



## Preparing for Installation

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Before installing your router, consider power and cabling requirements that must be in place at your installation site, special equipment for installing the router, and the environmental conditions your installation site must meet to maintain normal operation. This chapter guides you through the process of preparing for router installation.

The shipping package for the router is engineered to reduce the chances of product damage associated with routine material handling experienced during shipment.

- The router should always be transported or stored in its shipping package in the upright position.
- Keep the router in the shipping container until you have determined the installation site.

Use the *Cisco 12016*, *Cisco 12416*, and *Cisco 12816 Router Unpacking Instructions* included with the router to unpack it and inspect all items for shipping damage. If an item appears damaged, contact a Cisco customer service representative immediately.

This chapter contains the following installation topics:

- [Safety Guidelines, page 2-2](#)
- [Site Requirement Guidelines, page 2-7](#)
- [GRP Port Connection Guidelines, page 2-25](#)
- [PRP Port Connection Guidelines, page 2-36](#)
- [Alarm Card Connection Guidelines, page 2-45](#)

# Safety Guidelines

Before you perform any procedure in this publication, review the safety guidelines in this section to avoid injuring yourself or damaging the equipment. In addition, be sure to review the safety warnings listed in the *Regulatory Compliance and Safety Information for Cisco 12000 Series Internet Routers* publication that accompanied your router before you begin router installation.

Note that the information in this section are *guidelines* and do not include every potentially hazardous situation. When you install a router, always use common sense and caution.

## Safety with Equipment

- Cisco equipment operates safely when used in accordance with its specifications and product-usage instructions.
- Never install equipment that appears damaged.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.
- Never attempt to lift an object that might be too heavy for you to lift by yourself.
- Do not wear loose clothing, jewelry, or other items that could get caught in the router.
- Keep tools and assembly components away from walk areas.
- Do not work alone if potentially hazardous conditions exist.
- Keep the work area clear and dust-free during and after installation. Do not allow dirt or debris to enter into any laser-based components.

## Safety with Electricity

- The installation shall be in compliance with national and local electrical codes: in the United States, National Fire Protection Association (NFPA) 70, United States National Electrical Code; in Canada, Canadian Electrical Code, part I, CSA C22.1; in other countries, International Electrotechnical Commission (IEC) 60364, part 1 through part 7.
- Before you begin any procedures requiring access to the interior of the router, locate the emergency power-off switch for the room in which you are working.
- Disconnect all power source cables before installing or removing a router.
- Never assume that power has been disconnected from a circuit; always check.
- Carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.
- Only a DC power source that complies with the safety extra-low voltage (SELV) requirements in UL60950, CSA-C22.2 No. 60950, EN60950, ACATS001, AS/NZS 60950, and IEC60950 can be connected to the line card chassis DC-input power system.
- A line card chassis configured with the DC-input power system shall have a readily accessible two-poled disconnect device incorporated in the fixed wiring.
- The line card chassis requires short-circuit (overcurrent) protection to be provided as part of the building installation.
- If an electrical accident occurs, proceed as follows:
  - Use caution; do not become a victim. Disconnect power to the router.
  - If possible, send another person to get medical aid; otherwise, assess the condition of the victim and then call for help.

## Preventing Electrostatic Discharge Damage

Many router components can be damaged by static electricity. Not exercising the proper electrostatic discharge (ESD) precautions can result in intermittent or complete component failures. To minimize the potential for ESD damage, always use an ESD-preventive antistatic wrist strap (or ankle strap) and ensure that it makes good skin contact.

**Note**

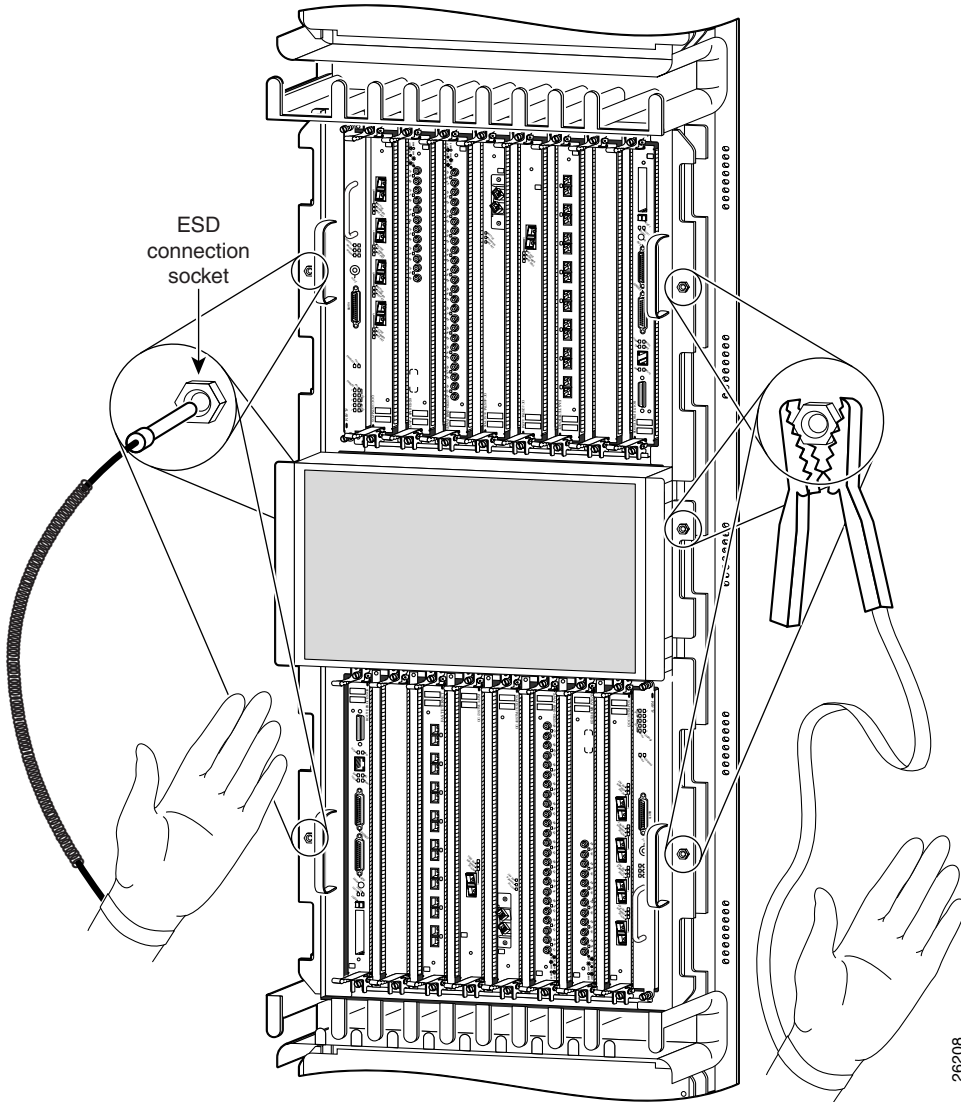
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Check the resistance value of the ESD-preventive strap periodically. The measurement should be between 1 and 10 megohms.

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Before you perform any of the procedures in this guide, attach an ESD-preventive strap to your wrist and connect the leash to the chassis or to another grounded, bare metal surface as shown in [Figure 2-1](#).

Figure 2-1 Connecting an ESD-Preventive Strap to the Router Chassis



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## Lifting Guidelines

A fully configured router can weigh as much as 275 pounds (lb) (124.74 kilograms (kg)), while an empty chassis weighs 125 lb (56.7 kg). These systems 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 router later to accommodate power sources and network connections.

Use the following lifting guidelines to avoid injury to yourself or damage to the equipment:

- Do not lift equipment alone; have another person help you to lift heavy equipment.
- Ensure that your footing is solid; balance the weight of the object between your feet.
- Lift the equipment slowly; never move suddenly or twist your body as you lift.
- Keep your back straight and lift with your legs, not your back. When bending down to lift equipment, bend at the knees (not at the waist), to reduce the strain on your lower back muscles.

**Caution**

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To prevent equipment damage, never attempt to lift or tilt the router chassis using the handles on the blower module or on line cards. These handles do not support the weight of the chassis.

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## Compliance and Safety Information

The Cisco 12016, Cisco 2416 and Cisco 12816 routers are designed to meet the regulatory compliance and safety approval requirements. Refer to the *Regulatory Compliance and Safety Information for the Cisco 12000 Series Router* (Document Number 78-4347-xx) if you require additional compliance information (see [“Cisco Technical Support & Documentation Website”](#) section on page -xx for site information).

## Laser Safety

Some line cards are equipped with ports that can emit hazardous laser radiation from the aperture when there is no cable connected to the port. This invisible radiation can cause eye injury if you stare into the port.



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**To avoid eye injury, never stare into open line card ports.**

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## Site Requirement Guidelines

This section provides the following site requirement guidelines that you must consider before installing the router:

- [Rack-Mounting Guidelines, page 2-7](#)
- [Air Flow Guidelines, page 2-15](#)
- [Temperature and Humidity Guidelines, page 2-17](#)
- [Power Connection Guidelines, page 2-17](#)
- [NEBS Supplemental Unit Bonding and Grounding Guidelines, page 2-22](#)
- [Site Wiring Guidelines, page 2-24](#)

## Rack-Mounting Guidelines

The router can be mounted in most 2-post, 4-post, or telco-type 19-inch equipment racks that comply with the Electronics Industries Association (EIA) standard for equipment racks (EIA-310-D). The rack must have at least two posts with mounting flanges to mount the router chassis. The distance between the center lines of the mounting holes on the two mounting posts must be 18.31 inches  $\pm$  0.06 inch (46.50 cm  $\pm$  0.15 cm). The rack-mounting hardware included with the router is suitable for most 19-inch equipment racks or telco-style frames.

