Preparing for Installation

This chapter includes specific information about required tools and parts, safety guidelines, and preparatory information required to ensure a successful installation of your Cisco 7500 series router.

Do not unpack the Cisco 7500 series router until you are ready to install it. Keep the chassis in the shipping container to prevent accidental damage until you have determined where you want it installed. Use the appropriate unpacking documentation included with your Cisco 7500 series router.

The *Cisco Information Packet* provides safety, and service, and support information, and is included in the shipping container, together with any companion publications you specified on your order. Inspect all items for shipping damage. If anything is damaged, immediately contact a customer service representative.

Sections in this chapter include the following:

Tools and Parts You Need

Following are the tools and parts generally required to install your Cisco 7500 series router:

- Number 1 Phillips and 3/16-inch (0.476 cm) flat-blade screwdrivers; additional tools, parts, and procedures listed and discussed in companion documentation
- Rack-mount kit (hardware and accompanying documentation)

  If you are installing the Cisco 7500 series router in a rack, you might also need the following tools:

  – Number 2 Phillips screwdriver
  – 1/4-inch flat-blade screwdriver
  – Tape measure
  – Level

Note The Cisco 7513, Cisco 7513-MX, and Cisco 7576 rack-mounting procedure requires two people.

- One interface cable for each physical interface required
- A 20A circuit breaker and 20A outlet for the Cisco 7513, Cisco 7513-MX, and Cisco 7576 (required)
- A CSU/DSU for each data terminal equipment (DTE) serial interface
- Ethernet and Fast Ethernet transceivers (if required)
- Modem for remote configuration (if required)
- Antistatic mat or antistatic foam pad if you plan to remove interface processors or replace components on the board
- Your own ESD grounding strap or the disposable ESD strap included with the system

Safety Recommendations

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

Observe the following safety guidelines before installing a Cisco 7500 series router; they will help to ensure your safety and protect your equipment. This list is not inclusive of all potentially hazardous situations, so *be alert*.

- Always turn all power supplies off (O) and unplug all power cables before opening the chassis.
- Keep the chassis area clear and dust-free during and after installation.
- Keep tools and chassis components away from walk areas.
- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the chassis. Fasten your tie or scarf and sleeves.

Warning **Metal objects heat up when connected to power and ground, and can cause serious burns.**

Safety with Electricity

Follow these basic guidelines when working with any electrical equipment:

- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, and missing safety grounds.
- If an electrical accident occurs, proceed as follows:
  - Use caution; do not become a victim yourself. Disconnect power to the system.
  - If possible, send another person to get medical aid. Otherwise, assess the condition of the victim and then call for help.
  - Determine if the person needs rescue breathing or external cardiac compressions; then take appropriate action.

- Before beginning any procedures requiring access to the chassis interior, locate the emergency power-off switch for the room in which you are working.
- Disconnect all power and external cables before installing or removing a chassis.
- Never assume that power has been disconnected from a circuit; always check.

Warning **See the installation instructions before you connect the system to its power source.**

Warning **Before working on a chassis or working near power supplies, unplug the power cord on AC units or disconnect the power at the circuit breaker on DC units.**

Warning **Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is off and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected.**

- Do not work alone when potentially hazardous conditions exist.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.
- Never install equipment that appears damaged.
- Carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.

In addition, use the guidelines that follow when working with any equipment that is disconnected from a power source, but still connected to telephone or network wiring:

- Never install telephone wiring during a lightning storm.
- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
- Use caution when installing or modifying telephone lines.
- Do not work alone if potentially hazardous conditions exist.
- Never assume that power is disconnected from a circuit; always check.

Warning **Ultimate disposal of this product should be handled according to all national laws and regulations.**

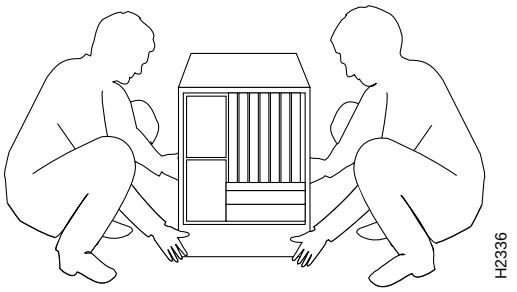
Chassis Lifting Guidelines

The Cisco 7500 series chassis are not intended to be moved frequently. Before you install the router, ensure that your site is properly prepared so you can avoid having to move the chassis later to accommodate power sources and network connections.

In general, two people are required to lift a Cisco 7507, Cisco 7507-MX, Cisco 7513, Cisco 7513-MX, or Cisco 7576 chassis. (See Figure 2-1.) Grasp the chassis underneath the lower edge and lift with both hands. To prevent injury, keep your back straight and lift with your legs, not your back.

Caution To prevent damage to the chassis and components, never attempt to lift the chassis by the plastic panels on the front of the chassis, or by the handles on power supplies or processor modules. These panels and handles were not designed to support the weight of the chassis.

Figure 2-1 Lifting Safely (Cisco 7507 Shown)



In general, whenever you lift a Cisco 7500 series chassis, follow these guidelines:

- Whenever possible, avoid lifting the chassis alone.
- Ensure that your footing is solid, and balance the weight of the object between your feet.
- Lift the chassis slowly; never move suddenly or twist your body as you lift.
- Keep your back straight and lift with your legs, not your back. If you must bend down to lift the chassis, bend at the knees, not at the waist, to reduce the strain on your lower back muscles.
- Whenever possible, lift a chassis from the bottom; grasp the underside of the chassis exterior with both hands.
- Always disconnect all external cables before lifting or moving the chassis.
- For the Cisco 7507, Cisco 7507-MX, Cisco 7513, Cisco 7513-MX, and Cisco 7576, we recommend you lift the chassis with power supplies removed; use both hands when handling the chassis power supply.

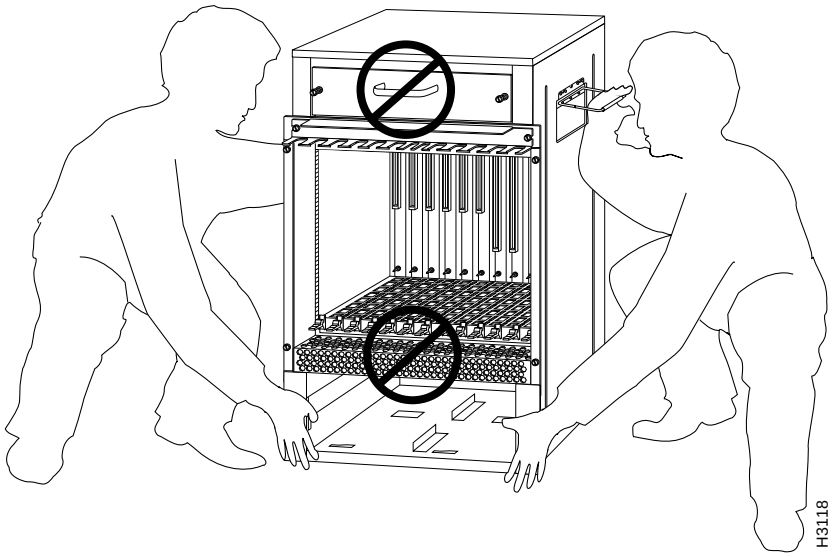
Caution To prevent damage, never attempt to lift or tilt the chassis with the handles on the interface processor carriers. These handles are not designed to support the weight of the chassis.

Warning **A Cisco 7513 or Cisco 7576 chassis weighs approximately 160 lb (72.6 kg) fully configured. To prevent injury, have someone help you lift the chassis.**

Note We recommend that you reduce the weight of the Cisco 7513, Cisco 7513-MX, or Cisco 7576 by removing the blower module, processor modules, power supplies, and card cage assembly before installation; however, this is not required.

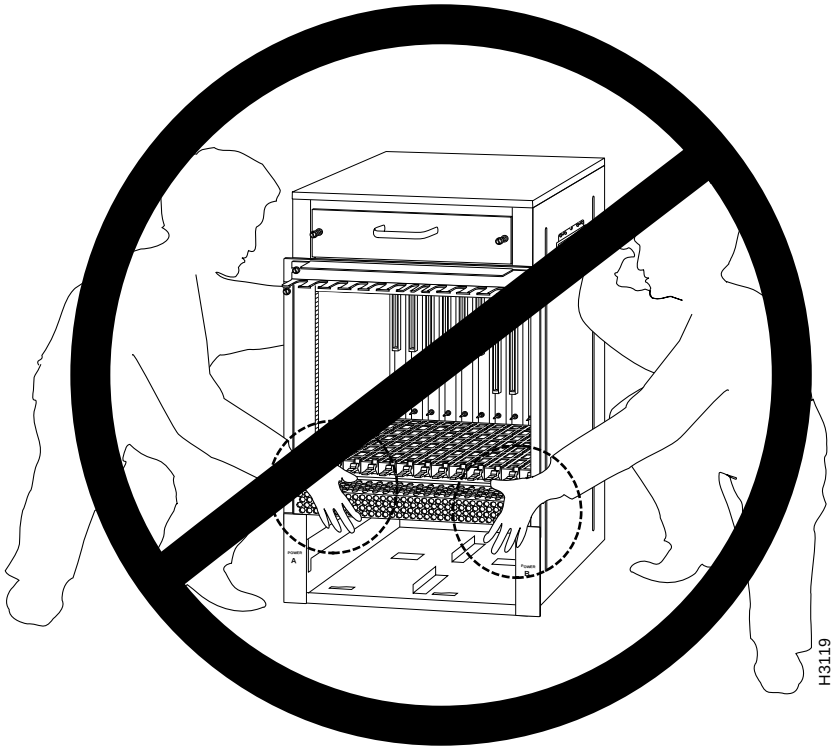
When you get ready to place the Cisco 7513, Cisco 7513-MX, or Cisco 7576 into a rack or onto a tabletop, each person should lift it by grasping the side handle with one hand and the bottom of the chassis with the other, and lift the chassis with your legs, as shown in Figure 2-2. (Do *not* lift the chassis using the blower module handle or the air intake vent below the card cage.)

Figure 2-2 Correct Way to Lift the Cisco 7513, Cisco 7513-MX, or Cisco 7576



Caution To prevent damage to the air intake vent below the card cage, do *not* lift the Cisco 7513, Cisco 7513-MX, or Cisco 7576 by grasping the side handle with one hand and the bottom of the card cage with the other, as shown in Figure 2-3. The air intake vent is not designed to support the weight of the chassis. Lift the chassis as shown in Figure 2-2.

Figure 2-3 Incorrect Way to Lift the Cisco 7513, Cisco 7513-MX, or Cisco 7576



Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) can damage equipment and impair electrical circuitry. It occurs when electronic components are improperly handled and can result in intermittent or complete failures. Always ensure that the chassis is electrically connected to earth ground. Wear an ESD-preventive wrist strap, ensuring that it makes good skin contact. To safely channel unwanted ESD voltages to ground, connect the clip to an unpainted surface of the chassis frame. If no wrist strap is available, ground yourself to the metal chassis.

Caution For safety, periodically check the resistance value of the ESD-preventive wrist strap, which should be between 1 and 10 megohms.

