CHAPTER 36

Environmental Monitoring and Power Management

This chapter describes power management and environmental monitoring features in the Catalyst 4500 series switches. It provides guidelines, procedures, and configuration examples.

This chapter consists of the following major sections:

Note For complete syntax and usage information for the switch commands used in this chapter, refer to the *Catalyst 4500 Series Switch Cisco IOS Command Reference* and related publications at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/index.htm.

Understanding Environmental Monitoring

This section contains the following subsections:

Environmental monitoring of chassis components provides early warning indications of possible component failure. This warning helps you to ensure the safe and reliable operation of your system and avoid network interruptions.

This section describes how to monitor critical system components so that you can identify and rapidly correct hardware-related problems.

Using CLI Commands to Monitor your Environment

Use the **show environment** CLI command to monitor the system. This section gives a basic overview of the command and keywords you will need.

Enter the **show environment** [**alarm** | **status** | **temperature**] command to display system status information. Keyword descriptions are listed in Table 36-1.

Table 36-1 show environment Keyword Descriptions

Keyword	Purpose
alarm	Displays environmental alarms for the system.
status	Displays field-replaceable unit (FRU) operational status and power and power supply fan sensor information.
temperature	Displays temperature of the chassis.

The following example shows how to display the environment conditions. This output indicates that the power supplies are different. The switch will use only one power supply and disable the other.

```
Switch# show environment
no alarm

Chassis Temperature                    = 35 degrees Celsius
Chassis Over Temperature Threshold     = 75 degrees Celsius
Chassis Critical Temperature Threshold = 95 degrees Celsius

Power                                                 Fan     Inline
Supply  Model No          Type       Status           Sensor  Status
------  ----------------  ---------  -----------      ------  ------
PS1     PWR-C45-2800AC    AC 2800W   good             good    good
→ PS2     PWR-C45-1000AC    AC 1000W   err-disable      good    n.a.

*** Power Supplies of different types have been detected***
Switch#
```

System Alarms

The system has two types of alarms: major and minor. A major alarm indicates a critical problem that could lead to system shutdown. A minor alarm is informational—it alerts you to a problem that could turn critical if corrective action is not taken.

When the system issues an alarm (major or minor) that indicates an over-temperature condition, the switch does not cancel the alarm nor take any action (such as module reset or shutdown) for five minutes. If the temperature falls 5 degrees Celsius below the alarm threshold during this period, the alarm is canceled.

An LED on the supervisor indicates if an alarm has been issued. See Table 36-2 for more information.

Note Refer to the *Catalyst 4500 Series Switch Module Installation Guide* for additional information on LEDs, including the supervisor engine system LED.

Table 36-2 Alarms for Supervisor Engine and Switching Modules

Event	Alarm Type	Supervisor LED Color	Description and Action
Supervisor engine temperature sensor exceeds major threshold[1]	Major	Red	Syslog message. If the over-temperature condition is not corrected, the system shuts down after 5 min. Alarm threshold: • Chassis critical temperature threshold = 95°C
Supervisor fails power on self-test (POST)	Major	Red	Syslog message. The supervisor fails to come up.
Chassis fan tray fails	Major	Red	If not corrected, the system shuts down in 5 minutes.
Supervisor engine temperature sensor exceeds minor threshold	Minor	Orange	Syslog message. Monitor the condition. Alarm threshold: • Chassis over temperature threshold = 75°C
No problems	None	Green	

1. Temperature sensors monitor key supervisor engine components, including daughter cards.

Power Management

This section describes the power management feature in the Catalyst 4500 and Catalyst 4006 series switches and includes the following major sections:

- Power Management for the Catalyst 4500 Series Switches, page 36-3
- Power Management for the Catalyst 4006 Switch, page 36-10
- Power Consumption of Chassis Components, page 36-14

Power Management for the Catalyst 4500 Series Switches

You can select from several different power supplies to ensure that you have enough power for the modules installed in your switch. The Catalyst 4500 series switches support the following power supplies:

- Fixed Wattage—This power supply always delivers a fixed amount of Power over Ethernet (PoE) and system power.
  - 1000 W AC (not recommended on the Catalyst 4510R series switch)
  - 1400 W AC—Data-only and does not support PoE (Required for Catalyst 4510R series switch)
  - 2800 W AC—Supports PoE

- Variable Wattage—These power supplies automatically adjusts the wattage to accommodate PoE and system power requirements.
  - 1300 W AC—Supports PoE.
  - 1400 W DC—Supports up to 1400 W of system power and variable amounts of PoE, depending on the input feed to the power supply. See "Special Considerations for the 1400 W DC Power Supply" section on page 36-9 for more information.

When you insert power supplies in your switch, use power supplies that are of the same wattage. If you mix power supplies, the switch will use the one it recognizes first and ignore the other power supply. The power supply status displays as err-disable and the summary displays as all zeros (0) for wattage values in the output for the **show power** command.

The following example shows the output for the **show power** command for mixed power supplies:

```
Switch# show power
Power                                              Fan     Inline
Supply  Model No          Type       Status        Sensor  Status
------  ----------------  ---------  ------------  ------  ------
PS1     PWR-C45-2800AC    AC 2800W   good          good    good
➔ PS2     PWR-C45-1000AC    AC 1000W   err-disable   good    n.a.

*** Power Supplies of different type have been detected***

Power supplies needed by system    :1
Power supplies currently available :1

Power Summary                      Maximum
 (in Watts)              Used      Available
----------------------   ----      ---------
System Power (12V)        328          1360
Inline Power (-50V)         0          1400
Backplane Power (3.3V)     10            40
----------------------   ----
Total Used                338 (not to exceed Total Maximum Available = 750)
Switch#
```

Power Management Modes

The Catalyst 4500 series switches support two power management modes:

- Redundant mode—Redundant mode uses one power supply as a primary power supply and the second power supply as a back-up. If the primary power supply fails, the second power supply immediately supports the switch without any disruption in the network. Both power supplies must be the same wattage. A single power supply must have enough power to support the switch configuration.
- Combined mode—Combined mode uses the power from all installed power supplies to support the switch configuration power requirements. However, combined mode has no power redundancy. If a power supply fails, one or more modules might shut down.

Note On the Catalyst 4510R series switch, the 1000W AC power supply is not enough to support redundant mode for all possible configurations. It is able to support redundant mode for limited configurations that require less than 1000W.

Note The 1400W DC power supply supports combined mode for data power. It does not support combined mode for PoE power.

