



# Cisco 7010 Hardware Installation and Maintenance

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# About This Manual

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This section discusses the objectives, intended audience, and organization of this hardware installation and maintenance publication, and defines the conventions used to convey instructions and noteworthy information.

## Document Objectives

This publication contains two kinds of procedures: specific procedures for preparing your site and network equipment for the initial installation of the router hardware, and procedures you may need in the future to modify or upgrade your system. It will guide you through the initial site preparation, hardware installation, and startup of your new router. After you install the hardware, you will use the appropriate companion publications to configure your system. The maintenance chapter provides maintenance procedures and guidelines for the general care and upkeep of your new router. All additions or upgrades to the router hardware, software, or microcode (firmware) that you order from the factory are accompanied by configuration notes that provide product-specific installation instructions and up-to-date product information.

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## Audience

Setting up and maintaining a network requires the knowledge and expertise of people with a variety of skills. In many cases, the people responsible for installing and maintaining hardware and wiring are not the ones who configure the software and administer the network. This publication provides information specific to installing and maintaining the router hardware. To use this publication, you should be familiar with electronic circuitry and wiring practices, and preferably have experience as an electronic or electromechanical technician. Although this document provides brief descriptions and examples of a few software configuration and display commands, it is not a reference for software. For comprehensive descriptions and examples of software configuration commands and the procedures for implementing them, refer to the related software configuration and reference documentation.

## Document Organization

The organization of this publication follows a recommended linear installation sequence: starting with Chapter 1, “Product Overview,” and continuing through Chapter 3, “Installing the Router.” You will refer to Chapter 4, “Troubleshooting,” only if you experience problems with the initial hardware installation or startup. Use the maintenance information in Chapter 5, “Maintenance,” whenever you add, replace, upgrade, or rearrange system components.

This publication also includes some information that you may not need at initial installation, but which can be useful when you upgrade or add components to the system. The appendices include additional reference information. Following is a brief description of each chapter:

- Chapter 1, “Product Overview,” describes the physical properties of the router, components, and interfaces. It also provides brief functional descriptions of the primary system features.
- Chapter 2, “Preparing for Installation,” is a preparatory section that describes site requirements, safety considerations, tools required, optional and required network connection equipment, unpacking checklists, and procedures you should perform *before* actual installation. This chapter contains descriptions and illustrations of all types of network interface cables, connectors, and interface devices that you may need for your network connections, so you can use this chapter as a reference.
- Chapter 3, “Installing the Router,” provides instructions for rack mounting the router, connecting the external power and network interface cables, and starting the system. After your system successfully initializes, you will proceed to the related software documentation to configure the interfaces. If the system fails to initialize successfully, you will proceed to Chapter 4 to troubleshoot the problem.
- Chapter 4, “Troubleshooting the Installation,” provides troubleshooting guidelines for the initial hardware installation and suggests steps to help you quickly isolate the source and resolve the problem.
- Chapter 5, “Maintaining the System Hardware,” provides procedures for replacing, adding, upgrading, modifying, and rearranging system components and field-replaceable units (FRUs).
- Appendix A, “Cabling Specifications,” lists pin signals for the network interface cables you will need to connect the router interfaces to external networks.
- Appendix B, “LED States,” describes the various states and indications of the LEDs on the power supply, route processor (RP), switch processor (SP), and the various interface processors (IPs). This information is of limited use at initial system startup because, although the LEDs for many interface types go on at the initial system startup, they do not indicate an accurate status until the interface is configured. This information is for your reference, to be used after the interfaces are configured and brought on line.
- Appendix C, “Industry Standard Wiring Plans,” lists the telephone industry color-code scheme for 25-pair wires including the pin numbers.

## Document Conventions

This publication uses the following conventions:

- The symbol ^ represents the key labeled *Control*.  
For example, the key combination ^z means hold down the *Control* key while you press the z key.
- Cross references to additional or related information within this publication specify the title (in quotes) of the section that contains the information and the chapter which that section appears. For example, refer to Document Conventions in this chapter.

Command descriptions use these conventions:

- Examples that contain system prompts denote interactive sessions, indicating the commands that you should enter at the prompt. The system prompt indicates the current level of the EXEC command interpreter. For example, the prompt 7010> indicates that you should be at the *user* level, and the prompt 7010# indicates that you should be at the *privileged* level. Access to the privileged level usually requires a password. Refer to the related software configuration and reference publications for additional information.
- Commands and keywords are in **boldface** font.
- Arguments for which you supply values are in *italic* font.
- Elements in square brackets ( [ ] ) are optional.
- Alternative but required keywords are grouped in braces ( { } ) and separated by vertical bars ( | ).

Examples use these conventions:

- Terminal sessions and sample console screen displays are in *screen* font.
- Information you enter is in **boldface screen** font.
- Nonprinting characters, such as passwords, are in angle brackets (< >).
- Default responses to system prompts are in square brackets ( [ ] ).
- Exclamation points (!) at the beginning of a line indicate a comment line.



**Caution** Means *reader be careful*. You are capable of doing something that might result in equipment damage or loss of data.

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**Note** Means *reader take note*. Notes contain helpful suggestions or references to materials not contained in this manual.

---



**Timesaver** Means *the described action saves time*. You can save time by performing the action described in the paragraph.



**Warning** Means *danger*. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and standard practices for preventing accidents. Chapter 2 provides general safety considerations and specific guidelines for safely installing the Cisco 7010 router.



# Product Overview

---

The 5-slot Cisco 7010, the newest router/bridge in the Cisco 7000 series, provides high reliability, availability, serviceability, and performance. Cisco 7000 series routers support multiprotocol, multimedia routing and bridging with a wide variety of protocols and any combination of Ethernet, Fast Ethernet, Token Ring, FDDI, serial, multichannel channel attachment, and HSSI media. Network interfaces reside on modular interface processors, which provide a direct connection between the high-speed Cisco Extended Bus (CxBus) and the external networks.

Online insertion and removal (OIR) allows you to add, replace, or remove interface processors without interrupting the system power or entering any console commands. Environmental monitoring and reporting functions enable you to maintain normal system operation by resolving adverse environmental conditions prior to loss of operation. If conditions reach critical thresholds, the system shuts down to avoid equipment damage from excessive heat or electrical current. Downloadable software and microcode, which is used for most software and microcode upgrades, allows you to load new images into Flash memory remotely, without having to physically access the router, for fast, reliable upgrades.

This chapter provides physical and functional overviews to familiarize you with your new router. It contains physical descriptions of the system hardware and major components, and functional descriptions of hardware-related features. Descriptions and examples of software commands appear only when they are necessary for installing or maintaining the system hardware. For complete command descriptions and instructions, refer to the *Router Products Configuration Guide* and *Router Products Command Reference*, which are available on UniverCD.

Following is a list of acronyms that identify the system components and features:

- CxBus—Cisco Extended Bus, 533-megabits-per-second (Mbps) data bus for interface processors
- AIP—Asynchronous Transfer Mode (ATM) Interface Processor
- CIP—Channel Interface Processor
- EIP—Ethernet Interface Processor
- FEIP—Fast Ethernet Interface Processor
- FIP—Fiber Distributed Data Interface (FDDI) Interface Processor
- FRU—Field-replaceable unit, a system component that must be replaced by a Cisco-certified technician (the arbiter board is an FRU)
- FSIP—Fast Serial Interface Processor
- HIP—High-Speed Serial Interface (HSSI) Interface Processor
- MIP—MultiChannel Interface Processor

- OIR—Online insertion and removal, the feature that allows you to replace interface processors without interrupting system power
- PA—Port adapter, for example, the FSIP and MIP daughter card
- RP—Route Processor, the system processor board
- RSP7000—7000 Series Route Switch Processor
- RSP7000CI—7000 Series Chassis Interface
- SP—Switch Processor, the CxBus traffic controller
- SSP—Silicon Switch Processor, the CxBus traffic controller
- TRIP—Token Ring Interface Processor

## Physical Description

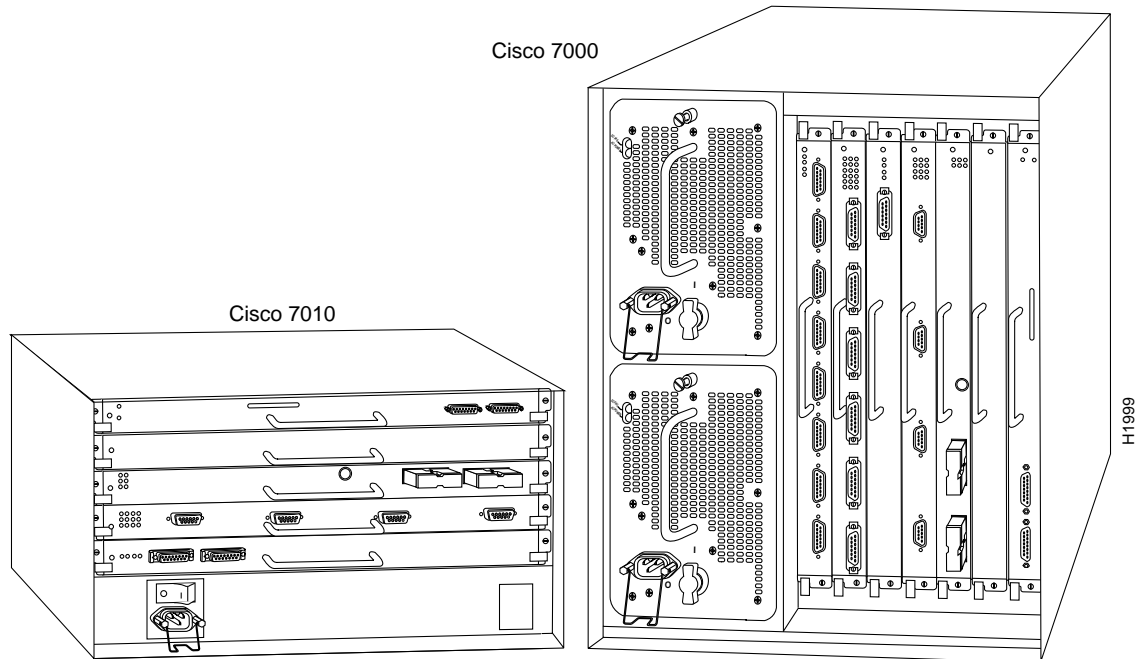
The Cisco 7010 is the entry-level model in the Cisco 7000 series product line, which currently includes the 7-slot Cisco 7000 and the 5-slot Cisco 7010. Both models use the same RP, SP (or SSP), and interface processors; all processor modules are interchangeable between the two models. The Cisco 7000 provides five interface slots and offers a second modular power supply for redundant power. The Cisco 7010 provides three interface slots and the same performance as the Cisco 7000 at a lower cost. Table 1-1 shows a comparison of the two Cisco 7000 series products. Figure 1-1 shows the interface processor end of both models.

**Table 1-1 Comparison of Cisco 7000 Series Routers**

Feature	Cisco 7010	Cisco 7000
Interface slots available	5 horizontal processor slots; 3 interface processor slots	7 vertical processor slots; 5 interface processor slots
Maximum interface ports	24	40
Redundant power	Not available	Available with optional second power supply
Dimensions (H x W x D)	10.5 x 17.5 x 17" (26.67 x 44.45 x 43.18 cm)	19.25 x 17.5 x 25.1" (48.90 x 44.45 x 63.75 cm)
Weight, fully configured	~70 lb (31.75 kg)	~147 lbs. (66.68 kg)
Radiated acoustic noise (bystander position)	Approximately 46 dBa (fans at normal speed) or 58 dBa (fans at high speed)	Approximately 62 dBa
Software	Software Release 9.17(6) or later	Software Release 9.17(1) or later

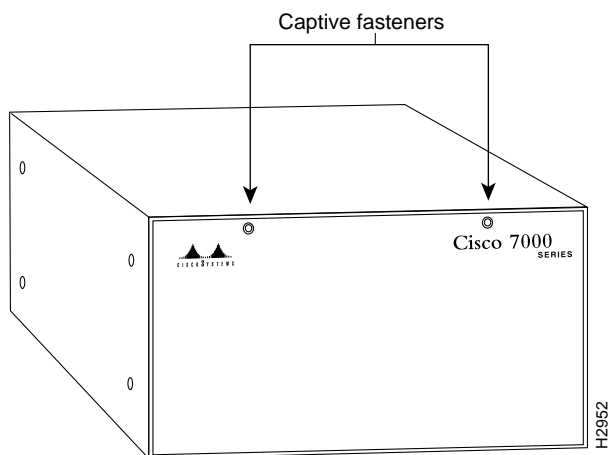


Figure 1-1 Cisco 7000 Series Routers



The front, or noninterface processor end, of the Cisco 7010 is a removable cover panel that is secured with two captive slotted fasteners. (See Figure 1-2.) Removing the cover panel provides access to the three internal components: the arbiter, power supply, and fan tray.

Figure 1-2 Cisco 7010 Chassis Cover Panel

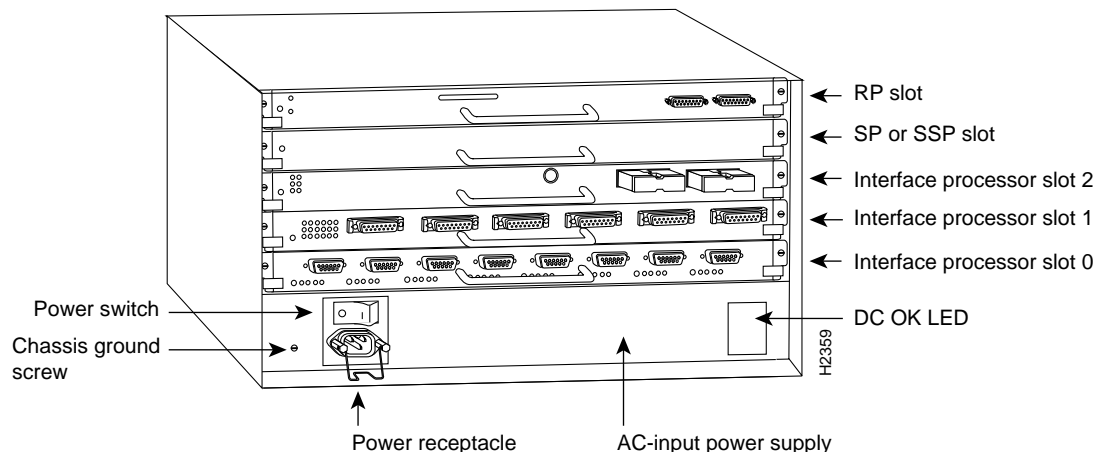


The interface processor end of the router contains the five-processor slots, the AC-input receptacle, the power switch, and a power status LED indicator. The processor slots contain the RP, SP (or SSP), and up to three interface processors. When viewing the router from the interface processor end, the RP is in the top slot (the RP slot), and the SP (or SSP) is in the slot directly below the RP. The remaining three slots are numbered from the bottom up beginning with slot 0 (the bottom slot) through 2 (the center slot).

The three interface processor slots support any combination of network interface types: Ethernet, Token Ring, FDDI, serial, multichannel attachment, and HSSI. The RP, SP (or SSP), and interface processors are keyed with guides on the backplane to prevent them from being fully inserted in the wrong slot.

Figure 1-3 shows the interface processor end of a Cisco 7010 with an AC-input power supply.

**Figure 1-3 Cisco 7010 —Interface Processor End**



The RP, SP (or SSP), and interface processors (collectively referred to as *processor modules* in this manual) slide into the processor slots in the rear of the router and connect directly to the backplane; there are no internal cables to connect. Spring-loaded ejector levers help to ensure that a processor module is either fully connected to the backplane or fully disconnected from it. Captive installation screws, one at each end of the interface processor faceplate, also ensure proper seating in the slot and prevent the processor module from disengaging from the backplane connectors. (During operation, the system will hang if the connection between the processor module connector and any of the backplane pins is interrupted.) Empty slots contain a blank interface processor filler (the metal interface processor carrier without a board, LEDs, or connectors) to maintain proper airflow through the chassis.

One 550-watt (W) AC-input power supply or one 600W DC-input power supply is standard equipment in the router.

The Cisco 7010 operates as either a tabletop or rack-mounted unit. A rack-mount kit is standard equipment that is included with all chassis. The kit provides the hardware needed to mount the router in a standard 19-inch equipment rack, or in a variety of other equipment rack configurations. When the router is not mounted in a rack, place it on a table or on a sturdy platform. Do not stack the router with any other equipment or place it directly on a floor. For clearance requirements and rack installation considerations, refer to the section “Site Environment” in the chapter “Preparing for Installation.”

## Chassis Specifications

Table 1-2 lists the Cisco 7010 physical specifications and power requirements.

