CHAPTER 2

Preparing for Installation

This chapter provides specific information about preparing your site for installation of the Cisco 12008 router. Included are safety guidelines, specific preparatory information, and tools and parts required to ensure successful installation of your router.

The shipping package for Cisco 12000 series routers is engineered to reduce the potential of product damage associated with routine material handling experienced during shipment. To minimize potential damage to the product, transport these products in their Cisco-specified packagings. Failure to do so may result in damage to the router or degradation of its performance. Also, do not remove the GSR or Internet Router from its shipping container until you are ready to install it. The router should always be transported or stored in an upright position. Keep the router in the shipping container until you have determined where you will install it.

To unpack the router, use the document entitled *Cisco 12008 Gigabit Switch Router System Packing and Unpacking Instructions* that was shipped with your router. Inspect all items for shipping damage; if any damage is evident, immediately contact a Cisco customer service representative.

The following sections are included in this chapter:

- Safety Recommendations
- Site Requirements Guidelines
- System Ground Connection Guidelines
- Site Wiring Guidelines
- Installation Tools Required
- Unpacking the Cisco 12008

- Checking the Contents of the Shipping Container
- Using a Site Log

Before attempting to install your router, consider the power and cabling requirements that must be satisfied, the equipment that you will need to install the router, and the environmental conditions that your site must meet.

Safety Recommendations

The following guidelines are provided to help ensure your safety and to protect the equipment. This list may not identify all potentially hazardous situations in your working environment, so *be alert* and *exercise good judgment* at all times.

- Never attempt to lift an object that might be too heavy for one person to handle.
- Always disconnect the power source and unplug all the power cables before working on the router.
- Keep the work area free of obstructions before, during, and after router installation.
- Keep tools and router components away from walk areas.
- Do not wear loose clothing, jewelry (such as rings, bracelets, or chains), or other items that could get caught in the router during handling and use.
- Use the router in accordance with its marked electrical ratings and product usage instructions.
- Do not work alone if potentially hazardous conditions exist anywhere in your workplace.
- Install the router in compliance with the following local and national electrical codes:
  - United States—National Fire Protection Association (NFPA) 70; United States National Electrical Code.
  - Canada—Canadian Electrical Code, part I, CSA C22.1.
  - Other countries—International Electrotechnical Commission (IEC) 364, part 1 through part 7.

- Review the safety warnings contained in the document entitled *Regulatory Compliance and Safety Information for the Cisco 12000 Series Gigabit Switch Routers* (Document Number 78-4347-02). This document accompanied the shipment of your Cisco 12008 router; familiarize yourself with its contents before attempting to install, configure, or maintain the router.
- Cisco 12008 routers configured with AC-input power supplies are shipped with a 3-wire electrical grounding-type plug that fits only into a grounding-type power outlet. This is a safety feature that you should not circumvent. Equipment grounding should comply with local and national electrical codes.
- Cisco 12008 routers configured with DC-input power supplies require a 40-ampere DC circuit breaker for the input DC power source. This circuit breaker should protect against short-circuit and overcurrent faults in accordance with United States National Electrical Code NFPA 70 (United States), Canadian Electrical Code, part I, CSA C22.1 (Canada), and IEC 364 (other countries).
- Only a DC power source that complies with the safety extra-low voltage (SELV) requirements in UL950, CSA 950, EN 60950, and IEC950 can be connected to a Cisco 12008 DC-input power supply.
- A Cisco 12008 configured with DC-input power supplies that is to be used in a restricted access area must be installed in accordance with Articles 110-16, 110-17, and 110-18 of the National Electric Code, ANSI/NFPA 70.
- A Cisco 12008 configured with DC-input power supplies must have a readily accessible disconnect device incorporated in the fixed wiring for the site.

Lifting Guidelines

A fully configured Cisco 12008 router weighs approximately 187 lb (84.8 kg); it is not intended to be moved frequently.

Before installing the router, ensure that your site is prepared properly so that you can avoid having to move the router later to accommodate the availability/proximity of power sources and network interface connections.

Whenever you lift or move the router (or any other heavy object), observe the following guidelines:

- Enlist the assistance of a second person when lifting the router; do not attempt to lift the router by yourself.
- Secure your footing when lifting the router; balance the lifted weight between your feet.
- Lift the assembly slowly; avoid making sudden movements; avoid twisting your body as you lift.
- Keep your back straight and lift with your legs. If you must bend down to lift the router, bend at your knees, rather than your waist, to reduce the strain on your lower back.
- Always disconnect all external cables before lifting or moving the router.

Caution Never attempt to lift, tilt, or move the router using the carrying handles on the AC-input and DC-input power supplies. These handles are meant to help you carry the power supplies; they are not designed to support the weight of the router.

Safety with Electricity

The line cards, a redundant CSC, the SFCs, the fan trays, and a redundant power supply can be removed and replaced while the system is running. In removing such components, there is no danger that an electrical hazard or system damage will result.

Observe the following basic guidelines when working with any electrical equipment:

- Before beginning any procedure that requires access to the interior of the router, locate the emergency power-off switch for the room in which you will be working.
- If an electrical accident occurs and someone is hurt, proceed as follows:
  - Use caution; do not become a victim yourself. Disconnect power from the system.
  - If possible, send another person to get medical aid; otherwise, assess the condition of the victim and call for help.
  - Determine if the person needs rescue breathing or external cardiac compressions; take appropriate action.
- Disconnect all power and external cables before installing or removing a router.
- Never assume that power has been disconnected from a circuit; always check beforehand.

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

In addition, observe the following guidelines 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.

