	Input cord		



Note The power cables for the Cisco CRS PDU are shipped pre-attached.

The PDU for the CRS 16-slot line card chassis is shipped with the following hardware for specific configurations:

- Two single AC Delta PDUs with 19 inch rack mounting brackets pre-attached and two custom chassis mounting brackets. Each AC Delta PDU has two AC power inputs and six AC power outputs
- Two Single AC Wye PDUs with 19 inch rack mounting brackets pre-attached and two custom mounting brackets. Each AC Wye PDU has one AC power input and six AC power outputs

Two versions of the AC PDU are available for AC input power, AC Wye and AC Delta. Each PDU has a different Cisco part number to distinguish it from the other.

AC Wye

- The AC Wye PDU has a Wye 3-phase, 5-wire input power connection consisting of 3 wire + neutral + protective earthing, or ground wire (3W+N+PE). Input: 200 to 240 (L-N)/346 to 415 (L-L) VAC, 50 to 60 Hz, 32A. Tolerance: +/-10% (180 to 264)(L-N)/(311 to 456)(L-L) VAC, 50 to 60 Hz, 32A.
- The AC Wye PDU has six single phase output power connections. Output: 200 to 240 VAC, 50 to 60 Hz, 16A. Tolerance: +/-10%(180 to 264) VAC, 50 to 60 Hz, 16A.

The following power cables are shipped preattached to the power shelves:

- The Wye input power cord is rated for 415 VAC, 32 A. The power cord has a 5-pin IEC 60309 plug (3W+N+PE).
- The Wye output cord has a 3-pin IEC-320 C21 90 degree female plug.

AC Delta

- The AC Delta PDU has two Delta 3-phase, 4-wire input power connections, each consisting of 3 wire + protective earthing, or ground wire (3W+PE). Input: 200 to 240 VAC, 50 to 60 Hz, 27.7A. Tolerance: +/-10% (180 to 264) VAC, 50 to 60 Hz, 27.7A.
- The AC Delta PDU has six single phase output power connections. Output: 200 to 240 VAC, 50 to 60 Hz, 16A. Tolerance: +/-10%(180 to 264) VAC, 50 to 60 Hz, 16A.

The following power cables are shipped preattached to the power shelves:

- The Delta input power cord is rated for 250 VAC, 60 A. The power cord has a 4-pin IEC 60309 plug (3W+PE).
- The Delta output cord has a 3-pin IEC-320 C21 90 degree female plug.