**Table 1-2 Cisco 7010 System Specifications**

Description	Specification
High-speed backplane	533-Mbps CxBus, 3 interface processor slots plus RP, SP, and SSP slots
Dimensions (H x W x D)	10.5 x 17.5 x 17.0" (26.67 x 44.45 x 43.18 cm) Chassis depth including power cord and cable management fixture is 19" (48.26 cm)
Weight	Chassis only (including power supply and fan array): 46 lb (20.87 kg) Chassis fully configured with 1 RP, 1 SP (or SSP), and 3 interface processors: 70 lb (31.75 kg)
Power dissipation	550W maximum configuration, 540W typical of maximum configuration with AC input 600W maximum configuration with DC input
Heat dissipation	715W (2440 Btu/hr)
Input voltage	100 to 240 VAC, wide input with power factor corrector (PFC)
Power distribution	70A maximum @ +5 VDC, 15A maximum @ +12 VDC, 3A maximum @ -12 VDC, 5A maximum @ +24 VDC
Frequency	50 to 60 Hz
AC current rating	9A maximum at 100 VAC, 4A maximum at 240 VAC at 600W
DC-input voltage	-40 volts DC (VDC) minimum in North America (-56 VDC in Europe) -48 VDC nominal in North America (-60 VDC in Europe) -52 VDC maximum in North America (-72 VDC in Europe)
DC voltages supplied and maximum, steady-state current ratings	+5.2 VDC @ 75 amps (A) +12 VDC @ 15A -12 VDC @ 3A +24 VDC @ 5A
DC-input power supply hold-up time specification	10 milliseconds (ms) of output after the input has been interrupted
DC-input power supply cable guage	10 American Wire Guage (AWG)
Airflow	Side-to-side through chassis by variable-speed, 6-fan array
Operating temperature	32 to 104°F (0 to 40°C)
Nonoperating temperature	-4 to 149°F (-20 to 65°C)
Humidity	10 to 90%, noncondensing
Agency approvals	Safety: UL 1950, CSA 22.2-950, EN60950, EN41003, AUSTEL TS001, AS/NZS 3260 EMI: FCC Class A, EN60555-2, EN55022 Class B, VDE 0878 Part 3, 30 Class B Immunity: EN55101/2 (ESD), EN55101/3 (RFI), EN55101/4 (Burst), EN55101/5 (Surge), EN55101/6 (Conducted), IEC77B (AC Disturbance)

For a chassis footprint, additional dimensions, and clearance requirements for the router perimeter, refer to the section "Site Requirements" in the chapter "Preparing for Installation."

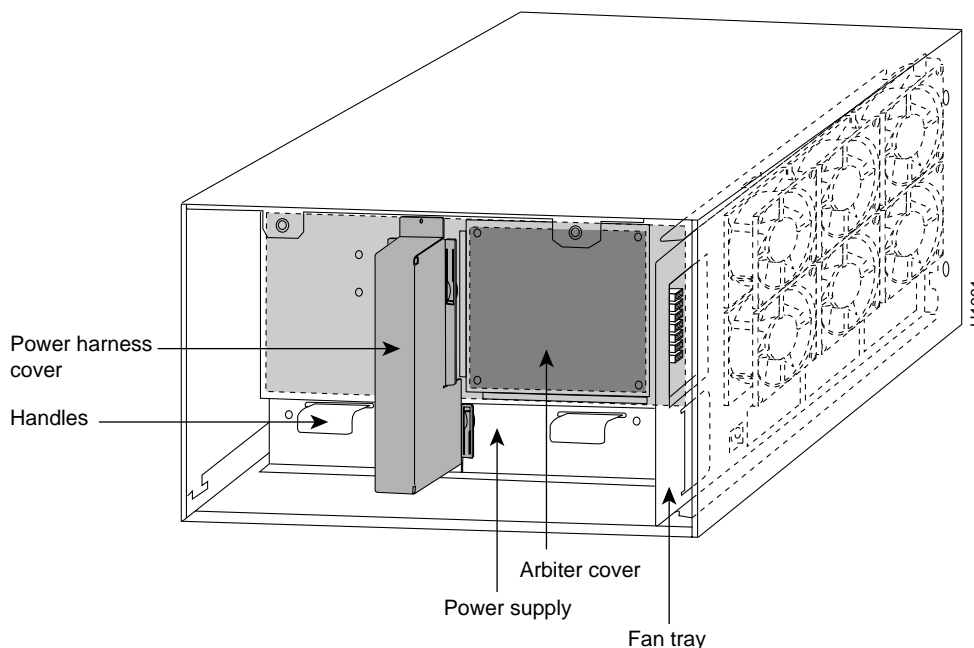
## Internal Components

The main internal components in the Cisco 7010 are the arbiter, power supply, fan tray, and backplane, all of which are located in the noninterface processor end of the router. The power supply and fan tray are available as spares. The arbiter is categorized as a field-replaceable unit (FRU), which means that it can only be replaced by a Cisco-certified technician. Note that the backplane is *not* a spare or an FRU.

The power supply, which rests on the interior chassis floor, provides DC voltages to the system components. The six individual fans on the fan tray move cooling air through the chassis interior to prevent components from overheating. The backplane contains the data busses for information exchange and distributes power throughout the system. The following sections describe the FRUs and other major system components.

Figure 1-4 shows the components in their normal operating positions.

**Figure 1-4 Internal Components at Noninterface Processor End of Router**



### Arbiter

The arbiter, which arbitrates traffic on the CxBus and generates the CxBus clock, is a printed circuit board that is mounted to the front (noninterface processor side) of the backplane. (See Figure 1-4.) The arbiter arbitrates traffic across the CxBus by prioritizing access requests from interface processors to ensure that each request is processed, and to prevent any interface processor from jeopardizing the CxBus and interfering with the ability of the other interface processors to access the SP (or SSP) and RP. The arbiter provides the following services for the system:

- CxBus clock generation—Generates the 16.667-megahertz (MHz) clock and provides a private copy of the clock to the SP and each interface processor.
- CxBus arbitration—Arbitrates interface processor requests to transmit commands on the CxBus. The arbitration is based on a round-robin priority scheme to ensure that all interface processors have access to a known portion of the CxBus bandwidth.

- Global lock arbitration—Arbitrates interface processor and SP requests for the global lock, a synchronization primitive used to control SP and interface processor access to shared data structures.

Slots in the arbiter cover allow secondary airflow and natural convection to cool the arbiter, which is outside the primary path of cooling air through the chassis. The chapter “Maintenance” provides replacement instructions for the arbiter.

## Power Supply

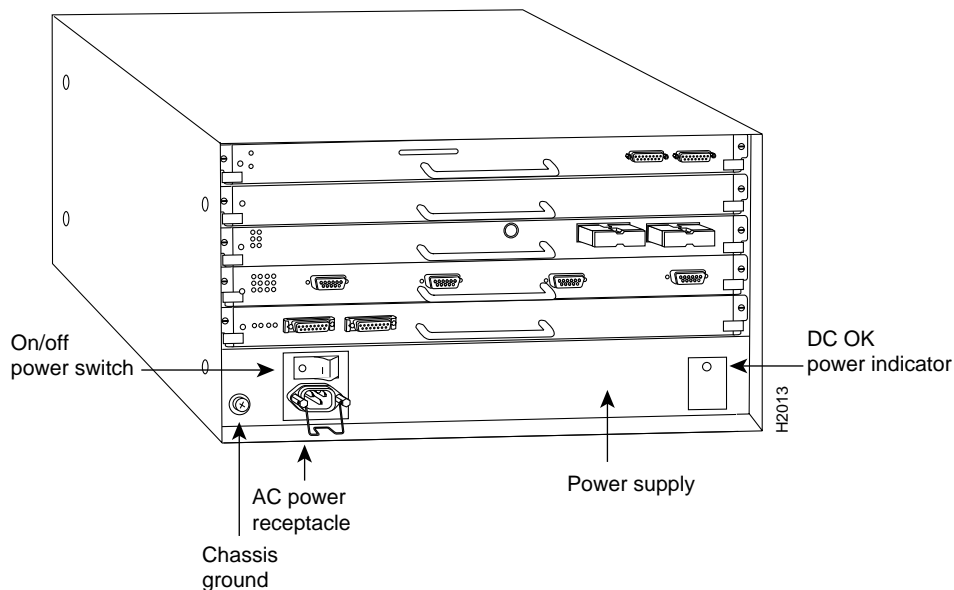
The Cisco 7010 comes equipped with one 550W, AC-input power supply (shown in Figure 1-4) or one 600W, DC-input power supply. The AC-input power supply operates on AC-input power and supplies DC power to the internal components. The DC-input power supply operates on DC input power and supplies DC power to the internal components. Table 1-2 lists the acceptable AC-input and DC-input ranges and the internal operating DC voltages and current levels.

At the noninterface processor end of the router, two handles on the power supply provide grip points for pulling the power supply out of the chassis. (See Figure 1-4.) Two Phillips-head screws secure the power supply to the chassis interior. The power supply delivers DC power to the internal components through a wiring harness that plugs into a polarized receptacle to the noninterface processor side of the backplane. An aluminum cover shields the harness and power connection. The backplane distributes the DC voltages to the fan tray, arbiter, and interface processor bus connectors.

The AC power receptacle (or DC-input terminal block), power on/off switch, and status LED are on the interface processor end of the power supply. A modular power cord connects the AC power supply to the site power source. A cable retention clip on the power supply AC receptacle prevents the cable from being pulled out accidentally. The DC-input is supplied by a three-lead, 10 AWG cable you provide. Strain relief consists of nylon cable ties that you also provide.

The power switch turns the power supply on and starts the system. To the left of the power switch and receptacle cutout is a ground screw that provides a chassis ground connection for ESD-preventive equipment or a grounding wire. Figure 1-5 shows the AC power supply from the interface processor end of the router.

**Figure 1-5 AC-Input Power Supply**



On the AC-input and DC-input power supplies, the green DC OK LED indicates the status of the power supply and internal DC voltages. The DC OK LED stays on when all of the following conditions are met:

- AC power supply is on and is receiving 100-240 VAC, 50-60 Hz source power or the DC power supply is on and the system is receiving -48 VDC in North America (or -60V in Europe).
- Power supply is providing the +5, +12, -12, and +24 VDC to internal components.
- All internal DC voltages are within tolerance.

If the AC or DC source power or any of the internal DC voltages exceeds allowable tolerances, the DC OK LED goes off and the system environmental monitor messages indicate the line that is out of tolerance. Because the RP (which uses +5, +12, -12 VDC), and the fan tray (which uses +24 VDC) are both required for operation, the system will probably shut down if any internal voltages reach an out-of-tolerance state.

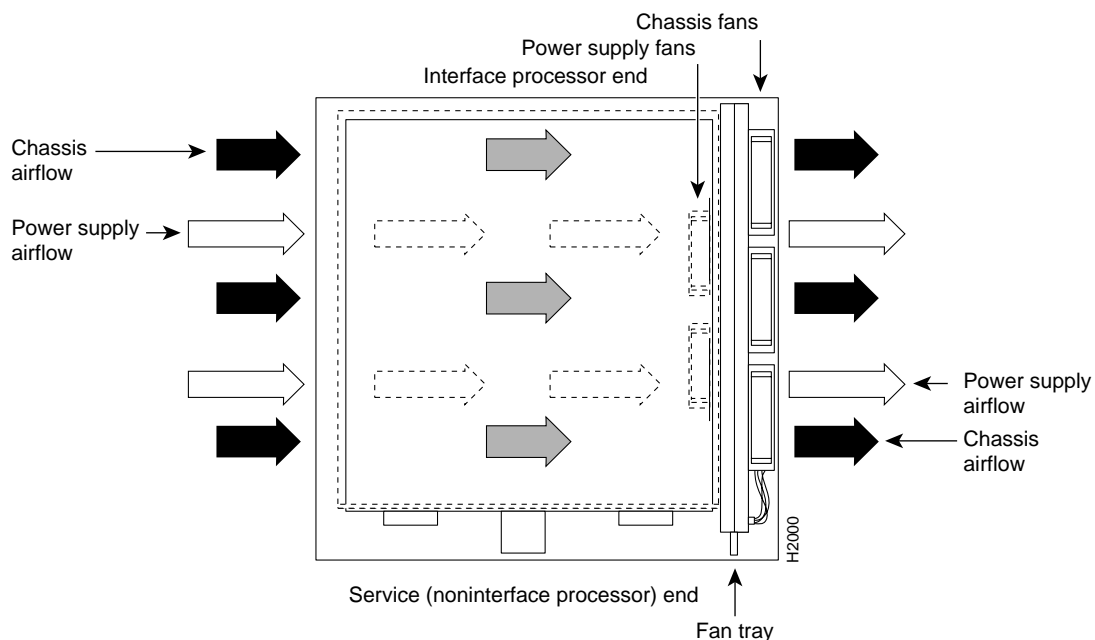
Inside the AC-input or DC-input power supply, two small fans draw cooling air through the power supply interior. The air flows in one side of the supply and out the other side, following the same direction as the chassis cooling air. (See Figure 1-6.)

In addition to the environmental monitoring performed by the system software, the power supply monitors its own temperature and internal voltages. If the supply detects an overvoltage, or overtemperature condition, it shuts down to avoid damage to the power supply or other system components. For a description of power-supply shutdown conditions and thresholds, refer to the section “Environmental Monitoring and Reporting Functions” in this chapter.

The AC-input and DC-input power supplies are available as spares for immediate onsite replacement in case the existing power supply fails. The chapter “Maintenance” provides power supply replacement instructions. In addition, detailed, up-to-date instructions are included with all spares when they are shipped from the factory.

**Figure 1-6 Internal Airflow, Top-Down View**

Top view of router



## Fan Tray

An array of six individual fans draw cooling air through the chassis interior to maintain an acceptable operating temperature for the internal components. The *fan tray* comprises the six fans and a printed circuit board (with the control circuits) mounted on a metal plate. (See Figure 1-4.) The fan tray slides into the right side of the chassis from the noninterface processor end of the router. The fans draw air in through the inlet vents on the opposite side of the chassis, across the processor modules and other internal components, and out through the exhaust vents adjacent to the fan tray. Figure 1-6 shows the airflow path. The sides of the chassis must remain unobstructed to ensure adequate airflow and prevent overheating inside the chassis. (See the section “Site Requirements” in the chapter “Preparing for Installation.”)

A fan control board on the fan tray monitors and controls the operation of the variable-speed fans. The variable-speed feature enables quieter operation by allowing the fans to operate at less than maximum speed when doing so provides adequate cooling air to maintain an acceptable operating temperature inside the chassis. A temperature sensor on the RP monitors the internal air temperature. When the ambient air temperature is within the normal operating range, the fans operate at the slowest speed, which is 55 percent of the maximum speed. If the temperature inside the chassis exceeds the normal range, the fan control board increases the fan speed to provide additional cooling air to the internal components. If the temperature continues to rise, the fan control board linearly increases the fan speed until the fans reach full speed (100 percent). If the internal temperature exceeds the specified threshold, the system environmental monitor shuts down all internal power to prevent equipment damage from excessive heat.

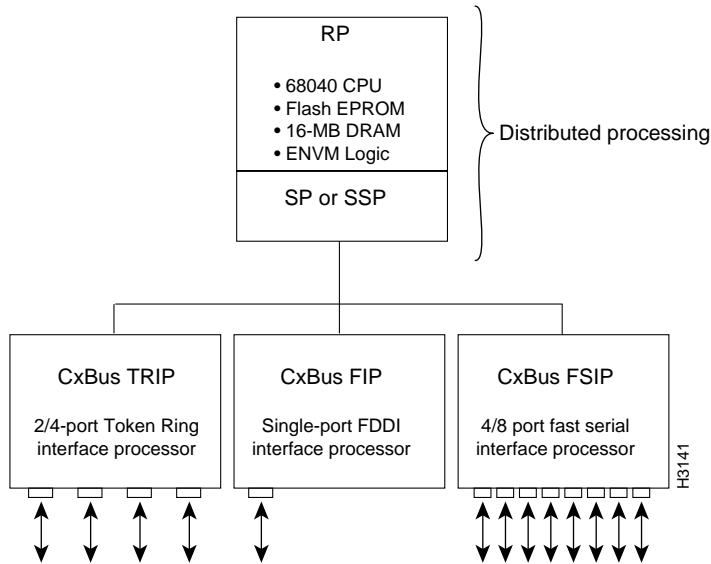
All six fans in the array must be operational. If the system detects a failed or failing fan, it will display a warning message on the console screen. If the condition is not corrected within two minutes, the entire system will shut down to avoid an overtemperature condition and shutdown. For specific thresholds and message descriptions, refer to the section “Environmental Monitoring and Reporting Functions” in this chapter and to the section “Troubleshooting the Cooling Subsystem” in the chapter “Troubleshooting the Installation.”

The fan tray is available as a spare. Individual fans are not field-replaceable; if a single fan fails, you must replace the fan tray. The chapter “Maintenance” provides fan tray replacement instructions.

## System Backplane

The high-speed CxBus transfers information at 533 Mbps. Figure 1-7 shows the basic system architecture. The RP, which contains the system processor, and the SP provide distributed processing and control for the interface processors. The SP (or SSP) controls communication between interface processors (interface processor-to-interface processor) and the system processor (interface processor-to-processor).