Preventing Electrostatic Discharge Damage

Many router components are sensitive to damage from static electricity. Some components can be degraded by exposure to as little as 30 volts. You can generate static voltages as high as 35,000 volts just by handling plastic or foam packing material, or by sliding an electronic assembly across plastic or carpeting. Failure to exercise proper electrostatic discharge damage (ESD) precautions can result in intermittent or complete failures of components.

To minimize the potential for ESD damage to electronic components, observe the following guidelines:

- Always wear an ESD wrist strap or ankle strap and ensure that it makes good contact with your skin.
- Insert the equipment end of your ESD strap (the banana plug) into the ESD socket in the upper left edge of the upper card cage before you insert or remove a line card, a CSC, or the RP.

  Avoid contact between the card and your clothing. The wrist strap protects the card from ESD voltages on the body only; EDS voltages on clothing can still cause electronic component damage.

- Always place a card component side up on an antistatic surface, in an antistatic card rack, or in a static-shielding bag. If you are returning a card to the factory, immediately place it in a static-shielding bag.
- Use the ejector levers to properly seat the card connectors in the backplane when you are installing line cards or the RP; tighten both captive installation screws on the card.

  These screws prevent accidental removal, provide proper grounding for the system, and help to ensure that the card connector is seated in the backplane.
- Use the ejector levers to unseat the card connector from the backplane when removing a line card or the RP.

  Slowly pull the metal card carrier out of the slot with one hand, placing your other hand along the bottom of the card carrier to support the card's weight and guide it straight out of the slot.
- Handle line cards or the RP only by the edges of the metal card carrier; avoid touching the board or the connector pins.

Caution For safety, periodically check the resistance value of the antistatic strap. The resistance measurement should be between 1 and 10 megohms.

Laser Safety

Single-mode style line cards for the Cisco 12008 are equipped with lasers that emit invisible radiation. Do not stare into open line card ports. Observe the following warning to prevent eye injury.

Warning Because invisible laser radiation may be emitted from the aperture of the port when no cable is connected, avoid exposure to laser radiation and do not stare into open apertures.

Site Requirements Guidelines

Before installing the Cisco 12008 router, review the guidelines presented in the following sections.

Rack-Mounting Guidelines

Before installing the Cisco 12008 in a telco-style or 19-inch equipment rack, consider the following rack-mounting guidelines:

- Install the router in an enclosed rack only if the rack has adequate ventilation or an exhaust fan; install the router in an open rack whenever possible.
- An enclosed rack with a ventilation system that is too powerful can prevent proper cooling of the router by creating negative air pressure around the router and redirecting air away from the intake of the air filter assembly. If necessary, operate the router with the rack door open.
- The proper use of baffles inside an enclosed rack can help ensure adequate router cooling.
- Equipment placed in the rack beneath the router can generate heat that is drawn into the router's air filter assembly, adding to the router's heat load.

  If the enclosed rack in which you install the router does not have a ventilation fan, you should install one.

The rack-mounting hardware included with the Cisco 12008 is suitable for most 19-inch equipment racks or telco-style racks. We strongly recommend a rack-mount installation for your router, due to size and weight considerations.

The specific rack-mounting guidelines for your router follow:

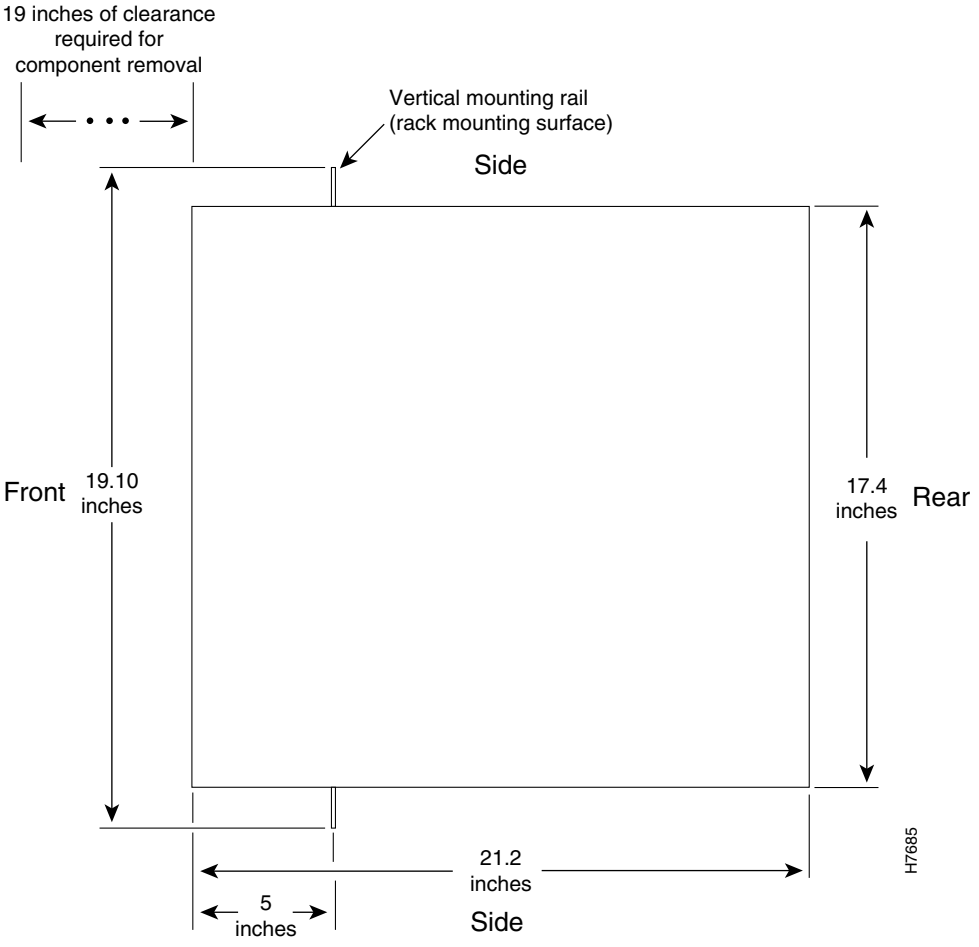
- Keep the center of gravity of the equipment rack as low as possible.