Selecting a Power Management Mode

By default, a switch is set to redundant mode. In the **show power** command, if the **power supplies needed by system** is 1, the switch is in redundant mode; if the **power supplies needed by system** is 2, the switch is in combined mode.

Your switch hardware configuration will dictate which power supply or supplies you should use. For example, if your switch configuration requires more power than a single power supply provides, use the combined mode. In combined mode, however, the switch has no power redundancy. Consider the following possibilities:

- The supervisor engine consumes 110 W, the fan boxes for the Catalyst 4503 switch consume 30 W each, the fan boxes for the Catalyst 4506 and Catalyst 4507 switches consume 50 W each, the backplane for the Catalyst 4503 and Catalyst 4506 switches consumes 10 W, and the backplane for the Catalyst 4507 switch consumes 40 W.
- 1000 W can support a fully loaded Catalyst 4503 switch with no powered device support.
- 1300 W can support a fully loaded Catalyst 4503 switch with Cisco powered devices.
- Each PoE port on a WS-X4148-RJ45V module requires 6.3 W. Five fully loaded WS-X4148-RJ45V modules in a switch comprise 240 ports. This configuration requires 1512 W of PoE, plus 300 W for the modules.

See Table 36-4 on page 36-14 for Catalyst 4500 series module power requirements.

Power Management Limitations in Catalyst 4500 Family Switches

It is possible to configure a switch that requires more power than the power supplies provide. The two ways you could configure a switch to exceed the power capabilities are as follows:

- The power requirements for the installed modules exceed the power provided by the power supplies.

  If you insert a single power supply and then set the switch to combined mode, the switch displays this error message:

  ```
  Insufficient power supplies present for specified configuration.
  ```

  This error message also displays in the output for the **show power** command. This error message displays because, by definition, combined mode requires that two working power supplies be installed in your switch.

  If the power requirements for the installed modules exceeds the power provided by the power supplies, the switch displays this error message:

  ```
  Insufficient power available for the current chassis configuration.
  ```

  This error message also appears in the **show power** command output.

  If you attempt to insert additional modules into your switch and exceed the power supply, the switch immediately places the newly inserted module into reset mode, and the switch displays these error messages:

  ```
  Module has been inserted
  Insufficient power supplies operating.
  ```

Additionally, if you power down a functioning switch and insert an additional module or change the module configuration so that the power requirements exceed the available power, one or more modules enter reset mode when you power on the switch again.

- The power requirements for the PoE exceed the PoE provided by the power supplies.

  If you have too many IP phones drawing power from the system, power to IP phones is cut, and some phones may be powered down to reduce the power requirements to match the power supplies.

In the first scenario (power requirements exceed the power supplied), the system attempts to resolve this power usage limitation by evaluating the type and number of modules installed. During the evaluation cycle, beginning from the bottom of the chassis, the system puts the modules that it is unable to support (for lack of power) into reset mode. The supervisor engine and modules for which there is adequate power always remain enabled, with no disruption of network connectivity. Modules placed in reset mode still consume some power and can be removed from the chassis to further reduce power requirements. If you configure the chassis correctly, the system will not enter the evaluation cycle.

A module in reset mode continues to draw power as long as it is installed in the chassis; you can use the **show power module** command to determine how much power is required to bring the module online.

To compute the power requirements for your system and verify that your system has enough power, add the power consumed by the supervisor engine module(s), the fan box(es), and the installed modules (including PoE). For PoE, total the requirements for all the phones. See the "Power Consumption of Chassis Components" section on page 36-14 for more information on the power consumption for the various components of your switch.

The 802.3af-compliant PoE modules can consume up to 20 W of PoE to power FPGAs and other hardware components on the module. Be sure to add at least 20 W to your PoE requirements for each 802.3af-compliant PoE module to ensure that the system has adequate power for the PDs connected to the switch.

On the WS-X4148-RJ45V PoE module, PoE consumption cannot be measured. Therefore, for all PoE calculations, the PoE consumption on this module is presumed to be equal to its administrative PoE.

You can use the **show module** command to verify which modules are active and which, if any, have been placed in reset.

The following example shows the **show module** command output for a system with inadequate power for all installed modules. The system does not have enough power for Module 5; the "Status" displays it as "PwrDeny."

If the PoE that is consumed by the module is more than 50 W above the PoE you allocated using the **power inline consumption default** command, the "Status" displays as "PwrOver." If the PoE consumed by the module is more than 50 W above the PoE module limit, the "Status" displays as "PwrFault."

```
Switch# show module
Mod  Ports Card Type                              Model              Serial No.
---+-----+--------------------------------------+------------------+-----------
 1      2  1000BaseX (GBIC) Supervisor(active)    WS-X4014           JAB054109GH
 2      6  1000BaseX (GBIC)                       WS-X4306           00000110
 3     18  1000BaseX (GBIC)                       WS-X4418           JAB025104WK
➔ 5      0  Not enough power for module           WS-X4148-FX-MT     00000000000
 6     48  10/100BaseTX (RJ45)                    WS-X4148           JAB023402RP

 M MAC addresses                   Hw  Fw           Sw                Status
--+--------------------------------+---+------------+-----------------+---------
 1 005c.9d1a.f9d0 to 005c.9d1a.f9df 0.5 12.1(11br)EW 12.1(20020313:00 Ok
 2 0010.7bab.9920 to 0010.7bab.9925 0.2                                Ok
 3 0050.7356.2b36 to 0050.7356.2b47 1.0                                Ok
➔ 5 0001.64fe.a930 to 0001.64fe.a95f 0.0                               PwrDeny
 6 0050.0f10.28b0 to 0050.0f10.28df 1.0                                Ok
Switch#
```

Configuring Redundant Mode on a Catalyst 4500 Series Switch

By default, the power supplies in a Catalyst 4500 series switch are set to operate in redundant mode. To effectively use redundant mode, follow these guidelines:

- Use two power supplies of the same type.
- If you have the power management mode set to redundant mode and only one power supply installed, your switch will accept the configuration but operates without redundancy.

Caution If you have power supplies with different types or different wattages installed in your switch, the switch will not recognize one of the power supplies and will not have power redundancy.

- For fixed power supplies, choose a power supply that by itself is powerful enough to support the switch configuration.
- For variable power supplies, choose a power supply that provides enough power so that the chassis and PoE requirements are less than the maximum available power. Variable power supplies automatically adjust the power resources at startup to accommodate the chassis and PoE requirements. Modules are brought up first, followed by IP phones.
- The maximum available power for chassis and PoE for each power supply are listed in Table 36-3 on page 36-9.