[Figure 2-2](#) shows examples of typical 2-post, 4-post, and telco-type equipment racks.

## Figure 2-2 Equipment Rack Types

### Enclosed Rack

Figure 2-2a shows a free-standing, enclosed rack with two mounting posts in the front. The router should *not* be installed in this type of enclosed rack, because the router requires an unobstructed flow of cooling air to maintain acceptable operating temperatures for its internal components. Installing the router in any type of enclosed rack—even with the front and back doors removed—could disrupt the air flow, trap heat next to the chassis, and cause an overtemperature condition inside the router.

### Open Rack

Figure 2-2b shows a free-standing, 4-post open rack with two mounting posts in the front and two mounting posts in the back. The mounting posts in this type of rack are often adjustable so that you can position the rack-mounted unit within the depth of the rack rather than flush-mount with the front of the rack.



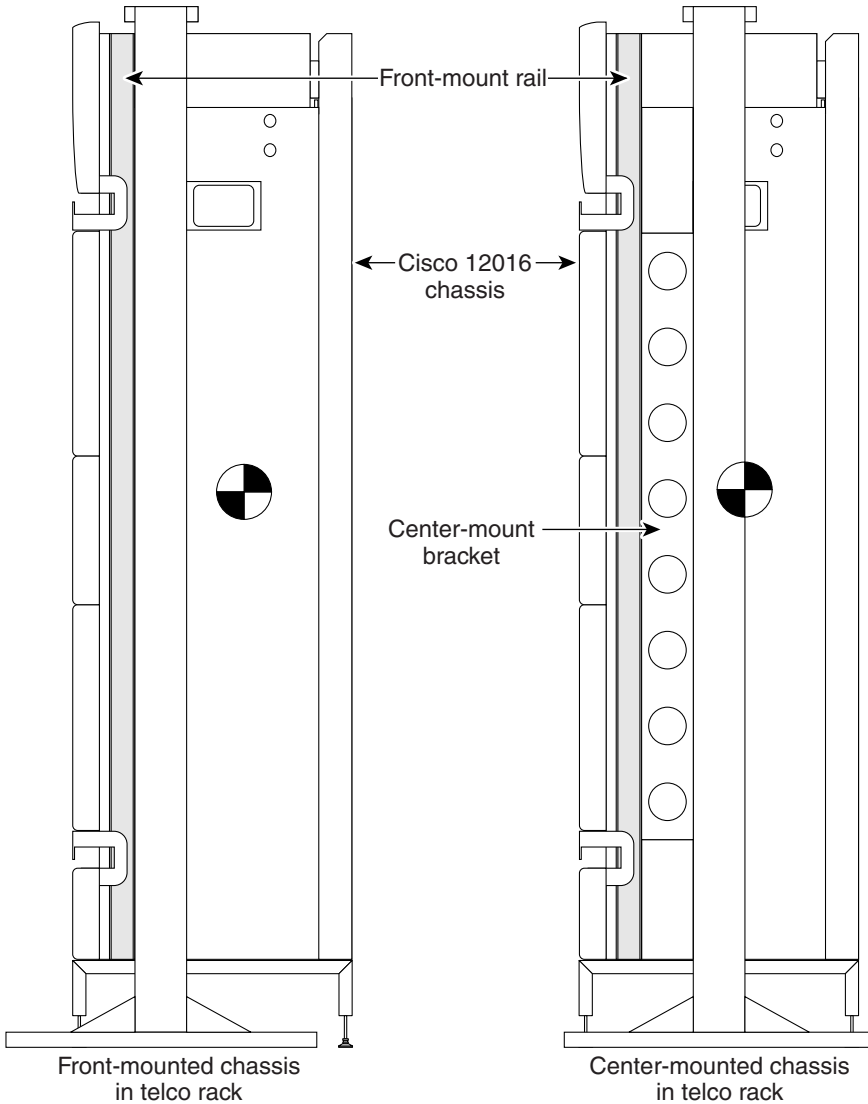
## Telco Rack

Figure 2-2c shows a telco-type rack. The telco-type rack is an open frame consisting of two posts tied together by a cross-bar at the top and a floor stand at the bottom.

This type of rack is usually secured to the floor and sometimes to an overhead structure or wall for additional stability. The router chassis can be installed in the telco-type rack either in a front-mounted position or a center-mounted position (Figure 2-3).

- In the front-mounted position, you secure the chassis rack-mounting brackets directly to the rack posts.
- In the center-mounted position, you secure a set of optional center-mount brackets to the rack posts. The chassis rack-mounting flanges are then secured to the center-mount brackets. The center-mounted position moves the center of gravity of the chassis closer to the vertical axis of the rack posts, which adds to the stability of the rack installation.

Figure 2-3 Front-Mounted and Center-Mounted Installation in a Telco Rack



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## Site Layout and Equipment Dimensions

To help maintain trouble-free operation, adhere to the following precautions when planning your rack installation:

- Ensure the site of the rack includes provisions for source AC or DC power, grounding, and network interface cables.
- Allow sufficient space to work around the rack during the installation. You need:
  - At least 3 feet adjacent to the rack to move, align, and insert the chassis.
  - At least 2 feet in front of the power shelf to insert power entry modules.
- Maintain at least 24 inches (61 cm) of clearance in front of and behind the chassis for maintenance after installation.
- To mount the router between two posts or rails, the usable aperture (the width between the *inner* edges of the two mounting flanges) must be at least 17.7 inches (45.0 cm).
- When fully populated with cards, the router can weigh as much as 440 lb (200 kg). Mount the router so that the bottom of the router chassis is no higher than 10 inches (25.4 cm) from the floor to keep the center of gravity of the rack as low as possible. To maintain equipment rack stability and to ensure your safety, make sure you install any stabilizing devices provided before you install the router.
- If you use a telco-style rack, the weight of the chassis is cantilevered off of the two rack posts. Make sure that:
  - The weight of the router does not make the frame unstable.
  - The frame is bolted to the floor and is secured to the building structure using either wall brackets or overhead brackets.
- When mounting the router in a telco-type rack or 4-post rack, be sure to use all of the screws provided to secure the chassis to the rack posts.
- For the enhanced models of the Cisco 12016 series routers, the mounting rails on a 4-post rack must be recessed no more than 1.5 inches for the front door to fully open and close and to provide adequate room for cable routing.

- Install the cable-management brackets included with the router to keep cables organized. Be sure to:
  - Use appropriate strain-relief methods to protect cables and equipment connections.
  - Make sure that cables from other equipment installed in the rack do not restrict access to the card cages.
- To avoid noise interference in network interface cables, do not route them directly across or along power cables.

Figure 2-4 shows the footprint and outer dimensions of the original series router chassis.