  Mount the router in the rack as low as possible without sacrificing router utility, accessibility, or serviceability.

- If you mount the router in a telco-style rack, ensure that the rack is bolted to the floor. Ensure that the weight of the router does not make the rack unstable. Some telco-style racks are also secured to ceiling brackets, if necessary, due to the weight of equipment in the rack. Make sure that the rack you are using to install the router is secured to the building structure.
- In mounting the router between two posts or rails, you must ensure that the clearance between the sides of the posts or rails is at least 17.5 inches (44.9 cm).
- Maintain a clearance of at least 6 inches (15.2 cm) at the front and back of the router to ensure adequate air intake and exhaust.
- Avoid installing the router in an overly congested rack. Air flowing to or from other equipment in the rack might interfere with the normal flow of cooling air through the router, increasing the potential for overtemperature conditions within the router.
- Allow at least 19 inches (48.7 cm) of clearance at the front of the rack for router maintenance.
- Install and use the cable-management system included with your router. The cable-management system helps to keep interface cables organized, out of the way, and free from kinks or bends that degrade cable performance.
- Consider the equipment and cabling that may already be installed in the rack. Ensure that interface cables from other equipment do not impair access to the router's upper card cage or lower card cage or require you to disconnect cables unnecessarily to perform equipment maintenance or upgrades.
- When mounting the router in a 4-post or telco-style rack, use the mounting hardware, as instructed, to properly secure the router in the rack.

Figure 2-1 shows the outer dimensions of the Cisco 12008 enclosure.

Figure 2-1 Outer Dimensions of Cisco 12008 Enclosure (Top View)



Air Flow Guidelines

The Cisco 12008 air circulation system includes two fan trays:

- Card cage fan tray—This router component is located behind the air filter assembly (see Figure 2-2).

  The card cage fan tray draws ambient air through a removable and serviceable air filter assembly in the front of the router, passes it over the switch fabric cards in the lower card cage, directs it upward through the circuit boards in the upper card cage, and exhausts it through vents at the top rear of the router enclosure (see Figure 2-4).

- Power supply fan tray—This router component is located at the bottom of the power supply bay (see Figure 2-3).

  The power supply fan tray draws ambient air through its faceplate, directs the air upward through the power supply bays, and exhausts it through vents at the top rear of the router enclosure (see Figure 2-4).

To ensure adequate air flow through the router's internal components, it is recommend that you maintain a clearance of at least 6 inches (15.4 cm) in the front and back of the router enclosure at all times.

If airflow through the router is blocked or restricted, or if the ambient air being drawn into the router is too warm, an overtemperature condition within the router can occur. Under extreme conditions, the router's environmental monitoring (MBus) system shuts down system power to protect internal electronic components from thermal damage.

The site should be as dust-free as possible. Dust tends to clog the air filter, reducing the flow of cooling air through the system and increasing the risk of an overtemperature condition.

