CHAPTER 22

Power Management and Environmental Monitoring

This chapter describes power management and environmental monitoring features in the Catalyst 4006 switch with Supervisor Engine III. It provides guidelines, procedures, and configuration examples.

This chapter consists of the following major sections:

Note For complete syntax and usage information for the commands used in this chapter, refer to the *Command Reference for the Catalyst 4006 Switch with Supervisor Engine III* and the publications at http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/index.htm

Understanding How Environmental Monitoring Works

Environmental monitoring of chassis components provides early warning indications of possible component failure. This warning helps to ensure safe and reliable system operation and avoid network interruptions. This section describes the monitoring of these critical system components, which will help you to identify and rapidly correct hardware-related problems in your system.

Environmental Monitoring Using CLI Commands

This section describes the **show environment** CLI command.

Enter the **show environment** [**alarm** | **status** | **temperature**] command to display system status information. Keyword descriptions are listed in Table 22-1. For more information on these commands, refer to the *Command Reference for the Catalyst 4006 Switch with Supervisor Engine III.*

Table 22-1 show environment Keyword Descriptions

Keyword	Purpose
alarm	Displays environmental alarms

Table 22-1 show environment Keyword Descriptions (continued)

Keyword	Purpose
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:

```
Switch#show env
no alarm

Chassis Temperature                    = 32 degrees Celsius
Chassis Over Temperature Threshold     = 75 degrees Celsius
Chassis Critical Temperature Threshold = 95 degrees Celsius

Power                                          Fan
Supply  Model No         Type        Status    Sensor
------  ---------------  ----------  --------  ------
PS1     PWR-C4K-400AC    AC  400W    good      good
PS2     none             --          --        --

Chassis Type :WS-C4006

Supervisor Led Color :Green

Fantray :good

Switch#
```

LED Indications

There are two alarm types, major and minor. Major alarms indicate a critical problem that could lead to system shutdown. Minor alarms are just informational, alerting you to a problem that could turn critical if corrective action is not taken.

When the system has an alarm (major or minor) indicating an over-temperature condition, the alarm is not canceled or any action taken (such as module reset or shutdown) for 5 minutes. If the temperature falls 5°C below the alarm threshold during this period, the alarm is canceled.

Table 22-2 lists the LEDs that are used as environmental indicators for the supervisor engine and switching modules.

Note Refer to the *Catalyst 4000 Family Module Installation Guide* for additional information on LEDs, including the supervisor engine system LED.

Table 22-2 Alarms for Supervisor Engine and Switching Modules

Event	Alarm Type	LED Color	Action
Supervisor engine temperature sensor exceeds major threshold[1]	Major	Status[2] LED red	Syslog message. If the overtemperature condition is not corrected, the system shuts down after 5 minutes. Alarm thresholds: • Chassis temperature = 32°C • Chassis over temperature threshold = 75°C • Chassis critical temperature threshold = 95°C
Supervisor engine temperature sensor exceeds minor threshold	Minor	Status LED orange	Syslog message. Monitor the condition.

1. Temperature sensors monitor key supervisor engine components including daughter cards.
2. A Status LED is located on the supervisor engine front panel and all module front panels.

Power Management

This section describes power management in the Catalyst 4006 switch and includes the following major sections:

Power Redundancy

The power redundancy feature is designed to support an optimized Catalyst 4006 chassis consisting of a Supervisor Engine III and four WS-X4148-RJ or WS-X4148-RJ21 modules operating in 1+1 redundancy mode (one primary power supply plus one redundant power supply). Additional configurations are possible.

In systems with redundant power supplies, it is recommended that both power supplies be of the same wattage. The Catalyst 4000 family switches allow you to mix AC-input and DC-input power supplies in the same chassis. For detailed information on supported power supply configurations for each chassis, refer to the *Catalyst 4000 Family Installation Guide*.

Catalyst 4000 family modules have different power requirements; thus, some switch configurations require more power than 1+1 redundancy mode (a single power supply) can provide. The 2+1 redundancy mode requires three power supplies (2 primary power supplies plus one redundant power supply). The default is 2+1 redundancy mode.