AC-Input and DC-Input Power Guidelines

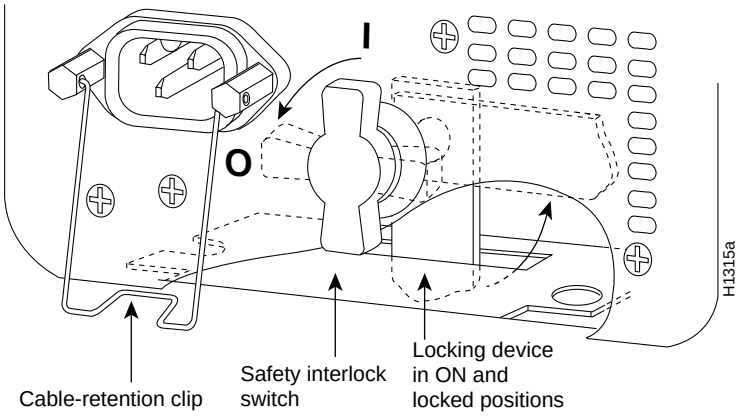
The wide-input AC-input power supplies in the Cisco 7500 series routers use a power factor corrector (PFC) that allows the router to operate on input voltage and current within the AC-voltage range of 100 to 240 VAC and 50 to 60 Hz.

In Chapter 1, Table 1-1 (for the Cisco 7505), Table 1-2 (for the Cisco 7507), Table 1-3 (for the Cisco 7507-MX), Table 1-4 (for the Cisco 7513), Table 1-5 (for the Cisco 7513-MX), and Table 1-6 (for the Cisco 7576) list system power specifications, including input voltage and operating frequency ranges. The power supplies in the Cisco 7507, Cisco 7507-MX, Cisco 7513, Cisco 7513-MX, and Cisco 7576 routers have two safety interlock features as shown inFigure 2-4 . A locking device on each power supply prevents the power supply from being removed from the chassis when the power supply switch is on. When the switch is in the on (|) position, a metal locking device extends into a slot in the chassis. When the switch is in the off (O) position, the locking device is raised and clears the slot. Also, a retention clip prevents the AC-input power supply power cable from being accidentally pulled out of the power supply socket.

For additional power supply information, see the "AC-Input and DC-Input Power Guidelines" section on page 2-7. 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. We recommend that you install a power conditioner between the AC power source and the router to help avoid problems caused by power spikes and brownouts, and to help protect against equipment damage from lightning strikes. We also recommend an uninterruptible power source (UPS) for the router to protect against power failures at your site.

Warning **This equipment is intended to be grounded. Ensure that the host is connected to earth ground during normal use.**

Figure 2-4 Power Supply Safety Interlocks (Cisco 7507 AC-Input Power Supply Shown)



Cisco 7505 Power Considerations

The single 600W wide-input AC-input power supply for the Cisco 7505 router uses a power factor corrector (PFC) that allows the Cisco 7505 to operate on input voltage and current within the range of 100 to 240 VAC and 50 to 60 Hz.

The 600W DC-input power supply allows the Cisco 7505 to operate between –40 and –52 VDC in North America (–48 VDC nominal) and between –56 and –72 VDC in the European Union (–60 VDC nominal). We recommend that you use an 8-AWG, highly flexible stranded cable for the DC power connections. (See Table 1-1 for a list of Cisco 7505 power specifications.)

Note The Cisco 7505 installation must comply with all applicable codes and is approved for use with copper conductors only. The ground bond fastening hardware should be of compatible material and preclude loosening, deterioration, and electrochemical corrosion of hardware and joined material. Attachment of the chassis ground to the central office or other interior ground system should be made with a 6-AWG, copper ground conductor at a minimum. The Cisco 7505 chassis employs two threaded M5 chassis grounding receptacles, which are intended to be bonded directly to the central office or other interior ground system. These receptacles are located on the rear of the chassis. The chassis ground requires M5 screws and locking hardware, which are not included.

Cisco 7507 and Cisco 7507-MX Power Considerations

The 700W AC-input power supply for the Cisco 7507 and Cisco 7507-MX routers uses a power factor corrector (PFC) that allows it to operate on input voltage and current within the range of 100 through 240 VAC and 47 through 63 Hz. The 700W DC-input power supply allows the Cisco 7507 and Cisco 7507-MX to operate between –40 and –72 VDC (–48 VDC nominal). We recommend that you use an 8-AWG, highly flexible stranded cable for the DC power connections. (See Table 1-2 and Table 1-3for a list of Cisco 7507 and Cisco 7507-MX power specifications.)

Note The Cisco 7507 or Cisco 7507-MX installation must comply with all applicable codes and is approved for use with copper conductors only. The ground bond fastening hardware should be of compatible material and preclude loosening, deterioration, and electrochemical corrosion of hardware and joined material. Attachment of the chassis ground to the central office or other interior ground system should be made with a 6-AWG, copper ground conductor at a minimum. The Cisco 7507 and Cisco 7507-MX chassis employs two threaded M5 chassis grounding receptacles, which are intended to be bonded directly to the central office or other interior ground system. These receptacles are located on the rear of the chassis. The chassis ground requires M5 screws and locking hardware, which are not included.

A second, identical power supply is also present in routers configured with the redundant power option; this ensures that power to the chassis continues uninterrupted if one power supply fails. It also provides uninterrupted power if the input power line fails, but *only* if the power supplies are connected to separate input lines.

Whenever possible, provide redundant power sources for each power supply installed in the chassis. For AC-input installations, install an uninterruptible power source where possible. Install proper grounding to avoid damage from lightning and power surges.

If only one input line is available, and you must connect both power supplies to the same source, the redundant power supply will provide continuous power if the first power supply fails. It cannot provide power backup if the input power fails.

Warning **This unit might have more than one power cord. To reduce the risk of electric shock, disconnect the two power supply cords before servicing the unit.**

Cisco 7513, Cisco 7513-MX, and Cisco 7576 Power Considerations

The 1200W AC-input power supply in the Cisco 7513, Cisco 7513-MX, and Cisco 7576 routers uses a power factor corrector (PFC) that allows it to operate on input voltage and current within the range of 100 through 240 VAC and 47 through 63 Hz. Follow these precautions and recommendations when planning power connections to the router. (See Table 1-4 for a list of Cisco 7513 power specifications, Table 1-5 for a list of Cisco 7513-MX power specifications, and Table 1-6 for a list of Cisco 7576 power specifications.)

Note Wiring codes prevent 20A plugs from being used with most equipment rack power strips. The Cisco 7513, Cisco 7513-MX, or Cisco 7576 installation must comply with all applicable codes. The ground bond fastening hardware should be of compatible material and preclude loosening, deterioration, and electrochemical corrosion of hardware and joined material. Installation is approved for use with copper conductors only. Attachment of the chassis ground receptacles to the central office or other interior ground system should be made with a 6-AWG, copper ground conductor at a minimum. The Cisco 7513, Cisco 7513-MX, and Cisco 7576 chassis employ two threaded M5 chassis grounding receptacles. These receptacles are intended to be bonded directly to the central office or other interior ground system and are located on the rear of the chassis. The chassis grounding receptacles require M5 screws and locking hardware, which are not included.

A second, identical power supply is also present in routers configured with the redundant power option; this ensures that power to the chassis continues uninterrupted if that one power supply fails. It also provides uninterrupted power if the input power line fails, but *only* if the power supplies are connected to separate input lines.

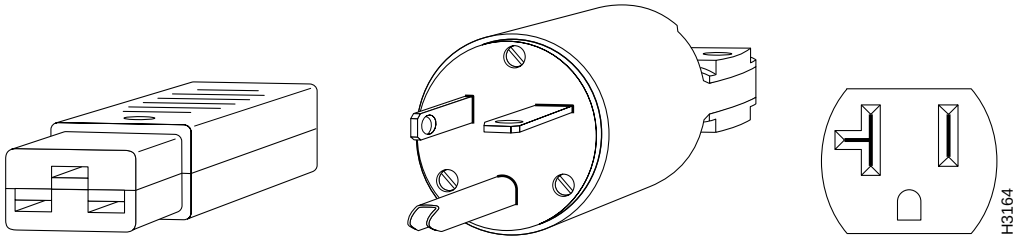
Whenever possible, provide redundant power sources for each power supply installed in the chassis. For AC-input installations, install an uninterruptible power source where possible. Install proper grounding to avoid damage from lightning and power surges.

If only one input line is available, and you must connect both power supplies to the same source, the redundant power supply will provide continuous power if the first power supply fails. It cannot provide power backup if the input power fails.

Warning **This unit might have more than one power cord. To reduce the risk of electric shock, disconnect the two power supply cords before servicing the unit.**

An AC-input-powered Cisco 7513, Cisco 7513-MX, or Cisco 7576 operating at 120 VAC requires a minimum of 20A service, with a 20A receptacle at the power source. The power cable supplied with the chassis uses a 20A plug. Figure 2-5 shows cable features required to connect the 20A plug to your AC source.

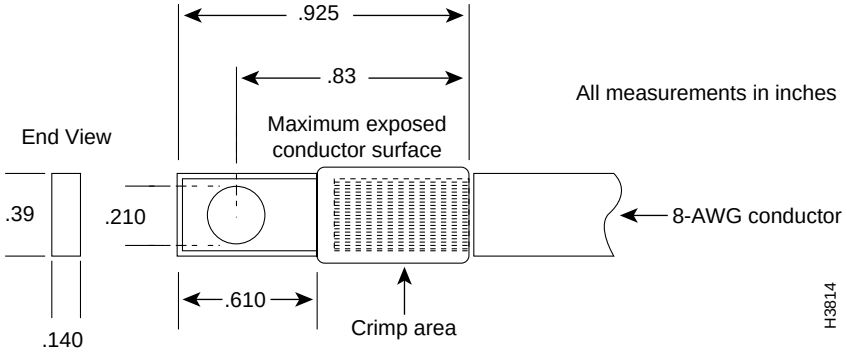
Figure 2-5 20A AC-Input Power Cable Connector, Plug, and Receptacle (Cisco 7513, Cisco 7513-MX, and Cisco 7576)



IEC 320 20-amp connector (to the AC power supply) | 20-amp plug | 20-amp receptacle

The DC-powered chassis requires a minimum 35A dedicated service (at –48 VDC). We recommend that you use an 8-AWG, highly flexible stranded cable for the DC power connections. Figure 2-6 shows the conductor preparations.

Figure 2-6 DC-Input Power Cable Connection to Terminal Block (Cisco 7513, Cisco 7513-MX, and Cisco 7576)



Plant Wiring Guidelines

This section provides guidelines for setting up the plant wiring and cabling at your site. When planning the location of the new system, consider wiring issues, distance limitations for signaling, electromagnetic interference, and connector compatibility, as described in the sections that follow.

Interference Considerations with Cabling

When wires are run for any significant distance in an electromagnetic field, interference can occur between the field and the signals on the wires. This fact has two implications for the construction of plant wiring:

- Bad practices can result in radio interference emanating from the plant wiring.
- Strong electromagnetic interference (EMI), especially as caused by lightning or radio transmitters, can destroy the signal drivers and receivers in the router, and can even create an electrical hazard by conducting power surges through lines and into equipment. (Review the safety warnings in the "Safety Recommendations" section on page 2-2.)

Note To predict and remedy strong EMI, you might need to consult experts in radio frequency interference (RFI).

If you use twisted-pair cable in your plant wiring with a good distribution of grounding conductors, the plant wiring is unlikely to emit radio interference. When exceeding the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal.

If wires exceed recommended distances, or if wires pass between buildings, give special consideration to the effect of a lightning strike in your vicinity. The electromagnetic pulse (EMP) caused by lightning or other high-energy phenomena can easily couple enough energy into unshielded conductors to destroy electronic devices. If you have had problems of this sort in the past, you might want to consult experts in electrical surge suppression and shielding.