**Figure 1-7 Router System Architecture**

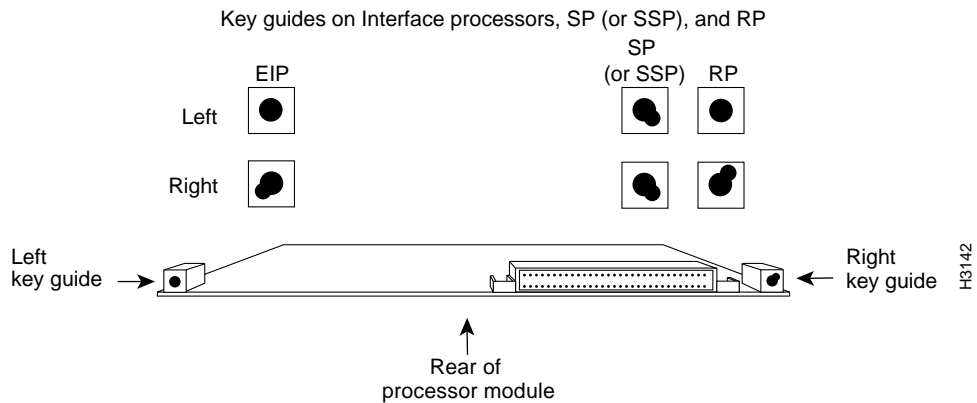


The backplane slots are keyed so that the processor modules can be installed only in the slots designated for them. Keys on the backplane fit into two key guides on each module. (See Figure 1-8.) Although the RP, SP, and SSP each use unique keys, all three interface processor slots use the *same* key, so you can install an interface processor in any interface processor slot.



**Caution** When installing an RP, SP, SSP, or interface processor, ensure that you are installing it in the appropriate slot to avoid damaging the key guides or the backplane.

**Figure 1-8 Backplane Slot Keys**





## Route Processor (RP)

The RP, shown in Figure 1-9, is the main system processor in the router. The RP contains the system central processing unit (CPU), the system software, and most of the system memory components, and it maintains and executes the management functions that control the system. The RP contains the following components:

- 25-MHz Motorola MC68040 CPU for processing key functions that are not time-critical.
- System hardware configuration register for setting default boot instructions.
- Bank of hardware (MAC-layer) addresses for the interface ports.
- Most of the memory components used by the system, including the eight erasable programmable read-only memory (EPROM) components that contain the default system software (Although these components actually are EPROMs, they are commonly referred to as the software or boot ROMs.).
- Air-temperature sensors for environmental monitoring.

In addition to the preceding system components, the RP contains and executes the following management functions that control the system:

- Sending and receiving routing protocol updates
- Managing tables and caches
- Monitoring interface and environmental status
- Providing SNMP management and the console/Telnet interface

The RP must be installed in the top processor slot, which is labeled *RP*.

## Memory Components

Table 1-3 lists the functions of the various types of memory on the RP, and Figure 1-9 shows the locations of each.

**Table 1-3 RP Memory Components**

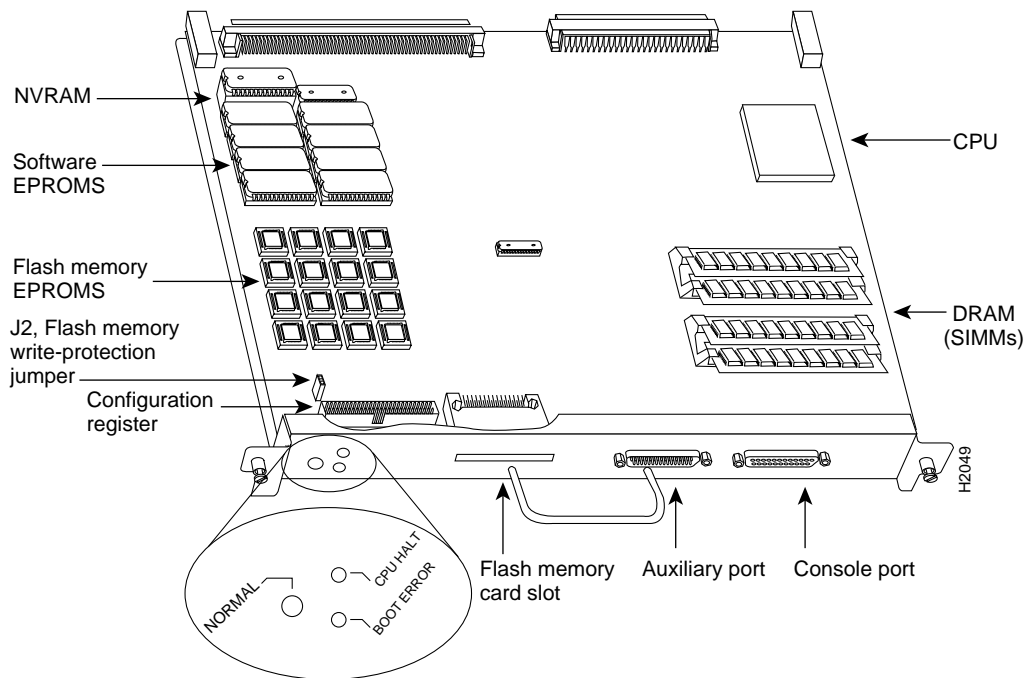
Memory Type	Size	Quantity	Description	Location
EPROM <sup>1</sup>	4 Mb <sup>2</sup>	8	4-Mb EPROMs	ROM1–ROM8 (see the chapter “Maintenance”)
DRAM	16 MB	4	4-MB SIMMs	SIMMS sockets U35, U36, U58, U59
	or 64 MB	4	16-MB SIMMs	
NVRAM	128 KB	1	128 KB	U120
Flash memory	4 MB	16	256-KB Flash memory components	U14–U17, U27–U30, U45–U48, U60–63
Flash memory card <sup>3</sup>	8 or 16 MB	1	PCMCIA Flash memory card	Flash memory card slot on faceplate
EEPROM	–	1	Board-specific information, address allocator	U108

1. Although these components actually are EPROMs, they are commonly known as the software or boot ROMs.

2. The size (capacity) of the software EPROMs changes as needed to accommodate the size of the system software image. Software Releases 9.17(6) and earlier reside on 2-Mb EPROMs, Software Release 9.17(7) resides on 4-Mb EPROMs, and the size of future software releases is likely to increase.

3. Required for downloading software images larger than 4MB (compressed). The Enterprise and the Enterprise and APPN images of Cisco IOS Release 11.0 and later will require a Flash memory card.

**Figure 1-9 Route Processor (RP)**



### System Software or Boot ROMs

Eight EPROM components contain the default and bootstrap system software. The downloadable system software and microcode feature, which the Cisco 7000 series supports for most upgrades, allows you to remotely download, store, and boot from a new image.

EPROMs for Software Release 9.17(7), and later, also contain the latest microcode version in compressed form for each interface processor. At system startup, an internal system utility scans for compatibility problems between the installed interface processor types and the bundled microcode images, then decompresses the images into running, random-access memory (RAM). The bundled microcode images then function the same as images loaded from the microcode EPROMs.

It is unlikely that you will ever need to replace the default system software EPROMs. If replacement is necessary in the future, refer to the section “RP and RSP7000 Configurations” in the chapter “Maintenance” and to the replacement instructions that accompany the upgrade kit.

### DRAM

Dynamic random-access memory (DRAM) stores routing tables, protocols, and network accounting applications. The DRAM resides on four single in-line memory modules (SIMMs). The standard RP configuration is 16 MB of DRAM, and an RP with 64 MB is available as an option or an upgrade.

Effective with Software Releases 9.17(8) and 9.21(3), the following options are available:

- The RP in new systems is available with 16 MB of DRAM, which is the default, or with 64 MB of DRAM (RP-64MB-OPT).

- RP spares are available with the default 16 MB (RP=) or with 64 MB of DRAM (RP-64MB=).
- An upgrade (RP-64MB-U) provides an RP-64MB= as a replacement for earlier RP versions that do not support 16 MB SIMMs. The upgrade requires that you return your existing RP to the factory and offers a significant cost savings over the RP-64MB= spare.

If your RP supports 16-MB SIMMs, you can upgrade the DRAM from 16 MB to 64 MB. (Because 8 MB x 9 SIMMs are not available, 32 MB is not an option.) Otherwise, you must replace the entire RP to increase the amount of DRAM. To determine whether or not your RP supports 16-MB SIMMs, refer to the section “RP and RSP7000 Configurations” in the chapter “Maintenance” and to the replacement instructions that accompany the upgrade kit.

Only RPs that meet the following prerequisites support the larger (16-MB) SIMMs:

- If your system contains Software Release 9.17, the minimum requirements are as follows:
  - Maintenance Release 9.17(8) (or a later 9.17 image) in ROM
  - System Bootstrap Version 4.6(7.3) (or a later 4.6 version)
  - RP board revision B0 or later
- If your system contains Software Release 9.21, the minimum requirements are as follows:
  - Maintenance Release 9.21(3) (or a later 9.21 image) in ROM
  - System Bootstrap Version 4.7(2.1) (or a later 4.7 version)
  - RP board revision B0 or later
- If your system contains Cisco Internetwork Operating System (Cisco IOS) Release 10.0, the minimum requirements are as follows:
  - Release 10.0(1) (or a later 10.0 image) in ROM
  - System Bootstrap Version 5.0(1) (or a later 5.0 bootstrap version)
  - RP board revision B0 or later

Bootstrap Version 4.6 is used exclusively with Software Release 9.17, and Bootstrap Version 4.7 is used exclusively with Software Release 9.21. The revision numbers (indicated in parentheses) for each system bootstrap version are revised independently of other bootstrap versions. Therefore, 4.6(7) can be a later version than 4.7(2).

Software Release 9.17(8), RP board revision B0, and System Bootstrap Version 4.6(7.3) started shipping as the default in March 1994.

RPs that shipped from the factory with Release 9.17(7) or earlier in ROM do *not* support 16-MB SIMMs. To verify that your RP supports the larger SIMMs, issue the following commands:

- Use the **show version** command to display the system bootstrap version.

```
7010# show version
GS Software (GS7), Version 9.17(8.1)
Copyright (c) 1986-1994 by cisco Systems, Inc.
Compiled Fri 04-Feb-94
```

```
System Bootstrap, Version 4.6(7.3)
```

If the display indicates that the system bootstrap version is an earlier version of 4.6 than 4.6(7.3), or an earlier version of 4.7 than 4.7(2.1), your RP will not support 16-MB SIMMs. Contact a service representative for information about the RP upgrade.

- Use the **show diag slot** command to display current hardware and diagnostic information about the processor installed in the slot you specify. Because the RP always resides in the same (RP) slot, specify slot 4 for a Cisco 7010 chassis. The third line of the display shows the current hardware (HW) and board revisions. (Do not confuse the HW revision with the board revision; you need only verify that the *board* revision is B0 or later.)

```
7010# show diag 4

Slot 4:
  EEPROM format version 1
  Route Processor, HW rev 1.1, board revision B0
  Serial number: 00809933  Part number: 73-0877-04
```

If the display indicates that the RP board revision is earlier than B0, your RP will not support 16-MB SIMMs. Contact a service representative for information about the RP upgrade.

### NVRAM

The nonvolatile random-access memory (NVRAM) stores the system configuration and the environmental monitoring logs, and is backed up with built-in lithium batteries that retain the contents for a minimum of five years. When replacing an RP, be sure to back up your configuration to a remote server so that you can retrieve it later. (See the Timesaver note that follows.)



**Timesaver** Before replacing an RP, back up the running configuration to a TFTP file server so that you can later retrieve it. If the configuration is not saved, the entire configuration will be lost—inside the NVRAM on the removed route processor—and you will have to reenter it manually. This procedure is not necessary if you are temporarily removing an RP you will reinstall; lithium batteries retain the configuration in memory until you replace the RP in the system.

### Flash Memory

The Cisco 7010 contains two types of Flash memory: onboard (imbedded) and on a (Flash memory) card that can be optionally installed in a slot on the RP. The Flash memory card is required for downloading software images larger than 4MB (compressed). Cisco IOS Release 11.0 and later require a Flash memory card.

Either the onboard Flash memory (on a SIMM) or the Flash memory card, allows you to remotely load and store multiple Cisco IOS and microcode images. You can download a new image over the network or from a local server and then add the new image to Flash or replace the existing files. You can also transfer images between Flash memory cards and the onboard 8-MB Flash memory.

You can then boot routers either manually or automatically from any of the stored images. Flash memory also functions as a TFTP server to allow other servers to remotely boot from stored images or to copy them into their own Flash memory.

For security of the onboard flash memory, jumper J2, which is adjacent to the imbedded Flash memory components, provides Flash memory write protection. (See the section “Jumpers,” which follows.)

The Flash memory card installs in the card slot on the RP faceplate. This card is an 8 or 16-MB, Intel Series 2+ Flash memory card, which conforms with the Personal Computer Memory Card International Association (PCMCIA) format. For more information, see the section, “Using the Flash Memory Card” in the chapter “Installing the Router.”

## EEPROM

An electrically erasable programmable read-only memory (EEPROM) component on the RP (and on the SP and each interface processor) stores board-specific information such as the board serial number, part number, controller type, hardware revision, and other details unique to each board. In addition to this standard information, the RP EEPROM also contains an address allocator, which is a bank of 40 *hardware* or *media access control (MAC)-level* addresses, one for each possible port in the system. For an explanation of the hardware addressing function, refer to the section “MAC Address Allocator” in this chapter.

## Jumpers

The hardware configuration register is a 50-pin jumper block located at the left front of the board, when viewing the RP in the orientation shown in Figure 1-9. By installing jumpers on specific pins, you can define system boot instructions, set broadcast addresses and console baud rates, instruct the router to perform factory diagnostics at startup, and recover from a lost password.

Jumper J2, which is located near the configuration register, provides write protection for Flash memory. (See Figure 1-9.) The jumper is installed on J2 by default, which allows you to write to Flash memory. When the jumper is removed, Flash memory is read-only; you cannot write to Flash or erase the contents until you replace the jumper.

Jumpers J3 and J4 are set according to the size of the eight system software EPROMs. You need to reset these jumpers only if you upgrade the system software by replacing the ROMs instead of downloading the new image, and if the size (capacity) of the new EPROMs is greater than those you replace.

For a detailed description of all jumper functions and settings, refer to the section “RP and RSP7000 Configurations” in the chapter “Maintenance”

## LEDs

The three LEDs on the RP indicate the system and RP status. The normal LED is on when the system is operational. During normal operation, the CPU halt and boot error LEDs on the RP should be off. When the system is turned on or restarted, the boot LED goes on for 1 or 2 seconds, then goes off. The CPU halt LED, which goes on only if the system detects a processor hardware failure, should never be on. For complete descriptions of the LED states, refer to the appendix “Reading LED Indicators.”

## Serial Ports

Two asynchronous serial ports on the RP, the console and auxiliary ports, provide the means for connecting a terminal, modem, or other device for configuring and managing the system. A data circuit-terminating equipment (DCE) EIA/TIA-232 receptacle console port on the RP provides a direct connection for a console terminal. The adjacent data terminal equipment (DTE) EIA/TIA-232 plug auxiliary port supports flow control and is often used to connect a modem, a channel service unit (CSU), or other optional equipment for Telnet management of the attached device.

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**Note** Prior to acceptance by the Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) as a standard, EIA/TIA-232 [or 449] was an EIA recommended standard (RS) known as EIA/TIA-232 [or 449].

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The two EIA/TIA-232 serial ports on the RP, console and auxiliary, support asynchronous transmission. Asynchronous transmission uses control bits to indicate the beginning and end of characters, rather than precise timing. The serial interface ports on the FSIP support synchronous transmission, which maintains precise clocking between the transmitter and receiver by sending frames of information that comprise separate clock signals along with the data signals. When connecting serial devices, ensure that the devices support the proper transmission timing methods for the respective port: asynchronous for the console and auxiliary ports, and synchronous for the FSIP serial ports.

### 7000 Series Route Switch Processor (RSP7000)

The RSP7000 is a new main system processor module for the Cisco 7000 series routers. The RSP7000 combines all of the switched routing and high-speed switching functions of the separate Route Processor (RP) and Switch Processor (SP), which are used in the Cisco 7000 series routers, but with improved performance on a single processor module. The RSP7000 contains the central processing unit (CPU) and most of the memory components for the Cisco 7000 series routers. You must install the RSP7000 in the 7000 RSP slot (slot 3 in the Cisco 7010).

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**Note** The RSP7000 requires that your Cisco 7000 is running Cisco Internetwork Operating System (Cisco IOS) Release 10.3(9) or later. For the RSP7000 to operate properly, the Cisco 7010 chassis must also be configured with the 7000 Series Chassis Interface (RSP7000CI), which installs in the 7000 CI slot (slot 4 in the Cisco 7010).

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The Cisco IOS images reside in Flash memory, which is located either on the RSP7000, in the form of a single in-line memory module (SIMM), or on up to two Personal Computer Memory Card International Association (PCMCIA) cards (called *Flash memory cards*) that insert in the two PCMCIA slots (slot 0 and slot 1) on the front of the RSP7000. (See Figure 1-10.)

Storing the Cisco IOS images in Flash memory enables you to download and boot from upgraded Cisco IOS images remotely or from software images resident in the RSP7000 Flash memory, without having to remove and replace read-only memory (ROM) devices.

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**Note** The RSP7000 uses a software-controlled configuration register, so it is not necessary to remove the RSP7000 to configure jumpers. There are no user-configurable jumpers on the RSP7000.