Figure 2-2 Card Cage Fan Tray

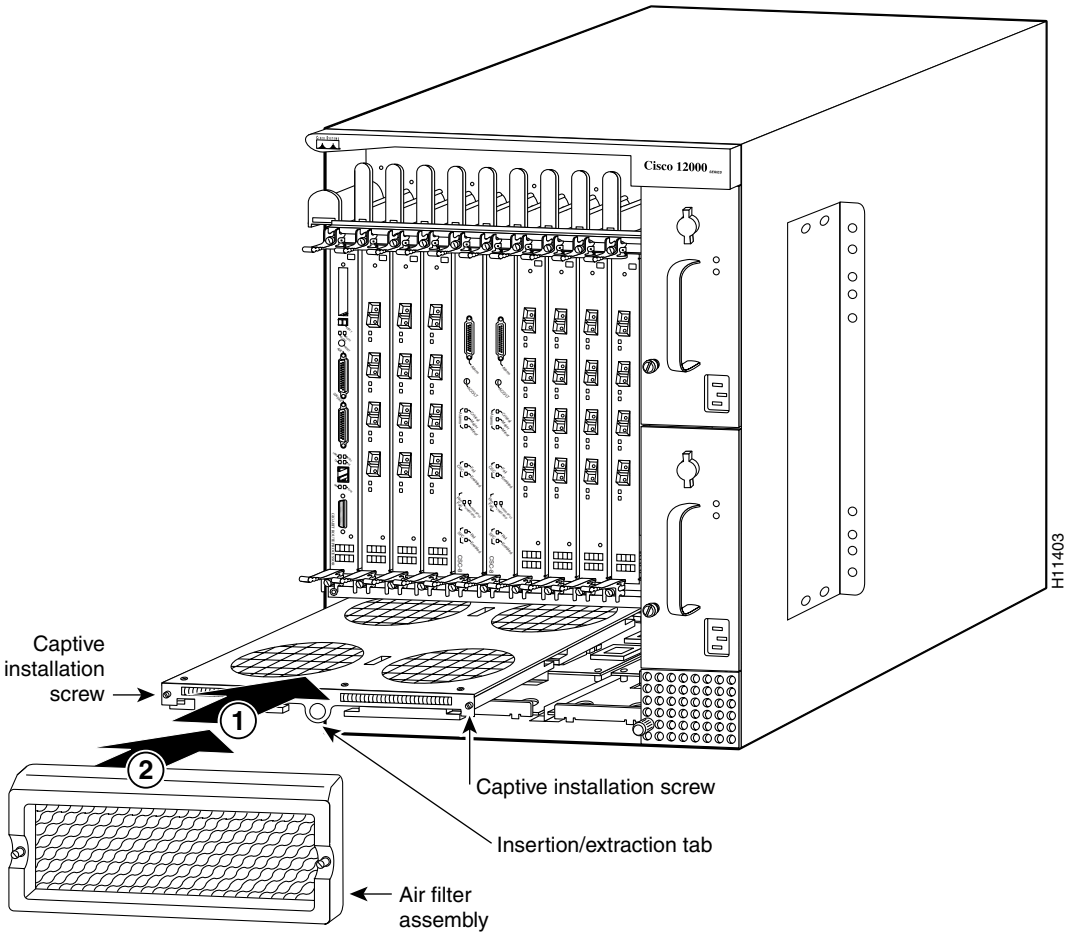


Figure 2-3 Power Supply Fan Tray

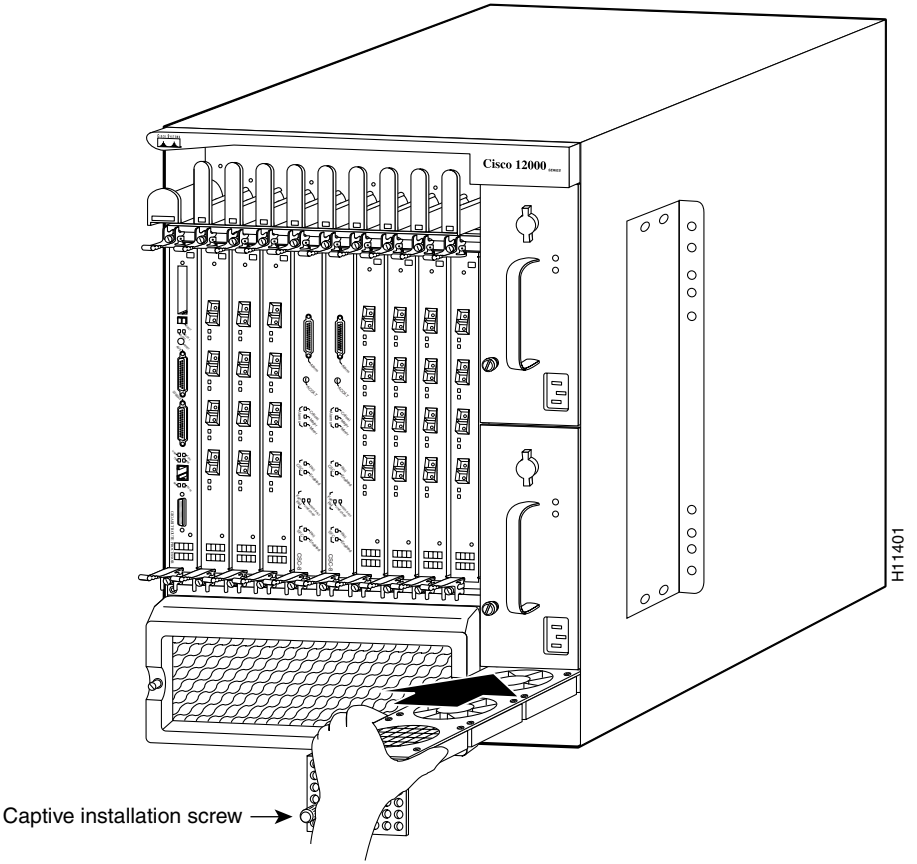
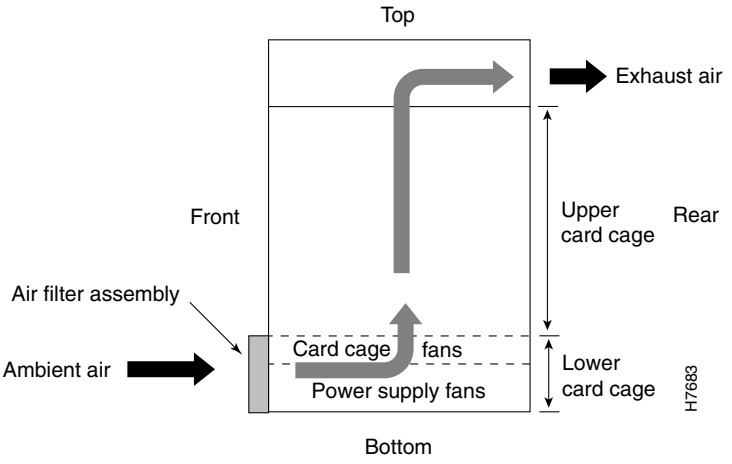


Figure 2-4 Internal Air Flow of the Cisco—Side View



Temperature and Humidity Guidelines

For the operating and nonoperating environmental specifications for the Cisco 12008, refer to Table 1-11 in Chapter 1. The router operates within the ranges specified in this table; however, a temperature that approaches a minimum or maximum level indicates a potential problem. You can maintain normal system operations by anticipating and correcting environmental anomalies before they approach a critical state.

The environmental monitors built into the Cisco 12008 protect system components from potential damage from overvoltage and overtemperature conditions. To ensure normal operations and avoid unnecessary maintenance, plan and prepare your site properly before installing the router.