Most data centers cannot resolve the infrequent but potentially catastrophic problems just described without pulse meters and other special equipment. These problems can cost a great deal of time to identify and resolve, so take precautions by providing a properly grounded and shielded environment, with special attention to issues of electrical surge suppression.

Warning **When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations should be the appropriate size for the wires and should clamp both the insulation and conductor.**

Warning **To be installed and maintained by service personnel as defined by AS/NZS 3260. Incorrect connection of this or connected equipment to a General Purpose Outlet could result in a hazardous situation. The telecommunication lines must be disconnected before unplugging the main power connection and while the housing is open.**

Warning **Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.**

Distance Limitations of Interface Cabling

The length of your networks and the distance between connections depend on the type of signal, the signal speed, and the transmission media (the type of cabling used to transmit the signals). For example, standard coaxial cable has a greater channel capacity than twisted-pair cabling.

The distance and rate limits for the available electrical interfaces supported by Cisco 7500 series routers are recommended maximum speeds and distances for signaling. If you understand the electrical problems that might arise and can compensate for them, you might get good results with faster rates and greater distances; however, do so at your own risk.

Note We recommend that you *do not* exceed specified transmission rate and distance limits for interface cabling.

For complete information on recommended maximum speeds and distances for signaling and interface specifications for the electrical interfaces supported by the Cisco 7500 series routers, refer to the companion publication *Interface Processor Installation and Configuration Guide*.

Site Environment, Chassis Temperature, and Airflow Guidelines

Cisco 7500 series routers can operate as standalone systems placed on a table or as rack-mounted systems in a data processing or lab environment. (We recommend rack-mounting for all Cisco 7500 series routers.)

The internal fan or blower operates so that it maintains an acceptable operating temperature inside the chassis. The router requires a dry, clean, well-ventilated, and air-conditioned environment. The internal blower pulls ambient air through the chassis to cool the internal components. To allow sufficient airflow, maintain a minimum of 2 inches (5.08 cm) of clearance at both the inlet and exhaust openings on the chassis. If the airflow is blocked or restricted, or if the inlet air is too warm, an overtemperature condition can occur. Under extreme conditions, the environmental monitoring system will shut down the power to protect the system components.

To help maintain normal operation and avoid unnecessary maintenance, plan your site configuration and prepare your site *before* installation. After installation, make sure that the site maintains an ambient temperature of 32 through 104 F(0 through 40 C),and keep the area around the chassis as free from dust as is practical. For a description of the environmental monitor and status levels, see the "Environmental Monitoring and Reporting Overview for the Cisco 7500 Series" section on page 2-22.

If the temperature of the air drawn into the chassis is higher than desirable, the air temperature inside the chassis might also be too high. This condition can occur when the wiring closet or rack in which the chassis is mounted is not ventilated properly, when the exhaust of one device is placed so it enters the air inlet vent of the chassis, or when the chassis is the top unit in an unventilated rack. Any of these conditions can inhibit airflow and create an overtemperature condition.

Because the inlet air flows into one part of the chassis and out another, other devices can be rack-mounted with as little as 1 inch (2.54 cm) of clearance above and below the chassis. However, when mounting a router in a rack with other equipment, or when placing it on a table with other equipment located close by, ensure that the exhaust from other equipment does not blow into the inlet of the chassis. The inlet air is drawn in and exhausted as shown in Figure 2-7 (for the Cisco 7505), Figure 2-8 (for the Cisco 7507 and Cisco 7507-MX), and Figure 2-9 (for the Cisco 7513, Cisco 7513-MX, and Cisco 7576).

Table 2-1 lists the operating and nonoperating environmental site requirements. To maintain normal operation and ensure high system availability, maintain an ambient temperature and clean power at your site.

The ranges in Table 2-1 are those within which the router will continue to operate; however, a measurement that is approaching the minimum or maximum of a range indicates a potential problem. You can maintain normal operation by anticipating and correcting environmental anomalies before they approach the maximum operating range.

Table 2-1 Environmental Specifications for the Cisco 7500 Series Routers

Specifications	Minimum	Maximum
Temperature, ambient operating	32 F (0 C)	104 F (40 C)
Temperature, ambient nonoperating and storage	–4 F (–20 C)	149 F (65 C)

Table 2-1 Environmental Specifications for the Cisco 7500 Series Routers (continued)

Specifications	Minimum	Maximum
Humidity, ambient (noncondensing) operating	10%	90%
Humidity, ambient (noncondensing) nonoperating and storage	5%	95%
Altitude, operating and nonoperating	Sea level	10,000 ft (3050 m)
Vibration, operating	5 to 200 Hz, 0.5 g[1] (1 octave per minute)	–
Vibration, nonoperating	5 to 200 Hz, 1 g (1 octave per minute) 200 to 500 Hz, 2 g (1 octave per minute)	–

1. g = force of gravity; 32 ft/sec^2.

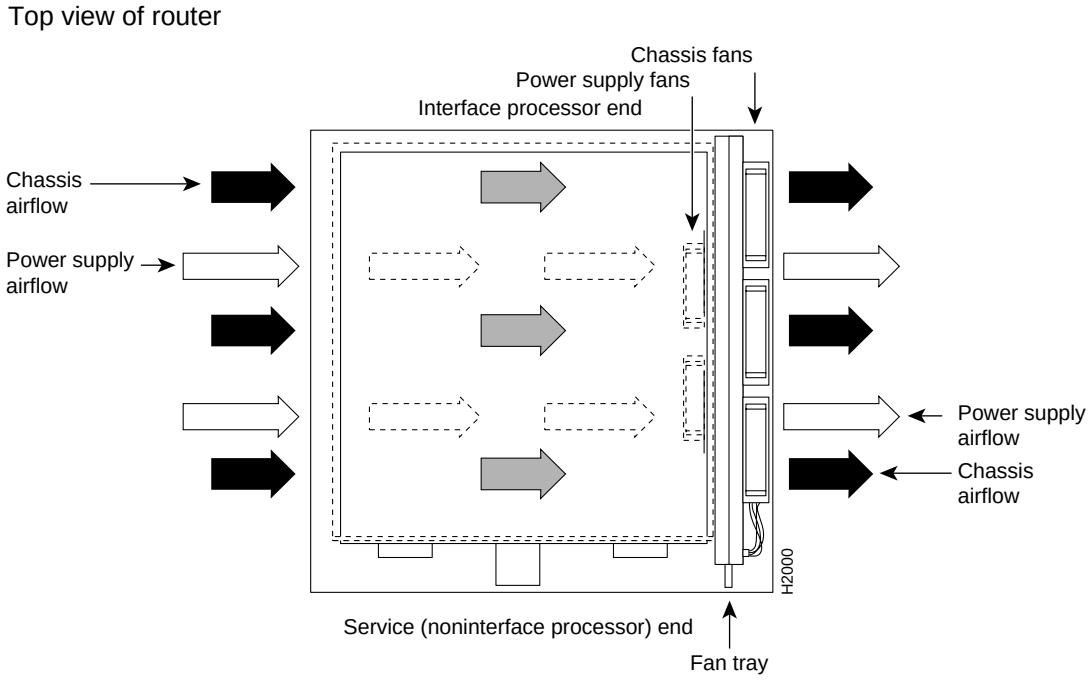
Cisco 7505 Airflow Considerations

In the Cisco 7505, six individual axial fans draw cooling air through the chassis interior to maintain an acceptable temperature for the internal components. The fans draw air in through the inlet vents on the side of the chassis opposite the fans, across the processor modules and other internal components, and through the exhaust vents adjacent to the fans.

The sides of the chassis must remain unobstructed to ensure adequate airflow and prevent overheating inside the chassis. A temperature sensor on the RSP monitors the internal air temperature. The power supply has two fans for cooling.

Figure 2-7 shows the chassis fans and airflow through the Cisco 7505.

Figure 2-7 Airflow Through the Cisco 7505

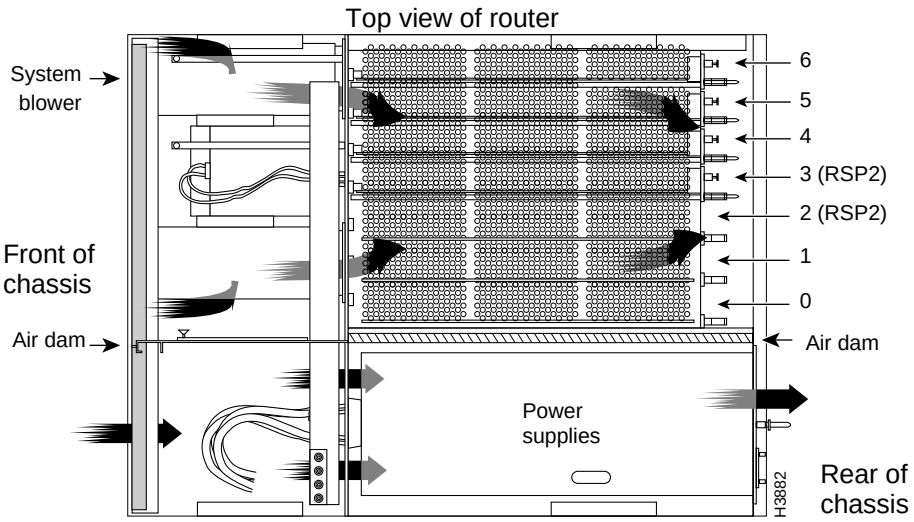


Cisco 7507 and Cisco 7507-MX Airflow Considerations

The system blower on the Cisco 7507 and Cisco 7507-MX provides cooling air for the processor modules. The blower draws air in through the air filter in the front chassis panel and directs it up through the floor of the internal slot compartment and over the cards. The exhaust air is forced out the rear of the chassis above and to each side of the processor slots. The blower needs a clean air filter in order to draw in sufficient amounts of cooling air; excessive dust in the filter will restrict the airflow. Keep the air filter clean and replace it when necessary.

Figure 2-8 shows the system blower and airflow through the Cisco 7507 and Cisco 7507-MX.

Figure 2-8 Airflow Through the Cisco 7507 and Cisco 7507-MX



Sensors on the RSP2 (for example) monitor the inlet and internal chassis air temperatures. If the air temperature at either of the sensors exceeds a desired threshold, an environmental monitor displays warning messages and can interrupt system operation to protect the system components from possible damage from excessive heat or electrical current.