---

The RSP7000 contains the following components:

- Mips R4600 Reduced Instruction Set Computing (RISC) processor, used for the CPU (The CPU runs at an external clock speed of 50 MHz and an internal clock speed of 100 MHz.)
- A bank of hardware (Media Access Control [MAC]-layer) addresses for the interface ports
- Most of the memory components used by the system, including onboard Flash
- Air-temperature sensors for environmental monitoring (All of the logic for the environmental monitoring functions is contained on the chassis interface card.)

In addition to the system software, the RSP7000 contains and executes the following management functions that control the system:

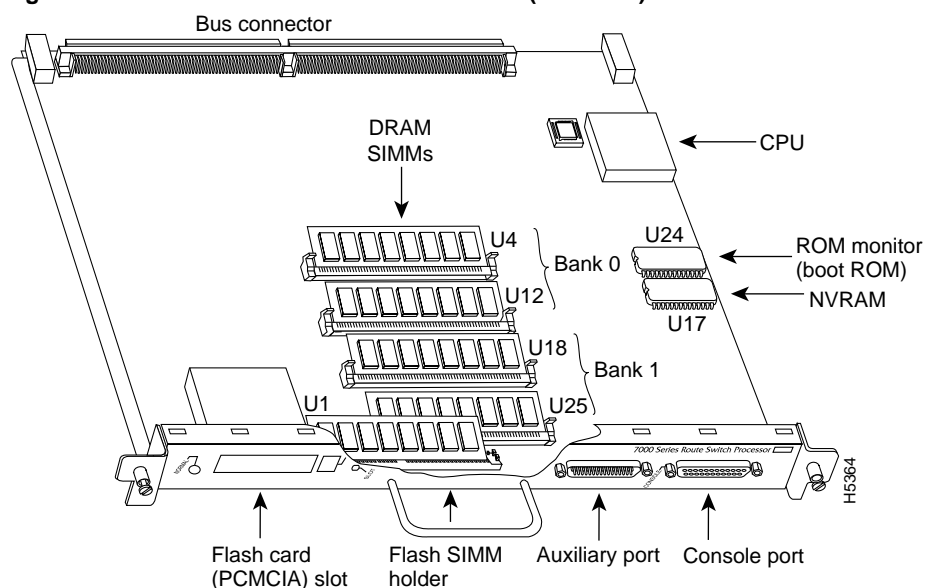
- Sending and receiving routing protocol updates
- Managing tables and caches
- Monitoring interface and environmental status
- Providing Simple Network Management Protocol (SNMP) management and the console/Telnet interface

The high-speed switching section of the RSP7000 communicates with and controls the interface processors on the high-speed CxBus. This switching section decides the destination of a packet and switches it accordingly. The RSP7000 uses a 16-million-instructions-per-second (mips) processor to provide high-speed, autonomous switching and routing.

## Memory Components

Figure 1-10 shows the various types of memory components on the RSP7000, and Table 1-4 lists the functions of each type.

**Figure 1-10 7000 Route Switch Processor (RSP7000)**



**Table 1-4 RSP7000 Memory Components**

Type	Size	Quantity	Description	Location
DRAM	16 to 128 MB	2 to 4	8, 16, or 32-MB SIMMs (based on maximum DRAM required)	Bank 0: U4 and U12 Bank 1: U18 and U25
NVRAM	128 KB	1	Nonvolatile EPROM for the system configuration file <sup>1</sup>	U17
Flash SIMM	8 MB	1	Contains the Cisco IOS images on the RSP7000 (standard)	U1
Flash Card	8, 16, and 20 MB <sup>2</sup>	Up to 2	Contains the Cisco IOS images on up to two PCMCIA cards	Slot 0, slot 1
Boot ROM	256 KB	1	EPROM for the ROM monitor program	U24

1. A system configuration file is contained in NVRAM, which allows the software to control several system variables.

2. Only Intel Series 2 Flash memory cards can be used with the RSP7000.

### DRAM

DRAM stores routing tables, protocols, and network accounting applications. The standard RSP7000 configuration is 16 megabytes (MB) of DRAM, with up to 128 MB available through single in-line memory module (SIMM) upgrades.

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**Note** When upgrading DRAM, you must use SIMMs from an approved vendor. To ensure that you obtain the most current vendor information, obtain the list from Cisco Information Online (CIO) or the Technical Assistance Center (TAC).

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### NVRAM

The system configuration, software configuration register settings, and environmental monitoring logs are contained in the 128-kilobyte (KB), nonvolatile random-access memory (NVRAM), which is backed up with built-in lithium batteries that retain the contents for a minimum of five years. When replacing an RSP7000, be sure to back up your configuration to a remote server so you can retrieve it later.



**Caution** Before you replace an RSP7000, back up the running configuration to a Trivial File Transfer Protocol (TFTP) file server so you can retrieve it later. If the configuration is not saved, the entire configuration will be lost—inside the NVRAM on the removed RSP7000—and you will have to reenter the entire configuration manually. For instructions on how to save the configuration file, refer to the section “Saving and Retrieving the Configuration File,” in the chapter “Maintenance.” This procedure is not necessary if you are temporarily removing an RSP7000 you will reinstall; lithium batteries retain the configuration in memory until you replace the RSP7000 in the system.

### Flash Memory

The imbedded or PCMCIA card-based Flash memory allows you to remotely load and store multiple Cisco IOS and microcode images. You can download a new image over the network or from a local server and then add the new image to Flash or replace the existing files. You can then boot routers either manually or automatically from any of the stored images. Flash memory also functions as a TFTP server to allow other servers to boot remotely from stored images or to copy the stored image into their own Flash memory.

---

**Note** If you have a Flash memory card installed in the PCMCIA slot of your RP, and you are replacing an RP with an RSP7000, you must reformat the Flash memory card if you want to use it with your new RSP7000. You must also install the RSP7000 in slot 6 and have an RSP7000 Chassis Interface (RSP7000CI) installed in slot 5, and be running Cisco IOS Release 10.3(9), or later, for the new RSP7000 to work properly. Using the RSP7000, you cannot read data on the RP’s Flash memory card, nor can you use it as bootable media. You must reformat the RP’s Flash card before you can use it with the RSP7000. Flash memory cards formatted on the RP-based systems (7000 series routers) are formatted differently from Flash memory cards formatted on RSP-based systems (7500 series routers).

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**Caution** The formatting procedure erases all information on the Flash memory card. To prevent the loss of important data that might be stored on a Flash memory card, proceed carefully. If you want to save the data on a Flash memory card, copy the data to a server before you format the card.



## System Software

The Cisco 7000 series routers support downloadable system software and microcode for most Cisco IOS and microcode upgrades, which enables you to remotely download, store, and boot from a new image. Flash memory contains the default system software. An erasable programmable read-only memory (EPROM) device contains the latest microcode version, in compressed form, for each interface processor. At system startup, an internal system utility scans for compatibility problems between the installed interface processor types and the bundled microcode images, then decompresses the images into running dynamic random-access memory (DRAM). The bundled microcode images then function the same as the EPROM images.

## Jumpers

There are no user-configurable jumpers on the RSP7000.

## LEDs

The two LEDs on the RSP7000 indicate the system and RSP7000 status. The normal LED is on when the system is operational. During normal operation, the CPU halt LED should be off. The CPU halt LED goes on only if the system detects a processor hardware failure.

## Serial Ports

Two asynchronous serial ports on the RSP7000, the console and auxiliary ports, allow you to connect external devices to monitor and manage the system. The console port is an Electronic Industries Association/Telecommunications Industry Association (EIA/TIA)-232 receptacle (female) that provides a data circuit-terminating equipment (DCE) interface for connecting a console terminal.

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**Note** EIA/TIA-232 was known as recommended standard RS-232 before its acceptance as a standard by the Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA).

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The auxiliary port is an EIA/TIA-232 plug (male) that provides a data terminal equipment (DTE) interface; the auxiliary port supports flow control and is often used to connect a modem, a channel service unit (CSU), or other optional equipment for Telnet management.

## 7000 Series Chassis Interface (RSP7000CI)

The RSP7000CI, shown in Figure 1-11, works with the RSP7000, and consists of a printed circuit board attached to a metal carrier. The RSP7000CI has no user-configurable jumpers or switches, and its faceplate contains no LEDs. The RSP7000CI is distinguishable only by the label on its faceplate, which reads *7000 Series Chassis Interface*. (See Figure 1-11.) The RSP7000CI provides the environmental monitoring and power supply monitoring functions for the Cisco 7000 series chassis. The RSP7000CI isolates the CPU and system software from chassis-specific variations.



**Caution** To prevent system problems, the RSP7000CI must *not* be removed or installed with power ON to the chassis. The RSP7000CI does not support online insertion and removal (OIR). You must install the RSP7000CI in the 7000 CI slot (slot 4 in the Cisco 7010).

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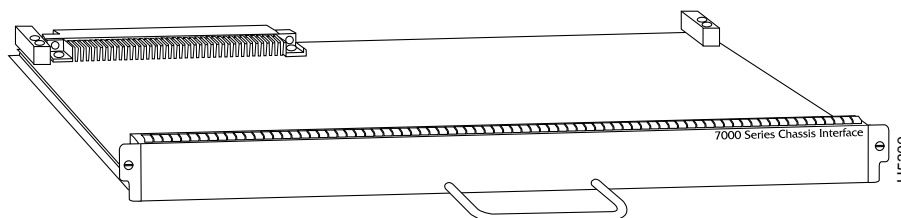
**Note** The RSP7000CI requires that your Cisco 7000 is running Cisco IOS Release 10.3(9) or later. You must also have the RSP7000 installed in the 7000 RSP slot (slot 3 in the Cisco 7010).

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The functions of the RSP7000CI are as follows:

- Report backplane type
- Report arbiter type
- Monitor power supply status
- Monitor fan/blower status
- Monitor temperature sensors on the RSP7000
- Provide router power up/down control
- Provide power supply power-down control

**Figure 1-11 RSP7000CI**

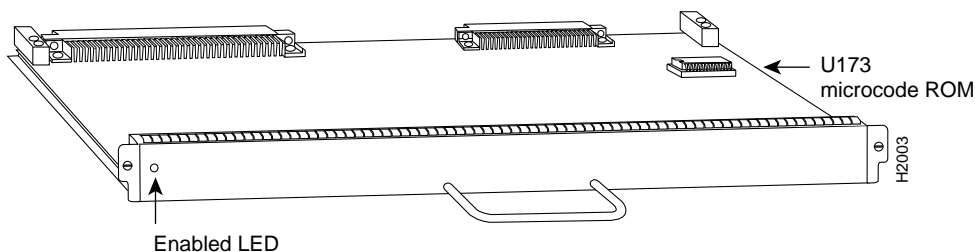


## Switch Processor (SP)

The SP, shown in Figure 1-12, controls and communicates with the interface processors on the high-speed CxBus. Its function is to decide the destination of a packet and switch it based on that decision. The SP uses a 16-million-instructions-per-second (mips) processor to provide high-speed, autonomous switching and routing. The SP microcode (firmware), which contains board-specific software instructions, resides in an ROM component in socket U173.

The SP is always installed in the SP slot, which is below the RP. (See Figure 1-3.) The single enabled LED is on when the SP is enabled for operation.

**Figure 1-12 Switch Processor (SP)**



## Silicon Switch Processor (SSP)

The SSP is the optional high-performance silicon switch for Cisco 7000 series routers. The SSP provides distributed processing and control for the interface processors, and communicates with and controls the interface processors on the high-speed CxBus. The SSP determines the destination of a packet and switches the packet, based on that decision.

The SSP is always installed in the backplane SP slot adjacent to the RP. A few seconds after bootup, the enabled LED comes on to indicate that the SSP is enabled for operation.

One SSP (or SP) is required in each Cisco 7000 series router.

There are two hardware versions of the SSP: one with 512 KB of packet memory and another with 2 MB of packet memory (for installations requiring increased memory capacity).

Following are minimum system requirements for the SSP types:

- The SSP with 512 KB of packet memory requires Cisco Internetwork Operating System (Cisco IOS) Release 10.0, or later.
- The SSP with 2 MB of packet memory requires Cisco IOS Release 10.0 or later. Cisco IOS Releases 10.2(x) and 10.3(x) will provide the best use of the 2-MB SSP. (Detailed procedures for upgrading your Cisco 7000 series router software are provided separately with the software upgrade.)

## Interface Processors

An interface processor comprises a modular, self-contained interface board and one or more network interface connectors in a single 11 x 14-inch unit. All CxBus interface processors support Online Insertion and Removal (OIR), so you can install and remove them without opening the chassis and without turning off the chassis power. (The early serial interface processor, known as the SX-SIP or PRE-FSIP, will not operate in the Cisco 7010; see the following Caution.) The RP, SP, and SSP, which are required system components, always reside in the RP, SP, and SSP slots. (See Figure 1-3.)

The remaining three slots are available for any combination of the following interface processors:

- AIP—ATM Interface Processor. For interface types and specifications, refer to the section “ATM Connection Equipment” in the chapter “Preparing for Installation.”
- CIP—Channel Interface Processor. Any combination of one or two bus and tag and/or one or two Enterprise System Connection (ESCON) interfaces. For bus and tag and ESCON interface configurations and specifications, refer to the section “Channel Attachment Connection Equipment” in the chapter “Preparing for Installation.”
- EIP—Ethernet Interface Processor with two, four, or six AUI ports, each of which operates at up to 10 Mbps.
- FEIP—For up to two 100BaseT, RJ-45 or Media Independent Interface (MII) ports. The interfaces on an FEIP can both be configured at 100 Mbps, half duplex (HDX) or full duplex (FDX), for a maximum aggregate bandwidth of 200 Mbps.
- TRIP—High-speed (4 or 16 Mbps) Token Ring Interface Processor with two or four DB-9 ports.
- FIP—High-speed (100 Mbps) FDDI Interface Processor with one single-attach or dual-attach port (PHY A/PHY B) in any combination of single-mode and multimode ports (such as single-single, multi-single, and so forth).
- FSIP—Fast (up to 8 Mbps, or 16 Mbps aggregate with 8 ports) serial Interface Processor that provides four or eight synchronous serial ports.
- HIP—High-speed (up to 52 Mbps) Serial Interface Processor with a single HSSI port.

- MIP—MultiChannel Interface Processor with up to two channelized T1 interfaces that operate at T1 speed: up to 1.544 Mbps.



**Caution** The early serial interface processor (SX-SIP or PRE-FSIP) cannot be used in the Cisco 7010 (the SX-SIP requires SxBus connectors that are not present in the Cisco 7010). In October 1993, the FSIP replaced the SIP in the product line, and most SIPs in the field have now been replaced with FSIPs. We recommend that you replace any SIPs that you still have as spares, as soon as possible; the upgrade is free of charge. Contact a customer service representative for upgrade information.

The microcode on the SP (and SSP) and on each interface processor contains board-specific software instructions. New features and enhancements to the system or interfaces are often implemented in microcode upgrades. The Cisco 7000 series routers support downloadable microcode for most maintenance upgrades, which enables you to download new microcode images remotely and store them in Flash memory. You can then use software commands to instruct the system to load a specific microcode image from Flash or to load the default microcode image from ROM.

System software upgrades also can contain upgraded microcode images, which will load automatically when the new software image is loaded. Although most upgrades support the downloadable microcode feature and are distributed on floppy disk, some may require ROM replacement. If replacement is necessary, refer to the section “Microcode Component Replacement” in the chapter “Maintenance.” Also, specific instructions are provided with the replacement component in an upgrade kit.

Each interface processor has a unique bank of status LEDs, and all have a common enabled LED at the left end of the interface processor face plate. The enabled LED goes on when the RP has completed initialization of the interface processor for operation, indicating that, as a minimum, the interface processor is correctly connected to the backplane, that it is receiving power, and that it contains a valid microcode version. If any of these conditions is not met, or if the initialization fails for other reasons, the enabled LED stays off. Additional LEDs on each interface processor type indicate the state of the interfaces.

The following sections describe each interface processor type. The appendix “Reading LED Indicators” describes the specific LED states of each.

### ATM Interface Processor (AIP)

The AIP provides a direct connection between the high-speed CxBus and the external networks. (See Figure 1-13.) The physical layer interface module (PLIM) on the AIP determines the type of ATM connection.

**Figure 1-13 AIP with 100 Mbps UNI PLIM**

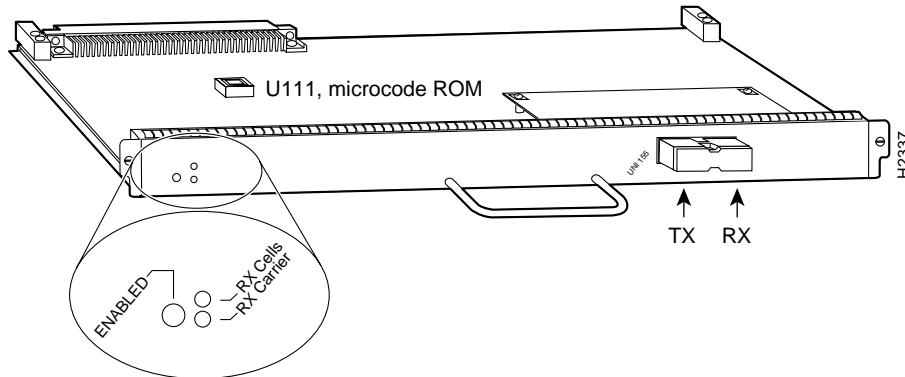


Table 1-5 lists the maximum number of AIP modules supported on Cisco 7000 series routers. There are no restrictions on slot locations or sequence; an AIP can be installed in any available interface processor slot.