Power Guidelines

The Cisco 12008 router can be configured with *either* AC-input *or* DC-input power supplies.

Note Combining an AC-input power supply with a DC-input power supply in the same router is *not* allowed.

A minimally configured router has one AC-input power supply or one DC-input power supply. Site requirements for the power supplies differ, depending on the type of source voltage required for the installed power supply(ies).

Observe the following general precautions and recommendations in planning the source power requirements for your router:

- Check the power at your site before router installation (and periodically after installation) to ensure that clean power is being received. Install a line conditioner, if necessary, to ensure proper voltages and power levels in the source voltage for the system.
- Install proper grounding for the site to avoid damage from lightning and power surges.

AC-Powered Systems

In a router to be equipped with AC-input power supplies, observe the following guidelines:

- The power supply must operate with a source voltage ranging from 185 to 264 VAC; the AC-input power supply requires a 20A service minimum for North America and 10A or 16A for the international area.
- Several styles of AC-input power supply power cords are available; make sure that you have the correct style for your site (see Figure 2-5 and Table 2-1).

  All AC-input power supply power cords are 14 feet (4.3 m) in length.
- Check the power at your site before installation and periodically thereafter to ensure that you are receiving clean power that is free of noise. Install a line conditioner, if necessary, to ensure proper electrical characteristics of source power.

- Provide a dedicated power source for each AC-input power supply installed in the router.
- Install an uninterruptible power source for your site, if possible.
- Install proper site grounding facilities to guard against damage from lightning or power surges.

For a listing of the electrical specifications for the AC-input power supply, see Table 1-9 in Chapter 1.

Figure 2-5 lists the source AC power cords available for the Cisco 12008.

Figure 2-5 Types of Plugs for Source AC Power

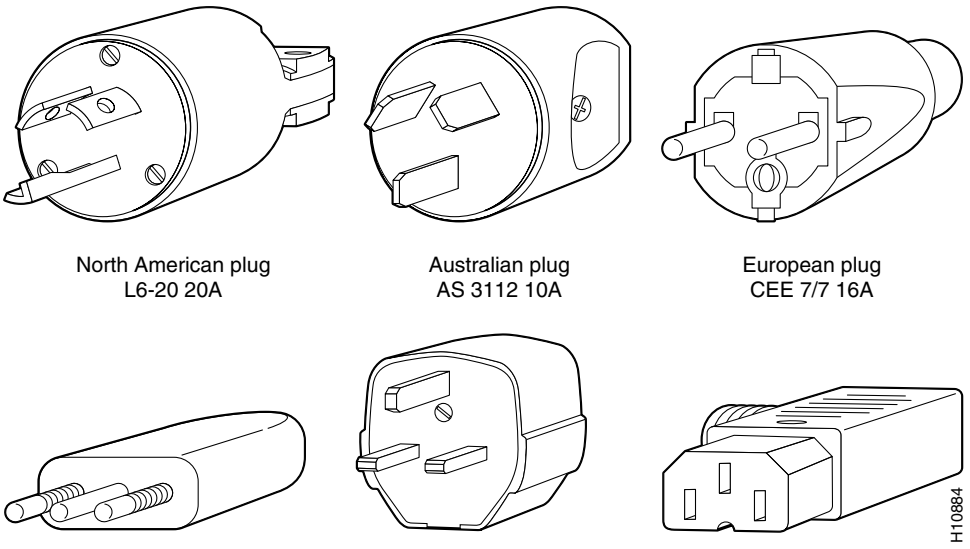


Table 2-1 lists the international options available for the source AC power cords.

Table 2-1 AC Power Cord International Options

Label	Description	Product Number
United States	208 VAC, 60 Hz AC power cord	CAB-GSR12-US=
Australian	240 VAC, 50 Hz AC power cord	CAB-GSR12-AU=
European	230 VAC, 50 Hz AC power cord	CAB-GSR12-EU=
Italian	220 VAC, 50 Hz AC power cord	CAB-GSR12-IT=
United Kingdom	240 VAC, 50 Hz AC power cord	CAB-GSR12-UK=

Note All source AC power cords are 14 feet (4.27 m) in length.

DC-Powered Systems

In a router to be equipped with DC-input power supplies, observe the following guidelines:

- Each DC-input power supply requires a dedicated 40A service.
- For DC power cables, it is recommended that you use 4 AWG, high-strand-count wire cable with dual hole lugs that fit over M6 (metric) terminals centered 0.625 inch (15.86 mm) apart.
- The DC-input power supply requires -48 to -60 VDC nominal operating input voltage and -40 to -72 VDC steady-state operating input voltage.

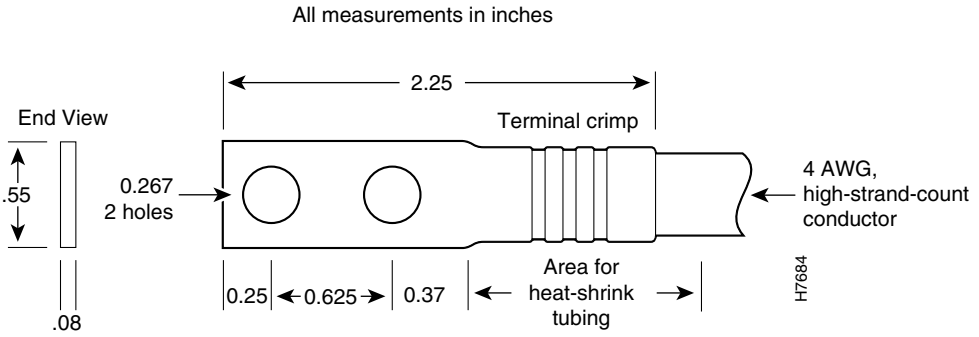
For a listing of the electrical specifications for the DC-input power supply, see Table 1-10 in Chapter 1.