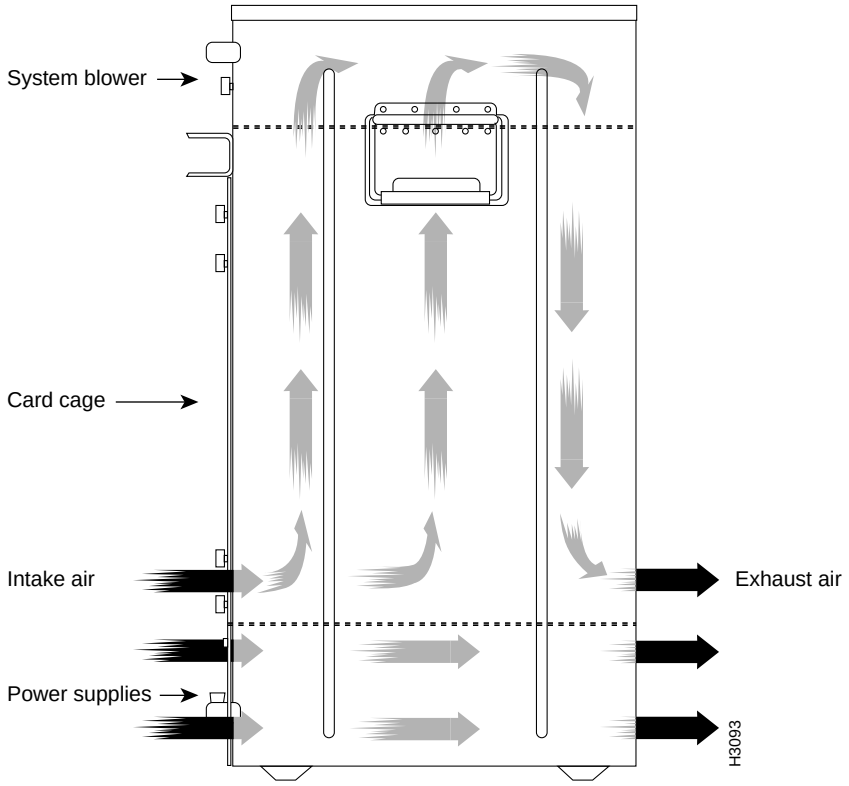
The power supplies have their own fans. An air dam between the power supply bays and the processor module compartment keeps the airflow constant.

Cisco 7513, Cisco 7513-MX, and Cisco 7576 Airflow Considerations

The blower on the Cisco 7513, Cisco 7513-MX, and Cisco 7576 provides cooling air for the processor modules. The exhaust air is forced out the front of the chassis behind the card cage.

Figure 2-9 shows the system blower and airflow through the Cisco 7513, Cisco 7513-MX, and Cisco 7576.

Figure 2-9 Airflow Through the Cisco 7513, Cisco 7513-MX, and Cisco 7576



The power supplies have their own fans with airflow that is independent of the chassis airflow. Ensure that there is minimum front and back clearance of 6 inches (15.24 cm).

Equipment Rack-Mounting Guidelines

This section provides the equipment rack-mounting guidelines that must be observed before installing a Cisco 7500 series router in an equipment rack.

General Equipment Rack Ventilation Considerations

If you plan to install the router in an equipment rack, you can avoid overtemperature conditions by observing the following precautions:

- There must be at least 2 inches (5.08 cm) of clearance between each side of the chassis and the side (or inner wall) of an enclosed rack.
- Enclosed racks must have adequate ventilation or an exhaust fan; use an open rack whenever possible.
- A ventilation system that is too powerful in a closed rack can also prevent cooling by creating negative pressure around the chassis and redirecting the air away from the inlet vents. If necessary, operate the chassis with the rack open.
- The correct use of baffles in an enclosed rack can help to ensure that cool air reaches the chassis.

- Equipment near the bottom of a rack can generate excessive heat that is drawn upward and into the inlet ports of equipment above, leading to overtemperature conditions in devices at or near the top of the rack.

In addition, the following sections contain specific rack-mounting guidelines for the Cisco 7500 series routers:

- Cisco 7505 Rack-Mount Considerations, page 2-16
- Cisco 7507 and Cisco 7507-MX Rack-Mount Considerations, page 2-18
- Cisco 7513, Cisco 7513-MX, and Cisco 7576 Rack-Mount Considerations, page 2-20

Cisco 7505 Rack-Mount Considerations

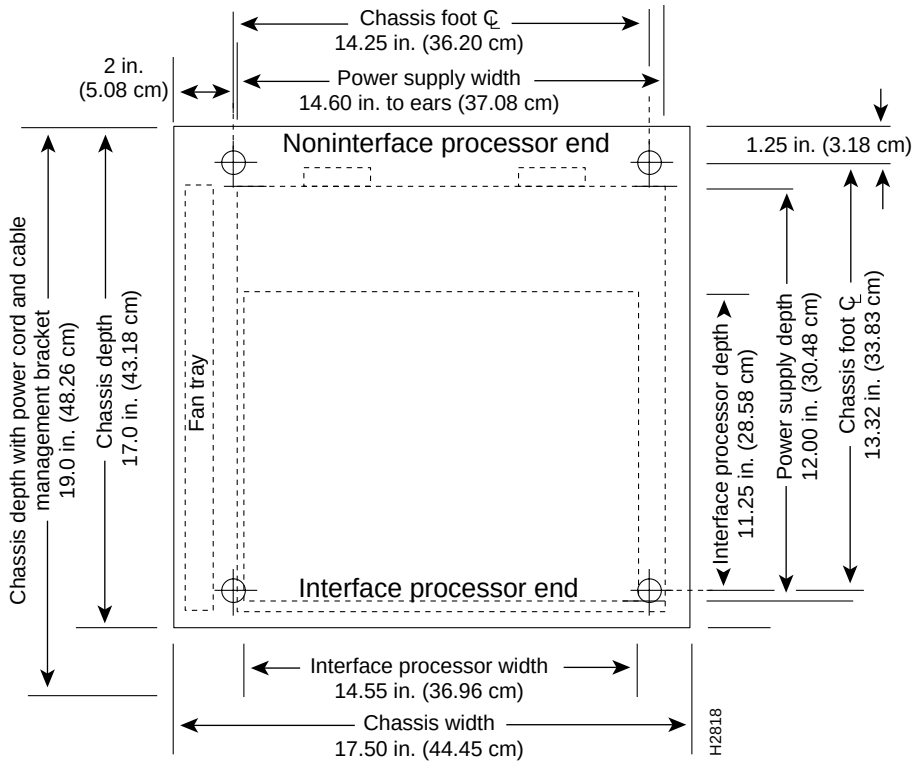
The rack-mounting hardware included with the Cisco 7505 is suitable for most 19-inch (48.26-cm) equipment racks or 2-post racks. The router chassis mounts to two posts or rails in the rack with two mounting ears, which attach to the sides of the chassis. Ideally, you should be able to access both the interface processor and noninterface processor ends of the router without having to remove it from the rack. Before using a particular rack, check for obstructions (such as a power strip) that could impair access to the interface processors or chassis cover panel.

As an alternative, the router can be mounted on an equipment shelf provided that the rack dimensions allow the router to be secured to the shelf, and the overall configuration permits safe installation and access. Figure 2-10 shows the chassis footprint and outer dimensions.

To use the rack-mounting hardware provided with the router, consider the following guidelines:

- To mount the router between two posts or rails using the mounting ears, the inner clearance (the width between the *inner* sides of the two posts or rails) must be at least 17.72 inches (45 cm).
- The height of the chassis is 11 inches (27.94 cm) with the chassis feet attached, and 10.5 inches (26.67 cm) when the chassis feet are removed.
- When mounting the router in four-post or 2-post racks, be sure to use all eight of the screws provided to secure the chassis ears to the rack posts (use four screws per ear). The ears secure one end of the chassis to two rack posts; the rest of the chassis is cantilevered off the posts. Using fewer than all eight screws might not be sufficient to support the weight of the chassis.
- If the rack has a vertical power strip or other obstacle, ensure that there is sufficient clearance to install and remove processor modules, which must be pulled straight out of their slots.

Figure 2-10 Chassis Footprint and Outer Dimensions (Cisco 7505)



Caution To prevent chassis overheating, never install the router in an enclosed rack that is not properly ventilated or air-conditioned.

When planning your Cisco 7505 rack installation, consider the following guidelines:

- Install the router in an open rack whenever possible. If installation in an enclosed rack is unavoidable, ensure that the rack has adequate ventilation.
- Allow sufficient clearance around the rack for maintenance. If the rack is mobile, you can push it back near a wall or cabinet for normal operation and pull it out when necessary for maintenance (installing or moving interface processors, connecting cables, or replacing or upgrading components).
- Maintain a minimum clearance of 2 inches (5.08 cm) on each side of the chassis for the cooling air inlet and exhaust ports. Avoid placing the router in an overly congested rack or directly next to another equipment rack. Otherwise, the heated exhaust from other equipment can enter the inlet air vents and cause an overtemperature condition inside the router.
- Install and use the cable-management brackets included with the router to keep cables organized and out of the way. Consider the equipment and cabling that is already installed in the rack. Ensure that cables from other equipment will not impair access to the interface processors or require you to disconnect cables unnecessarily to perform equipment maintenance or upgrades.
- Install heavier equipment in the lower half of the rack to maintain a low center of gravity.

- If you plan to use an equipment shelf, ensure that the shelf is constructed to support the weight and dimensions of the chassis. Figure 2-10 shows the chassis footprint, which you will need if you are designing a customized shelf.
- If you use 2-post racks, be sure that the rack is bolted to the floor and secured. One end of the chassis mounts to the two rack posts with the chassis ears, and the rest of the chassis is cantilevered off the posts. Ensure that the weight of the chassis does not make the rack unstable. Some 2-post racks are also secured to ceiling brackets if warranted by the weight of the equipment in the rack.

In addition to the preceding guidelines, we recommend you review the precautions for avoiding overtemperature conditions in the "General Equipment Rack Ventilation Considerations" section on page 2-15.

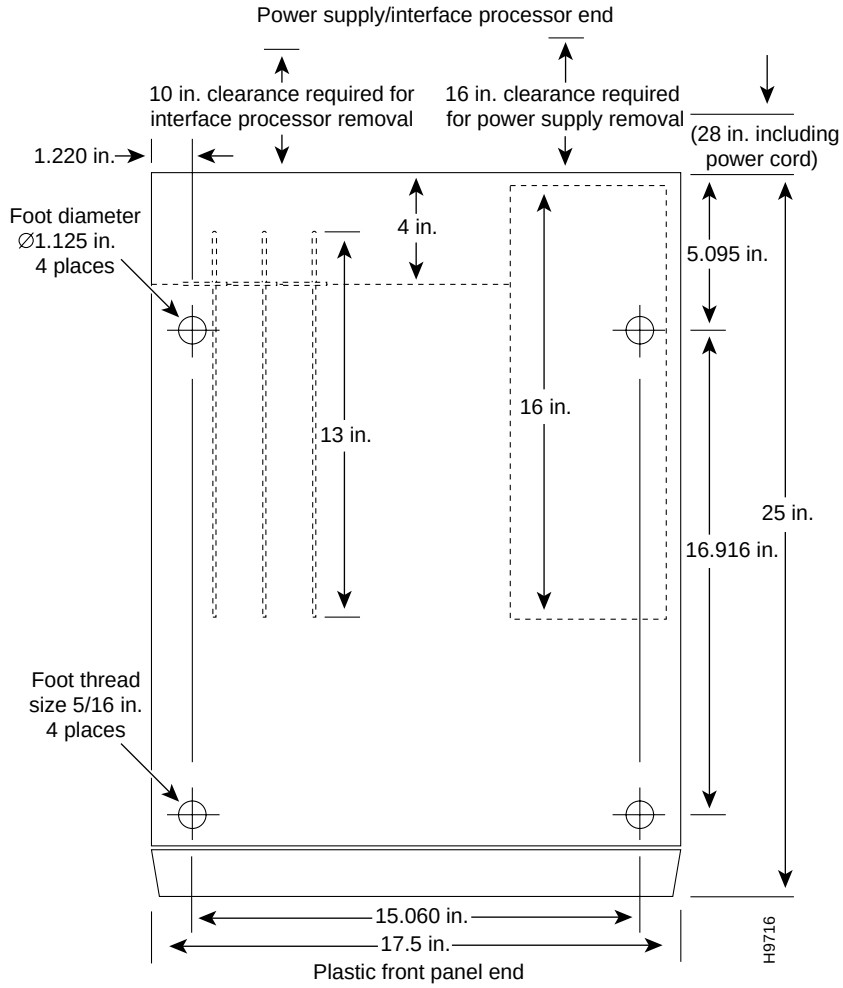
Cisco 7507 and Cisco 7507-MX Rack-Mount Considerations

An optional rack-mounting kit is available for mounting the Cisco 7507 or Cisco 7507-MX in a standard 19-inch (48.26 cm) equipment rack. The mounting kit is not suitable for use with 2-post equipment racks, or those with obstructions (such as a power strip) that could impair access to the interface processors and power supplies. In telco environments or at installation sites that use nonstandard racks, the router can be mounted on an equipment shelf, provided that the rack dimensions allow safe installation and access to the power supplies and interface processors. Figure 2-11 shows the chassis footprint and outer dimensions.