**Table 1-5 Maximum AIP Modules by Chassis Model**

Chassis	Maximum AIP Modules
Cisco 7000 (7-slot system)	5
Cisco 7010 (5-slot system)	3

**Note** Traffic from multiple ATM network interfaces could theoretically exceed the bandwidth of the CxBus. This would cause packets to be dropped. As a practical limit, Cisco 7000 series routers can contain up to two AIP modules per chassis.

The AIP supports the following features:

- Multiple rate queues.
- Reassembly of up to 512 buffers simultaneously. Each buffer represents a packet.
- Support for up to 2,048 virtual circuits.
- Support for both ATM Adaptation Layer (AAL) 5 and AAL3/4.

**Note** AAL3/4 is not supported in the initial release of Cisco IOS Release 10.0. AAL3/4 is supported with Cisco IOS Release 10.2 and later.

- Exception queue, which is used for event reporting. Events such as CRC errors are reported to the exception queue.
- Raw queue, which is used for all raw traffic over the ATM network. Raw traffic includes operation and maintenance (OAM) cells and Interim Local Management Interface (ILMI) cells. (ATM signaling cells are not considered raw.)

### Channel Interface Processor (CIP)

The CIP provides up to two channel attachment interfaces, eliminating the need for a separate front-end processor. (See Figure 1-14.) The CIP interfaces are combinations of a bus and tag (also called an original equipment manufacturer’s interface [OEMI] and a parallel I/O interface) adapter and/or an Enterprise Systems Connection (ESCON) adapter.

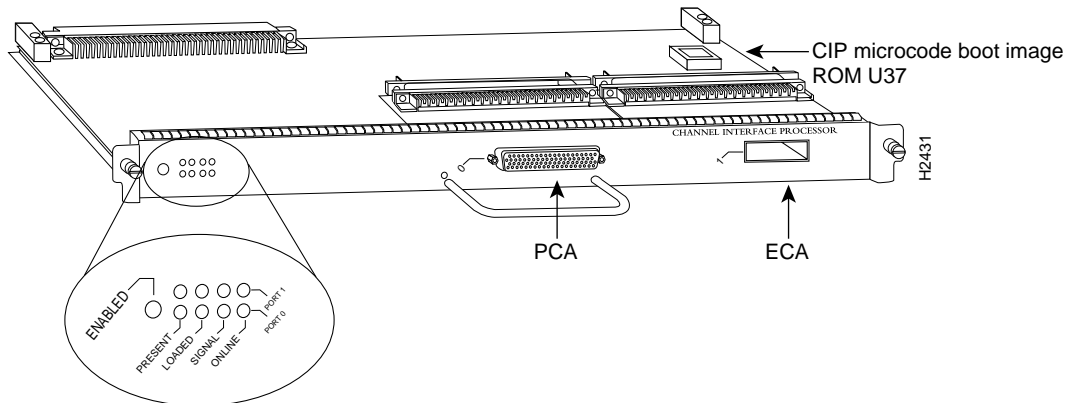
The bus and tag adapter is called the Parallel Channel Adapter (PCA) and the ESCON adapter is called the ESCON Channel Adapter (ECA). The PCA and ECA connect directly to the CIP motherboard, and any combination of the two adapters can be used on the CIP.

**Note** The ECA and PCA adapters can be upgraded or replaced in the field by a Cisco-certified maintenance provider *only*.

While up to three CIPs can be installed in the Cisco 7010, we recommend that you leave one slot available for a WAN interface. The default CIP microcode boot image resides on an ROM in socket U37.

The supported processor input/output architectures for the CIP include ESA/390 for ESCON and System/370, 370/Xa, and ESA/390 for bus and tag. The ESCON interface is capable of a data rate up to 17 megabytes per second (MBps) and the bus and tag interface is capable of a data rate up to 4.5 MBps.

**Figure 1-14 Channel Interface Processor (CIP)**



Following are the functions of the CIP LEDs.

- Enabled—Indicates that the CIP has been enabled for operation by the system.
- Present—Indicates that the adapter (ECA or PCA) has been detected by the CIP.
- Loaded—Indicates that the adapter (ECA or PCA) firmware has been completely loaded.
- Signal—For the ECA, this LED indicates that the Sync signal has been detected.

For the PCA, this LED indicates that the Operational Out signal has been detected. Note that even though a system reset and selective reset both cause the Operational Out signal to drop, the signal LED will still be on during those sequences.

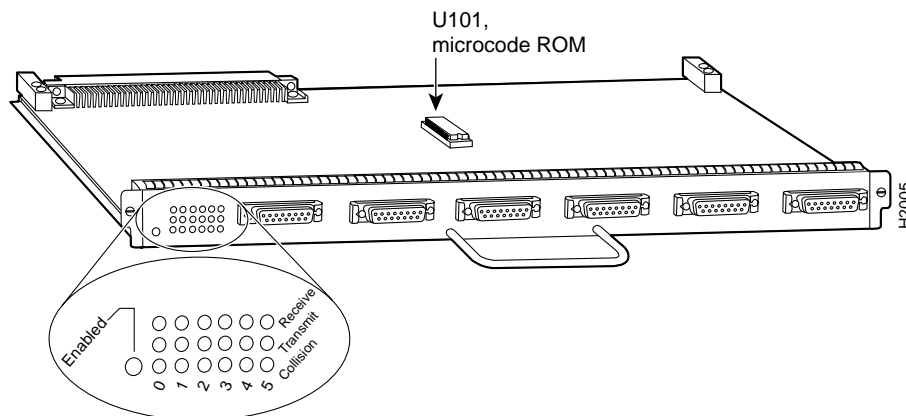
- Online—For the ECA, this LED indicates that an establish-logical-path request has been received from the channel.

For the PCA, this LED indicates that the PCA is ready to establish connection to the host channel.

## Ethernet Interface Processor (EIP)

The EIP, shown in Figure 1-15, provides two, four, or six Ethernet ports that operate at up to 10 Mbps. Each port supports both Ethernet Version 1 and IEEE 802.3/Ethernet Version 2 interfaces. A bit-slice processor provides a high-speed data path between the EIP and other interface processors. The default EIP microcode resides on a ROM in socket U101.

**Figure 1-15 Ethernet Interface Processor (EIP)**



As with the other interface processors, the enabled LED is on when the EIP is enabled for operation. The three LEDs for each port indicate the following:

- Receive—Frames are being received.
- Transmit—Frames are being transmitted.
- Collision—A frame collision has been detected.

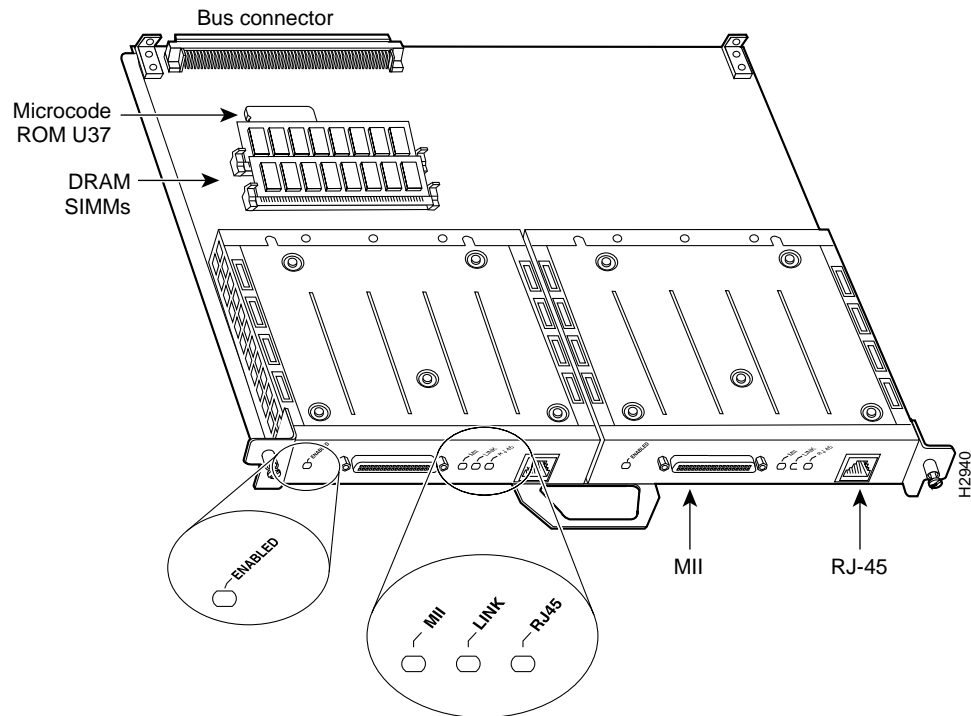
For complete descriptions of the LED states, refer to the appendix “Reading LED Indicators.”

The EIP is available with two, four, or six ports. The Cisco 7010 supports up to three EIPs for a maximum of 18 Ethernet ports. Each port requires an Ethernet transceiver or a media attachment unit (MAU) and attachment unit interface (AUI) cable to connect to the external network. For descriptions of Ethernet transceivers and AUIs, refer to the section “Ethernet Connection Equipment” in the chapter “Preparing for Installation.” For descriptions of Ethernet network connections, refer to the section “Ethernet Connections” in the chapter “Installing the Router.”

Each port on the EIP automatically supports both Ethernet Version 1 and Version 2/IEEE 802.3 connections. When an interface is connected to an EIP port, the port automatically adjusts to the interface type. The ports are independent, so you can mix both versions on one EIP.

## Fast Ethernet Interface Processor

The FEIP provides up to two 100-Mbps, IEEE 802.3u 100BaseT ports. (Figure 1-16 shows a two-port FEIP.) IEEE 802.3u specifies several different physical layers for 100BaseT: 100BaseTX—100BaseT half duplex, over Category 5, unshielded twisted-pair (UTP), EIA/TIA-568-compliant cable; 100BaseFX—100BaseT full duplex, over twisted pair or optical fiber); and 100BaseT4—100BaseT full duplex, using Category 3 and 4 cabling with four pairs (also called 4T+).

**Figure 1-16 Fast Ethernet Interface Processor**

Following are the product numbers associated with the FEIP:

- CX-FEIP-1TX= (interface processor with one 100BaseTX port adapter)
- CX-FEIP-2TX= (interface processor with two 100BaseTX port adapters)

The interfaces on an FEIP can both be configured at 100 Mbps, half duplex (HDX) or full duplex (FDX), for a maximum aggregate bandwidth of 200 Mbps. The FEIP microcode boot image resides in an EPROM in socket location U37.

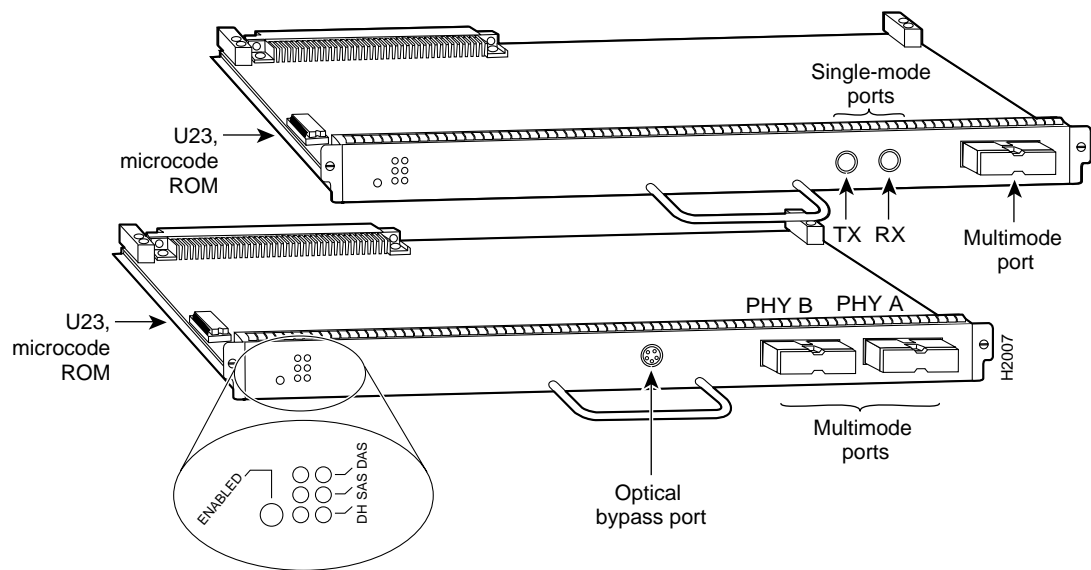
For maximum port densities, refer to the section “Port Densities” in this chapter.

### Fiber Distributed Data Interface Processor (FIP)

The FIP contains a 16-mips processor for high-speed (100 Mbps) interface rates and the industry-standard AMD SuperNet chipset for interoperability. Figure 1-17 shows a multimode/multimode FIP on the bottom and a single-mode/multimode FIP on the top. The FIP supports single-attach stations (SASs), dual-attach stations (DASs), dual homing, and optical bypass. The FIP complies with ANSI X3.1 and ISO 9314 FDDI standards. The default FIP microcode resides on a ROM in socket U23.

**Figure 1-17 FDDI Interface Processor (FIP), Multimode/Multimode and Single-Mode/Multimode**





Each FIP provides a single network interface for both multimode and single-mode FDDI networks. The two FIP connectors are available in any combination of multimode (MIC) or single-mode (FC) connectors for matching multimode and single-mode fiber in the same FDDI network. The following combinations are available:

- CX-FIP-MM—FDDI PHY-A multimode, PHY-B multimode interface processor
- CX-FIP-MS—FDDI PHY-A multimode, PHY-B single-mode interface processor
- CX-FIP-SM—FDDI PHY-A single-mode, PHY-B multimode interface processor
- CX-FIP-SS—FDDI PHY-A single-mode, PHY-B single-mode interface processor

As with the other interface processors, the enabled LED is on when the FIP is enabled for operation. To the right of the enabled LED, a bank of six LEDs indicate the state of the two physical sublayer connections (PHY B and PHY A). The left column of three LEDs indicates PHY B; the right column indicates PHY A. (On the front of the FIP, the left interface is PHY B and the right interface is PHY A as shown in Figure 1-17.) The state of each B/A pair of LEDs indicates the status of one type of three possible station connections: dual-homed, single-attach station (SAS), or dual-attach station (DAS). For complete descriptions of the LED states, refer to the appendix “Reading LED Indicators.”

Each FIP provides the interface for connection to a Class A DAS (with primary and secondary rings), or to a Class B SAS (with only a primary ring). The Cisco 7010 supports up to three FIPs for a maximum of 3 FDDI network connections. The multimode MIC or single-mode FC ports on the FIP provide a direct connection to the external FDDI network.

A six-pin mini-DIN connector on the multimode-multimode (CX-FIP-MM) and single-mode (CX-FIP-SS) FIPs provides the connection for an optical bypass switch. When the interface is shut down, the bypass switch allows the light signal to pass directly from the receive port to the transmit port on the bypass switch, completely *bypassing* the FIP transceivers. The bypass switch does not repeat the signal, and significant signal loss may occur when transmitting to stations at maximum distances. Optical bypass switches typically use a six-pin DIN or mini-DIN connector. A DIN-to-mini-DIN adapter cable (CAB-FMDD) is included with the FIP to allow connection to either type of connector. For a detailed description of optical bypass and FDDI connections, refer to the

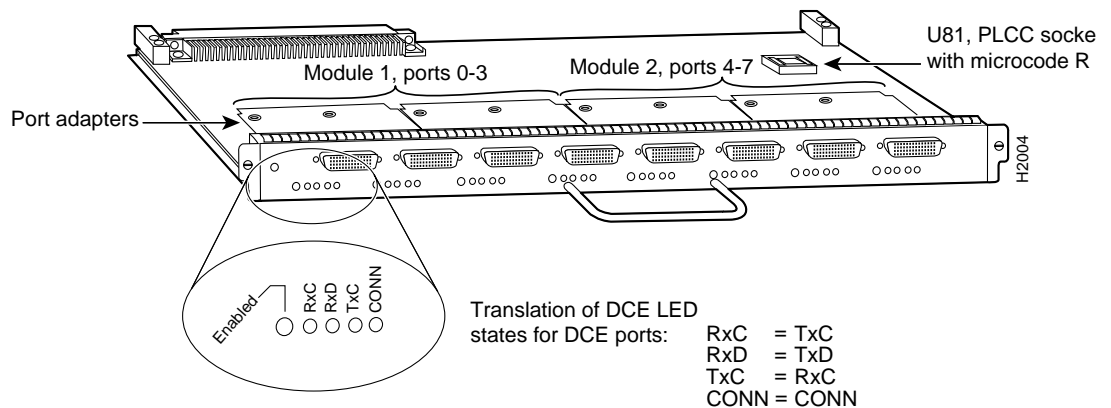
section “FDDI Connection Equipment” in the chapter “Preparing for Installation.” For descriptions of FDDI network connections, refer to the section “FDDI Connections” in the chapter “Installing the Router.”