Figure 2-6 shows the specifications of the lug used for source DC power cable connections.

Note To prevent the crimp area on the lug (see Figure 2-6) from coming in contact with the metal faceplate of the DC-input power supply, add a length of heat-shrink tubing to this area of the lug to provide extra insulation.

Each set of power terminals on the DC-input power supply faceplate consists of two 6-mm, metric-threaded, nickel-plated brass studs centered 0.625 inch apart. The earth ground studs extend 0.52 inch (13.2 mm) above the power supply faceplate; the set of positive (+) and negative (–) studs extend 0.9 inch (22.9 mm) above the faceplate. The nickel plating on the studs enhance their conductivity and ensure corrosion resistance.

Figure 2-6 Dimensions of the Lugs Used with the Source DC Power Cables



For convenience, the lockwashers and nuts for connecting the source DC cables to the nickel-plated brass studs are loosely mounted on the studs ready for use.

In making source DC connections to the power supply, use the power cables and lugs having the specifications outlined in Table 2-2. An equivalent 2-hole lug is acceptable as a substitute for the Panduit DC power cable lug.

Table 2-2 Specifications of the Source DC Power Cable and Lug

Characteristic	Specification
DC power cable size	#4 AWG, high strand count copper wire
DC power cable lug	Panduit copper, standard barrel, 2-hole lug—Type LDC (Panduit part number: LCD4-14A-L). An equivalent 2-hole lug is acceptable as a substitute for the Panduit part.

System Ground Connection Guidelines

Before connecting power to or turning on the Cisco 12008, be sure to provide an adequate ground connection for your system.

Two system (earth) grounding holes are provided on each side panel of the router enclosure, approximately 3 inches from the bottom rear of the panel (Figure 2-7).

To make an adequate grounding connection, you will need the following parts:

- Two grounding lugs—The grounding lugs must have two M6 screw holes that have 0.625 to 0.75 inch (15.86 to 19.05 mm) spacing between them.

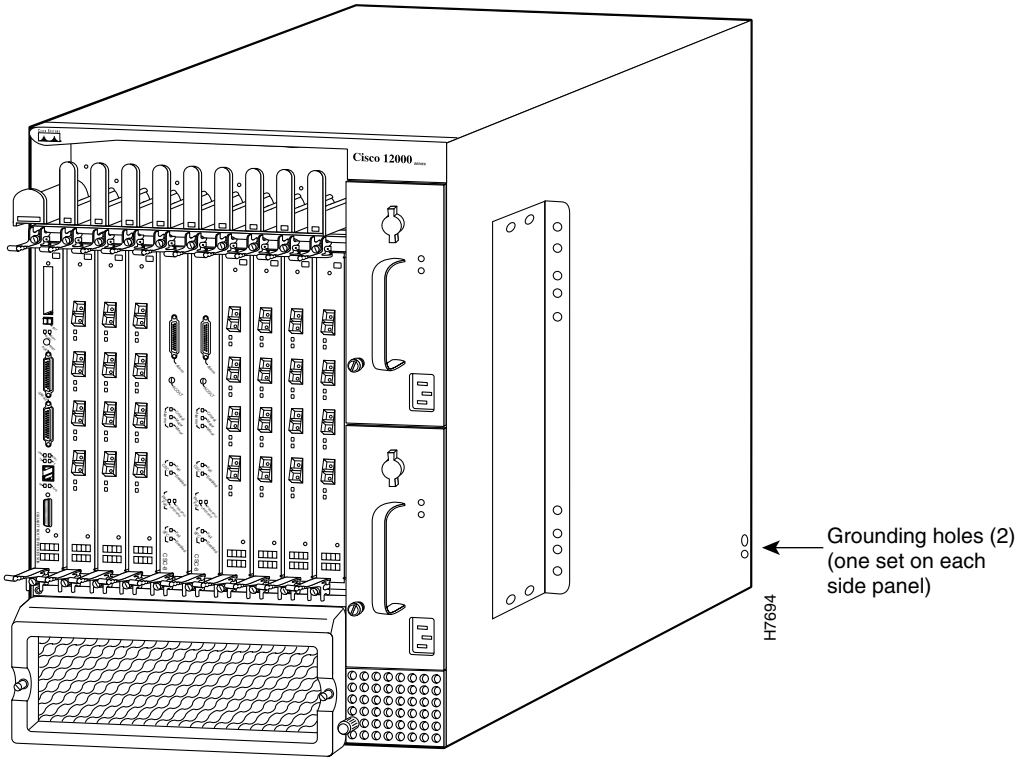
  These lugs are similar to those used for the DC-input power supply (see Figure 2-6). The grounding lugs are not available from Cisco Systems; any electrical-connector vendor, such as Panduit, can readily provide this lug.

- Four M6 (metric) hex-head screws with locking washers—These screws are not available from Cisco Systems; they are readily available from any commercial hardware vendor.

- Two grounding wires (4 AWG recommended)—The length of the grounding wires depends on the location of your router within the site and its proximity to proper grounding facilities. The grounding wire is not available from Cisco Systems; it is readily available from any commercial cable vendor.

The procedure for connecting system ground to your router is presented in Chapter 3 in the section entitled “Connecting System Ground.”