To use the optional rack-mount kit, your equipment rack must meet the following requirements:

- The width of the rack, between the two front mounting strips or rails, must be 17.75 inches (45.09 cm).
- The depth of the rack, between the front and rear mounting strips, must be at least 19.25 inches (48.90 cm) but not more than 32 inches (81.28 cm).
- The height of the chassis is approximately 20 inches (50.08 cm) (19.25 inches [48.90 cm] when the chassis feet are removed). The rack must have sufficient vertical clearance to insert the chassis and, if required after installation, to remove the chassis feet.
- If the rack has a vertical power strip or other potential obstacle, ensure that it will allow sufficient clearance to install and remove both interface processors (11 inches [27.94 cm] deep) and power supplies (16 inches [40.64 cm] deep), both of which must be pulled straight out of the chassis.

Figure 2-11 Chassis Footprint and Outer Dimensions (Cisco 7507 and Cisco 7507-MX)



Caution To prevent overheating, never install the router in an enclosed rack that is not properly ventilated or air conditioned.

When planning your Cisco 7507 or Cisco 7507-MX rack installation, consider the following guidelines:

- Allow at least 3 to 4 feet (0.91 to 1.22 m) of clearance behind the rack for maintenance. If the rack is mobile, you can push it back within 1 foot (0.3 m) of a wall or cabinet for normal operation and pull it out when necessary for maintenance (installing or replacing interface processors or power supplies, or connecting network cables or interface units).
- The ports for cooling air are located on the front and rear of the chassis, so multiple routers can be rack-mounted with little or no vertical clearance. However, avoid placing the router in an overly congested rack.
- Consider the equipment and cabling that is already installed in the rack. Ensure that cables from other equipment will not obstruct the airflow through the chassis or impair access to the power supplies or interface processors. Route cables away from field-replaceable components to avoid having to disconnect cables unnecessarily to perform equipment maintenance or upgrades.
- Install heavier equipment in the lower half of the rack to maintain a low center of gravity.

- If you plan to use an equipment shelf, ensure that the shelf is constructed to support the weight and dimensions of the chassis. Figure 2-11shows the chassis footprint, which you will need if you are designing a customized shelf.
- Install the router in an open rack whenever possible. If installation in an enclosed rack is unavoidable, ensure that the rack has adequate ventilation or an exhaust fan.
- To properly install the Cisco 7507 or Cisco 7507-MX in a rack, use the instructions in the configuration note *Cisco 7000 and Cisco 7507 Rack-Mount Kit Installation Instructions* (Document Number 78-1058-xx, where xx indicates the latest document version) that accompanies the rack-mount kit. The rack-mount kit for the Cisco 7507 and Cisco 7507-MX is the same kit (ACS-7000RMK=) as the rack-mount kit for the Cisco 7513, Cisco 7513-MX, and Cisco 7576.

In addition to the preceding guidelines, we recommend you review the precautions for avoiding overtemperature conditions in the "General Equipment Rack Ventilation Considerations" section on page 2-15.

Cisco 7513, Cisco 7513-MX, and Cisco 7576 Rack-Mount Considerations

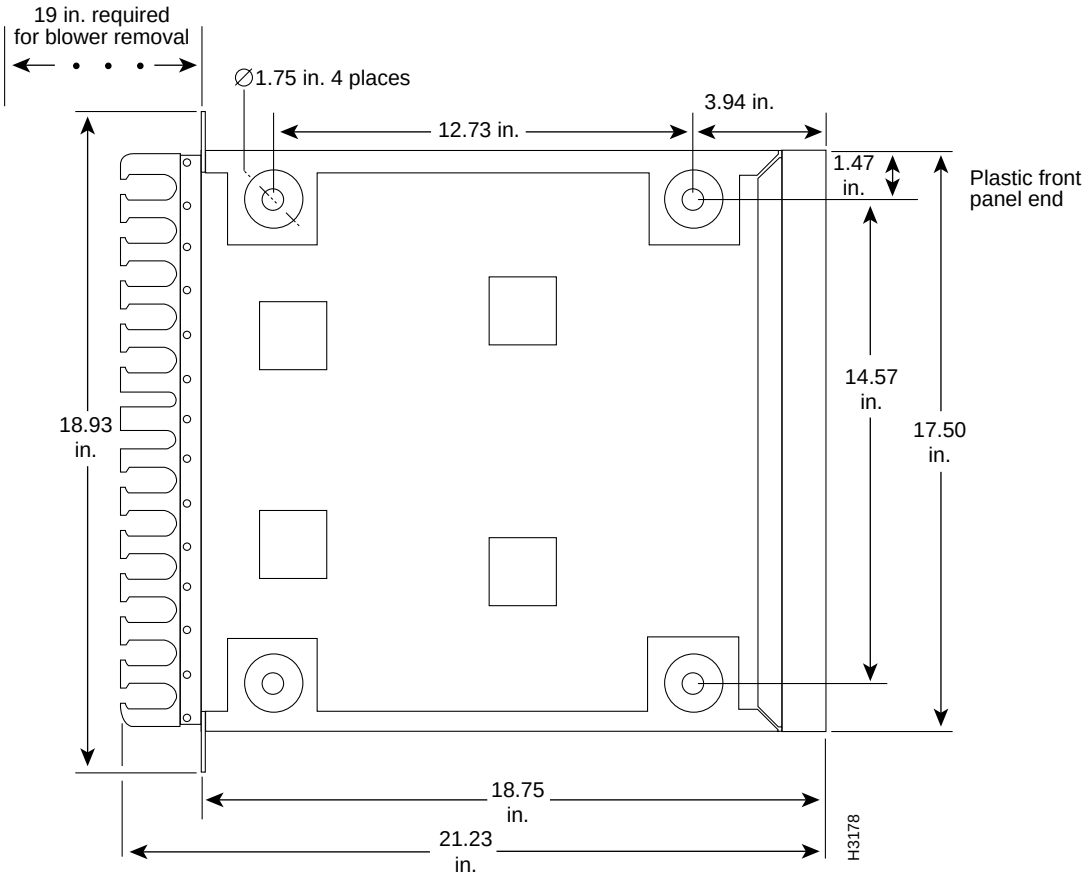
The rack-mounting hardware included with the Cisco 7513, Cisco 7513-MX, and Cisco 7576 is suitable for most 19-inch equipment racks and 2-post racks. Ideally, you should be able to access both the interface processor and noninterface processor ends of the router without having to remove the chassis from the rack.

The router can be mounted in the rear of a rack. Before using a particular rack, check for obstructions (such as a power strip) that could impair rack-mount installation. If a power strip does impair a rear rack-mount installation, remove the power strip before installing the router in the rack and then replace it after the chassis is installed. As an alternative, the router can be mounted on an equipment shelf provided that the shelf and rack dimensions allow the router to be secured to the shelf and the overall configuration permits safe installation and access; however, we recommend rack-mount installation for the Cisco 7513, Cisco 7513-MX, and Cisco 7576. Figure 2-12 shows the chassis footprint and outer dimensions.

To use the rack-mounting hardware provided with the router, consider the following guidelines:

- To mount the router between two posts or rails using the mounting ears, the inner clearance (the width between the *inner* sides of the two posts or rails) must be at least 17.72 inches (45 cm).
- The height of the chassis is 33.75 inches (85.725 cm).
- When mounting the router in four-post or 2-post racks, be sure to use all of the screws provided to secure the chassis to the rack posts. Using fewer than all the screws provided in the rack-mount kit might not be sufficient to support the weight of the chassis.
- If the rack has a vertical power strip or other obstacle, ensure that there is sufficient clearance to install and remove processor modules, which must be pulled straight out of their slots.

Figure 2-12 Chassis Footprint and Outer Dimensions (Cisco 7513, Cisco 7513-MX, and Cisco 7576)



Caution To prevent chassis overheating, never install the router in an enclosed rack or room that is not properly ventilated or air-conditioned.

When planning your Cisco 7513, Cisco 7513-MX, or Cisco 7576 rack installation, consider the following guidelines:

- Install the router in an open rack whenever possible. If installation in an enclosed rack is unavoidable, ensure that the rack has adequate ventilation.
- If you plan to use an equipment shelf, ensure that the shelf is constructed to support the weight and dimensions of the chassis. Figure 2-12 shows the chassis footprint, which you will need if you are designing a customized shelf. We recommend that you use the rack-mount kit designed for the Cisco 7513, Cisco 7513-MX, and Cisco 7576.
- Allow sufficient clearance around the rack for maintenance. If the rack is mobile, you can push it back near a wall or cabinet for normal operation and pull it out when necessary for maintenance (installing or moving interface processors, connecting cables, or replacing or upgrading components). Otherwise, allow 19 inches (48.3 cm) of clearance to remove the blower module, power supplies, and processor modules.

- Maintain a minimum clearance of 6 inches (15.24 cm) on the rear and front of the chassis for the cooling air inlet and exhaust ports, respectively. Avoid placing the router in an overly congested rack or directly next to another equipment rack. Otherwise, the heated exhaust air from other equipment can enter the inlet air vents and cause an overtemperature condition inside the router.
- Install and use the cable management bracket included with the router to keep cables organized and out of the way of processor modules, power supplies, and the blower module. Consider the equipment and cabling that is already installed in the rack. Ensure that cables from other equipment will not impair access to the interface processors or require you to disconnect cables unnecessarily to perform equipment maintenance or upgrades.
- Always install heavier equipment in the lower half of a rack to maintain a low center of gravity to prevent the rack from falling over. If you install one Cisco 7513, Cisco 7513-MX, or Cisco 7576 in a rack, the chassis bottom should not be higher than 20 inches (50.8 cm) from the floor.
- If you use 2-post racks, be sure that the rack is bolted to the floor and secured. One end of the chassis mounts to the two rack posts with the chassis ears; the rest of the chassis is cantilevered off the posts. Ensure that the weight of the chassis does not make the rack unstable. Some 2-post racks are also secured to ceiling brackets if warranted by the weight of the equipment in the rack.
- To properly install the Cisco 7513, Cisco 7513-MX, or Cisco 7576 in a rack, use the instructions in the configuration note *Cisco 7513 and Cisco 7576 Rack-Mount Kit Installation Instructions* (Document Number 78-2023-xx, where xx indicates the latest document version), which accompanies the rack-mount kit. The rack-mount kit is the same for the Cisco 7507, Cisco 7507-MX, Cisco 7513, Cisco 7513-MX, and Cisco 7576 (ACS-7000RMK=).

In addition to the preceding guidelines, we recommend you review the precautions for avoiding overtemperature conditions in the "General Equipment Rack Ventilation Considerations" section on page 2-15.