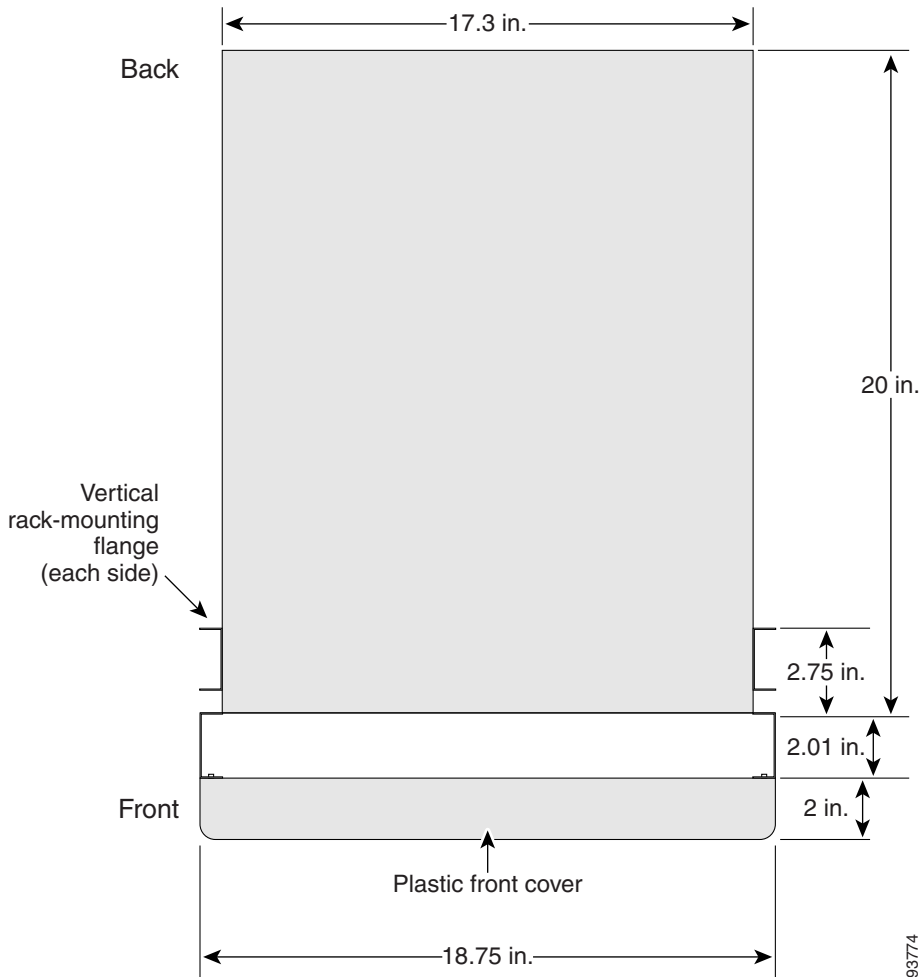
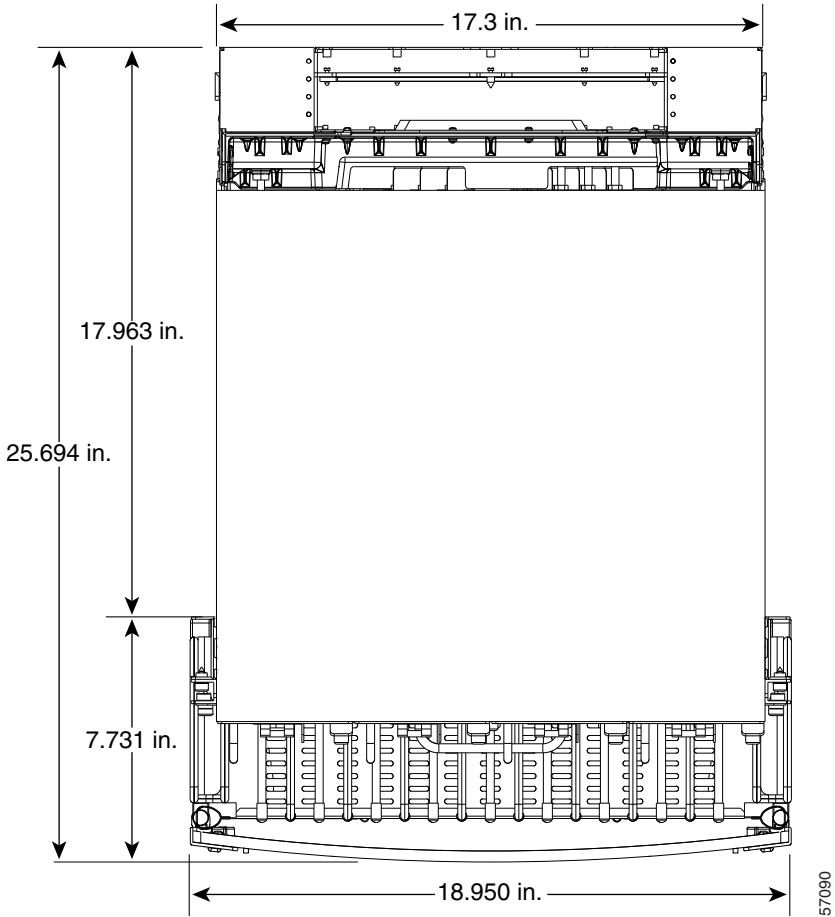
**Figure 2-4 Router Chassis Footprint and Dimensions—Top View)**

Figure 2-5 shows the footprint and outer dimensions of the enhanced version of router chassis.

Figure 2-5 Enhanced Router Chassis Footprint and Dimensions—Top View



## Air Flow Guidelines

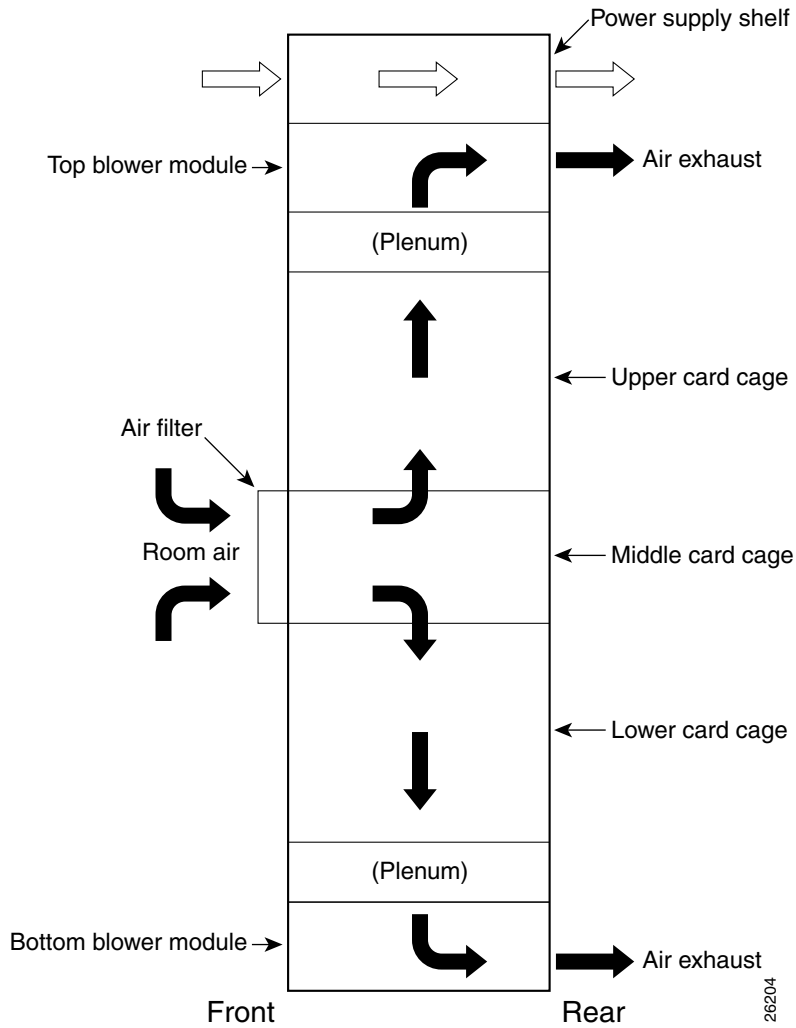
Cool air is circulated through the router chassis by two blower modules. The blower modules maintain acceptable operating temperatures for the internal components by drawing in cool air through the air filter in front of the switch fabric card cage (middle), and circulating the air through both card cages (Figure 2-6).

Each power supply is also equipped with a fan that draws cooler air into the front of the power supply and forces warmer air out of the back of the chassis.

When selecting a site to install the router, observe the following guidelines:

- **Dust free area**—The site should be as dust free as possible. Dusty environments can clog the air filter or power supply intake vents, reducing the cooling air flow through the router. Clogged filters and vents can cause an overtemperature condition in the router.
- **Unrestricted air flow**—Allow sufficient air flow by maintaining a minimum of 6 inches (15.24 cm) of clearance at both the inlet and exhaust openings on the chassis and the power modules. If the air flow is blocked or restricted, or if the inlet air is too warm, an overtemperature condition can occur within the router. Under extreme conditions, the environmental monitoring system will power off the router to protect the components.

Figure 2-6 Air Flow Path through the Router - Side View





## Temperature and Humidity Guidelines

The operating and nonoperating environmental site requirements are listed in [Table A-4 on page A-4](#). The router normally operates within the ranges listed in Table A-4, however, if a temperature measurement is approaching a minimum or maximum parameter it indicates a potential problem. Maintain normal operation by anticipating and correcting environmental anomalies before they approach critical values by properly planning and preparing your site before you install the router.

## Power Connection Guidelines

You can configure the router with either an AC-input or DC-input power subsystem, so the site power source requirements differ depending on the power subsystem in your router. Ensure all power connection wiring conforms to the rules and regulations in the National Electrical Code (NEC), as well as local codes.



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**Caution**

Proper grounding is necessary to avoid damage from lightning and power surges. See the [“Router Bonding and Grounding Receptacles—Top Rear” section on page 2-23](#) for grounding requirements.

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## AC-Powered Routers

AC PEMs operate in the nominal range of 200 VAC to 240 VAC and require a minimum service of:

- 20 A for operation in North America
- 16 A for international operation
- 13 A for operation in the UK

Each of the AC power inputs requires separate dedicated branch circuit. For a list of the nominal and acceptable value ranges for source AC power, refer to [Table A-2 on page A-3](#).

[Figure 2-7](#) shows different styles of AC power cords used to connect to the local AC power source that are available for North America and various locales.