Figure 2-7 Grounding Holes on the Cisco 12008



Site Wiring Guidelines

This section presents guidelines for setting up site wiring and cabling for your router. When planning the location for your router, you should take into account the following:

- Electromagnetic interference (EMI)
- Distance limitations for fiber-optic transmission
- Connector compatibility

EMI Considerations

When wires are run for any significant distance in an electromagnetic field, interference can occur between the electromagnetic field and the signals on the wires. Be aware of the following points:

- Bad site wiring practices can result in the emanation of radio frequency interference (RFI) within the site.
- Strong EMI, especially that caused by lightning or radio transmitters, can destroy the signal drivers and receivers in the router. EMI can even create an electrical hazard by conducting power surges through lines into equipment.

Note To predict and remedy strong EMI, you might need to consult an RFI expert.

If you use twisted-pair cables in your plant wiring with an adequate distribution of grounding conductors, the plant wiring is unlikely to emit RFI. If you exceed the recommended cabling 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 kind in the past, you may want to ask experts for assistance in electrical surge suppression and shielding.

Most data centers cannot resolve the infrequent, but potentially catastrophic, problems described above without pulse meters and other special equipment. Such problems are difficult to identify and resolve, so take precautions by providing a properly grounded and shielded environment, paying special attention to issues regarding electrical surge suppression.

Synchronous Optical Network Connection Guidelines

The Synchronous Optical Network (SONET) specification for fiber-optic transmission defines two types of fiber:

- Single mode
- Multimode

Data transmission in either mode occurs by means of bundles of light rays that enter the fiber at a particular angle.

Single-mode fiber allows only one mode of light to propagate through the fiber; multimode fiber allows multiple modes of light to propagate through the fiber.

Multiple modes of light propagating through the fiber travel different distances, depending on entry angles, causing the light to arrive at destinations at different times. This phenomenon is called modal dispersion.

Single-mode fiber provides higher-bandwidth transmission and supports greater cable distances than multimode fiber. Table 2-3 lists the maximum distances for single-mode and multimode fiber-optic transmissions, as defined by SONET.

If the distance between two connected stations is greater than the maximum distance specified in Table 2-3, significant signal loss can result, making fiber-optic transmission unreliable.

Table 2-3 SONET Maximum Fiber-Optic Transmission Distances

Transceiver Type	Maximum Distance between Stations[1]
Single-mode	Up to 9 miles (14.5 km)
Multimode	Up to 1.5 miles (2.4 km)

1. Typical results; you should use the power budget calculations to determine the actual distances.

Power Budget

To design an efficient optical data link, you must evaluate the power budget.

The power budget represents the amount of light that must be available to overcome attenuation in the optical link and to exceed the minimum power required by the receiver to operate within specifications. Proper operation of an optical data link depends on modulated light reaching the receiver with enough power to be correctly demodulated.

The following variables reduce the power of the signal (light) transmitted to the receiver in multimode transmission:

- Attenuation losses—Losses incurred by passive media components, such as cables, cable splices, and connectors. Such losses are common in both multimode and single-mode data transmission.
- Chromatic dispersion losses—Losses incurred by the spreading of the signal in time due to the different speeds of light wavelengths.
- Modal dispersion losses—Losses incurred by the spreading of the signal in time due to the different propagation modes in the fiber.

Attenuation is significantly lower for optical fiber than for other media.

For multimode transmission, chromatic and modal dispersion reduce the available power of the system by what is referred to as the combined dispersion penalty (in decibels [dB]). The power lost over the data link is the sum of the attenuation losses, dispersion losses, and modal losses.

Table 2-4 lists the attenuation and dispersion limits for typical fiber-optic cable.

Table 2-4 Typical Fiber-Optic Link Attenuation and Dispersion Limits

Factor	Single-Mode	Multimode
Attenuation	0.5 dB	1.0 dB/km
Dispersion limit	No limit	500 MHz/km[1]

1. The product of bandwidth and distance must be less than 500 MHz/km.

Approximating the Line Card Power Margin

The LED used for a multimode transmission light source creates multiple propagation paths of light, with each path having a different path length and time requirement to cross the optical fiber. This causes signal dispersion (smear).

Higher order loss (HOL) results from light from the LED entering the fiber and being radiated into the fiber cladding. A worst-case estimate of power margin (PM) for multimode transmissions is based on assumptions of minimum transmitter power (PT), maximum link loss (LL), and minimum receiver sensitivity (PR). The worst-case analysis provides a margin of error, because not all parts of an actual system will operate at worst-case levels.

The power budget (PB) is defined as the maximum possible amount of power transmitted. The following equation shows the calculation of the power budget:

PB = PT – PR

PB = –18.5 dBm – (– 30 dBm)

PB = 11.5 dB

The power margin is equal to the power budget minus the link loss:

PM = PB – LL

If the power margin is positive, as a rule, the fiber-optic link will work satisfactorily.

Table 2-5 lists the factors that contribute to link loss and the estimate of the link loss value attributable to the link loss factors.

Table 2-5 Estimating Link Loss

Link Loss Factor	Estimate of Link Loss Value
Higher order mode losses	0.5 dB
Clock recovery module	1 dB
Modal and chromatic dispersion	Depends on fiber and wavelength used
Connector	0.5 dB
Splice	0.5 dB
Fiber attenuation	1 dB/km

Subtracting the data link loss from the power budget should produce a result greater than zero. If a result is less than zero, you may have insufficient power for receiver operation.

For SONET line cards, the signal must meet the signal requirements listed in Table 2-6.