To configure redundant mode on your Catalyst 4500 series switch, perform this task:

	Command	Purpose
Step 1	`Switch# configure terminal`	Enters configuration mode.
Step 2	`Switch(config)# power redundancy-mode redundant`	Sets the power management mode to redundant mode.
Step 3	`Switch(config)# end`	Exits configuration mode.
Step 4	`Switch# show power supplies`	Verifies the power redundancy mode for the switch.

Note The **power redundancy-mode redundant** command is not supported on a Catalyst 4006 switch.

The following example shows how to set the power management mode to redundant mode.

```
Switch (config)# power redundancy-mode redundant
Switch (config)# end
Switch#
```

The following example shows how to display the current power redundancy mode. The power supplies needed by system: 1 indicates that the switch is in redundant mode.

```
Switch# show power supplies
Power supplies needed by system :1
Switch#
```

Configuring Combined Mode on a Catalyst 4500 Series Switch

If your switch configuration requires more power than a single power supply can provide, set the power management mode to combined mode. Combined mode utilizes the available power for both power supplies; however, your switch will have no power redundancy.

To effectively use combined mode, follow these guidelines:

- Use power supplies of the same type and wattage (fixed or variable and AC or DC).
- If you use power supplies with different types or wattages, the switch will utilize only one of the power supplies.
- For variable power supplies, choose a power supply that provides enough power so that the chassis and PoE requirements are less than the maximum available power. Variable power supplies automatically adjust the power resources at startup to accommodate the chassis and PoE requirements.
- The 1400 W DC power supply does not support combined mode. If you set the power budget to 2, the switch disregards this setting.
- If you have the power management mode set to combined mode and only one power supply installed, your switch will accept the configuration, but power is available from only one power supply.
- When your switch is configured to combined mode, the total available power is not the mathematical sum of the individual power supplies. The power supplies have a predetermined current sharing ratio (See Table 36-3 on page 36-9 for more information.)
- The maximum available power for chassis and PoE for each power supply are listed in Table 36-3 on page 36-9.

To configure combined mode on your Catalyst 4500 series switch, perform this task:

	Command	Purpose
Step 1	`Switch# configure terminal`	Enters configuration mode.
Step 2	`Switch(config)# power redundancy-mode combined`	Sets the power management mode to combined mode.
Step 3	`Switch(config)# end`	Exits configuration mode.
Step 4	`Switch# show power supplies`	Verifies the power redundancy mode for the switch.

Note The **power redundancy-mode combined** command does not work on a Catalyst 4006 switch.

The following example shows how to set the power management mode to combined mode.

```
Switch (config)# power redundancy-mode combined
Switch (config)# end
Switch#
```

The following example shows how to display the current power redundancy mode. The power supplies needed by system: 2 indicates that the switch is in combined mode.

```
Switch# show power supplies
Power supplies needed by system :2
Switch#
```

Available Power for Catalyst 4500 Series Switches Power Supplies

Table 36-3 lists the power available for use in the various Catalyst 4500 series switches power supplies. When your switch is configured to combined mode, the total available power in not the mathematical sum of the individual power supplies. The power supplies have a sharing ratio predetermined by the hardware. In combined mode, the total power available is P + (P * sharing-ratio), where P is the amount of power in the power supply.

Table 36-3 Available Power for Switch Power Supplies

Power Supply	Redundant Mode (W)	Combined Mode (W)	Sharing Ratio
1000 W AC	Chassis[1] = 1000 PoE = 0	Chassis = 1667 PoE = 0	2/3
1300 W AC	Chassis (max) = 1000 PoE (max) = 800 Chassis + PoE + Backplane ≤ 1300	Chassis (min) = 767 PoE (max) = 1333 Chassis (max) = 1667 PoE (min) = 533 Chassis + PoE + Backplane ≤ 2200	2/3
1400 W DC	Chassis (min) = 200 Chassis (max) = 1360 PoE (max)[2] = (DC Input[3] - [Chassis (min) + Backplane] / 0.75) * 0.96	Chassis = 2267[4] PoE[5]	Chassis—2/3 PoE—0
1400 W AC	Chassis = 1360 PoE = 0[6]	Chassis = 2473 PoE = 0	9/11
2800 W AC	Chassis = 1360 PoE = 1400	Chassis = 2473 PoE = 2333	Chassis[7]—9/11 PoE[8]—2/3

1. Chassis power includes power for the supervisor(s), all line cards, and the fan tray.
2. The efficiency for the 1400 W DC power supply is 0.75, and 0.96 is applied to PoE.
3. DC input can vary for the 1400 W DC power supply and is configurable. For more information, see “Special Considerations for the 1400 W DC Power Supply” on page 9.
4. Not available for PoE.
5. Not available for PoE.
6. No voice power.
7. Data-only.
8. Inline power.

Special Considerations for the 1400 W DC Power Supply

Caution Do not mix the 1400 W DC power supply with any other power supply, even for a hot swap or other short-term emergency. Doing so can seriously damage your switch.

Keep in mind the following guidelines when using a 1400 W DC power supply with your Catalyst 4500 series switch:

- The 1400 W DC power supply works with a variety of DC sources. The DC input can vary from 300 W to 7500 W. Refer to the power supply documentation for additional information.
- The supervisor engine cannot detect the DC source plugged into the 1400 W DC power supply. If you are using the 1400 W DC power supply, use the **power dc input** command to set the DC input power. For more information on this command, see the "Configuring the DC Input for a Power Supply" section on page 36-10.
- The software automatically adjusts between system power (for modules, backplane, and fans) and PoE. Although PoE is 96 percent efficient, system power has only 75 percent efficiency. For example, each 120 W of system power requires 160 W from the DC input. This requirement is reflected in the "Power Used" column of the output for the **show power available** command.
- The 1400 W DC power supply does not support combined mode. If you set the power budget to 2 (combined mode), the switch allows you to configure combined modes but disregards the setting and remains in redundant mode.
- The 1400 W DC power supply has a separate power on/off switch for PoE. The power supply fan status and main power supply status are tied together. If either of them fails, both the power supply and its fan report as bad/off. You should verify that the main power is on before turning on the power for the inline switch. In addition, you should verify that the power for the inline switch is off before turning off the main power.

Configuring the DC Input for a Power Supply

To configure the DC input power for the 1400 W DC power supply or a power shelf, perform this task:

	Command	Purpose
Step 1	`Switch# configure terminal`	Enters configuration mode
Step 2	`Switch(config)# power dc input watts`	Sets the capacity of the DC input source.
Step 3	`Switch(config)# end`	Exits configuration mode.