**Figure 2-7 AC Power Cord Plugs and Appliance Coupler**

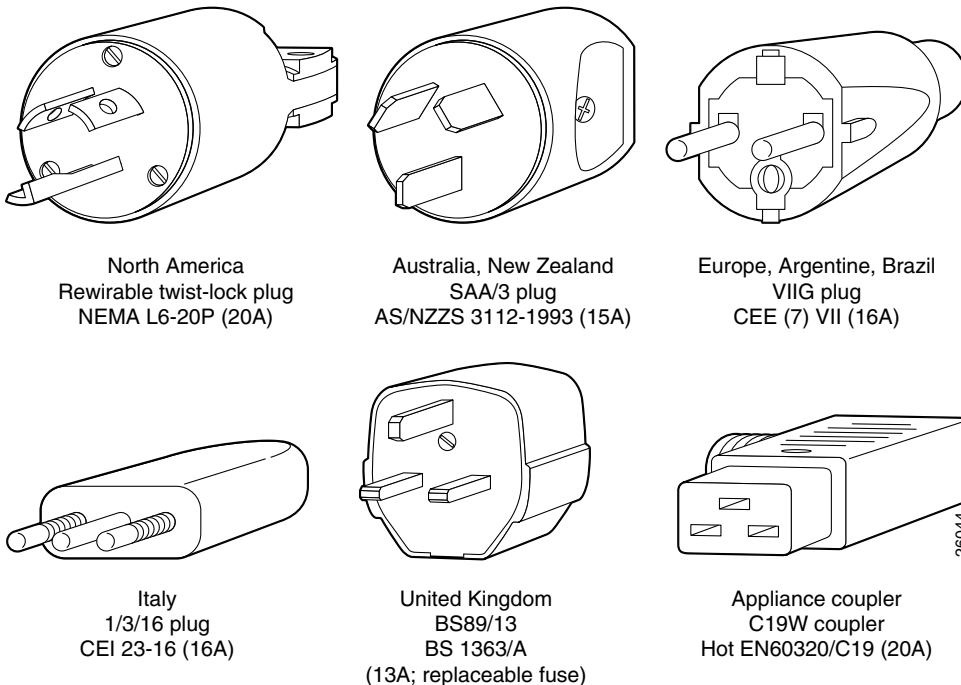


Table 2-1 lists power cord options. All AC-input power supply power cords measure 14 feet (4.3 m).

**Table 2-1 AC Power Cord International Options**

| Label                     | Description                              | Part Number   |
|---------------------------|--|---------------|
| North America             | 20 A, 250 VAC                            | CAB-GSR16-US= |
| Australia, New Zealand    | 15 A, 250 VAC                            | CAB-GSR16-AU= |
| Europe, Argentina, Brazil | 16 A, 250 VAC                            | CAB-GSR16-EU= |
| Italy                     | 16 A, 250 VAC                            | CAB-GSR16-IT= |
| United Kingdom            | 13 A, 250 VAC<br>(13 A replaceable fuse) | CAB-GSR16-UK= |

## DC-Powered Routers

Connections to DC PEMs are rated at 60 amps maximum. A dedicated, commensurately rated DC power source is required for each PEM connection.

For DC power cables, we recommend that you use a commensurately rated, high-strand-count copper wire cable. Connection to the DC power shelf requires one earth ground cable and two cable leads; a source DC (–) and source DC return (+) for each PEM. The length of the cables depends on your router location from the source power.



### Note

DC power cables are not available from Cisco, but are available from any commercial cable vendor.

You must terminate DC power cables using cable lugs at the power shelf end. Ensure the lugs are dual-hole and that they are able to fit over M4 terminal studs at 0.625-inch (15.88-mm) centers (for example, Panduit Part Number LCD8-14A-L or equivalent).

Figure 2-8 shows the type of lug required for the DC-input cable connections.

**Figure 2-8 DC Power Cable Lug**

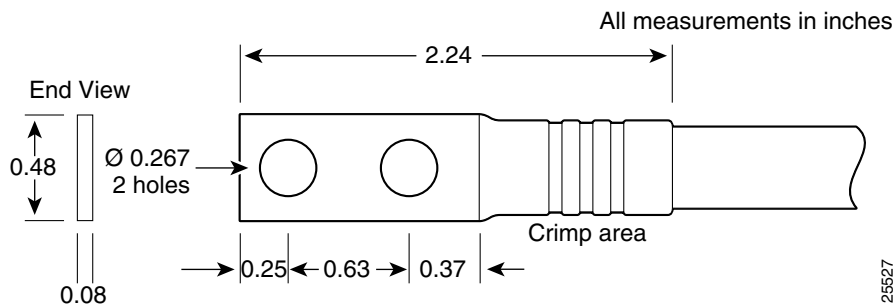


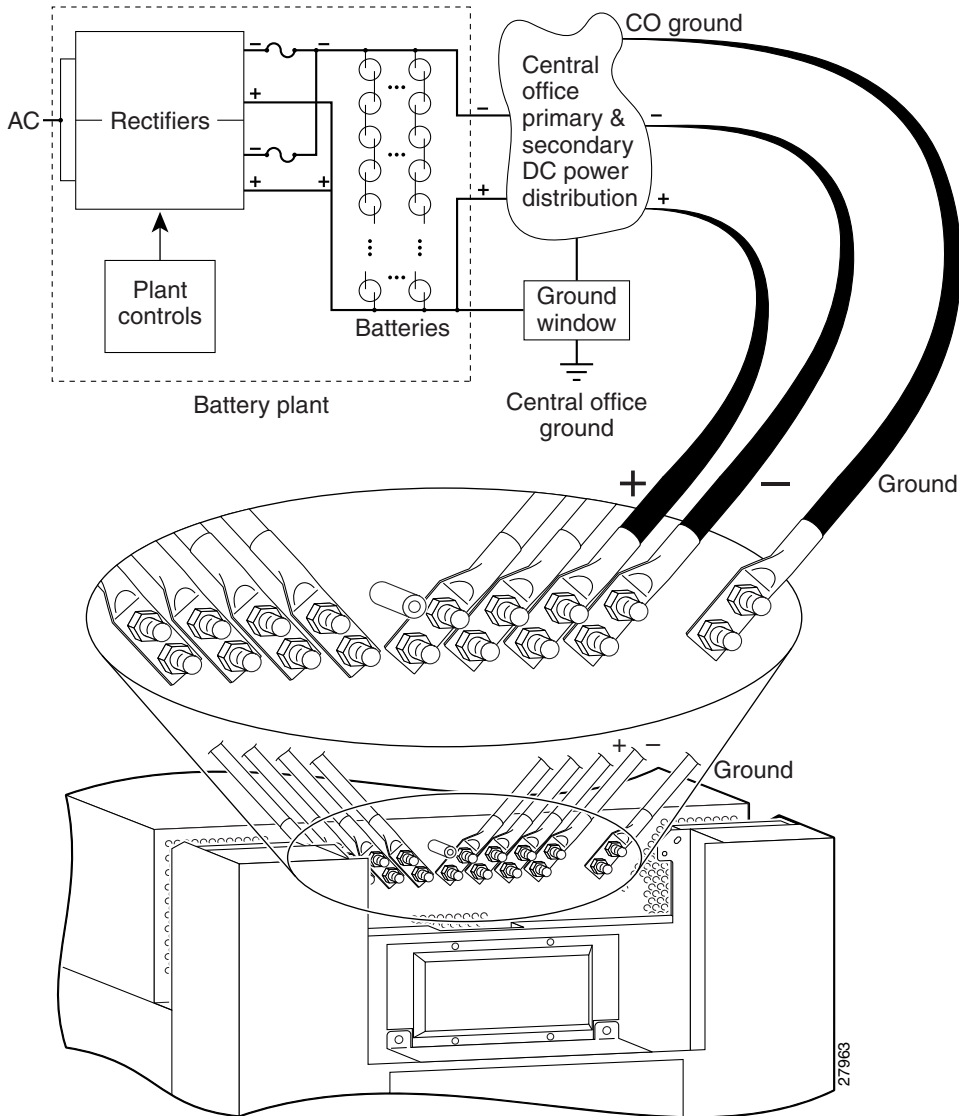
Figure 2-9 shows a source DC power distribution scheme for a DC-input power shelf.

It shows two power cables attached to the DC-input power lugs for power shelf bay B1 (far right bay of the DC-input power shelf when looking at the back panel).

The color coding of the source DC power cable leads depends on the color coding of the site DC power source. Typically, green or green and yellow indicate that the cable is a ground cable. Because there is no color code standard for the source DC wiring, be sure that the power cables are connected to the DC-input power shelf terminal studs using the proper positive (+) and negative (-) polarity.

- In some cases, the source DC cable leads might have a positive (+) or a negative (-) label. This is a relatively safe indication of the polarity, but you must verify the polarity by measuring the voltage between the DC cable leads. When making the measurement, the positive (+) lead and the negative (-) lead must always match the (+) and (-) labels on the power shelf.
- A green (or green and yellow) cable typically indicate that it is a ground cable.

Figure 2-9 Typical Source DC Power Cabling Scheme for Power Shelf Bay B1



**Caution**

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DC PEMs contains circuitry to trip the breaker on the PEM if the PEM detects a reverse polarity condition. No damage should occur from reverse polarity, but you should correct a reverse polarity condition immediately.

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For a list of the nominal and acceptable value ranges for source DC power, refer to [Table A-3 on page A-3](#).

## NEBS Supplemental Unit Bonding and Grounding Guidelines

Although the router chassis requires a safety earth ground connection as part of the power cabling to the power shelf, we also recommend that you connect the central office ground system or interior equipment grounding system to the supplemental bonding and grounding connections.

Supplemental connections are located at the top of the power interface panel on the back of the chassis ([Figure 2-10](#)), and near the lower corners of the switch fabric card cage on the front flanges of the chassis ([Figure 2-11](#)). The DC return of this system should remain isolated from the system frame and chassis (DC-I).