### Fast Serial Interface Processor (FSIP)

The FSIP provides four or eight channel-independent, synchronous serial ports that support full duplex operation at T1 (1.544 Mbps) and E1 (2.048 Mbps) speeds. Each port supports any of the available interface types: EIA/TIA-232, EIA/TIA-449, V.35, X.21, EIA-530, and E1-G.703/G.704.

Figure 1-18 shows an eight-port FSIP. The eight ports are divided into two four-port modules, each of which is controlled by a dedicated Motorola MC68040 processor and contains 128 kilobytes (KB) of static random-access memory (SRAM). Each module can support up to four T1 or three E1 interfaces, and an aggregate bandwidth of up to 6.132 Mbps at full-duplex operation. The type of electrical interface, the amount of traffic, and the types of external data service units (DSUs) connected to the ports affect actual rates. For information on setting up high-speed interfaces, refer to the section “Replacing RSP7000 DRAM SIMMs” in the chapter “Maintenance.”

**Figure 1-18 Fast Serial Interface Processor (FSIP)**



Each FSIP comprises an FSIP board with two or four port adapters installed. Additional port adapters are available as spares so that you can replace one that fails; however, you cannot upgrade a four-port FSIP to an eight-port by adding port adapters. The 4-port FSIP is not constructed to support additional ports after it leaves the factory; it contains the circuitry to control only one 4-port module. For port adapter descriptions, refer to the section “Universal Serial Port Adapters” in this chapter.

The default FSIP microcode resides on a PLCC-type ROM in socket U81.

The Cisco 7010 supports up to three FSIPs for a maximum of 24 high-speed serial interfaces. There are no restrictions on slot locations or sequence; you can install FSIPs in any available interface processor slots. For descriptions of serial connection equipment, refer to the section “Serial Connection Equipment” in the chapter “Preparing for Installation.” For examples of network connections, refer to the section “Serial Connections” in the chapter “Installing the Router.”

All interface types except EIA-530 are individually configurable for operation with either external timing (DTE mode) or internal timing (DCE mode); EIA-530 operates with external timing only. In addition, all interfaces support nonreturn to zero (NRZ) and nonreturn to zero inverted (NRZI) format, and both 16-bit and 32-bit cyclic redundancy checks (CRCs). The default configuration is for NRZ format and 16-bit CRC. You can change these default settings with software commands. (See the section “Replacing RSP7000 DRAM SIMMs” in the chapter “Maintenance.”)

In order to provide a high density of ports, the FSIP uses special *port adapters* and *adapter cables*. A port adapter is a daughter card that provides the physical interface for two FSIP ports. Both ports use the same high-density, 60-pin universal receptacle that supports all interface types. The adapter cable connected to the port determines the interface type and mode.

The interface ports are not set to a default mode or for a default clock source, so there are no software commands required to enable internal or external timing (DCE or DTE). Each port automatically supports the mode of the port adapter cable when one is connected; however, there is no default clockrate set. You must set the clockrate on all DCE ports with the **clockrate** command before the port can operate with an external timing signal. To use the port as a DCE interface, you must set the clockrate and connect a DCE adapter cable.

To use the port as a DTE interface, you need only connect a DTE adapter cable to the port. If you connect a DTE cable to a port on which a clockrate is set, the system will ignore the clockrate until a DCE cable is attached. For example, you can change an interface from an EIA/TIA-232 to a V.35 by replacing the adapter cable, or change the mode of an EIA/TIA-232 DTE port by replacing the EIA/TIA-232 DTE cable with an EIA/TIA-232 DCE cable, provided that you have already specified a clockrate for the port.

---

**Note** Although no software configuration is necessary to enable internal clocking for DCE mode, you cannot bring up a DCE interface until you set the clockrate. For a brief description of the **clockrate** command, refer to the section “Replacing RSP7000 DRAM SIMMs” in the chapter “Maintenance.” For complete command descriptions and configuration instructions, refer to the related software documentation, which is available on UniverCD.

---

Figure 1-18 shows the FSIP LEDs. As with the other interface processors, the enabled LED is on when the FSIP is enabled for operation. The four LEDs below each port indicate the state of that interface. The labels on each LED indicate the signal state when the FSIP port is in DTE mode. However, the direction of the signals is reversed when the FSIP port is in DCE mode. For example, a DCE device usually generates a clock signal, which it sends to the DTE device. Therefore, when the Receive Clock (RxC) LED on a DTE interface is on, it indicates that the DTE is receiving the clock signal from the DCE device. However, when the RxC LED on a DCE interface is on, it indicates that the DCE is sending a clock signal to the DTE device. Because of limited space on the FSIP faceplate, only DTE mode states are labeled on each port. Figure 1-18 shows the interpretation of each LED for ports that are operating in DCE mode.

The following LED state descriptions include the meanings for both DTE and DCE interfaces. The signals indicated for DTE interfaces correspond to the LED labels. However, the signals on DCE interfaces travel in the opposite direction and do not correspond directly to the LED labels. Refer to the LED labels for DTE interfaces and the cross-reference for DCE signals shown in Figure 1-18 when reviewing the LED state descriptions that follow:

- RxC (Receive Clock)—On both DTE and DCE interfaces, this LED is on when the port is receiving an external clock signal.
- RxD (Receive Data)—On both DTE and DCE interfaces, this LED is on when the port is receiving data signals (packets) from the network. This LED is also on when it detects an idle pattern that is commonly sent across the network during idle time.
- TxC (Transmit Clock)—On DTE interfaces, this LED is on when the port is sending the transmit clock signal. On DCE interfaces, it indicates that the DCE is sending the TxC signal to the DTE.

- **Conn (connected or loopback)**—On both DTE and DCE interfaces, this LED is on to indicate normal operation: the FSIP is properly connected to the external device, and TA (DTE available) and CA (DCE available) are active. When this LED is off, the FSIP is in loopback mode or is not connected to the network or external device.

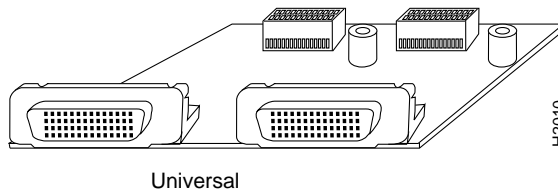
For complete descriptions of the LED states, refer to the appendix “Reading LED Indicators.”

### Universal Serial Port Adapters

The FSIP uses special universal serial port adapters and adapter cables to allow the high density (eight) of interface ports on an FSIP, regardless of the size or form factor of the connectors typically used with each electrical interface type. Figure 1-19 shows a universal port adapter with 60-pin connectors that support all interface types. The adapter cable connected to the port determines the interface type and mode.

The universal port adapters are field-replaceable daughter cards mounted to the FSIP, and each provides two high-density connectors for two FSIP ports. (See Figure 1-19.) The 60-pin D-shell receptacle supports EIA/TIA-232, V.35, EIA/TIA-449, X.21, and EIA-530.

**Figure 1-19 Universal Serial Port Adapter**



The router (FSIP) end of all universal-type adapter cables is a 60-pin plug that connects to the 60-pin port (receptacle) on the FSIP. The network end of the cable is an industry-standard connector for the type of electrical interface that the cable supports: DB-25 for EIA/TIA-232 and EIA-530, DB-37 for EIA/TIA-449, DB-15 for X.21, or a standard V.35 block connector. For most interface types, the adapter cable for DTE mode uses a plug at the network end, and the cable for DCE mode uses a receptacle at the network end. However, V.35 adapter cables are available with either a V.35 plug or a receptacle for either mode, and EIA-530 is available only in DTE mode with a DB-25 plug. Factory-installed 4-40 thumbscrews are standard at the network end of all cable types except V.35. A metric conversion kit with M3 thumbscrews is included with each cable to allow connection to devices that use metric hardware.

The FSIP is shipped from the factory with two or four dual-port adapters installed. Additional port adapters are available as spares so that you can replace one that fails; however, you cannot upgrade a four-port FSIP to an eight-port by adding port adapters. (The four-port FSIP is manufactured with only one four-port module and processor.)

For port adapter replacement instructions, refer to the section “Replacing Serial Port Adapters” in the chapter “Maintenance.” The appendix “Cabling Specifications” provides adapter cable pinouts; however, because the FSIP uses a special high-density port that requires special adapter cables for each electrical interface type, we recommend that you obtain serial interface cables from the factory.

### E1-G.703/G.704 Port Adapter

The FSIP E1-G.703/G.704 interface connects Cisco 7000 series routers with 2.048-Mbps leased line services. The interface eliminates the need for a separate, external data termination unit to convert a standard serial interface (such as V.35) to a G.703/G.704/G.732 interface.

The FSIP can be configured to support up to eight E1-G.703/G.704 ports (four ports per module, two modules per FSIP). FSIP bandwidth can be allocated by the user, and the maximum aggregate bandwidth per four-port module is 16 Mbps, full duplex. We recommend that you leave one port on each module shut down to avoid exceeding this 16-Mbps maximum per module. Each of the four interfaces can operate up to 2.048 Mbps, which potentially presents a load greater than 16 Mbps, full duplex, if all four interfaces are configured. Eight E1-G.703/G.704 ports can be supported up to the 16-Mbps aggregate bandwidth capability; however, it is not possible to simultaneously support eight E1-G.703/G.704 ports at 100-percent peak bandwidth utilization, without exceeding the 16-Mbps maximum per module.

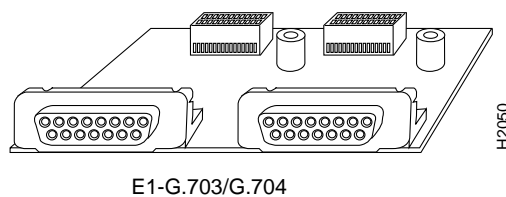
Two versions of the E1-G.703/G.704 interface are available: one supports balanced mode, and the other supports unbalanced mode. Neither the modes nor the cables are interchangeable; you cannot configure a balanced port to support an unbalanced line, nor can you attach an interface cable intended for a balanced port to an unbalanced port.

The FSIP E1-G.703/G.704 interface supports both framed and unframed modes of operation, a loopback test, and a four-bit *cyclic redundancy check* (CRC). The interface can operate with either a line-recovered or an internal clock signal. The FSIP is configured at the factory with from one to four E1-G.703/G.704 port adapters. Each port adapter provides two 15-pin D-shell (DB-15) receptacles, which support only E1-G.703/G.704 interfaces.

The FSIP E1-G.703/G.704 interface uses a DB-15 receptacle for both the balanced and unbalanced ports. The label adjacent to the port indicates whether the port is balanced or unbalanced; you must connect the correct type of interface cable, or the port will not operate.

Figure 1-20 shows the 15-pin port and the label that indicates either balanced or unbalanced mode.

**Figure 1-20 FSIP E1-G.703/G.704 Port Adapter**



The FSIP end of all E1-G.703/G.704 adapter cables is a 15-pin D-shell connector (DB-15). At the network end, the adapter cable for unbalanced connections uses a BNC connector. The adapter cables for balanced mode are available with several connector types to accommodate connection standards in different countries. You must use the proprietary cables to connect the E1-G.703/G.704 port to your network.

Cables for balanced and unbalanced mode are available with the following types of network-end connectors:

- Balanced (120-ohm) twinax split at the network end, with separate transmit and receive cables, each with a BNC connector
- Balanced (120-ohm) cable with a DB-15 connector at the network end
- Unbalanced (75-ohm) coax with BNC connectors at the network end (used primarily for connection in the United Kingdom)

In addition, some connections require bare-wire connections (directly to terminal posts).

Table 1-6 lists the model numbers and descriptions of the E1-G.703/G.704 port adapters and cables.

**Table 1-6 Model Numbers and Descriptions of E1-G.703/G.704 Port Adapter and Cables**

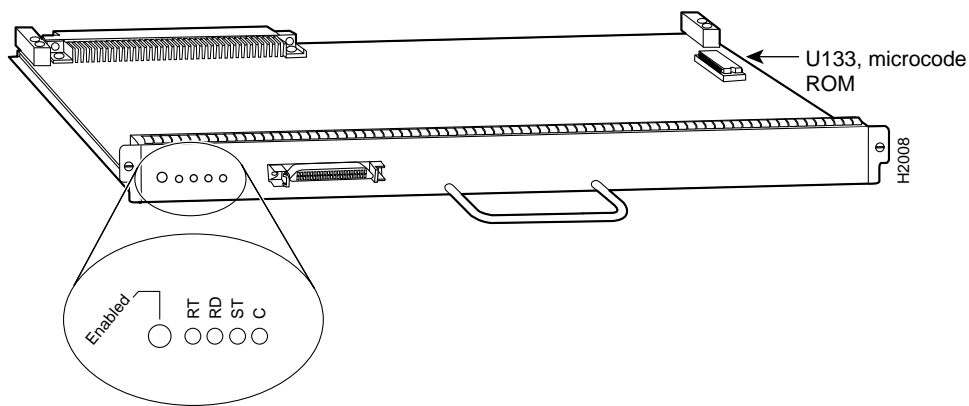
Port Adapter and Cable Model Numbers	Description
PA-7KF-E1/120= <sup>1</sup>	Dual-port E1-G.703/G.704 120 ohm, balanced
PA-7KF-E1/75=	Dual-port E1-G.703/G.704 75 ohm, unbalanced
CAB-E1-TWINAX=	E1 cable twinax 120 ohm, balanced, 5 m
CAB-E1-DB15=	E1 cable, DB-15, 120 ohm, balanced, 5 m
CAB-E1-BNC=	E1 cable BNC 75 ohm, unbalanced, 5 m

1. The appended equal sign (=) indicates a spare part.

### HSSI Interface Processor (HIP)

The HIP, shown in Figure 1-21, provides a full-duplex synchronous serial interface for transmitting and receiving data at rates of up to 52 Mbps. The HSSI interface, recently standardized as EIA/TIA-612/613, provides access to services at T3 (45 Mbps), E3 (34 Mbps), and SONET STS-1 (51.82 Mbps) rates. The actual rate of the interface depends on the external data service unit (DSU) and the type of service to which it is connected. The default HIP microcode resides on an ROM in socket U133.

**Figure 1-21 High-Speed Serial (HSSI) Interface Processor (HIP)**



As with the other interface processors, the enabled LED is on when the HIP is enabled for operation. The four LEDs above the HSSI port (see Figure 1-21) indicate the following:

- **RT (Receive Timing)**—When on, indicates that the HIP has detected a receive clock signal. During normal operation, this signal is received from the external DSU. During loopback, this signal is generated internally.
- **RD (Receive Data)**—On when the HIP detects packet traffic and indicates that the HIP is able to receive packets from the external DSU.
- **ST (Send Timing)**—On when the HIP is sending a transmit clock signal to the external DSU. During normal operation, this signal is derived from the receive timing (RT) signal from the external DSU. During loopback, this signal is generated internally.
- **C (Connected)**—When on, indicates normal operation; the HIP is properly connected to the external DSU, and TA (DTE available) and CA (DCE available) are active. This LED is off when the HIP is in loopback mode and when it is not connected to the DSU.

For complete descriptions of the LED states, refer to the appendix “Reading LED Indicators.”

The HIP interface port is a 50-pin, SCSI-II-*type* receptacle. You need a HSSI interface cable to connect the HIP with an external DSU. Although the HSSI port and cable are physically similar to SCSI-II format, the HSSI specification is more stringent than that for SCSI-II, and we cannot guarantee reliable operation if a SCSI-II cable is used.

A null modem cable allows you to connect two collocated routers back to back to verify the operation of the HSSI interface or to build a larger node by linking the routers directly. For a description of HSSI network and null modem connections, refer to the section “HSSI Connections” in the chapter “Installing the Router.” The appendix “Cabling Specifications” provides connector pinouts and cable assembly drawings.

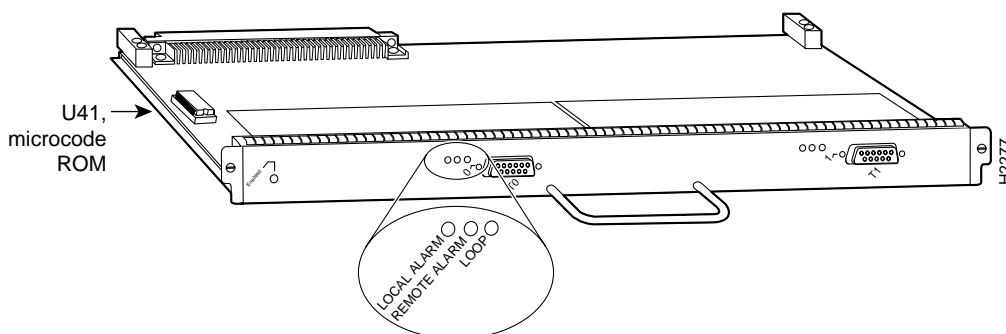
The Cisco 7010 supports up to three HIPs for a total of three HSSI interfaces. There are no restrictions on slot locations or sequence; you can install a HIP in any available interface processor slot.