The same configuration is applied to both power slots. For example, if you set the **dc power input** to 1000 W, the switch expects 1000 W as the external DC source for both slot 1and slot 2 (if present) respectively.

The following example shows how to set the external DC power source to 1000 W:

```
Switch# configure terminal
Switch (config)# power dc input 1000
Switch (config)# end
Switch#
```

Power Management for the Catalyst 4006 Switch

The power management feature for the Catalyst 4006 switch is designed to support an optimized Catalyst 4006 chassis with a limited module configuration on a reduced number of power supplies.

The Catalyst 4006 chassis supports only the 400 W AC, 400 W DC, and 650 W DC power supplies and allows you to mix AC-input and DC-input power supplies in the same chassis. In systems with redundant power supplies, both power supplies should be of the same wattage. If you mix a 400 W power supply

and a 650 W power supply, the switch performs as if there were two 400 W power supplies. For detailed information on supported power supply configurations for each chassis, refer to the *Catalyst 4000 Series Installation Guide*.

Each Catalyst 4500 series module has different power requirements; thus, some switch configurations require more power than 1+1 redundancy mode (a single power supply) can provide. In those configurations, redundancy requires three power supplies. Redundant and nonredundant power configurations are discussed in later sections of this chapter.

The Catalyst 4006 switch contains holding bays for up to three power supplies. You need two primary power supplies to operate a fully loaded Catalyst 4006 chassis. You can set the power redundancy to two primary plus one redundant power supply (2+1 redundancy mode) or to one primary plus one redundant power supply (1+1 redundancy mode). The 1+1 redundancy mode might not support a fully loaded chassis.

If your switch has only two power supplies and is in 2+1 redundancy mode (the default mode), there is no redundancy. You can create redundancy with only two power supplies by setting the power redundancy to operate in 1+1 redundancy mode (one primary plus one redundant power supply). However, 1+1 redundancy will not support all configurations.

The 1+1 redundancy mode is designed and optimized for the following hardware configurations:

- One Catalyst 4006 chassis with a WS-X4014 supervisor engine with two 400 W power supplies (in 1+1 redundancy mode) and four WS-X4148-RJ or WS-X4148-RJ21 modules
- One Catalyst 4006 chassis with a WS-X4014 supervisor engine with two 650 W power supplies (in 1+1 redundancy mode) and five WS-X4148-RJ or WS-X4148-RJ21 modules

Although other configurations are possible, we do not recommend that you use them without careful consideration of the power usage in the system. For example, other similar and possible configurations may consist of four modules that consume less power, and the total module power usage does not exceed the absolute maximum power usage for the system.

The supervisor engine uses 110 W, the fan box uses 25 W, and the backplane does not consume any power. The system total load for the modules + supervisor + fan cannot total more than the power supplied by the power supply. The 1+1 redundancy mode might not support a fully loaded chassis and, therefore, one slot of the chassis *might be empty.* An attempt to use five modules risks an oversubscription of available power.

If you opt to use the 1+1 redundancy mode, the type and number of modules supported are limited by the power available from a single power supply. To determine the power consumption for each module in your chassis, see the "Power Consumption of Chassis Components" section on page 36-14.

To choose a 1+1 redundancy configuration, you must change the system configuration from the default 2+1 redundancy mode to 1+1 redundancy mode by using the **power supplies required 1** command. The **power supplies required 1** command sets the power redundancy to 1+1 redundancy mode. In the 1+1 redundancy mode, the nonredundant power available to the system is the power of the single weakest power supply. The second power supply installed in your switch provides full redundancy.

Limitations of the 1+1 Redundancy Mode

If you attempt to configure the system to operate in 1+1 redundancy mode, and you have more modules installed in the chassis than a single power supply can handle, the system displays the following error message:

```
Insufficient power supplies for the specified configuration
```

This message will also appear in the **show power** command output.

If you are already operating in 1+1 redundancy mode with a valid module configuration and you attempt to insert additional modules that require more power than the single power supply provides, the system immediately places the newly inserted module into reset mode and issues these error messages:

```
Module has been inserted
Insufficient power supplies operating
```

Additionally, if a chassis that has been operating in 1+1 redundancy mode with a valid module configuration is powered down, and you insert a module or change the module configuration inappropriately and power on the switch again, the module(s) in the chassis (at boot up) that require more power than is available, are placed into reset mode.

A module in reset mode continues to draw power as long as it is installed in the chassis and as long as the **show module** command output indicates that there is not enough power for the module to be brought out of reset mode.

A single power supply provides 400 W or 650 W. Two 400 W power supplies provide 725 W. Two 650 W power supplies supply only 750 W. The 750 W limit is a restriction on the power supply cooling capacity for the Catalyst 4006 switches.

If you mix a 400 W power supply and a 650 W power supply, the switch performs as if there were two 400 W power supplies. If you have one 400 W power supply and one 650 W power supply in 1+1 redundancy mode, and a second 650 W power supply is set as the backup, the system performs as if there were 400 W. If the 400 W power supply fails, the backup 650 W power supply comes into service; however, the switch still has only 400 W available. You need to remove the failed 400 W power supply for the switch to make use of the 650 W available.

To compute the power requirements for your system and verify that your system has enough power, add up the power consumed by the supervisor engine module, the fan box, and the installed modules. (See the "Power Consumption of Chassis Components" section on page 36-14 for more information on the power consumption for the various components of your switch.) For 1+1 redundancy mode, verify that the total is less than 400 W or 650 W, depending on the power supplies installed in your switch. The following examples are provided to further explain the use of power supplies.

The following configuration requires a minimum of 395 W:

- WS-X4014 supervisor engine—110 W
- Four WS-X4148-RJ modules—65 W each (260 W total—the optimized module configuration)
- Fan box—25 W

This configuration requires less than the maximum that a single power supply can provide in 1+1 redundancy mode.

The following configuration requires more power than a single 400 W power supply can provide:

- WS-X4014 supervisor engine—110 W
- Two WS-X4148-RJ modules in slots 2 and 3—65 W each (130 W total)
- Two WS-X4448-GB-LX modules in slots 4 and 5—90 W each (180 W total)
- Fan box—25 W

This configuration requires 445 W and cannot be used in 1+1 redundancy mode for a 400 W power supply. A single 650 W power supply provides enough power for 1+1 redundancy mode for this configuration.