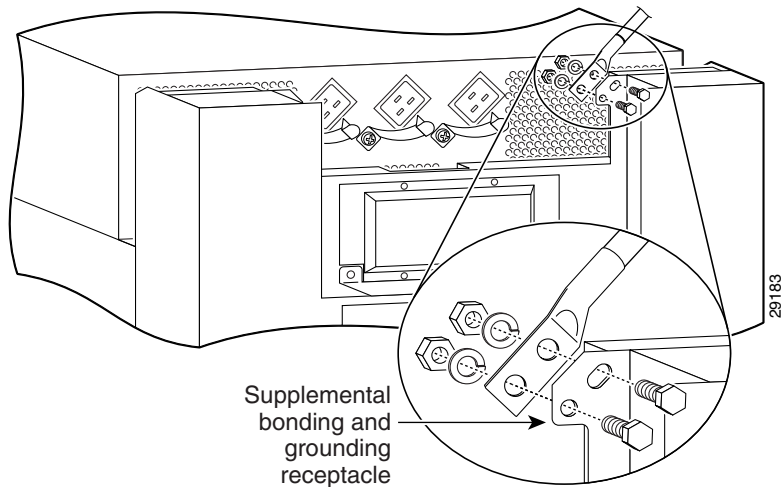
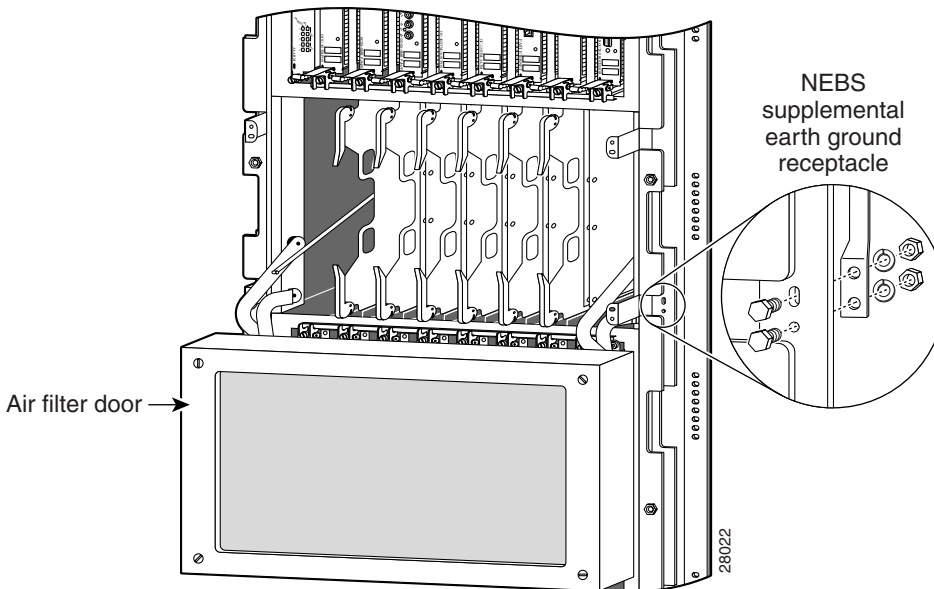
This grounding points are also referred to as the network equipment building system (NEBS) bonding and grounding connections.

**Note**

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These bonding and grounding connections satisfy the Telcordia NEBS requirements for supplemental bonding and grounding connections. If you are not installing the router in a NEBS environment, you can choose to bypass these guidelines and rely on the safety earth ground connections to the AC and DC power shelves.

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**Figure 2-10 Router Bonding and Grounding Receptacles—Top Rear****Figure 2-11 Router Bonding and Grounding Receptacles—Front**

To ensure a satisfactory supplemental ground connection to the router, use the following parts:

**Note**

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These parts are not available from Cisco, but are available from commercial vendors.

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- Two grounding lugs, which have two M4 bolt holes with 0.625 to 0.75-inch (15.86 to 19.05-mm) spacing between them, and a wire receptacle large enough to accept a 6-AWG or larger, multistrand copper wire. This lug is similar to those used for the DC-input power supply leads (see [Figure 2-8](#)).
- Two M4 hex-head nuts and locking washers (nickel-plated brass is ideal).
- Two grounding wires. Although we recommend at least 6-AWG multistrand copper wire, the wire diameter and length depend on your router location and site environment.

## Site Wiring Guidelines

When planning the location of the router, consider distance limitations for signaling, electromagnetic interference (EMI), and connector compatibility. If the wiring is run for any significant distance in an electromagnetic field, interference can occur between the field and the signals on the wires. Poor wiring can cause:

- Radio interference emanating from the wires.
- Strong EMI, especially when caused by lightning or radio transmitters. EMI 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.

**Note**

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

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Site wiring is unlikely to emit radio interference if you use twisted-pair cable with a good distribution of grounding conductors. Use a high-quality twisted-pair cable with one ground conductor for each data signal, when applicable.

Give special consideration to the effect of a lightning strike in your vicinity, especially if the wiring exceeds the recommended distances, or if it passes between buildings. The electromagnetic pulse (EMP) caused by lightning or other high-energy phenomena can easily induce enough energy into unshielded conductors to destroy electronic devices. If you have experienced EMP problems in the past, you may want to consult experts in electrical surge suppression and shielding.

Most data centers cannot resolve the infrequent but potentially catastrophic problems without pulse meters and other special equipment. In addition, these problems can take a great deal of time to identify and resolve. We recommend that you take the necessary precautions to avoid these problems by providing a properly grounded and shielded environment, with special attention to issues of electrical surge suppression.

## GRP Port Connection Guidelines

This section contains detailed cabling and signal information for all interface and port connections to the GRP. It also provides information for Ethernet routing and equipment.



### Caution

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Ports labeled Ethernet, 10BASE-T, Token Ring, Console, and AUX are safety extra-low voltage (SELV) circuits. Only connect SELV circuits to other SELV circuits.

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- [GRP Auxiliary and Console Port Connections, page 2-26](#)
- [GRP Ethernet Port Connections, page 2-29](#)
- [PRP Auxiliary and Console Port Connection Guidelines, page 2-36](#)
- [PRP Ethernet Connections, page 2-40](#)

## GRP Auxiliary and Console Port Connections

The GRP has two EIA/TIA-232 ports (Figure 2-12):

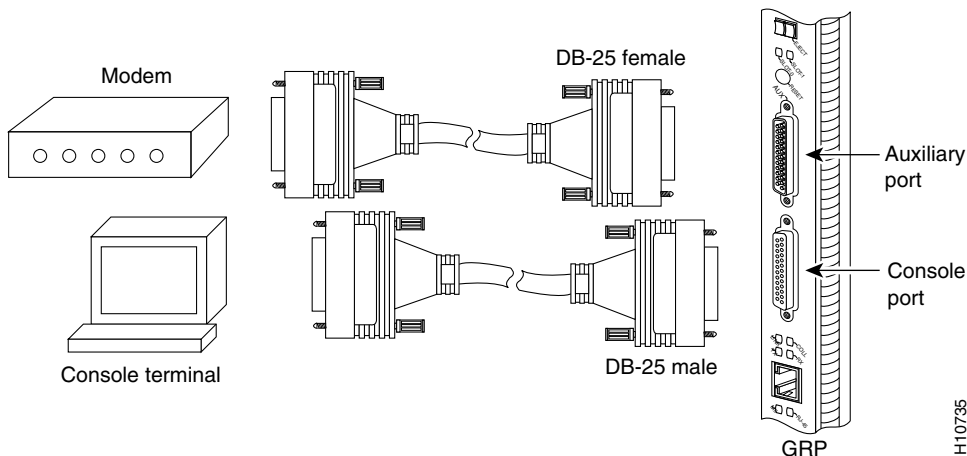
- Auxiliary port— DB-25 plug, DTE-mode port for connecting a modem or other DCE device (such as a CSU/DSU or another router) to the GRP.
- Console port—DB-25 receptacle, DCE-mode port for connecting a data terminal to perform the initial configuration of the router.



### Note

The auxiliary and console ports are asynchronous serial ports. Devices connected to these ports must be capable of asynchronous transmission.

**Figure 2-12 GRP Auxiliary and Console Port Connections**



Because the connectors on some standard cables are large enough to interfere with the front covers installed on the card cages, a lower-profile cable adapter is included that permits you to connect a flat cable with modular RJ-45 plugs to the GRP console port.



### Note

EIA/TIA-232 cables are not available from Cisco, but are available from any commercial cable vendor.

**Caution**

To maintain Class B EMI compliance, you must use shielded cables when connecting to the auxiliary and console ports of original GRPs (part numbers GRP= and GRP-B=). An updated version of the GRP-B= board (Rev. F0) does not require shielded cables for Class B compliance.

## GRP Auxiliary Port Signals

The GRP auxiliary port is a DB-25 DTE port for connecting a modem or other DCE device to the router. The auxiliary port supports hardware flow control and modem control.

[Table 2-2](#) lists the signals used on the auxiliary port.