Table 2-6 Line Card SONET Signal Requirements

Characteristic	Single-Mode	Multimode
Minimum transmitter power (PT)	–18.5	–15
Minimum receiver sensitivity (PR)	–30	–28
Power Budget (PB)	–11.5	–13

Multimode Power Budget Example (with Sufficient Power for Transmission)

This section contains a sample calculation of a multimode power budget, based on the following variables:

- Length of multimode link = 3 km
- Four connectors
- Three splices
- Higher order loss (HOL)
- Clock recovery module (CRM)

Estimate the power budget, as follows:

PB = 13 dB – 3 km (1.0 dB/km) – 4 (0.5 dB) – 3 (0.5 dB) – 0.5 dB (HOL) – 1 dB (CRM)

PB = 13 dB – 3 dB – 2 dB – 1.5 dB – 0.5 dB – 1 dB

PB = 5 dB

The resulting power budget (PB) value of 5 dB indicates that this link would have sufficient power for fiber-optic transmission.

Multimode Power Budget Example of Dispersion Limit

Below is a multimode power budget example based on the same parameters as in the previous example, but with a multimode link distance of 4 km:

PB = 13 dB – 4 km (1.0 dB/km) – 4 (0.5 dB) – 3 (0.5 dB) – 0.5 dB (HOL) – 1 dB (CRM)

PB = 13 dB – 4 dB – 2 dB – 1.5 dB – 0.5 dB – 1 dB

PB = 4 dB

The resulting power budget (PB) value of 4 dB indicates that this link would have sufficient power for transmission; however, due to the dispersion limit on the link (4 km x 155.52 MHz > 500 MHz/km), this link would not work with multimode fiber. In this case, single-mode fiber would be the better choice.

Single-Mode Transmission

The single-mode signal source for fiber-optic transmission is an injection laser diode.

Single-mode transmission is useful for longer distances because a single transmission path within the fiber is used and smear does not occur. In addition, chromatic dispersion is reduced because laser light is essentially monochromatic.

The maximum overload limit on the single-mode receiver is –14 dBm. The single-mode receiver can be overloaded when short lengths of fiber are used because the transmitter can transmit up to –8 dB. The receiver could be overloaded at –14 dB, but no damage will result.

To prevent overloading the receiver when you are interconnecting short fiber links, insert a 5 to 10 dB attenuator on the link between any single-mode SONET transmitter and the receiver.

SONET Single-Mode Power Budget Example

The following example of a single-mode power budget is for two buildings, 11 kilometers apart, that are connected through a patch panel in an intervening building. The entire link is made up of 12 connectors.

- Length of single-mode link = 11 km
- 10 connectors

Estimate the power budget as follows:

PB = 11.5 dB – 11 km (0.5 dB/km) – 10 (0.5 dB)

PB = 11.5 dB – 5.5 dB – 5 dB

PB = 1 dB

The resulting power budget (PB) value of 1 dB indicates that this link would have sufficient power for transmission and would not exceed the maximum receiver input power.

Using Statistics to Estimate the Power Budget

Statistical models are more accurate in determining the power budget than "worst-case" methods.

Determining the link loss with statistical methods requires accurate knowledge of variations in the data link components. However, statistical power budget analysis is beyond the scope of this document.

For further information on this topic, refer to the UNI Forum specifications, ITU-T standards, and your equipment specifications.

Installation Tools Required

The Cisco 12008 can be installed with a minimum number of tools:

- 1/4-inch flat-blade screwdriver
- 3/16-inch flat-blade screwdriver
- Number 2 Phillips head screwdriver
- ESD-preventive wrist strap
- Antistatic mat
- Tape measure
- Level
- 10-mm wrench (boxed-end, socket, or nut driver)—for connecting DC source power cables to the DC-input power supply terminals

- 9/16-inch wrench (open-end or socket)—for removing the lag bolts from the router shipping pallet
- Wire cutters
- Pliers

Unpacking the Cisco 12008

To unpack your Cisco 12008, use the instructions in the document entitled *Cisco 12008 Gigabit Switch Router System Packing and Unpacking Instructions*, which was shipped with the router. Appendix A of this document describes the shipping container for the Cisco 12008; it also provides instructions for unpacking the router prior to installation and how to repackage the router if you need to move it at some later time.

Note Do not discard the packaging materials used in shipping your router. You will need this material in the future if you move or ship your router.

If the packing materials are lost or damaged, replacement packing materials are available as an orderable item (product number PKG-GSR8=).

Checking the Contents of the Shipping Container

Check the contents of the shipping container to verify that the following items have been included in the shipment:

- One Cisco 12008 router as ordered, fully assembled
- One RP
- CSCs, SFCs, and line cards, as ordered
- One or two AC-input or DC-input power supplies, as ordered, already installed in the router
- An accessories box (packed with the router on the shipping pallet)

If you do not receive everything you ordered, contact a Cisco customer service representative for assistance.

Using a Site Log

It is good practice to use a site log to record all actions taken relevant to router operation and maintenance. Keep the site log near the router for ready access by the site manager or other personnel.

Site log entries might include the following:

- Installation progress—Make entries in the site log about any difficulties encountered and the remedial steps taken during the installation process.
- Upgrades and removal/replacement procedures—Make entries in the site log about system maintenance activity and hardware/software upgrades.

  Relevant items in the site log might include the following:

  — Installation, removal, or replacement of an FRU

  — Router configuration changes

  — Software upgrades

  — Hardware upgrades

  — Corrective or preventive maintenance procedures

  — Intermittent failures/problems

  — Related comments

Figure 2-8 is an example of a typical site log. You can use this one or design one of your own that meets the needs of your particular site.

Figure 2-8 Sample Site Log

Date	Description of Action Performed or Symptom Observed	Initials

H7706