### MultiChannel Interface Processor (MIP)

The MIP provides up to two channelized E1 or T1 connections via serial cables to a channel service unit (CSU). On the MIP, two controllers can each provide up to 24 virtual channels. Each virtual channel is presented to the system as a serial interface that can be configured individually.

The MIP, shown in Figure 1-22, provides two controllers for transmitting and receiving data bidirectionally at the T1 rate of 1.544 Mbps (in a future version at the E1 rate of 2.044 Mbps). For wide-area networking, the MIP can function as a concentrator for a remote site.

**Figure 1-22** Multichannel Interface Processor (MIP)—Dual-Port Module Shown



There are no restrictions on slot locations or sequence; you can install a MIP in any available interface processor slot. The MIP is compatible with any Cisco 7000 series router that is operating with the following software and microcode:

- The system software is Cisco IOS Release 10.0 or later.
- The microcode version is Release 1.4 or later.

Refer to the appropriate software configuration and command reference publications for specific configuration information.

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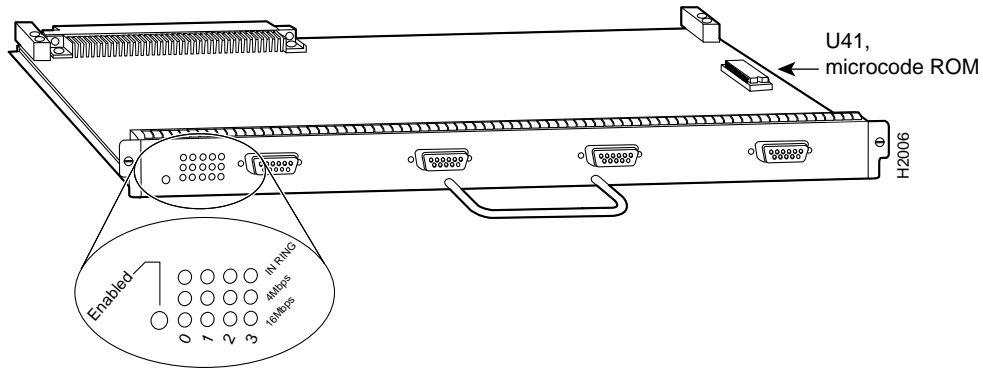
**Note** For T1 and E1, the Cisco 7010 supports a maximum of three MIP modules for a total of 6 MIP ports and up to 180 serial interfaces.

---

### Token Ring Interface Processor (TRIP)

The TRIP, shown in Figure 1-23, provides two or four Token Ring ports for interconnection with IEEE 802.5 and IBM Token Ring media. The TRIP uses the IBM 16/4-Mbps chipset with an imbedded performance-enhanced interface driver and a 16.7-MHz bit-slice processor for high-speed processing. The speed on each port is independently software-configurable for either 4 or 16 Mbps. The default TRIP microcode resides on a ROM in socket U41.

**Figure 1-23 Token Ring Interface Processor (TRIP)**



All TRIPs, regardless of whether they provide two or four ports, contain the bank of LEDs shown in Figure 1-23. As with the other interface processors, the enabled LED is on when the TRIP is enabled for operation. The three LEDs for each port indicate the following:

- In Ring—On when the interface is currently active and inserted into the ring. Off when the interface is not active and is not inserted into a ring.
- 4 Mbps—On when the interface is operating at 4 Mbps.
- 16 Mbps—On when the interface is operating at 16 Mbps.

For complete descriptions of the LED states, refer to the appendix “Reading LED Indicators.”

The TRIP is available with two or four ports. The Cisco 7010 supports up to 3 TRIPs for a maximum of 12 Token Ring ports. Each port requires a media access unit (MAU) to connect the DB-9 TRIP connectors to the external Token Ring networks.

For descriptions of Token Ring connectors and MAUs, refer to the section “Token Ring Connection Equipment” in the chapter “Preparing for Installation.” For descriptions of Token Ring network connections, refer to the section “Token Ring Connections” in the chapter “Installing the Router.”

## Functional Overview

This section describes functions that support the router’s high availability and maintainability. Online insertion and removal (OIR) enables you to quickly install new interfaces without interrupting system power or shutting down existing interfaces. The environmental monitoring and reporting functions continuously monitor temperature and voltage points in the system, and provide reports and warning messages that enable you to quickly locate and resolve problems and maintain uninterrupted operation. These descriptions will help you become familiar with the capabilities of the router and the functional differences between the Cisco 7010 and other products.



## Port Densities

The three available interface slots support any combination of network interface processors, or any three of the same type for the following maximum port densities:

- Up to 3 ATM interfaces
- Up to 18 Ethernet interfaces
- Up to 22 Fast Ethernet ports (one or two interfaces per FEIP)
- Up to 6 channel attachment interfaces
- Up to 12 Token Ring interfaces
- Up to 3 FDDI interfaces
- Up to 24 serial interfaces
- Up to 3 HSSI interfaces
- Up to 6 multichannel ports for 180 serial interface

You can install any combination of interface processors in any of the three available interface processor slots. There are no restrictions on either the number of interfaces possible or their location with respect to the main system processor (RP).

## Port Addresses

Each interface (port) in a Cisco 7000 series router uses several different types of addresses. The *physical* port address is the actual physical location (slot/port) of the interface connector within the chassis. The system software uses the physical addresses to control activity within the router and to display status information. These physical slot/port addresses are not used by other devices in the network; they are specific to the individual router and its internal components and software.

The system software also assigns a *logical* interface address to each interface, which is included in some of the status displays. The logical address is used in our other modular platforms (A-type, M, and C chassis) and is present in all router software, but it is not implemented (or needed) in the Cisco 7000 series routers.

A third type of address is the *MAC-layer* or *hardware* address, which is a standardized data link layer address that is required for every port or device that connects to a network. Other devices in the network use these addresses to locate specific ports in the network and to create and update routing tables and data structures. The Cisco 7000 series uses a unique method to assign and control the MAC-layer addresses of its interfaces.

The following sections describe how Cisco 7000 series routers assign and control both the physical (slot/port) and MAC-layer addresses for interfaces within the chassis.

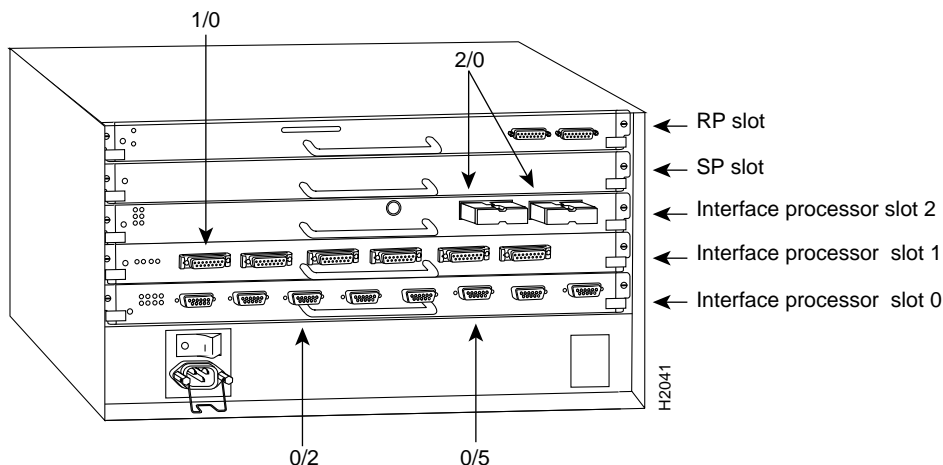
## Physical Interface Addresses

In the Cisco 7010, physical port addresses specify the actual physical location of each interface port on the router interface processor end. (See Figure 1-24.) The address is composed of a two-part number in the format *slot/port number*. The first number identifies the slot in which the interface processor is installed (0 through 2, beginning at the bottom slot). The second number identifies the physical port number on the interface processor. The ports on each interface processor are numbered sequentially from *left to right* beginning with the port 0.

Interface ports maintain the same address regardless of whether other interface processors are installed or removed. However, when you move an interface processor to a different slot, the first number in the address changes to reflect the new slot number. For example, on a six-port EIP in slot 1, the address of the first port (on the left) is 1/0 and that of the right-most port is 1/5. If you remove the EIP from slot 1 and install it in slot 2, the addresses of those same ports become 2/0 and 2/5.

Figure 1-24 shows some of the port numbers of a sample system.

**Figure 1-24 Interface Port Address Examples**



Interface slots are numbered 0 to 2 from the bottom slot up. The port numbers always begin at 0 and are numbered from left to right. The number of additional ports (/1, /2, and so on) depends on the number of ports available on an interface. FDDI interfaces are always *n/0*, because each FIP supports one interface. (The multiple connectors on the FIP can be misleading, but they provide multiple attachment options for a single FDDI interface.) Ethernet interfaces can be numbered from /0 through /5 because EIPs support up to six Ethernet ports. Serial interfaces on an eight-port FSIP are numbered /0 through /7, and so on.

You can identify interface ports by physically checking the slot/port location on the back of the router or by using software commands to display information about a specific interface or all interfaces in the router. To display information about every interface, use the **show interfaces** command (*interfaces* is plural) without variables. To display information about a specific interface, use the **show interface** command (*interface* is singular) with the interface type and port address in the format **show interface [type slot/port]**. If you abbreviate the command (**sho int**) and do not include variables, the system interprets the command as **show interfaces** and displays the status of all interfaces.

Following is an example of how the **show interfaces** command, which you use without variables, displays status information (including the physical slot and port address) for each interface in the router.

In the following example, most of the status information for each interface is omitted.

```
7010# show int

Serial0/0 is up, line protocol is up
Hardware is cxBus Serial
Internet address is 131.108.123.4, subnet mask is 255.255.255.0
(display text omitted)
Ethernet1/2 is up, line protocol is up
Hardware is cxBus Ethernet, address is 0000.0c02.d0f1 (bia 0000.0c02.d0f1)
```

```
(display text omitted)
```

```
Fddi2/0 is administratively down, line protocol is down
  Hardware is cxBus Fddi, address is 0000.0c02.adc2 (bia 0000.0c02.adc2)
  Internet address is 131.108.31.4, subnet mask is 255.255.255.0
  (display text omitted)
```

You can also use variables such as the interface type (Ethernet, Token Ring, FDDI, serial, or HSSI) and the port address (slot/port) to display information about a specific interface only. The following example shows the display for the top Ethernet port on an EIP in slot 1:

```
7010# show int ether 4/0

Ethernet1/0 is up, line protocol is up
  Hardware is cxBus Ethernet, address is 0000.0c02.d0ce (bia 0000.0c02.d0ce)
  Internet address is 131.108.31.7, subnet mask is 255.255.255.0
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set, keepalive set (10 sec)
  (display text omitted)
```

For complete command descriptions and instructions, refer to the related software documentation, which is available on UniverCD.

## MAC Address Allocator

All network interface connections (ports) require a unique *Media Access Control (MAC)-layer address*, which is also known as a *physical* or *hardware* address. Typically, the MAC address of an interface is stored on a component that resides directly on the interface circuitry, as it does on our earlier router platforms (for example, on individual appliques). Every interface on the earlier platforms contains a programmable read-only memory (PROM) component with a unique MAC address for that interface. The router system code reads the PROM for each interface in the system, learns the MAC addresses, and then initializes appropriate hardware and data structures.

However, the OIR feature makes it necessary to use a different method of handling the MAC addresses in Cisco 7000 series routers. OIR allows you to remove an interface processor and replace it with another identically-configured one. If the new interfaces match the current configuration (that of the interfaces you removed), the system immediately brings them on line. In order to allow OIR, an address allocator with 40 unique MAC addresses is stored in an EEPROM on the RP. (Because the RP is used on both the 7-slot and 5-slot platforms, the address bank must contain addresses for the maximum possible configuration: 40 possible interfaces [5 interface processor slots x 8 ports] in the 7-slot model. The 5-slot model uses only the first 24 addresses [3 interface processor slots x 8 ports] in the MAC allocator.) Each address is reserved for a specific slot/port in the router regardless of whether an interface resides in that port.

The MAC addresses are assigned to the ports in sequence; the first address is assigned to port 0/0, the ninth to port 1/0, and the last (40th) to port 4/8. This address scheme allows you to remove interface processors and insert them into other routers without causing the MAC addresses to move around the network or be assigned to multiple devices.

Note that if the MAC addresses were stored on each interface processor, OIR would not function because you could never replace one interface with an identically configured one; the MAC addresses would always be different. Also, each time an interface was replaced, other devices on the network would have to update their data structures with the new address and, if they did not do so quickly enough, could cause the same MAC address to appear in more than one device at the same time. Storing the MAC addresses on the RP avoids these problems. When an interface is replaced with another interface with the same configuration, there is no need for other devices in the network to update their data structures and routing tables.

Storing the MAC addresses for every port in one central location on the RP also means that the MAC addresses stay with the RP on which they are stored. If you replace the RP, the addresses of all ports will change to those specified in the address allocator on the new RP. Because the system configuration is also stored on the RP (in NVRAM) and stays with the RP when you remove it, you will need to reenter the configuration if you replace the RP.

Before replacing an RP, you must back up the running configuration to a TFTP file server so that you can later retrieve it. If the configuration is not saved, the entire configuration will be lost—inside the NVRAM on the removed route processor—and you will have to reenter it manually. This procedure is not necessary if you are temporarily removing an RP you will reinstall; lithium batteries retain the configuration in memory until you replace the RP in the system.

## Online Insertion and Removal (OIR)

The OIR function allows you to install and replace interface processors while the system is operating; you do not need to notify the software or shut down the system power. All CxBus interface processors (AIP, CIP, EIP, FIP, FSIP, HIP, MIP, and TRIP) support OIR. The following is a functional description of OIR for background information only; for specific procedures for installing and replacing interface processors on line, refer to the section “Online Insertion and Removal Information” in the chapter “Maintenance.”

All CxBus interface processors support OIR; however, *you must shut down the system before removing or installing the RP or SP (or SSP)*, both of which are required system components. Removing an RP or SP (or SSP) while the system is operating will cause the system to shut down or crash, and might damage or destroy memory files.

Each RP, SP (or SSP), and interface processor contains a bus connector with which it connects to the system backplane. The bus connector is a set of tiered pins, in three lengths. The pins send specific signals to the system as they make contact with the backplane. The system assesses the signals it receives and the order in which it receives them to determine what event is occurring and what task it needs to perform, such as reinitializing new interfaces or shutting down removed ones.

For example, when you insert an interface processor, the longest pins make contact with the backplane first, and the shortest pins make contact last. The system recognizes the signals and the sequence in which it receives them. The system expects to receive signals from the individual pins in this logical sequence, and the ejector levers help to ensure that the pins mate in this sequence.

When you remove or insert an interface processor, the backplane pins send signals to notify the system, which then performs as follows:

- 1 Rapidly scans the backplane for configuration changes and does not reset any interfaces.
- 2 Initializes all newly inserted interface processors, noting any removed interfaces and placing them in the administratively shutdown state.
- 3 Brings all previously configured interfaces on the interface processor back to the state they were in when they were removed. Any newly inserted interfaces are put in the administratively shutdown state, as if they were present (but unconfigured) at boot time. If a similar interface processor type has been reinserted into a slot, then its ports are configured and brought on line up to the port count of the original interface processor.

OIR functionality enables you to add, remove, or replace interface processors with the system online, which provides a method that is seamless to end users on the network, maintains all routing information, and ensures session preservation.

When you insert a new interface processor, the system runs a diagnostic test on the new interfaces and compares them to the existing configuration.

If this initial diagnostic test fails, the system remains off line for another 15 seconds while it performs a second set of diagnostic tests to determine whether or not the interface processor is faulty and if normal system operation is possible.

If the second diagnostic test passes, which indicates that the system is operating normally and the new interface processor is faulty, the system resumes normal operation but leaves the new interfaces disabled. If the second diagnostic test fails, the system crashes, which usually indicates that the new interface processor has created a problem in the bus and should be removed.

The system brings on line only interfaces that match the current configuration and were previously configured as up; all other interfaces require that you configure them with the **configure** command. On interface processors with multiple interfaces, only the interfaces that have already been configured are brought on line.

## Microcode

The Cisco 7000 series routers support downloadable microcode for most upgrades, which enables you to load new microcode images into Flash memory instead of replacing the microcode ROMs on the boards. The latest microcode version for each interface processor type is bundled with the system software image. New microcode images are now distributed on floppy disk as part of a software maintenance release; microcode upgrades are no longer distributed individually.

The default operation is to load the microcode from the bundled image. At system startup, an internal system utility scans for compatibility problems between the installed interface processor types and the bundled microcode images, then decompresses the images into running memory (RAM). The bundled microcode images then function the same as images loaded from the individual microcode ROMs on the processor modules. You can override the default and instruct the system to load a specific microcode image from a Flash memory file or from the microcode ROM with the **microcode** [*card type*] **flash** [*file name*] command.

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**Note** We strongly recommend that the microcode bundled with the system software be used as a package. Overriding the bundle could possibly result in incompatibility between the various interface processors in the system.