The following configuration requires more power than either a single 400 W or 650 W power supply can provide:

- WS-X4014 supervisor engine—110 W
- Five 48-port 100BASE-FX modules in slots 2 through 6—120 W each (600 W total)
- Fan box—25 W

This configuration requires 735 W and cannot be used in 1+1 redundancy mode for either a 400 W or 650 W power supply.

Remember, when considering the 1+1 redundancy mode, you must carefully plan the configuration of the module power usage of your chassis. An incorrect configuration will momentarily disrupt your system during the evaluation cycle. To avoid this disruption, carefully plan your configuration to ensure that it is within the power limits, or return to the default 2+1 redundancy configuration by installing a third power supply in your switch and setting the power redundancy to 2+1 redundancy mode.

Use the **power supplies required 2** command to set the power redundancy to the 2+1 redundancy mode.

Setting the Power Redundancy Mode

To configure the power redundancy mode on a Catalyst 4006 switch, perform this task:

	Command	Purpose
Step 1	`Switch# configure terminal`	Enters configuration mode.
Step 2	`Switch(config)# power supplies required {1 | 2}`	Sets the power redundancy mode.
Step 3	`Switch(config)# end`	Exits configuration mode.
Step 4	`Switch# show power`	Verifies the power redundancy mode and the current power usage for the switch.

Note The **power supplies required** command is not supported on a Catalyst 4500 series switch.

The default power redundancy mode is 2 (2+1) redundancy mode.

The following example shows how to set the power redundancy mode to 1 (1+1 redundancy mode).

```
Switch (config)# power supplies required 1
Switch (config)# end
Switch#
```

The following example shows how to display the current power status of system components and the power redundancy mode. The **Power supplies needed by system: 1** indicates that the switch is in 1+1 redundancy mode:

```
Switch# show power supplies
Power supplies needed by system :1
Switch#
```

The following example shows the **show module** command output for a system with inadequate power for all installed modules. The system does not have enough power for Module 5; the "Status" displays it as "PwrDeny."

```
Switch# show module

Mod  Ports Card Type                              Model              Serial No.
---+-----+--------------------------------------+------------------+-----------
 1      2  1000BaseX (GBIC) Supervisor(active)    WS-X4014           JAB054109GH
 2      6  1000BaseX (GBIC)                       WS-X4306           00000110
 3     18  1000BaseX (GBIC)                       WS-X4418           JAB025104WK
 5      0  Not enough power for module            WS-X4148-FX-MT     00000000000
 6     48  10/100BaseTX (RJ45)V, Cisco/IEEE       WS-X4248-RJ45V     JAB074804LE

 M MAC addresses                    Hw  Fw           Sw               Status
--+-------------------------------+---+------------+----------------+---------
 1 005c.9d1a.f9d0 to 005c.9d1a.f9df 0.5 12.1(11br)EW 12.1(20020313:00 Ok
 2 0010.7bab.9920 to 0010.7bab.9925 0.2                               Ok
 3 0050.7356.2b36 to 0050.7356.2b47 1.0                               Ok
 5 0001.64fe.a930 to 0001.64fe.a95f 0.0                               PwrDeny
 6 000d.edc6.dac0 to 000d.edc6.daef 2.0                               Ok
Switch#
```

Power Consumption of Chassis Components

For power consumption of common Catalyst 4000 family modules, see Table 36-4.

Enter the **show power** command to display the current power redundancy and the current system power usage.

Table 36-4 Power Consumption for Catalyst 4000 Family Components

Module	Power Consumed During Operation (W)	Power Consumed in Reset Mode (W)
Supervisor Engine II-Plus	110	110
Supervisor Engine III	110	110
Supervisor Engine IV	145	145
Supervisor Engine V	170	170
Catalyst 4003 fan box	20	20
Catalyst 4006 fan box	30	30
Catalyst 4503 fan box	30	30
Catalyst 4506 and 4507R fan box	50	50
Catalyst 4510R fan box	80	80
Catalyst 4006 switch backplane	0	0
Catalyst 4503 switch backplane	10	10
Catalyst 4506 switch backplane	10	10
Catalyst 4507R switch backplane	40	40
Catalyst 4510R switch backplane	160	160

Table 36-4 Power Consumption for Catalyst 4000 Family Components (continued)

Module	Power Consumed During Operation (W)	Power Consumed in Reset Mode (W)
2-port 1000BASE-X (GBIC) Gigabit Ethernet WS-X4302-GB	8	5
6-port 1000BASE-X (GBIC) Gigabit Ethernet WS-X4306-GB	35	30
32-port 10/100 Fast Ethernet RJ-45 WS-X4232-RJ-XX	50	35
24-port 100BASE-FX Fast Ethernet switching module WS-X4124-FX-MT	90	75
48-port 100BASE-BX10-D line card WS-X4148-FE-BD-LC	88	10
48-port 100BASE-LX10 Fast Ethernet MT-RJ single-mode fiber switching module WS-X4148-FE-LX-MT	115	10
32-port 10/100 Fast Ethernet RJ-45, plus 2-port 1000BASE-X (GBIC) Gigabit Ethernet WS-4232-GB-RJ	55	35
32-port 10/100-Mbps plus 2-port 1000BASE-X Layer 3 Ethernet routing module WS-4232-L3	120	70
48-port 100BASE-FX Fast Ethernet switching module WS-4148-FX-MT	120	10
18-port server switching 1000BASE-X (GBIC) Gigabit Ethernet WS-4418-GB	80	50
Catalyst 4006 Backplane Channel Module WS-X4019	10	10
48-port 10/100 Fast Ethernet RJ-45 WS-X4148-RJ	65	40
12-port 1000BASE-T Gigabit Ethernet, plus 2-port 1000BASE-X (GBIC) Gigabit Ethernet WS-X4412-2GB-T	110	70
24-port 1000BASE-X Gigabit Ethernet WS-X4424-GB-RJ45	90	50
48-port 1000BASE-X Gigabit Ethernet WS-X4448-GB-RJ45	120	72
48-port 1000BASE-X Gigabit Ethernet WS-X4448-GB-LX	90	50
48-port Telco 10/100BASE-TX switching module WS-X4148-RJ21	65	40
48-port PoE 10/100BASE-TX switching module WS-X4148-RJ45V	60	50

Table 36-4 Power Consumption for Catalyst 4000 Family Components (continued)

Module	Power Consumed During Operation (W)	Power Consumed in Reset Mode (W)
4-port MT-RJ Uplink module WS-U4504-FX-MT	10	10
48-port PoE 10/100 BASE-TX switching module WS-X4248-RJ21V	60	25
48-port PoE 10/100BASE-TX switching module WS-X4248-RJ45V	60	25
48-port 10/100/1000BASE-T Gigabit Ethernet WS-X4548-GB-RJ45	60	25
48-port PoE 10/100/1000BASE-T switching module WS-X4548-GB-RJ45V	60	25
Catalyst 4500 series switch Access Gateway Module WS-X4604-GWY	120	60
Backplane channel module WS-X4019	10	10

Configuring Power Over Ethernet

This section contains the following subsections:

The Catalyst 4006 switch and the Catalyst 4500 series switches can sense if a powered device is connected to a PoE module. The Catalyst 4006 switch and Catalyst 4500 series switches can supply PoE to the powered device if there is no power on the circuit. The powered device can also be connected to an AC power source and supply its own power to the voice circuit. If there is power on the circuit, the switch does not supply it.