**Table 2-2 GRP Auxiliary Port Signals**

| Pin | Signal | Direction | Description   |
|-----|--------|-----------|---|
| 1   | GND    | —         | Shield ground                                       |
| 2   | TxD    | Output    | Transmit data (to DCE)                              |
| 3   | RxD    | Input     | Receive data (from DCE)                             |
| 4   | RTS    | Output    | Request to send<br>(used for hardware flow control) |
| 5   | CTS    | Input     | Clear to send (used for hardware flow control)      |
| 6   | DSR    | Input     | Data set ready                                      |
| 7   | GND    | —         | Signal ground                                       |
| 8   | DCD    | Input     | Carrier detect (used for modem control)             |
| 20  | DTR    | Output    | Data terminal ready (used for modem control only)   |
| 22  | RING   | Input     | Ring  |

## GRP Console Port Signals

The GRP console port is a DB-25 DCE interface for connecting a DTE terminal device to the router. Both Data Set Ready (DSR) and Data Carrier Detect (DCD) signals are active when the router is powered on. The console port does not support modem control or hardware flow control and requires a straight-through EIA/TIA-232 cable.

Before you connect a terminal to the console port, check the terminal setting for the data transmission rate, in bits per second (bps). The terminal transmission rate setting must match the default rate of the GRP console port, which is 9600 bps. Set the terminal to these operational values: 9600 bps, 8 data bits, no parity, 2 stop bits (9600 8N2).

[Table 2-3](#) lists the signals used on the console port.

**Table 2-3 GRP Console Port Signals**

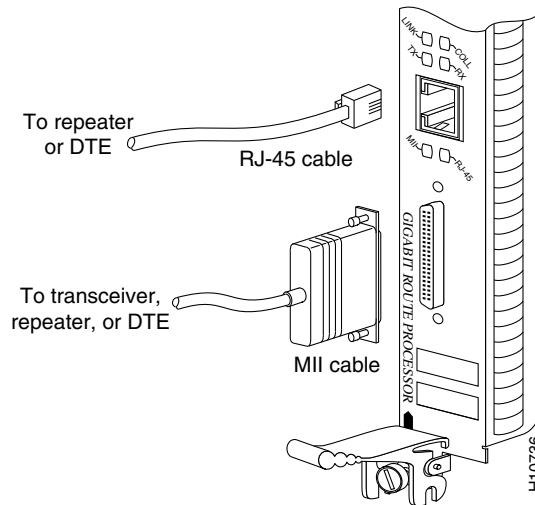
| Pin | Signal | Direction | Description                     |
|-----|--------|-----------|---------------------------------|
| 1   | GND    | —         | Shield ground                   |
| 2   | TxD    | Output    | Transmit data (from DTE)        |
| 3   | RxD    | Input     | Receive data (to DTE)           |
| 6   | DSR    | Input     | Data set ready (always on)      |
| 7   | GND    | —         | Signal ground                   |
| 8   | DCD    | Input     | Data carrier detect (always on) |
| 20  | DTR    | Output    | Data terminal ready             |

## GRP Ethernet Port Connections

The GRP has the following two types of Ethernet connections (Figure 2-13):

- RJ-45 media-dependent interface (MDI)
- 40-pin, D-shell type media-independent interface (MII)

**Figure 2-13 GRP RJ-45 and MII Ethernet Connections**



You can use either Ethernet connection, but not both at the same time. Two LEDs on the GRP front panel indicate which Ethernet port is active. Each connection supports IEEE 802.3 and IEEE 802.3u interfaces compliant with the 10BASE-T and 100BASE-TX standards.



### Note

The Ethernet port can use either unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cables. Shielded twisted-pair cables are recommended for sites at which extremely high immunity to noise is required.

The GRP Ethernet port does not provide external routing functions. Its primary roles are to act as a Telnet port into the router, and to boot or access Cisco IOS software images over a network to which the GRP Ethernet port is directly connected.

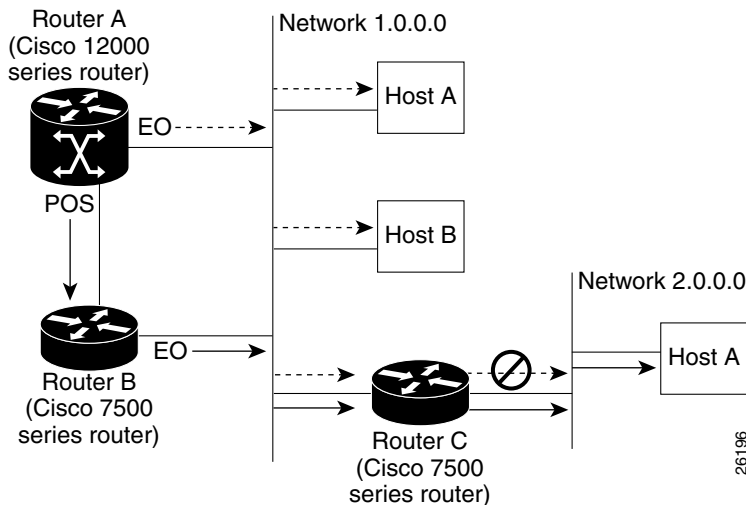
**Caution**

Cisco Express Forwarding (CEF) functions on these ports are switched off by default for security reasons. Cisco strongly cautions you to consider the security implications of switching on CEF routing functions on these ports.

Figure 2-14 shows:

- You cannot access Network 2.0.0.0 from Ethernet port (E0) on the GRP in Router A. You can only access Host A, Host B, and Router C, which are in Network 1.0.0.0 (see dotted-line arrows).
- To access Network 2.0.0.0 from Router A, you must use an interface port on one of the line cards (a POS line card in this example) in Router A. Data from Router A is routed through Router B and Router C, to reach Network 2.0.0.0 (see solid-line arrows).

**Figure 2-14 Using the Ethernet Port on the GRP**

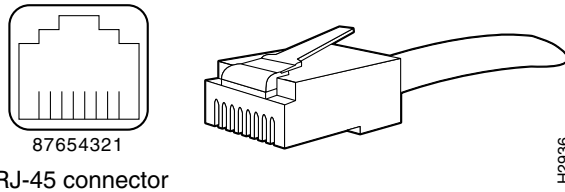


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## GRP RJ-45 Ethernet Connections

The RJ-45 Ethernet connection does not require an external transceiver. [Figure 2-15](#) shows the pin orientation of the RJ-45 Ethernet port and the modular cable plug it accepts.

**Figure 2-15 GRP RJ-45 Ethernet Receptacle and Modular Plug**



RJ-45 connector

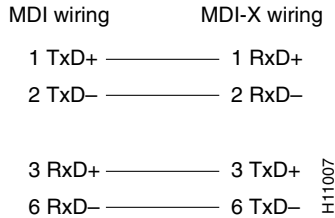
[Table 2-4](#) lists the RJ-45 pin signals used on the connector.

**Table 2-4 GRP RJ-45 Ethernet Receptacle Pinout**

| Ethernet Port Pin | Signal              | Description     |
|-------------------|---------------------|-----------------|
| 1                 | TxD+                | Transmit data + |
| 2                 | TxD-                | Transmit data - |
| 3                 | RxD+                | Receive data +  |
| 4                 | Termination network | No connection   |
| 5                 | Termination network | No connection   |
| 6                 | RxD-                | Receive data -  |
| 7                 | Termination network | No connection   |
| 8                 | Termination network | No connection   |

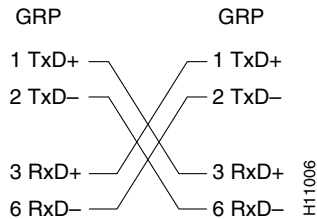
When connecting the RJ-45 port to a hub or repeater, use the straight-through cable pinout shown in [Figure 2-16](#).

**Figure 2-16 Straight-Through Ethernet Cable Pinout**



When connecting two GRPs back-to-back, use the crossover cable pinout shown in [Figure 2-17](#).

**Figure 2-17 Crossover Ethernet Cable Pinout**





## GRP MII Ethernet Connections

The GRP MII Ethernet connection requires an external physical sublayer (PHY) and an external transceiver that permits connection to multimode fiber for 100BASE-FX or 100BASE-T4 physical media. Depending on the type of media between the MII receptacle and the switch or hub, the network side of your 100-Mbps transceiver should be appropriately equipped with fiber-optic SC-type or ST-type connectors, coaxial cable BNC connectors, or other appropriate hardware.

Figure 2-18 shows the pin orientation of the female MII connector on the GRP. The MII connector uses 2-56 screw-type locks, called *jackscrews*, to secure the cable or transceiver to the MII port. MII cables and transceivers have knurled thumbscrews that you fasten to the jackscrews on the MII connector to provide strain relief for your MII cable.

**Figure 2-18 GRP MII Ethernet Connector**

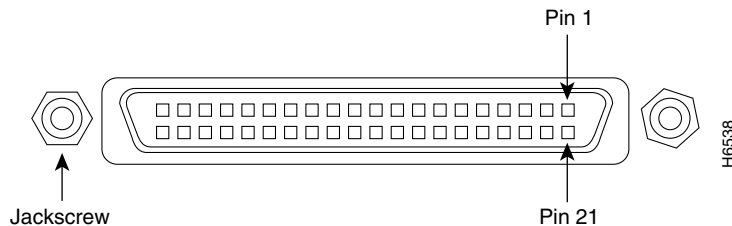


Table 2-5 lists the signals used on the MII connector.