Environmental Monitoring and Reporting Overview for the Cisco 7500 Series

In the Cisco 7500 series routers, the environmental monitoring and reporting functions are controlled by the chassis interface (CI) board. These functions enable you to maintain normal system operation by identifying and resolving adverse conditions prior to loss of operation. The environmental monitoring functions constantly monitor the internal chassis air temperature and DC supply voltages and currents.

Each power supply monitors its own voltage and temperature and shuts itself down if it detects a critical condition within the power supply. If conditions reach shutdown thresholds, the system shuts down to avoid equipment damage from excessive heat. The reporting functions periodically log the values of measured parameters so that you can retrieve them for analysis later, and the reporting functions display warnings on the console if any of the monitored parameters exceed defined thresholds.

In addition to monitoring internal temperature and voltage levels, the system also monitors the fan tray or blower. If the fan tray or blower fails, the system displays a warning message on the console. If the blower is still not operating properly after 2 minutes, the system shuts down to protect the internal components against damage from excessive heat.

The following sections provide information on environmental monitoring, temperature and voltage thresholds, and environmental reporting functions in the Cisco 7500 series routers:

Cisco 7500 Series Environmental Monitoring

The temperature of the cooling air that flows through the processor slots is monitored by three sensors on the RSP: *inlet*, *hotpoint*, and *exhaust*.

The power supply DC voltages are monitored by the chassis interface (CI) and indicated by the systems as Normal, Critical, and Warning levels, as follows:

- Normal—All monitored parameters are within normal tolerances. The system blower operates at 55 percent of its maximum speed if the internal air temperature does not exceed this level.
- Warning (low and high)—The system is approaching an out-of-tolerance condition. The system will continue to operate, but we recommend that you monitor the system and take action to bring the system back to a normal state. If the internal air temperature is above the normal range, the blower speed will increase linearly from 55 percent of maximum speed until it reaches 100 percent speed at 33 C (91 F).
- Critical (low and high)—An out-of-tolerance temperature or voltage condition exists. The system may not continue operation. If a voltage measurement reaches this level, the power supply can shut down the system. If the blower fails, the system will display a warning message and shut down in 2 minutes. Immediate operator action is required.

Processor shutdown occurs when the chassis interface detects a temperature or blower-failure condition that could result in physical damage to system components and has disabled DC power to all interface processors. DC power to the RSP, chassis interface, and fans or blower stays on, but no RSP-related processing takes place. Immediate action is required. DC power remains off until the inside temperature of the chassis reaches 40 C (104 F), at which point the system will restart, up to 15 times (if required). After the fifteenth restart, if the source of the shutdown has not been corrected, the system will execute a hard shutdown. Before any shutdown, the system logs the status of monitored parameters in NVRAM so that you can retrieve it later to help determine the cause of the problem.

Power supply shutdown occurs when an out-of-tolerance voltage, current, or temperature condition is detected within the power supply and it is shut down (or a shutdown is imminent). All DC power remains disabled until you toggle the power switch and correct the problem that caused the shutdown (if any).

This shutdown typically occurs for one of the following reasons:

- Loss of AC or DC input power occurred (the power source failed).
- Power supply detected an overvoltage, overcurrent, AC or DC undervoltage, or overtemperature condition within the power supply. This includes operator shutdown by turning off the system power switch, which the power supply interprets as an undervoltage condition.
- The chassis interface detected an overtemperature condition within the system.

Note In the Cisco 7513 and Cisco 7513-MX, a hard shutdown is achieved by disabling the power source. In the Cisco 7576, both routers share the same power source. In the Cisco 7576, when one router senses a problem requiring a hard shutdown, the RSP and all interface processors installed in that router (only) are powered off. In the first 14 temperature cycles, the RSP and IPs are powered back on once the

temperature of the system falls below a certain temperature setpoint. At the fifteenth temperature cycle, this temperature setpoint is changed to a very low value, preventing the affected router from powering back up.

This achieves a hard shutdown of one router without affecting the other router. The RSP and IPs will remain disabled until the power is manually recycled. This allows you to choose a suitable time to recycle the power when it will not adversely affect your users.

In the Cisco 7507, Cisco 7507-MX, Cisco 7513, Cisco 7513-MX, and Cisco 7576, a blower failure is indicated when the blower impeller has stopped turning. A warning message is displayed on the console, and the system will continue operating until it shuts itself down because of overheating, or until you shut it down.

Cisco 7500 Series Temperature and Voltage Thresholds

If the air temperature exceeds a defined threshold, the system processor displays warning messages on the console terminal, and if the temperature exceeds the shutdown threshold, it shuts down the system. The system stores the present parameter measurements for both temperature and DC voltage in NVRAM, so that you can retrieve them later as a report of the last shutdown parameters.

The power supplies monitor internal power supply temperature and voltages. A power supply is either within tolerance (Normal) or out of tolerance (Critical or Warning levels). If an internal power supply temperature or voltage reaches a critical level, the power supply shuts down without any interaction with the system processor.

If the system detects that AC or DC input power is dropping, but it is able to recover before the power supply shuts down, it logs the event as an intermittent power failure. The reporting functions display the cumulative number of intermittent power failures logged since the last power up.

The following sections include the temperature and voltage threshold specifications for the Cisco 7500 series routers:

- Cisco 7505 Temperature and Voltage Thresholds, page 2-24
- Cisco 7507 and Cisco 7507-MX Temperature and Voltage Thresholds, page 2-25
- Cisco 7513, Cisco 7513-MX, and Cisco 7576 Temperature and Voltage Thresholds, page 2-25

Note For additional environmental temperature and airflow guidelines, see the "Site Environment, Chassis Temperature, and Airflow Guidelines" section on page 2-12.

Cisco 7505 Temperature and Voltage Thresholds

Table 2-2 lists temperature thresholds for the first four processor-monitored levels. (The system displays all temperatures in Celsius only.) Table 2-3 lists the DC power thresholds for the Normal and Critical power supply-monitored levels.

)

Table 2-2 Typical Processor-Monitored Temperature Thresholds (Cisco 7505)

Parameter	Warning	Normal	Warning	Critical	Shutdown
Inlet air	< 10 C	10–39 C	39–46 C	46–64 C	> 64 C
Airflow	< 10 C	10–70 C	70–77 C	77–88 C	> 88 C

Table 2-3 Typical Power Supply-Monitored Voltage Thresholds (Cisco 7505)

Parameter	Critical	Normal	Critical
+5VDC	< 4.74	4.74–5.26	> 5.26
+12VDC	< 10.20	10.20 to 13.8	> 13.80
–12VDC	< –10.20	–10.20 to –13.80	> –13.80
+24VDC	< 20.00	20.00 to 28.00	> 28.00

Cisco 7507 and Cisco 7507-MX Temperature and Voltage Thresholds

Table 2-4 lists temperature thresholds for the three processor-monitored levels. (The system displays all temperatures in Celsius only.) Table 2-5 lists the DC power thresholds for the Normal and Critical power supply-monitored levels.

Table 2-4 Typical Processor-Monitored Temperature Thresholds (Cisco 7507 and Cisco 7507-MX)

Parameter	Normal	High Warning	High Critical	Shutdown
Inlet	10–40 C	44 C	50 C	–
Hotpoint	10–40 C	54 C	60 C	–
Exhaust	10–40 C	–	–	–
Processors	–	–	–	70 C
Power supply	–	–	–	75 C
Restart	40 C	–	–	–

Table 2-5 Typical Power Supply-Monitored DC-Voltage Thresholds (Cisco 7507 and Cisco 7507-MX)

Parameter	Normal	Low Critical	Low Warning	High Warning	High Critical
+5VDC	4.74 to 5.26	4.61	4.94	5.46	5.70
+12VDC	10.20 to 13.8	10.90	11.61	12.82	13.38
–12VDC	–10.20 to –13.80	–10.15	–10.76	–13.25	–13.86
+24VDC	20.00 to 28.00	20.38	21.51	26.42	27.65

Cisco 7513, Cisco 7513-MX, and Cisco 7576 Temperature and Voltage Thresholds

Table 2-6 lists temperature thresholds for the three processor-monitored levels. (The system displays all temperatures in Celsius only.) Table 2-7 lists the DC power thresholds for the Normal and Critical power supply-monitored levels.

Table 2-6 Typical Processor-Monitored Temperature Thresholds (Cisco 7513, Cisco 7513-MX, and Cisco 7576)

Parameter	Normal	High Warning	High Critical	Shutdown
Inlet	10–40 C	44 C	50 C	–
Hotpoint	10–40 C	54 C	60 C	–
Exhaust	10–40 C	–	–	–
Processors	–	–	–	70 C
Power supply	–	–	–	75 C[1]
Restart	40 C	–	–	–

1. Processor-monitored power supply shutdown is not supported on the Cisco 7576.

Table 2-7 Typical Power Supply-Monitored DC-Voltage Thresholds (Cisco 7513, Cisco 7513-MX, and Cisco 7576)

Parameter	Normal	Low Critical	Low Warning	High Warning	High Critical
+5VDC	4.74 to 5.26	4.49	4.74	5.25	5.52
+12VDC	10.20 to 13.8	10.76	11.37	12.64	13.24
–12VDC	–10.20 to –13.80	–10.15	–10.76	–13.25	–13.86
+24VDC	20.00 to 28.00	19.06	21.51	26.51	28.87

Cisco 7500 Series Environmental Reports

The system displays warning messages on the console if chassis interface-monitored parameters exceed a desired threshold or if a blower failure occurs. You can also retrieve and display environmental status reports with the **show environment**, **show environment all**, **show environment last**, and **show environment table** commands. Parameters are measured and reporting functions are updated every 60 seconds.

Note All temperature ranges and values described in this section are subject to change.

Caution To prevent overheating the chassis, ensure that your system is drawing cool inlet air. Overtemperature conditions can occur if the system is drawing in the exhaust air of other equipment. Ensure adequate clearance around the sides of the chassis so that cooling air can flow through the chassis interior unimpeded. Obstructing or blocking the air vents will restrict the airflow and can cause the internal chassis temperature to exceed acceptable limits.

The following sections include the environmental reporting and fan or blower functions for the Cisco 7500 series routers:

- Cisco 7505 Environmental show Command Examples, page 2-27
- Cisco 7507 and Cisco 7507-MX Environmental show Command Examples, page 2-29
- Cisco 7513 and Cisco 7513-MX Environmental show Command Examples, page 2-31

- Cisco 7576 Environmental show Command Examples, page 2-35

Note For complete **show** command descriptions and instructions, refer to the related software command reference publication, which is available on the Documentation CD-ROM, or in print. For a listing of available documentation, see the "If You Need More Configuration Information" section on page 4-32.