Note A powered device is any device connected to the switch that requires external power or can utilize PoE, for example, an access point or Cisco IP phone.

Power Management Modes

If your switch has a module capable of providing PoE to end stations, you can set each interface on the module to automatically detect and apply PoE if the end station requires power.

The Catalyst 4500 series switch has three PoE modes:

- **auto**—PoE interface. The supervisor engine directs the switching module to power up the interface *only* if the switching module discovers the phone and the switch has enough power. You can specify the maximum wattage that is allowed on the interface. If you do not specify a wattage, then the switch will deliver no more than the hardware-supported maximum value. This mode has no effect if the interface is not capable of providing PoE.
- **static**—High priority PoE interface. The supervisor engine preallocates power to the interface, even when nothing is connected, guaranteeing that there will be power for the interface. You can specify the maximum wattage that is allowed on the interface. If you do not specify a wattage, then the switch preallocates the hardware-supported maximum value. If the switch does not have enough power for the allocation, the command will fail. The supervisor engine directs the switching module to power up the interface *only* if the switching module discovers the powered device.
- **never**—Data interface only The supervisor engine never powers up the interface, even if an unpowered phone is connected. This mode is only needed when you want to make sure power is never applied to a PoE-capable interface.

The switch allocates PoE to the interfaces configured to static mode before it allocates power to the interfaces configured to auto mode. In the event of insufficient PoE due to a partial power supply failure, interfaces configured to auto mode are shutdown before interfaces configured to static mode.

The switch can measure the actual PoE consumption for an 802.3af-compliant PoE module, and displays this in the **show power module** command. The switch cannot measure the actual PoE consumption for the WS-X4148-RJ45V module nor for an individual interface on an 802.3af-compliant PoE module. For more information, see the "Displaying the PoE Consumed by a Module" section on page 36-22

On the WS-X4148-RJ45V PoE module, PoE consumption cannot be measured. Therefore, for all PoE calculations, the PoE consumption on this module is presumed to be equal to its administrative PoE.

For most users, the default configuration of "auto" works well, providing plug and play capability. No further configuration is required. However, to make an interface higher priority or data only, or to specify a maximum wattage, perform this task:

	Command	Purpose
Step 1	`Switch(config)# interface {fastethernet | gigabitethernet} slot/port`	Selects the interface to configure.
Step 2	`Switch(config-if)# power inline {auto [max milli-watts] | never | static [max milli-watts]}`	The **auto** keyword sets the interface to automatically detect and supply power to the powered device. This is the default configuration. The **static** keyword sets the interface to higher priority than auto. If necessary, you can use the **max** keyword to specify the maximum wattage allowed on the interface (4000 to 15400 milliwatts). Use the **never** keyword to disable detection and power for the PoE capable interface.
Step 3	`Switch(config-if)# end`	Exits configuration mode.
Step 4	`Switch# show power inline {fastethernet | gigabitethernet} slot/port`	Displays the PoE state for the switch.

If you set a non-PoE-capable interface to automatically detect and apply power, an error message indicates that the configuration is not valid.

The following example shows how to set the Fast Ethernet interface 4/1 to automatically detect PoE and send power through that interface:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface fastethernet 4/1
Switch(config-if)# power inline auto
Switch(config-if)# end
```

This example shows how to verify the PoE configuration for the Fast Ethernet interface 4/1:

```
Switch# show power inline fastethernet 4/1
Available:677(w)  Used:11(w)  Remaining:666(w)

Interface Admin  Oper            Power(Watts)     Device              Class
                              From PS    To Device
--------- ------ ---------- ---------- ---------- ------------------- -----
Fa4/1     auto   on         11.2       10.0       Ieee PD             0

Interface  AdminPowerMax   AdminConsumption
             (Watts)           (Watts)
---------- --------------- --------------------
Fa4/1                15.4                 10.0
Switch#
```

The following example shows how to configure an interface so that it never supplies power through the interface:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface fastethernet 5/2
Switch(config-if)# power inline never
Switch(config-if)# end
Switch#
```

Configuring Power Consumption for Powered Devices on an Interface

By default, when the switch detects a powered device on an interface, it assumes the powered device consumes the maximum the port can provide (7W on a legacy Power over Ethernet (PoE) linecard and 15.4W on the IEEE PoE linecards introduced in Release 12.2(20)EW). Then, when the switch receives a CDP packet from the powered device, the wattage automatically adjusts downward to the specific amount required by that device. Normally, this automatic adjustment works well, and no further configuration is required or recommended. However, you can specify the powered device's consumption for the entire switch (or for a particular interface) to provide extra functionality from your switch. This is useful when CDP is disabled or not available.

When using PoE, pairs 2 and 3 (pins 1, 2, 3, and 6) of the four pairs in a standard UTP cable are used for both the Ethernet data signals and the DC power at the same time. In DC, PoE flows from pair 3 (pins 3 and 6) to the device using PoE and back to pair 2 (pins 1 and 2) while the Ethernet port transmits differential signals in pair 2 (between pins 1 and 2). This method of supplying DC power is sometimes called "phantom power" because the power signals travel over the same two pairs used to transmit Ethernet signals. The inline power signals are transparent to the Ethernet signals and do not interfere with each other. The main electrical parameter that affects inline power operation and performance is the DC resistance of the cable. The inline power method is designed to work with category 3 cable and above, up to 100 meters.

PoE has been tested and found to work with the IBM Token Ring STP cable (100 meters) when used with a Token Ring to Fast Ethernet adapter.