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 2+1 redundancy mode or 1+1 redundancy mode. The 1+1 redundancy mode may not support a fully loaded chassis.

If your switch has only two power supplies and is in 2+1 redundancy 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 a specific hardware configuration: a Catalyst 4006 chassis with a Supervisor Engine III and four 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 can consist of four modules, where each module consumes 65W or less (for a total of 265W) or, more generally, where the total module power usage does not exceed the absolute maximum module usage of 265W.

The Supervisor Engine III uses 110W, and the fan box uses 25W, for a system total of 400W (modules + supervisor + fan). 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 Modules" section on page 22-5.

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 current chassis 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` and `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.

Both of these scenarios initiate the five-minute evaluation countdown timer. When this timer runs out, the system attempts to resolve this power usage limitation by evaluating the type and number of modules installed. The evaluation process may require several cycles to stabilize the chassis' power usage.

During the evaluation cycle, the modules are in effect removed and re-inserted, thus causing disruption of network connectivity; the switch reactivates only the modules it is able to support with the limited power available and leaves the remaining modules in reset mode. The supervisor engine always remains enabled. Modules placed in reset mode still consume some power. If the chassis module combination, including the modules in reset, still require more power than is available, the five-minute evaluation countdown timer starts for another evaluation cycle, and additional modules are placed in reset mode until the power usage is stable.

If the power requirement of the active modules and with the modules in reset does not exceed the available power, the system is stable and no more evaluation cycles are run, until something again causes insufficient power usage. One or possibly two cycles are required to stabilize the system. If you configure the chassis correctly, the system will not enter the evaluation cycle.

Note If you have all three power supplies installed and you still choose to operate in 1+1 redundancy mode but later add additional modules which exceed the power available, the five-minute evaluation timer starts again. The switch may require several evaluation cycles to stabilize the system. To correct this power situation caused by the additional modules, you can either remove the extra modules or change the power redundancy to 2+1 redundancy mode. If you choose to return to the 2+1 redundancy mode, each module held in reset mode is brought up one-by-one to an operational state.

A module in reset continues to draw power as long as it is installed in the chassis; however, the **show module** command output indicates that there is not enough power for the module.

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 modules you wish to use. A single power supply provides 400W, and two power supplies provide 750W. For 1+1 redundancy mode, verify that the total is less than 400W.

For example, the following configuration requires a minimum of 395W:

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

This is 5W less than the maximum that a single power supply can provide in 1+1 redundancy mode.

The following configuration, however, requires more power than a single power supply can supply:

- WS-X4013 supervisor engine—110W
- Two WS-X4148-RJ modules, in slots 2 and 3—65W each (130W total)
- Two WS-X4448-GB-LX modules in slots 4 and 5—90W each (180W total)
- Fan box—25W

This configuration requires 445W and cannot be used in 1+1 redundancy mode.

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 momentary disrupt your system during the evaluation cycle. To avoid this disruption, carefully plan your configuration to ensure 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 set 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.

Power Consumption of Modules

A single power supply provides 400W; two power supplies provide 750W. When operational, the supervisor engines consume no more than 110W and the fan box consumes 25W. For power consumption of common Catalyst 4006 modules, see Table 22-3.

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

Table 22-3 Power Consumption Rates for Catalyst 4006 Modules

Module	Power Consumed During Operation (W)	Power Consumed in Reset Mode (W)
6-port 1000BASE-X (GBIC) Gigabit Ethernet WS-X4306-GB	35	30
32-port 10/100 Fast Ethernet RJ-45 WS-X4232-RJ-XX	55	35
Catalyst 4000 Access Gateway Module with IP/FW IOS WS-X4604-GWY	120	60
24-port 100BASE-FX Fast Ethernet switching module WS-X4124-FX-MT	90	75
32-port 10/100 Fast Ethernet RJ-45, plus 2-port 1000BASE-X (GBIC) Gigabit Ethernet WS-X4232-GB-RJ	50	35
48-port 100BASE-FX Fast Ethernet switching module WS-X4148-FX-MT	120	10
18-port server switching 1000BASE-X (GBIC) Gigabit Ethernet WS-X4418-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
Catalyst 4003 and 4006 Layer 3 Services Module WS-X4232-L3	120	70
12-port 1000BASE-T Gigabit Ethernet, plus 2-port 1000BASE-X (GBIC) Gigabit Ethernet WS-X4416	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 inline power 10/100BASE-TX switching module WS-X4148-RJ45V	60	50
4-port MT-RJ uplink module WS-U4504-FX-MT	10	10