**Table 2-5 GRP MII Ethernet Pinout**

| Pin <sup>1</sup> | In  | Out | Input/<br>Output | Description                          |
|------------------|-----|-----|------------------|--------------------------------------|
| 14–17            | –   | Yes | –                | Transmit data (TxD)                  |
| 12               | Yes | –   | –                | Transmit clock (Tx_CLK) <sup>2</sup> |
| 11               | –   | Yes | –                | Transmit error (Tx_ER)               |
| 13               | –   | Yes | –                | Transmit enable (Tx_EN)              |
| 3                | –   | Yes | –                | MII data clock (MDC)                 |
| 4–7              | Yes | –   | –                | Receive data (RxD)                   |
| 9                | Yes | –   | –                | Receive clock (Rx_CLK)               |
| 10               | Yes | –   | –                | Receive error (Rx_ER)                |
| 8                | Yes | –   | –                | Receive data valid (Rx_DV)           |
| 18               | Yes | –   | –                | Collision (COL)                      |
| 19               | Yes | –   | –                | Carrier sense (CRS)                  |
| 2                | –   | –   | Yes              | MII data input/output (MDIO)         |
| 22–39            | –   | –   | –                | Common (ground)                      |
| 1, 20, 21, 40    | –   | –   | –                | +5 V                                 |

1. Pins not listed in the table are not used.
2. Tx\_CLK and Rx\_CLK are provided by the external transceiver.

Table 2-6 lists the cabling specifications for 100-Mbps transmission over unshielded twisted-pair (UTP) cables.

**Table 2-6 Specifications and Connection Limits for 100-Mbps Transmission**

| Parameter            | RJ-45   | MII   |
|----------------------|---|---|
| Cable specification  | Category 5 <sup>1</sup> UTP, 22 - 24 AWG <sup>2</sup> | Category 3, 4, or 5, 150-ohm UTP or STP, or multimode optical fiber |
| Cable length (max)   | —   | 1.64 ft (0.5 m) (MII-to-MII cable <sup>3</sup> )                    |
| Segment length (max) | 328 ft (100 m) for 100BASE-TX                         | 3.28 ft (1 m) <sup>4</sup> or 1,312 ft (400 m) for 100BASE-FX       |
| Network length (max) | 656 ft (200 m) <sup>4</sup> with 1 repeater           | —   |

1. EIA/TIA-568 or EIA-TIA-568 TSB-36 compliant. Not supplied by Cisco.
2. AWG = American Wire Gauge. This gauge is specified by the EIA/TIA-568 standard.
3. The cable between the MII port on the GRP and the appropriate transceiver.
4. Specifically, the length between any two stations on a repeated segment.

Table 2-7 lists IEEE 802.3u physical characteristics for 100BASE-TX cabling.

**Table 2-7 IEEE 802.3u Physical Characteristics**

| Parameter                   | 100BASE-TX                        |
|-----------------------------|-----------------------------------|
| Data rate (Mbps)            | 100                               |
| Signaling method            | Baseband                          |
| Segment length (max meters) | 100 m between DTE and repeaters   |
| Media                       | Category 5 UTP (for RJ-45) or MII |
| Topology                    | Star/hub                          |

# PRP Port Connection Guidelines

This section contains detailed cabling and signal information for all interface and port connections to the PRP. It also provides information for Ethernet routing and equipment.

**Caution**

---

Ports labeled Ethernet, 10BASE-T, Token Ring, Console, and AUX are safety extra-low voltage (SELV) circuits. Only connect SELV circuits to other SELV circuits.

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## PRP Auxiliary and Console Port Connection Guidelines

The PRP has two RJ-45 connection ports:

- Auxiliary port— DTE RJ-45 interface for connecting a modem or other DCE device (such as a CSU/DSU or another router) to the PRP.
- Console port—DCE RJ-45 interface for connecting a data terminal device to the router, which you need to perform the initial configuration of the router.

**Note**

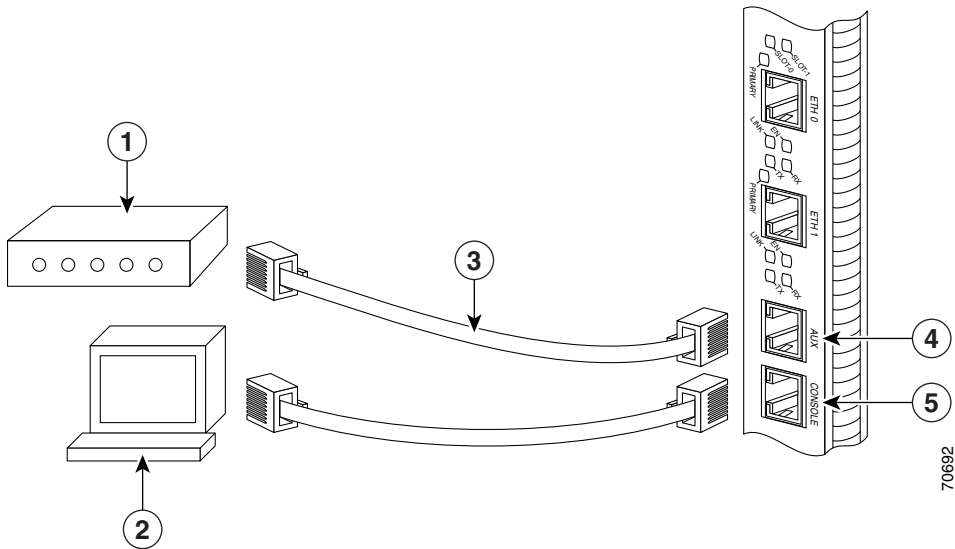
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The auxiliary and console ports are asynchronous serial ports. Ensure that devices connected to these ports are capable of asynchronous transmission.

---

[Figure 2-19](#) shows the auxiliary and console port connections from the PRP to the associated devices.

Figure 2-19 PRP Auxiliary and Console Port Connections



|   |                  |   |                |
|---|------------------|---|----------------|
| 1 | Modem            | 4 | Auxiliary port |
| 2 | Console terminal | 5 | Console port   |
| 3 | RJ-45 cables     |   |                |

## PRP Auxiliary Port Signals

The PRP auxiliary port is a DTE, RJ-45 interface for connecting a modem or other DCE device (such as a CSU/DSU or another router) to the PRP. The auxiliary port supports hardware flow control and modem control.

Table 2-8 lists the signals used on the auxiliary port.

**Table 2-8 PRP Auxiliary Port Signals**

| Auxiliary Port Pin | Signal | Input/Output | Description         |
|--------------------|--------|--------------|---------------------|
| 1                  | RTS    | Output       | Request to send     |
| 2                  | DTR    | Output       | Data terminal ready |
| 3                  | TxD    | Output       | Transmit data       |
| 4                  | GND    | —            | Signal ground       |
| 5                  | GND    | —            | Signal ground       |
| 6                  | RxD    | Input        | Receive data        |
| 7                  | DSR    | Input        | Data set ready      |
| 8                  | CTS    | Input        | Clear to send       |

## PRP Console Port Signals

The PRP console port is a DCE RJ-45 interface for connecting a terminal to the router. The console port does not support modem control or hardware flow control and requires a roll-over RJ-45 cable.

Before connecting a terminal to the console port, check the terminal setting for the data transmission rate, in bits per second (bps). The terminal transmission rate setting must match the default rate of the PRP console port, which is 9600 bps. Set the terminal to these operational values: 9600 bps, 8 data bits, no parity, 2 stop bits (9600 8N2).

[Table 2-9](#) lists the signals used on the console port.

**Table 2-9 PRP Console Port Signals (with RJ45 roll-over cable)**

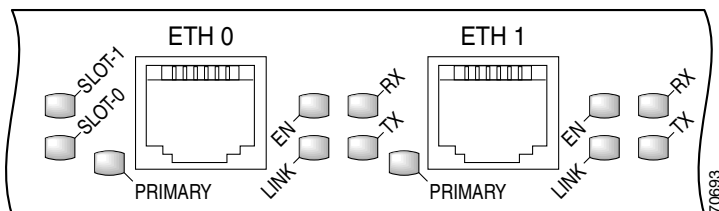
| Console Port Pin | Signal | Input/Output | Description         |
|------------------|--------|--------------|---------------------|
| 1 <sup>1</sup>   | —      | —            | —                   |
| 2                | DTR    | Output       | Data terminal ready |
| 3                | TxD    | Output       | Transmit data       |
| 4                | GND    | —            | Signal ground       |
| 5                | GND    | —            | Signal ground       |
| 6                | RxD    | Input        | Receive data        |
| 7                | DSR    | Input        | Data set ready      |
| 8 <sup>1</sup>   | —      | —            | —                   |

1. These pins are not connected.

## PRP Ethernet Connections

The PRP has two RJ-45 MDI Ethernet ports; ETH0 and ETH1 (Figure 2-20).

**Figure 2-20 PRP Ethernet Connections**



These connections support IEEE 802.3 and IEEE 802.3u interfaces compliant with 10BASE-T and 100BASE-TX standards. The transmission speed of the Ethernet ports is autosensing by default and is user configurable.

The PRP Ethernet port does not provide external routing functions. Its primary roles are to act as a Telnet port into the router, and to boot or access Cisco IOS software images over a network to which the PRP Ethernet port is directly connected.