Cisco 7505 Environmental show Command Examples

In the Cisco 7505, the **show environment** command display reports the current environmental status of the system. The report displays the date and time of the query, the refresh times, the overall system status, and any parameters that are out of the normal values. No parameters are displayed if the system status is normal. The example that follows shows the display for a system in which all monitored parameters are within normal status range:

```
Router# show env

Environmental Statistics
  Environmental status as of Wed 5-10-1995 16:42:48
  Data is 0 second(s) old, refresh in 60 second(s)

  All Environmental Measurements are within specifications
```

If the environmental status is *not* normal, the system reports the worst-case status level in the last line of the display, instead of the status summary that is shown in the last line of the preceding example. In the Cisco 7505, the **show environment last** command retrieves and displays the NVRAM log of the reason for the last shutdown and the environmental status at that time. If no status is available, it displays the reason as *unknown*.

```
Router# show env last

Environmental Statistics
  Environmental status as of Wed 5-10-1995 16:42:48
  Data is 10 second(s) old, refresh in 50 second(s)

  All Environmental Measurements are within specifications

LAST Environmental Statistics
  Environmental status as of Wed 5-10-1995 12:22:43
  Power Supply: 600W, OFF

  No Intermittent Powerfails

  +12 volts measured at  12.05(V)
   +5 volts measured at   4.82(V)
  -12 volts measured at -12.00(V)
  +24 volts measured at  23.90(V)

  Air-Flow temperature measured at 32(C)
  Inlet    temperature measured at 26(C)
```

In the Cisco 7505, the **show environment table** command displays the temperature and voltage thresholds for each monitored status level, which are the same as those listed in Table 2-2 and Table 2-3. The current measured values are displayed with the unit of measure noted, (V) or (C), and each is listed below a column heading that indicates its current status level. Measurements that fall within the Normal range are displayed in the Normal column of the table, whereas measurements that have reached a critical level are shifted to the Critical column, and so on.

In the following example, all current measured values fall within the Normal status range. The first voltage parameter in the table, +12(V), shows that the Normal range for the +12V sense spans 10.20V through 13.80V. The current measured value, 12.05V, falls within that range and is therefore displayed in the Normal column.

```
Router# show env table

Environmental Statistics
  Environmental status as of Wed 5-10-1995 18:50:21
  Data is 46 second(s) old, refresh in 14 second(s)

  WARNING: Fan has reached CRITICAL level

Voltage Parameters:

 SENSE        CRITICAL                NORMAL                CRITICAL
-------|--------------------|-----------------------|------------------

+12(V)                    10.20      12.05(V)      13.80
 +5(V)                     4.74       4.96(V)       5.26
-12(V)                   -10.20     -12.05(V)     -13.80
+24(V)                    20.00      23.80(V)      28.00

Temperature Parameters:

SENSE     WARNING       NORMAL       WARNING       CRITICAL SHUTDOWN
------|------------|-----------|------------|--------------|---------

Inlet               10   32(C)   39            46             64
Air-flow            10   40(C)   70            77             88
```

The following example shows only the Temperature Parameters section of the table. In this example, the measured value at the inlet sensor is 41 C,which falls within the warning range (39 Cthrough 46 C)and is therefore displayed in the Warning column.

```
Temperature Parameters:

SENSE     WARNING       NORMAL       WARNING       CRITICAL SHUTDOWN
------|------------|-----------|------------|--------------|-----

Inlet               10           39    41(C)   46             64
Air-flow            10   40(C)   70            77             88
```

In the Cisco 7505, the **show environment all** command displays an extended report that includes all the information in the **show environment** command display, plus the power supply status, the number of intermittent power failures (if any) since the system was last powered on, and the measured values at the temperature sensors and the DC lines. The refresh time indicates that the parameters will be measured again in 29 seconds; any changes to a measurement will not be reflected in the display until at least 40 seconds have elapsed and the current information is refreshed.

```
Router# show env all

Environmental Statistics
  Environmental status as of Wed 5-10-1995 19:10:41
  Data is 31 second(s) old, refresh in 29 second(s)

  WARNING: Fan has reached CRITICAL level
  Power Supply: 600W AC (or 600W DC)
  No Intermittent Powerfails

  +12 volts measured at  12.00(V)
   +5 volts measured at   5.02(V)
  -12 volts measured at -12.05(V)
```

```
  +24 volts measured at  23.70(V)

  Airflow temperature measured at 35(C)
  Inlet   temperature measured at 26(C)
```

When the system power is on, all six fans in the fan array must be operational. If the system detects a failed or failing fan, it will display a warning message on the console screen. If the condition is not corrected within 2 minutes, the entire system will shut down to avoid an overtemperature condition and possible damage.

The system uses a Hall Effect signal to monitor the six fans in the array. The current to the fans and the magnetic field generated by the fans' rotation generate a voltage, which the system monitors to determine if all of the fans are operating. If the monitored voltage signal drops below a specified value, the system assumes a fan failure and initiates a system shutdown.

In the following example, the system has detected an out-of-tolerance fan, which it interprets as a fan failure. The failure message is displayed for 2 minutes before the system shuts down.

```
%ENVM-2-FAN: Fan array has failed, shutdown in 2 minutes
```

If the system does shut down because of a fan failure, the system will display the following message on the console screen and in the environment display and in the **show environment** command display when the system restarts:

```
Queued messages:
%ENVM-1-SHUTDOWN: Environmental Monitor initiated shutdown
```

Cisco 7507 and Cisco 7507-MX Environmental show Command Examples

In the Cisco 7507 and Cisco 7507-MX, the **show environment** command display reports the current environmental status of the system. The report displays parameters that are out of the normal values. No parameters are displayed if the system status is normal. The example that follows shows the display for a system in which all monitored parameters are within normal status range.

```
Router# show env

All measured values are normal
```

If the environmental status is *not* normal, the system reports the worst-case status level in the last line of the display.

In the Cisco 7507 and Cisco 7507-MX, the **show environment last** command retrieves and displays the NVRAM log showing the reason for the last shutdown (if the shutdown was related to voltage or temperature) and the environmental status at that time. Air temperature is measured and displayed, and the DC voltages supplied by the power supply are also displayed.

Following is sample output of the **show env last** command:

```
Router# show env last

  RSP(2) Inlet       previously measured at 27C/80F
  RSP(2) Hotpoint    previously measured at 38C/100F
  RSP(2) Exhaust     previously measured at 31C/87F
  +12 Voltage        previously measured at 12.17
  +5 Voltage         previously measured at 5.19
  -12 Voltage        previously measured at -12.17
  +24 Voltage        previously measured at 23.40
```

In the Cisco 7507 and Cisco 7507-MX, the **show environment table** command displays the temperature and voltage thresholds for each of the three RSP temperature sensors for each monitored status level: low critical, low warning, high warning, and high critical, which are the same as those listed in Table 2-4

and Table 2-5. The slots in which the RSP can be installed are indicated in parentheses (slot 2 and slot 3). Also listed are the shutdown thresholds for the processor boards and power supplies. Following is sample output of the **show env table** command:

```
Router# show env table

Sample Point LowCritical LowWarning HighWarning HighCritical

RSP(2) Inlet     44C/111F 50C/122F
RSP(2) Hotpoint  54C/129F 60C/140F
RSP(2) Exhaust   101C/213F101C/213C
RSP(3) Inlet      44C/111F 50C/122F
RSP(3) Hotpoint   54C/129F 60C/140F
RSP(3) Exhaust   101C/213F101C/213F
+12 Voltage     10.90         11.61         12.82         13.38
+5 Voltage        4.49          4.74          5.25          5.52
-12 Voltage     -10.15        -10.76        -13.25        -13.86
+24 Voltage      19.06         21.51         26.51         28.87
Shutdown boards at           101C/213F
Shutdown power supplies at   101C/213F
```

In the Cisco 7507 and Cisco 7507-MX, the **show environment all** command displays an extended report that includes the arbiter type, backplane type, power supply type (AC or DC), wattage and status, the number and type of intermittent power failures (if any) since the system was last powered on, and the currently measured values at the RSP temperature sensors and the power supply voltages. The **show environment all** command also displays a report showing which slots in the Cisco 7507 or Cisco 7507-MX are occupied (indicated by an X) and which are empty.

Active fault conditions are indicated when the blower or power supply has failed or is not present. The system expects to see one blower in the Cisco 7507 or Cisco 7507-MX, the main system blower.

The system blower is designated *#1*. The active fault condition in the following example shows that there is no power supply installed in power bay A because the display indicates that power supply #1 (in the lower bay) is removed.

There are four active trip points: *restart OK*, *temperature warning*, *board shutdown*, and *power supply shutdown*. (There are no active trip points shown in the following example.) The *soft shutdowns* entry refers to the number of times the system will reset itself before it executes a complete system (or hard) shutdown.

The current temperature measurements at the three RSP sensors are displayed as *inlet*, *hotpoint*, and *exhaust*. The shutdown temperature source is the *hotpoint* sensor, which is located toward the center of the RSP. System voltage measurements are also displayed, followed by the system current measurements and power supply wattage calculation. Following is sample output of the **show env all** command:

```
Router# show env all

Arbiter type 1, backplane type 7507 (id 4)
Power supply #1 is removed (id 3), power supply #2 is 700W (id 2)
Active fault conditions: none
Active trip points: Restart_Inhibit
15 of 15 soft shutdowns remaining before hard shutdown
```

Note When the system temperature increases above the board shutdown level, a soft shutdown occurs (that is, the processor modules are shut down, and the power supplies, fans, and CI continue to operate). When the system cools to the restart level, the system restarts. The system counts the number of times this occurs and keeps the up/down cycle from continuing endlessly. When the counter reaches 15, the system performs a hard shutdown, which requires a power cycle to recover. The soft shutdown counter is reset to its minimum value after the system has been up for 6 hours.

```
0123456
Dbus slots: XX XXX

         inlet        hotpoint     exhaust
RSP(3) 16C/60F 24C/71F 20C/68F

Shutdown temperature source is 'hotpoint' slot3 (requested slot2)

+12V measured at 11.84
 +5V measured at  5.05
-12V measured at -11.84
+24V measured at  23.78
+2.5 reference is  2.46

PS1 +5V Current    measured at 42.35 A (capacity 200 A)
PS1 +12V Current   measured at  6.86 A (capacity  35 A)
PS1 -12V Current   measured at  0.55 A (capacity   3 A)
PS1 output is 296 W
```

When the system power is on, the blower must be operational. If the system detects that the blower has failed or is failing, it will display a warning message on the console screen. The entire system will shut down when the voltage at the hotpoint sensor (center of the RSP) reaches a predetermined value.

In the following example, the system has detected an out-of-tolerance blower, which it interprets as a blower failure.

```
%ENVM-2-FAN: Blower has failed.
```

When the temperature reaches a critical level, the system will display the following message on the console screen and in the **show environment** command display when the system restarts:

```
Queued messages:
%ENVM-1-SHUTDOWN: Environmental Monitor initiated shutdown
```

Cisco 7513 and Cisco 7513-MX Environmental show Command Examples

In the Cisco 7513 and Cisco 7513-MX, the **show environment** command display reports the current environmental status of the system. The report displays parameters that are out of the normal values. No parameters are displayed if the system status is normal. The example that follows shows the display for a system in which all monitored parameters are within normal status range.

Note The current monitor circuits of the 7513 power supply are only accurate at high power levels. They are there to prevent over-configuration and serve no purpose at low power levels. If the system is not operating above 70% power, the measurement results are not accurate. Above 70%, the measurements have the degree of accuracy needed to prevent the insertion of too many line cards into the system.

Following is sample output of the **show env** command:

```
Router# show env

Environmental Statistics
  Environmental status as of Wed 5-10-1995 16:42:48
  Data is 0 second(s) old, refresh in 60 second(s)

  All Environmental Measurements are within specifications

All measured values are normal
```

If the environmental status is *not* normal, the system reports the worst-case status level in the last line of the display.

In the Cisco 7513 and Cisco 7513-MX, the **show environment last** command retrieves and displays the NVRAM log showing the reason for the last shutdown (if the shutdown was related to voltage or temperature) and the environmental status at that time. Air temperature is measured and displayed; the DC voltages supplied by the power supply are also displayed.