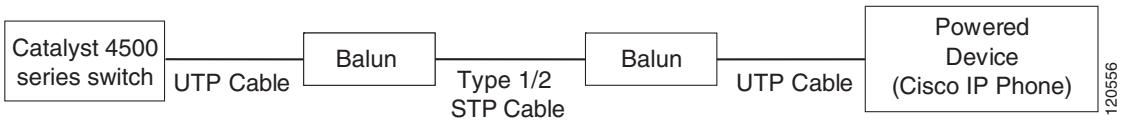
When you use PoE modules with type 1/2 shielded twisted pair (STP) cable configurations (90 and 125 meters), the modules perform the same as with Category 5 cable for the IEEE 802.3af standard at 10 and 100 Mb/s.

The following adapters have been tested and are the only ones supported by Cisco:

- LanTel Silver Bullet (SB-LN/VIP-DATA adapter)
- BIP-1236/S (BATM)
- RIT P/N 13712017
- RIT balun with integrated unshielded twisted pair (UTP) cable, 6 and 24 foot lengths

The following topology is supported:

Figure 36-1 Supported Adapter Topology



In Figure 36-1, a Catalyst 4500 series switch is connected to a balun through a short length of Category 5 UTP cable. Type 1 or Type 2 STP cable connects this balun to a second balun. A short length of Category 5 UTP cable connects the second balun to another Powered Device (such as a Cisco IP phone)

Note When manually configuring the consumption for powered devices, you need to account for the power loss over the cable between the switch and the powered device.

To change the power consumption for the entire switch, perform this task:

	Command	Purpose
Step 1	`Switch(config)# [no] power inline consumption default milli-watts`	Sets the PoE consumption (in milliwatts) of all powered devices connected to the switch. The power consumption can range from 4000 to 15,400. To re-enable the automatic adjustment of consumption, either use the **no** keyword or specify 15,400 milliwatts.
Step 2	`Switch(config)# end`	Exits configuration mode.
Step 3	`Switch# show power inline consumption default`	Displays the administrative PoE consumption of powered devices connected to the switch. The administrative PoE is not the measured PoE value.

This example shows how to set the default PoE consumption of all powered devices connected to the switch to 5000 milliwatts:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# power inline consumption default 5000
Switch(config)# end
Switch#
```

This example shows how to verify the PoE consumption:

```
Switch# show power inline consumption default
Default PD consumption : 5000 mW
Switch#
```

To change the power consumption of a single powered device, perform this task:

	Command	Purpose
Step 1	`Switch(config)# interface {fastethernet | gigabitethernet} slot/port`	Selects the interface to configure.
Step 2	`Switch(config-if)# [no] power inline consumption milli-watts`	Sets the PoE consumption (in milliwatts) of the powered device connected to a specific interface. The power consumption can range from 4000 to 15,400. To re-enable the automatic adjustment of consumption, either use the **no** keyword or specify 15,400 milliwatts
Step 3	`Switch(config-if)# end`	Exits configuration mode.
Step 4	`Switch# show power inline consumption {fastethernet | gigabitethernet} slot/port`	Displays the PoE consumption for the interface.

This example shows how to set the PoE consumption to 5000 milliwatts for Fast Ethernet interface 4/1 regardless what is mandated by the 802.3af class of the discovered device, or by any CDP packet received from the powered device:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface fastethernet 4/1
Switch(config-if)# power inline consumption 5000
Switch(config-if)# end
Switch#
```

This example shows how to verify the PoE consumption for a given interface:

```
Switch# show power inline fastethernet 4/1
Available:677(w)  Used:11(w)  Remaining:666(w)

Interface Admin  Oper            Power(Watts)     Device              Class
                              From PS    To Device
--------- ------ ---------- ---------- ---------- ------------------- -----

Fa4/1     auto   on         11.2       10.0       Ieee PD             0

Interface  AdminPowerMax   AdminConsumption
             (Watts)           (Watts)
---------- --------------- --------------------

Fa4/1                 15.4                 10.0
Switch#
```

Intelligent Power Management

All Catalyst 4500 PoE-capable modules use Intelligent Power Management to provision power on each interface. When a powered device (PD) is attached to a PoE-capable port, the port will detect the PD and provision power accordingly. If a Cisco PD is used, the switch and PD negotiate power using CDP packets to determine the precise amount of power needed by the PD. If the PD is 802.3af compatible,

the difference between what is mandated by the 802.3af class and what is actually needed by the PD is returned to the power budget for use by additional devices. In this way, power negotiation allows customers to stretch their power budget and use it more effectively.

Power negotiation also enables the interoperability of newer Cisco powered devices with older legacy PoE-capable ports from Cisco. Newer Cisco PDs do not consume more than what the switch port can provide.

Powering Down a Module

If your system does not have enough power for all modules installed in the switch, you can power down a module, and place it in **reset** mode. To power down a module, perform this task:

Command	Purpose
`Switch(config)# no hw-module module num power`	Turns power down to the specified module by placing it in **reset** mode.

To power on a module that has been powered down, perform this task:

Command	Purpose
`Switch(config)# hw-module module num power`	Turns power on to the specified module.

This example shows how to power down module 6:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# no hw-module module 6 power
Switch(config)# end
Switch#
```

Displaying the Operational Status for an Interface

Each interface has an operational status which reflects the PoE status for an interface. The operational status for an interface is defined as one of the following:

- on—Power is supplied by the port.
- off—Power is not supplied by the port. If a powered device is connected to an interface with external power, the switch does not recognize the powered device. The “Device” column in the **show power inline** command displays as n/a.
- Power-deny—The supervisor engine does not have enough power to allocate to the port, or the power that is configured for the port is less than the power required by the port; power is not being supplied by the port.
- err-disable—The port is unable to provide power to the connected device that is configured in static mode.
- faulty—The port failed diagnostics tests.

You can use the **show power inline** command to view the operational status for an interface.

This example shows how to display the operational status for all interfaces on module 3.