### Caution

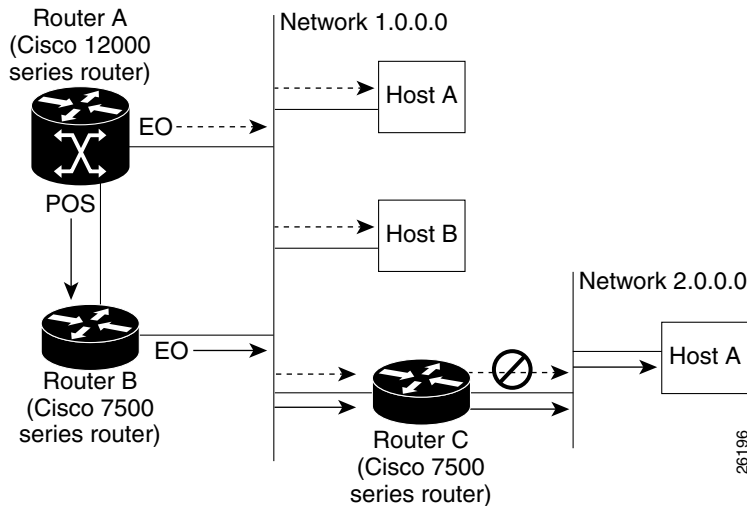
Cisco Express Forwarding (CEF) functions on these ports are switched off by default for security reasons. We strongly caution you to consider the security implications of switching on CEF routing functions on these ports.



Figure 2-21 shows:

- You cannot access Network 2.0.0.0 from Ethernet port (E0) on the GRP in Router A. You can only access Host A, Host B, and Router C, which are in Network 1.0.0.0 (see dotted-line arrows).
- To access Network 2.0.0.0 from Router A, you must use an interface port on one of the line cards (a POS line card in this example) in Router A. Data from Router A is routed through Router B and Router C, to reach Network 2.0.0.0 (see solid-line arrows).

**Figure 2-21 Using the Ethernet Port on the PRP**



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## PRP RJ-45 Ethernet Connections

The RJ-45 Ethernet connection does not require an external transceiver.

Figure 2-22 shows the pin orientation of the RJ-45 Ethernet port and the modular cable plug it accepts.

**Figure 2-22 RJ-45 Receptacle and Plug**

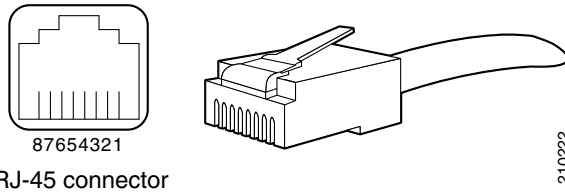


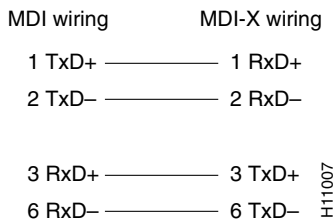
Table 2-10 lists the RJ-45 pin signals used on the connector.

**Table 2-10 PRP RJ-45 Ethernet Receptacle Pinout**

| Ethernet Port Pin | Signal              | Description     |
|-------------------|---------------------|-----------------|
| 1                 | TxD+                | Transmit data + |
| 2                 | TxD-                | Transmit data - |
| 3                 | RxD+                | Receive data +  |
| 4                 | Termination network | No connection   |
| 5                 | Termination network | No connection   |
| 6                 | RxD-                | Receive data -  |
| 7                 | Termination network | No connection   |
| 8                 | Termination network | No connection   |

When connecting the RJ-45 port to a hub or repeater, use the straight-through cable pinout shown in [Figure 2-23](#).

**Figure 2-23 Straight-Through Cable Pinout to Hub or Repeater**



When connecting two PRPs back-to-back, use the crossover cable pinout shown in [Figure 2-24](#).

**Figure 2-24 Crossover Cable Pinout Between PRPs**

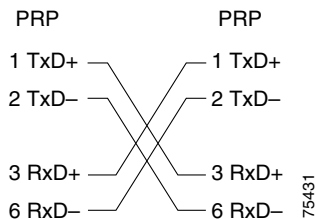


Table 2-11 lists the cabling specifications for 100-Mbps transmission over unshielded twisted-pair (UTP) cables.

**Note**

The transmission speed of the Ethernet ports is autosensing by default and is user configurable.

**Table 2-11 Specifications and Connection Limits for 100-Mbps Transmission**

| Parameter            | RJ-45  |
|----------------------|--|
| Cable specification  | Category 5 <sup>1</sup> UTP, 22 to 24 AWG <sup>2</sup> |
| Cable length (max)   | —  |
| Segment length (max) | 328 feet (100 m) for 100BASE-TX                        |
| Network length (max) | 656 feet (200 m) <sup>3</sup> with 1 repeater          |

1. EIA/TIA-568 or EIA-TIA-568 TSB-36 compliant. Not supplied by Cisco.
2. AWG = American Wire Gauge. This gauge is specified by the EIA/TIA-568 standard.
3. Specifically, the length between any two stations on a repeated segment.

Table 2-12 lists IEEE 802.3u physical characteristics for 100BASE-TX.

**Table 2-12 IEEE 802.3u Physical Characteristics**

| Parameter              | 100BASE-TX                      |
|------------------------|---------------------------------|
| Data rate (Mbps)       | 100                             |
| Signaling method       | Baseband                        |
| Maximum segment length | 100 m between DTE and repeaters |
| Media                  | Category 5 UTP                  |
| Topology               | Star/Hub                        |

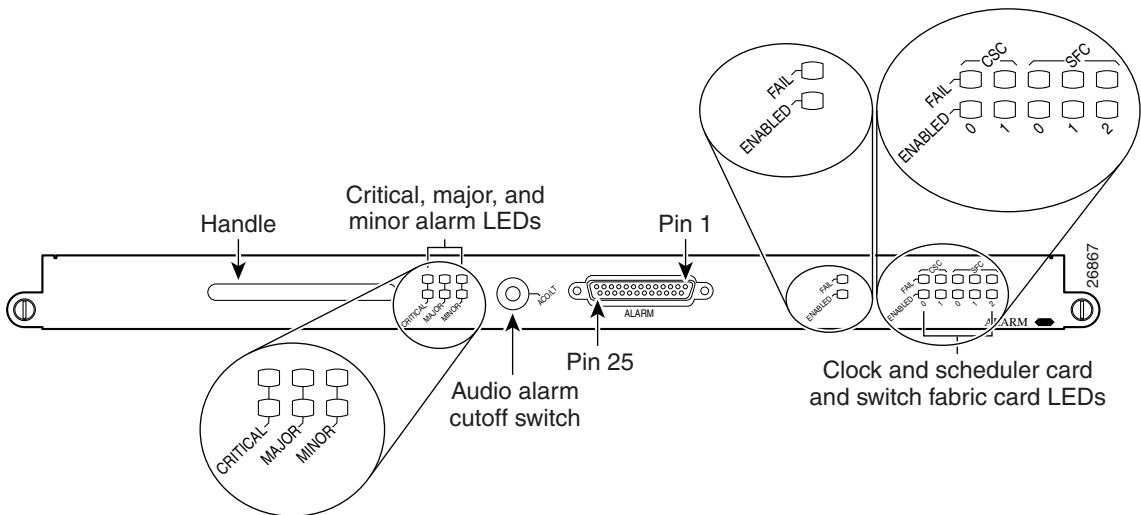
# Alarm Card Connection Guidelines

The router is equipped with two alarm cards:

- One alarm card occupies the dedicated far *left* slot in the upper card cage
- The second alarm card occupies the dedicated far *right* slot in the lower card cage

Each alarm card has one 25-pin D-subconnector (ALARM) on the front panel that connects the router to an external site alarm maintenance system (Figure 2-25). When a critical, major, or minor alarm is generated, it energizes the alarm relays on the alarm card to activate the external site alarm.

**Figure 2-25 Alarm Card Connector Location**



The alarm relay contacts on the alarm card consist of standard *common*, *normally open*, and *normally closed* relay contacts that are wired to the pins on the connectors.



## Caution

Only safety extra-low voltage (SELV) circuits can be connected to the alarm connector. Maximum rating for the alarm circuit is 2 A, 50 VA.

**Note**

To comply with the intrabuilding lightning surge requirements of GR-1089-CORE, Issue II, Revision 01, February 1999, you must use a shielded cable when connecting to the external alarm ports on the alarm card. The shielded cable is terminated by shielded connectors on both ends, with the cable shield material tied to both connectors.

[Table 2-13](#) lists the pin-to-signal correspondence between the cable connector pins and the alarm card relay contacts.

**Table 2-13 Alarm Connector Pinout**

| <b>Pin Group</b>       | <b>Common</b> | <b>Normally Open</b> | <b>Normally Closed</b> |
|------------------------|---------------|----------------------|------------------------|
| Critical audible alarm | 2             | 1                    | 14                     |
| Major audible alarm    | 16            | 3                    | 15                     |
| Minor audible alarm    | 5             | 4                    | 17                     |
| Critical visual alarm  | 19            | 6                    | 18                     |
| Major visual alarm     | 8             | 7                    | 20                     |
| Minor visual alarm     | 22            | 9                    | 21                     |
| Alarm input            | 13            | 25                   | —                      |