Setting the Power Redundancy Mode

To configure the power redundancy mode, perform the following procedure:

	Task	Command
Step 1	Enter configuration mode	`Switch# configure terminal`
Step 2	Set the power redundancy mode.	`Switch(config)# power supplies required {1 | 2}`
Step 3	Verify the power redundancy mode and the current power usage for the switch.	`Switch(config)# show power`

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)#
```

The following example shows how to display the current power status of system components and the power redundancy mode:

```
Switch# show power
Power                                       Fan
Supply  Model No         Type        Status   Sensor
------  --------------  ---------  -------  ------
PS1     WS-X4008         AC 400W    good     good
PS2     WS-X4008         AC 400W    good     good
PS3     none             --         --       --
PEM     none             --         --       --


Power Summary
 (in Watts)    Available   Used   Remaining
-------------  ---------  ------  ---------
System Power    750        255     495
Inline Power    0          0       0

Power supplies needed by system = 2
Switch#
```

The following example shows the **show module** command output for a system with inadequate power for all installed modules.

```
Switch# show module

Mod  Ports Card Type                                Model              Serial No.
----+-----+---------------------------------------+------------------+--------
---
 1      2  1000BaseX (GBIC) Supervisor Module     WS-X4014
JAB06070600
 2     48  10/100BaseTX (RJ45)                    WS-X4148
JAB040409GK
 3     48  10/100BaseTX (RJ45)                    WS-X4148
JAB023402RM
```

```
 M MAC addresses                   Hw  Fw                Sw              Stat
--+--------------------------------+---+-----------------+---------------+-----
 1 0004.27b6.5a00 to 0004.27b6.5dff 1.2 12.1(11r)EW       12.1(11)EK2(0.2 Ok
 2 00b0.6465.2cf0 to 00b0.6465.2d1f 2.3                                   Ok
 3 0050.0f10.2850 to 0050.0f10.287f 1.0                                   Ok
 4 0001.6445.c3e0 to 0001.6445.c40f 0.0                                   Other
 5 0030.850e.2dc8 to 0030.850e.2ddf 0.7                                   Other
 6 0002.b9f1.e340 to 0002.b9f1.e36f 1.0                                   Other
Switch#
```

Configuring Inline Power

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

To set an interface to automatically detect an end station requiring power, and apply the inline power, perform this procedure:

	Task	Command
Step 1	Select the interface to configure.	`Switch(config)# interface {fastethernet | gigabitethernet} slot/port`
Step 2	Set the interface to automatically detect if the end device requires power and apply inline power to the end device if necessary. Use the **never** keyword to disable detection and power for the inline-power capable interface.	`Switch(config-if)# power inline {auto | never}`
Step 3	Exit configuration mode.	`Switch(config-if)# end`
Step 4	Display the inline power state for the switch.	`Switch# show power inline {fastethernet | gigabitethernet} slot/port`

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

This example shows how to set the Fast Ethernet interface 5/8 to automatically detect inline power and send power through that interface.

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface fastethernet 5/8
Switch(config-if)# power inline auto
Switch(config-if)# end
```

This example shows how to verify the inline power configuration for the Fast Ethernet interface 5/8.

```
Switch# show power inline fastethernet 5/8

Interface            Admin  Oper      Power ( mWatt )  Device
-------------------- ----- ---------- --------------- -----------
FastEthernet5/8      auto  on         400             cisco phone device
Switch#
```

If a Cisco IP phone is connected to an interface with external power, the switch does not recognize the phone. The **Device** column in the **show power inline command** displays as unknown.

The following example shows 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
```