```
Switch# show power inline module 3
Available:677(w)  Used:117(w)  Remaining:560(w)

Interface Admin  Oper            Power(Watts)     Device              Class
                              From PS    To Device
--------- ------ ---------- ---------- ---------- ------------------- -----

Fa3/1     auto   on         17.3       15.4       Ieee PD             0
Fa3/2     auto   on         4.5        4.0        Ieee PD             1
Fa3/3     auto   on         7.1        6.3        Cisco IP Phone 7960 0
Fa3/4     auto   on         7.1        6.3        Cisco IP Phone 7960 n/a
Fa3/5     auto   on         17.3       15.4       Ieee PD             0
Fa3/6     auto   on         17.3       15.4       Ieee PD             0
Fa3/7     auto   on         4.5        4.0        Ieee PD             1
Fa3/8     auto   on         7.9        7.0        Ieee PD             2
Fa3/9     auto   on         17.3       15.4       Ieee PD             3
Fa3/10    auto   on         17.3       15.4       Ieee PD             4
Fa3/11    auto   off        0          0          n/a                 n/a
Fa3/12    auto   off        0          0          n/a                 n/a
Fa3/13    auto   off        0          0          n/a                 n/a
Fa3/14    auto   off        0          0          n/a                 n/a
Fa3/15    auto   off        0          0          n/a                 n/a
Fa3/16    auto   off        0          0          n/a                 n/a
Fa3/17    auto   off        0          0          n/a                 n/a
Fa3/18    auto   off        0          0          n/a                 n/a

--------- ------ ---------- ---------- ---------- ------------------- -----

Totals:          10   on    117.5      104.6
Switch#
```

This example shows how to display the operational status for Fast Ethernet interface 4/1:

```
Switch#show power inline fa4/1
Available:677(w)  Used:11(w)  Remaining:666(w)

Interface Admin  Oper            Power(Watts)     Device              Class
                              From PS    To Device
--------- ------ ---------- ---------- ---------- ------------------- -----

Fa4/1     auto   on         11.2       10.0       Ieee PD             0

Interface  AdminPowerMax   AdminConsumption
             (Watts)           (Watts)
---------- --------------- --------------------

Fa4/1                15.4                 10.0
Switch#
```

Displaying the PoE Consumed by a Module

The switch can measure the actual PoE consumption for an 802.3af-compliant PoE module, and it displays the measured PoE in both the **show power module** and **show power detail** commands. The switch cannot measure the actual PoE consumption for the WS-X4148-RJ45V module, nor can it display the consumption of an individual interface on an 802.3af-compliant PoE module.

The 802.3af-compliant PoE modules can consume up to 20 W of PoE to power FPGAs and other hardware components on the module. Be sure to add at least 20 W to your PoE requirements for each 802.3af-compliant PoE module to ensure that the system has adequate power for the PDs connected to the switch.

On the WS-X4148-RJ45V PoE module, PoE consumption cannot be measured. Therefore, for all PoE calculations, the PoE consumption on this module is presumed to be equal to its administrative PoE.

The example below displays the PoE consumption for an 802.3af-compliant module using the **show power module** command.

The "Inline Power Oper" column displays the amount of PoE consumed by the powered devices that are attached to the module, in addition to the PoE consumed by the FPGAs and other hardware components on the module. The "Inline Power Admin" column displays only the amount of PoE allocated by the powered devices attached to the module.

Note The operating PoE consumption for an 802.3af-compliant module can be non-zero, even when there are no powered devices attached to the module, because of the PoE consumed by FPGAs and other hardware components on the module. In addition, the operating PoE can vary due to fluctuations in the PoE consumed by the hardware components.

```
Switch# show power module
Watts Used of System Power (12V)
Mod   Model               currently  out of reset  in reset
----  ------------------  ---------  ------------  --------
 1    WS-X4013+              110         110         110
 3    WS-X4448-GB-LX          90          90          50
 4    WS-X4418                80          80          50
 5    WS-X4248-RJ45V          65          65          25
 6    WS-X4248-RJ45V          65          65          25
 7    WS-4548-GB-RJ45         58          58          15
 --   Fan Tray                50          --          --
----------------------   ---------  ------------   -------
       Total                518         468         275

                         Inline Power Admin  Inline Power Oper
Mod   Model                 PS     Device       PS     Device  Efficiency
----  ------------------  ----------------    ----------------- ----------
 1    WS-X4013+              -        -          -        -           -
 3    WS-X4448-GB-LX         -        -          -        -           -
 4    WS-X4418               -        -          -        -           -
 5    WS-X4248-RJ45V        24       22         22       20          89
 6    WS-X4248-RJ45V         0        0         17       15          89
 7    WS-4548-GB-RJ45        -        -          -        -           -
----------------------  ----------------    ---------------- ----------
       Total                24       22         39       35
Switch#
```

The example below displays the PoE consumption for an 802.3af-compliant module using the **show power detail** command.

The "Inline Power Oper" column displays the amount of PoE consumed by the powered devices that are attached to the module, in addition to the PoE consumed by the FPGAs and other hardware components on the module. The "Inline Power Admin" column displays only the amount of PoE allocated by the powered devices attached to the module.

Note The operating PoE consumption for an 802.3af-compliant module can be non-zero, even when there are no powered devices attached to the module, because of the PoE consumed by FPGAs and other hardware components on the module. In addition, the operating PoE can vary due to fluctuations in the PoE consumed by the hardware components.

```
switch# show power detail
Power                                              Fan      Inline
Supply  Model No           Type       Status       Sensor   Status
------  -----------------  ---------  -----------  -------  -------
PS1     PWR-C45-1300ACV    AC 1300W   good         good     good
PS2     none               --         --           --       --

Power supplies needed by system    :1
Power supplies currently available :1

Power Summary                       Maximum
 (in Watts)              Used      Available
----------------------   ----      ---------
System Power (12V)        518         1000
Inline Power (-50V)        24          742
Backplane Power (3.3V)     40           40
----------------------   ----
Total Used                582 (not to exceed Total Maximum Available = 1300)


                           Watts Used of System Power (12V)
Mod   Model               currently  out of reset  in reset
----  ------------------  ---------  ------------  --------
 1    WS-X4013+              110         110          110
 3    WS-X4448-GB-LX          90          90           50
 4    WS-X4418                80          80           50
 5    WS-X4248-RJ45V          65          65           25
 6    WS-X4248-RJ45V          65          65           25
 7    WS-4548-GB-RJ45         58          58           15
 --   Fan Tray                50          --           --
----------------------   ---------  ------------   -------
       Total                 518         468          275

                        Inline Power Admin  Inline Power Oper
Mod   Model                PS     Device       PS     Device  Efficiency
----  ------------------  -----------------    ---------------- ----------
 1    WS-X4013+              -        -          -        -           -
 3    WS-X4448-GB-LX         -        -          -        -           -
 4    WS-X4418               -        -          -        -           -
 5    WS-X4248-RJ45V        24       22         22       20          89
 6    WS-X4248-RJ45V         0        0         22       20          89
 7    WS-4548-GB-RJ45        -        -          -        -           -
----------------------  -----------------    ---------------- ----------
       Total                 24       22         44       40
Switch#
```