Following is sample output of the **show env last** command:

```
Router# show env last

Environmental Statistics
  Environmental status as of Wed 5-10-1995 16:42:48
  Data is 10 second(s) old, refresh in 50 second(s)

  All Environmental Measurements are within specifications

LAST Environmental Statistics
  Environmental status as of Wed 5-10-1995 12:22:43
  Power Supply: 1200W, OFF

  No Intermittent Powerfails

  +12 volts measured at  12.05(V)
   +5 volts measured at   4.82(V)
  -12 volts measured at -12.00(V)
  +24 volts measured at  23.90(V)

  Air-Flow temperature measured at 32(C)
  Inlet    temperature measured at 26(C)

  RSP(6) Inlet       previously measured at 27C/80F
  RSP(6) Hotpoint    previously measured at 38C/100F
  RSP(6) Exhaust     previously measured at 31C/87F
  +12 Voltage        previously measured at 12.17
  +5 Voltage         previously measured at 5.19
  -12 Voltage        previously measured at -12.17
 +24 Voltage        previously measured at 23.40
```

In the Cisco 7513 and Cisco 7513-MX, the **show environment table** command displays the temperature and voltage thresholds for each of the three RSP temperature sensors for each monitored status level: low critical, low warning, high warning, and high critical, which are the same as those listed in Table 2-6 and Table 2-7. The slots in which the RSP can be installed are indicated in parentheses (slot 6 and slot 7). Also listed are the shutdown thresholds for the processor boards and power supplies.

Following is sample output of the **sh env table** command:

```
Router# show env table

Environmental Statistics
  Environmental status as of Wed 5-10-1995 18:50:21
  Data is 46 second(s) old, refresh in 14 second(s)

  WARNING: Fan has reached CRITICAL level

Voltage Parameters:

 SENSE        CRITICAL                NORMAL                CRITICAL
-------|--------------------|-----------------------|------------------

+12(V)                   10.20      12.05(V)      13.80
 +5(V)                    4.74       4.96(V)       5.76
-12(V)                  -10.20     -12.05(V)     -13.80
```

```
+24(V)                    20.00      23.80(V)      28.00

Temperature Parameters:

SENSE     WARNING       NORMAL       WARNING       CRITICAL SHUTDOWN
------|-------------|------------|-------------|--------------|---------

Inlet               10   32(C)   39            46             64
Air-flow            10   40(C)   70            77             88
```

The following example shows only the Temperature Parameters section of the table. In this example, the measured value at the inlet sensor is 41 C,which falls within the warning range (39 Cthrough 46 C)and is therefore displayed in the Warning column.

```
Temperature Parameters:

SENSE     WARNING       NORMAL       WARNING       CRITICAL SHUTDOWN
------|-------------|------------|-------------|--------------|---------

Inlet               10           39    41(C)   46             64
Air-flow            10   40(C)   70            77             88


Sample Point    LowCritical    LowWarning     HighWarning HighCritical

RSP(6) Inlet                                    44C/111F       50C/122F
RSP(6) Hotpoint                                 54C/129F       60C/140F
RSP(6) Exhaust
RSP(7) Inlet                                    44C/111F       50C/122F
RSP(7) Hotpoint                                 54C/129F       60C/140F
RSP(7) Exhaust
+12 Voltage         10.76          11.37          12.64          13.24
+5 Voltage           4.49           4.74           5.25           5.52
-12 Voltage        -10.15         -10.76         -13.25         -13.86
+24 Voltage         19.06          21.51          26.51          28.87
Shutdown boards at           101C/213F
Shutdown power supplies at   101C/213F
```

Note Temperature ranges and values are subject to change.

In the Cisco 7513 and Cisco 7513-MX, the **show environment all** command displays an extended report that includes the arbiter type, backplane type, power supply type (AC or DC), wattage and status, the number and type of intermittent power failures (if any) since the system was last powered on, and the currently measured values at the RSP temperature sensors and the DC-input lines. The **show environment all** command also displays a report showing which slots in the Cisco 7513 or Cisco 7513-MX are occupied (indicated by an X) and which are empty.

Active fault conditions are indicated when the blower or power supply has failed or is not present (as "Blower #3" indicates in the following example). The system expects to see three blowers or fans in the Cisco 7513 or Cisco 7513-MX: the main system blower, and one fan in each power supply. The system blower is designated *#1*, the power supply fan in power bay A is *#2*, and the power supply fan in power bay B is *#3*. The active fault condition in the following example shows that there is no power supply installed in power bay B because the display indicates that power supply #2 (in power bay B) is removed. System blower speed is displayed as a percentage of maximum.

There are four active trip points: *restart OK*, *temperature warning*, *board shutdown*, and *power supply shutdown*. (There are no active trip points shown in the following example.) The *soft shutdowns* entry refers to the number of times the system will reset itself before it executes a complete system (or hard) shutdown.

The current temperature measurements at the three RSP sensors are displayed as *inlet*, *hotpoint*, and *exhaust*. The shutdown temperature source is the *hotpoint* sensor, which is located toward the center of the RSP. System voltage measurements are also displayed, followed by the system current measurements and power supply wattage calculation.

Note The current monitor circuits of the 7513 power supply are only accurate at high power levels. They are there to prevent over-configuration and serve no purpose at low power levels. If the system is not operating above 70% power, the measurement results are not accurate. Above 70%, the measurements have the degree of accuracy needed to prevent the insertion of too many line cards into the system.

Following is sample output of the **show env all** command:

```
Router# show env all
Environmental Statistics
  Environmental status as of Wed 5-10-1995 19:10:41
  Data is 31 second(s) old, refresh in 29 second(s)

  WARNING: Fan has reached CRITICAL level
  Power Supply: 1200W AC
  No Intermittent Powerfails

  +12 volts measured at  12.00(V)
   +5 volts measured at   5.02(V)
  -12 volts measured at -12.05(V)
  +24 volts measured at  23.70(V)

  Airflow temperature measured at 35(C)
  Inlet   temperature measured at 26(C)

Arbiter type 1, backplane type 7513 (id 2)
Power supply #1 is 1200W AC (id 1), power supply #2 is removed (id 7)
Active fault conditions: Blower #3
Fan speed is 50%
Active trip points: none
15 of 15 soft shutdowns remaining before hard shutdown
```

Note When the system temperature increases above the board shutdown level, a soft shutdown occurs (that is, the processor modules are shut down, and the power supplies, fans, and CI continue to operate). When the system cools to the restart level, the system restarts. The system counts the number of times this occurs and keeps the up/down cycle from continuing endlessly. When the counter reaches zero, the system performs a hard shutdown, which requires a power cycle to recover. The soft shutdown counter is reset to its maximum value after the system has been up for 6 hours.

```
                    1
           0123456789012
Dbus slots: XX XXXX XXXX

         inlet        hotpoint     exhaust
RSP(6)   24C/75F      35C/95F      29C/84F

Shutdown temperature source is 'hotpoint' slot6 (requested slot6)

+12V measured at    12.17
 +5V measured at     5.19
-12V measured at   -12.26
+24V measured at    24.44
+2.5 reference is    2.49
```

```
PS1 +5V Current    measured at 42.35 A (capacity 200 A)
PS1 +12V Current   measured at  6.86 A (capacity  35 A)
PS1 -12V Current   measured at  0.55 A (capacity   3 A)
PS1 output is 296 W
```

When the system power is on, the blower must be operational. If the system detects that the blower has failed or is failing, it will display a warning message on the console screen. The entire system will shut down when the voltage at the hotpoint sensor (center of the RSP) reaches a predetermined value.

In the following example, the system has detected an out-of-tolerance blower, which it interprets as a blower failure.

```
%ENVM-2-FAN: Blower has failed.
```

When the temperature reaches a critical level, the system will display the following message on the console screen and in the **show environment** command display when the system restarts:

```
Queued messages:
%ENVM-1-SHUTDOWN: Environmental Monitor initiated shutdown
```

Cisco 7576 Environmental show Command Examples

In the Cisco 7576, the **show environment** command reports the current environmental status of the system. The report displays parameters that are out of the normal values. No parameters are displayed if the system status is normal. The example that follows shows the display for a system in which all monitored parameters are within normal status range.

Following is sample output of the **show env** command:

```
Router# show env

All measured values are normal
```

If the environmental status is *not* normal, the system reports the worst-case status level in the last line of the display.

In the Cisco 7576, the **show environment last** command retrieves and displays the NVRAM log showing the reason for the last shutdown (if the shutdown was related to voltage or temperature) and the environmental status at that time. Air temperature is measured and displayed; the DC voltages supplied by the power supply are also displayed.

Following is sample output of the **show env last** command:

```
Router# show env last

          RSP(6) Inlet       previously measured at 21C/69F
  RSP(6) Hotpoint    previously measured at 29C/84F
  RSP(6) Exhaust     previously measured at 25C/77F
  +12 Voltage        previously measured at 12.12
  +5 Voltage         previously measured at 5.15
  -12 Voltage        previously measured at -12.17
  +24 Voltage        previously measured at 23.87
```

In the Cisco 7576, the **show environment table** command displays the temperature and voltage thresholds for each of the three RSP temperature sensors for each monitored status level: low critical, low warning, high warning, and high critical, which are the same as those listed in Table 2-6 and Table 2-7. The slots in which the RSP can be installed are indicated in parentheses (slot 6 and slot 7). Also listed are the shutdown thresholds for the processor boards and power supplies.

Following is sample output of the **sh env table** command:

```
Router# show env table

Sample Point      LowCritical    LowWarning     HighWarning HighCritical
RSP(6) Inlet                                    44C/111F       50C/122F
RSP(6) Hotpoint                                 54C/129F       60C/140F
RSP(6) Exhaust
+12 Voltage       10.90          11.61          12.82          13.38
+5 Voltage        4.61           4.94           5.46           5.70
-12 Voltage       -10.15         -10.76         -13.25         -13.86
+24 Voltage       20.38          21.51          26.42          27.65
2.5 Reference                    2.43           2.51
Shutdown boards at           70C/158F
Shutdown power supplies at   76C/168F
Restart after shutdown below 40C/104F
```

Note Temperature ranges and values are subject to change.

In the Cisco 7576, the **show environment all** command displays an extended report that includes the arbiter type, backplane type, power supply type (AC or DC), wattage and status, the number and type of intermittent power failures (if any) since the system was last powered on, and the currently measured values at the RSP temperature sensors and the DC-input lines. The **show environment all** command also reports which slots in the Cisco 7576 are occupied (indicated by an X) and which are empty.

Active fault conditions are indicated when the blower or power supply has failed or is not present. The system expects to see three blowers or fans in the Cisco 7576: the main system blower, and one fan in each power supply. The system blower is designated *#1*, the power supply fan in power bay A is *#2*, and the power supply fan in power bay B is *#3*.

An example of an active fault condition includes the absence of a power supply. In the above example a power supply is installed in both power bays; therefore no active fault condition exists. There are three active trip points: *restart OK*, *temperature warning*, and *board shutdown*. (There are no active trip points shown in the following example.) The *soft shutdown* entry refers to the number of times the system will reset itself before it executes a complete system (or hard) shutdown.

The current temperature measurements at the three RSP sensors are displayed as *inlet*, *hotpoint*, and *exhaust*. The shutdown temperature source is the *hotpoint* sensor, which is located toward the center of the RSP. System voltage measurements are also displayed, followed by the system current measurements and power supply wattage calculation.