---

The **show microcode** command lists all of the microcode images that are bundled with the system software image. In order to support OIR, the system loads a microcode image for all available processor types.

Following is an example of the **show microcode** command:

```
Router# show microcode
Microcode bundled in system
```

Card Type	Microcode Version	Target Hardware Version	Description
EIP	10.1	1.x	EIP version 10.1
FIP	10.2	2.x	FIP version 10.2
TRIP	10.1	1.x	TRIP version 10.1
AIP	10.5	1.x	AIP version 10.5
FEIP	10.1	1.x	FEIP version 10.1
FSIP	10.6	1.x	FSIP version 10.6
HIP	10.2	1.x	HIP version 10.2
MIP	11.0	1.x	MIP version 11.0
CIP	10.3	1.x	CIP version 10.3

Router#

The microcode version and description lists the bundled microcode version for each processor type, which is not necessarily the version that is currently loaded and running in the system. A microcode image that is loaded from ROM or a Flash memory file is not shown in this display. To display the currently loaded and running microcode version for each processor type, issue the **show controller cxbus** command.

The target hardware version lists the minimum hardware revision required to ensure compatibility with the new software and microcode images. When you load and boot from a new bundled image, the system checks the hardware version of each processor module that it finds installed and compares the actual version to its target list. If the target hardware version is different from the actual hardware version, a warning message appears when you boot the router, indicating that there is a disparity between the target hardware and the actual hardware. You will still be able to load the new image; however, contact a service representative for information about upgrades and future compatibility requirements.

To display the current microcode version for each interface processor, enter the **show controller cxbus** command. The following example shows that the SP is running Microcode Version 1.4, and the FSIP is running Microcode Version 1.0:

```
7010# show cont cxbus

Switch Processor 5, hardware version 1.1, microcode version 1.4
  (display text omitted)
FSIP 0, hardware version 4, microcode version 1.0
  (display text omitted)
```

Although most microcode upgrades are distributed on floppy disk, some exceptions may require ROM replacement. If so, refer to the chapter “Maintenance” for replacement procedures. Instructions are also provided with the upgrade kit. For complete command descriptions and instructions, refer to the related software documentation.

## Environmental Monitoring and Reporting Functions

The environmental monitoring and reporting functions enable you to maintain normal system operation by identifying and resolving adverse conditions prior to loss of operation. Environmental monitoring functions constantly monitor the internal chassis air temperature and DC line voltages. The 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 or current. 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 array. If any one or more of the fans fail, the system displays a warning message on the console. If the fan is still not operating properly after two minutes, the system shuts down to protect the internal components against damage from excessive heat.



**Timesaver** With Maintenance Release 9.17(10) and later, the system can identify which type of power supplies are in your chassis: DC-input or AC-input. As a general precaution, use the **show environment all** command and note the type of power supply indicated in each of your chassis (indicated as either “600W DC” or “550W AC”). Record and save this information in a secure place.

---

**Note** If you are currently using software other than Maintenance Release 9.17(10) or later, then the **show environment all** command will indicate the AC-input power supply as “850W.” A DC-input power supply will still be indicated as “600W.”

---

## Environmental Monitoring

The environmental monitoring functions use the following levels of status conditions to monitor the system. The processor uses the first four levels to monitor the temperature inside the processor slots, and the power supply uses the Normal and Critical levels to monitor DC voltages. Table 1-7 lists temperature thresholds for the first four (processor-monitored) levels. Table 1-8 lists the DC power thresholds for the Normal and Critical (power-supply-monitored) levels.

- **Normal**—All monitored parameters are within normal tolerances. The fans operate at 55 percent of their maximum speed as long as the internal air temperature does not exceed this level.
- **Warning**—The system is approaching an out-of-tolerance condition. The system will continue to operate, but operator monitoring or action is recommended to bring the system back to a normal state. If the internal air temperature reaches 23°C (73°F), the fan speed will increase linearly from 55 percent of maximum speed until it reaches 100 percent speed at 33°C (91°F).
- **Critical**—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 a fan in the fan array fails, the system will display a warning message and shut down in two minutes. Immediate operator action is required.
- **Processor shutdown**—The processor has detected a temperature or fan-failure condition that could result in physical damage to system components and has disabled all DC power. Immediate operator action is required. Before 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. The system power remains off until the operator toggles the system power switch off and on again.
- **Power supply shutdown**—The power supply has detected an out-of-tolerance voltage, current, or temperature condition within the power supply and has shut down (or a shutdown is imminent). All DC power remains disabled until the operator toggles the AC power and corrects the problem that caused the shutdown (if any). This status condition is typically due to one of the following:
  - Loss of AC power (the AC source failed).
  - Power supply detected an overvoltage, overcurrent, AC 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 under-voltage condition).
- **Fan failure** — One or more of the fans has failed. This message is displayed for two minutes, after which the system initiates a full processor shutdown.

**Table 1-7 Processor-Monitored Temperature Thresholds**

Parameter	Warning	Normal	Warning	Critical	Shutdown
Inlet air	< 10°C	10–39°C	39–46°C	46–64°C	> 64°C
Airflow <sup>1</sup>	< 10°C	10–70°C	70–77°C	77–88°C	> 88°C

1. These thresholds were corrected in Software Releases 9.17(8) and 9.21(3); refer to the description of the **show environment table** command in the next section, “Environmental Reports.”

**Table 1-8 Power-Supply Monitored Voltage Thresholds**

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

The system processor uses the first four status levels (Normal, Warning, Critical, and Processor Shutdown) to monitor the air temperature in the interface processor compartment and the voltage levels on the four DC lines. Sensors on the RP monitor the temperature of the cooling air that flows through the processor slots.

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 it later as a report of the last shutdown parameters.

The power supply self-monitors its own internal temperature and voltages. The power supply is either within tolerance (Normal) or out of tolerance (Critical level), as shown in Table 1-8. 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 input power is dropping but it is able to recover before the power supply shuts down, it logs the event as an intermittent powerfail. The reporting functions display the cumulative number of intermittent powerfails logged since the last power up.

## Environmental Reports

The system displays warning messages on the console if processor-monitored parameters exceed a desired threshold or if a fan 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. A brief description of each of these commands follows. For complete command descriptions and instructions, refer to the related software documentation.



**Caution** 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. When viewing the chassis from the interface processor end, the airflow inlet vents are on the right side of the chassis, and the exhaust vents are on the left. (See Figure 1-6.) Ensure adequate clearance around the sides of the chassis so that cooling air can flow through the chassis interior unimpeded. Obstructing or blocking the chassis sides will restrict the airflow and can cause the internal chassis temperature to exceed acceptable limits.



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 range.

```
7010# show env

Environmental Statistics
Environmental status as of Sat 10-31-1992 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. For example, if the fan array is not operating properly, the system displays the following warning message:

```
WARNING: Fan has reached CRITICAL level
```

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*.

```
7010# show env last

Environmental Statistics
Environmental status as of Sat 10-31-1992 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 Thu 10-15-1992 12:22:43
Power Supply: 550W, 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)
```

The **show environment table** command displays the temperature and voltage thresholds for each monitored status level, which are the same as those listed in Tables 1-7 and 1-8. 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, while measurements that have reached a critical level are shifted to the Critical column, and so on.

**Note** In the Temperature Parameters section of the table, the airflow thresholds are incorrect in Software Releases earlier than 9.17(8) and 9.21(3). As a result, your system might incorrectly report a high internal air temperature and display an airflow warning message when the internal air temperature is actually still within the Normal operating range. If you observe this message:

```
%ENVM-2-TEMP: Airflow temperature has reached WARNING level at 60(C)
```

issue the **show environment table** command and verify that the Inlet air temperature is within the Normal range, as in the following example:

Temperature Parameters:

SENSE	WARNING	NORMAL	WARNING	CRITICAL	SHUTDOWN
Inlet	10	24(C)	39	46	64
Airflow	10	60	65(C)	70	88

If so, even if the Airflow temperature is shown within the Warning range, ignore the message. This is an anomaly and it will not affect operation.

The thresholds were corrected in Software Releases 9.17(8) and 9.21(2).

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.

```
7010# show env table

Environmental Statistics
Environmental status as of Fri 11-5-1993 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°C through 46°C) and therefore is 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

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 powerfails (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.

```
7010# show env all

Environmental Statistics
  Environmental status as of Fri 11-5-1993 19:10:41
  Data is 31 second(s) old, refresh in 29 second(s)

WARNING: Fan has reached CRITICAL level

Power Supply: 550W 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)
```

## Fan Shutdown

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 two minutes, the entire system will shut down to avoid an overtemperature condition and shutdown. 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 generates a voltage, which the system monitors to determine whether or not 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 fan 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 two 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 show environment display when the system restarts:

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

For complete command descriptions and instructions, refer to the related software configuration and command reference documentation.

# Preparing for Installation

---

This chapter describes the equipment and site requirements for router installation. It includes the power and cabling requirements that must be in place at the installation site, descriptions of additional equipment you will need to complete the installation, and the environmental conditions your site must meet to maintain normal operation.

This chapter includes the following preinstallation requirements:

- Safety recommendations to protect you and your equipment
  - Lifting the chassis
  - Safety with electricity
  - Preventing electrostatic discharge (ESD) damage
- General site requirements
  - AC and DC power requirements
  - Plant wiring (interference considerations, signaling and distance limitations)
  - Site environment
  - Equipment rack installation considerations
  - Preventive site configuration
- Network connections (optional and additional equipment such as connectors, cables, and media interface devices that you will need for connections to your Ethernet, Token Ring, FDDI, serial, or HSSI networks)
- Tools required for installation
- Initial configuration information that you will need
- Installation Checklist (a table that lists each installation step that you can check off when completed and then save the checklist as a permanent record in your Site Log)
- Unpacking Guidelines in addition to the complete unpacking descriptions that are posted on the outside of the router shipping container
- Site Log instructions and sample format
- Chassis Components Checklist (an inventory list that you should also complete and put into the Site Log for a permanent record of the system initial configuration)
- Port Configuration Worksheet (a place to record the type and port address of each interface)

## Safety Recommendations

The following guidelines will help to ensure your safety and protect the equipment. This list is not inclusive of all potentially hazardous situations, so *be alert*.

- Never attempt to lift an object that might be too heavy for you to lift by yourself.
- Always turn all power supplies OFF (O) and unplug all power cords before opening the chassis.
- Always unplug the power cord before installing or removing a 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.

### Lifting Safely

A fully configured Cisco 7010 weighs approximately 70 pounds. The chassis is 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.

Whenever you lift the chassis or any heavy object, follow these guidelines:

- Whenever possible, avoid lifting the chassis by yourself.
- 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.
- Lift the 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.
- Use two hands when handling the chassis power supply, which weighs 12 pounds.



**Warning** 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.

### Working with Electricity

The CxBus network interface processors are designed to be removed and replaced while the system is operating without presenting an electrical hazard or damage to the system. However, you must shut down the system before removing or replacing the RP, SP, or any of the replaceable components inside the front panel: the arbiter, fan tray, or power supply.

Follow these basic guidelines when working with any electrical equipment:

- 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.

- Do not work alone when potentially hazardous conditions exist.
- Never assume that power has been disconnected from a circuit; always check.
- 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 wiring or other network cabling.

- 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

Electrostatic discharge (ESD) damage, which occurs when electronic cards or components are improperly handled, can result in complete or intermittent failures. Each processor module comprises a printed circuit board that is fixed in a metal carrier. Electromagnetic interference (EMI) shielding, connectors, and a handle are integral components of the carrier. Although the carrier helps to protect the module, use an antistatic strap whenever handling processor modules. Handle the carriers by the handles and the carrier edges only; never touch the boards or connector pins.



**Caution** Always tighten the captive installation screws on RP, SP (or SSP), and interface processors. (See Figure 5-1.) These screws prevent accidental removal, provide proper grounding for the system, and help to ensure that the bus connectors are properly seated in the backplane.

Following are guidelines for preventing ESD damage:

- Always use an ESD-preventive wrist strap or ankle strap and ensure that it makes good skin contact.
- When removing interface processors, connect the equipment end of the strap to the chassis ground screw (see Figure 1-5) or to one of the captive installation screws on an installed interface processor. When replacing internal components that are accessible from the noninterface processor end of the chassis (for example, the fan tray), connect the strap to an unpainted inner surface of the chassis, such as one of the power supply handles.
- When installing an RP, SP (or SSP), or interface processor, use the ejector levers to properly seat the bus connectors in the backplane, then tighten both captive installation screws. These screws prevent accidental removal, provide proper grounding for the system, and help to ensure that the bus connectors are seated in the backplane.
- When removing an RP, SP (or SSP), or interface processor, use the ejectors to release the bus connectors from the backplane. Grasp the handle and pull the carrier out slowly, using your hand along the bottom of the carrier to guide it straight out of the slot.

- Handle interface processors by the handles and carrier edges only; avoid touching the board or any connector pins.
- When removing an RP, SP (or SP), interface processor, or the arbiter, place the removed component board-side-up on an antistatic surface or in a static shielding bag. If the component will be returned to the factory, immediately place it in a static shielding bag.
- Handle bare boards (such as the arbiter board) by the edges only.
- Avoid contact between the board or interface processor and clothing. The wrist strap only protects the card from ESD voltages on the body; ESD voltages on clothing can still cause damage.



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

## Site Requirements

The environmental monitoring in the router protects the system and components from potential damage from overvoltage and overtemperature conditions. To assure normal operation and avoid unnecessary maintenance, plan your site configuration and prepare your site *before* installation. After installation, make sure the site maintains an ambient temperature of 32°F through 104°F (0°C through 40°C), and keep the area around the chassis as free from dust as is practical.

The following sections address the site environment requirements for the router.

### AC and DC Power

The 550W, wide-input, AC-input power supply uses a power factor corrector (PFC) that allows it to operate on input voltages between 100 and 240 VAC and 50 through 60 Hz. Table 1-2 lists system power specifications, including input voltage and operating frequency ranges. Install a power conditioner between the AC line input and the router to help avoid network outages caused by power spikes and brownouts, and to help protect against equipment damage from lightning strikes. The 600W, DC-input power supply allows the Cisco 7010 to operate between -40 and -52 VDC (-48 VDC nominal). In the European Community, the power supply operates between -56 VDC and -72 VDC (-60 VDC nominal).

### Plant Wiring

Following are guidelines for setting up the plant wiring and cabling at your site. When planning the location of the new system, consider the distance limitations for signaling, electromagnetic interference, and connector compatibility, as described in the following sections.



## Interference Considerations

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 wiring practice can result in radio interference emanating from the plant wiring.
- Strong electromagnetic interference, 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 section “Working with Electricity” earlier in this chapter.)

---

**Note** To predict and remedy strong electromagnetic interference, you may 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 when applicable.

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 may 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.

The ground screw on the left side of the interface processor end of the chassis provides a connection point for connecting a ground wire or antistatic device to chassis ground. (See Figure 1-5.)

## Distance Limitations

The length of your networks and the distances 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 in these descriptions are the IEEE recommended maximum speeds and distances for signaling; however, you can usually get good results at speeds and distances far greater than these. For example, the recommended maximum rate for V.35 is 2 Mbps, but it is commonly used at 4 Mbps without any problems. If you understand the electrical problems that might arise and can compensate for them, you should get good results with rates and distances greater than those shown here. However, do so at your own risk. The following distance limits are provided as guidelines for planning your network connections before installation.

### Ethernet Connections

The maximum distances for Ethernet network segments and connections depend on the type of transmission cable used: 0.4-inch diameter coaxial (10Base5), 0.25-inch diameter coaxial (10Base2), or unshielded twisted-pair (10BaseT). The term *10BaseN* is an abbreviation for 10 Mbps transmission, *Baseband* medium, and *N* is the maximum cable length in hundreds of meters.

Network connections to the coaxial cables are tapped into a network segment and must be spaced at specific intervals. Table 2-1 lists the maximum number of connections (taps) per segment and the intervals at which they must be placed. A maximum of four repeaters can be used to link segments in a single network.

**Table 2-1 Ethernet Coaxial Connection Limits for 10-Mbps Transmission**

Parameter	10Base5	10Base2
Cable diameter	0.4" (1 cm)	0.25" (0.6 cm)
Max. segment length	1640' (500 m)	656' (200 m)
Max. connections (taps) per segment	100	30
Min. connection (tap) spacing	8.2' (2.5 m)	1.64' (0.5 m)

The unshielded twisted-pair (UTP) cabling used with 10BaseT is suitable for voice transmission, but may incur problems at 10-Mbps transmission rates. UTP wiring does not require the fixed spacing between connections that is necessary with the coaxial-type connections. IEEE recommends a maximum distance of 328 feet (100 meters) between station (connection) and hub for 10BaseT connections.

### Fast Ethernet Connections

IEEE 802.3u specifies several different physical layers for 100BaseT: among them are 100BaseTX, which is 100BaseT, half duplex, over Category 5, unshielded twisted-pair (UTP), Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)-568-compliant cable; 100BaseFX, which is 100BaseT, full duplex or half duplex over optical fiber; and 100BaseT4, which is 100BaseT using Category 3, 4, or 5 UTP or shielded twisted-pair (STP) cabling with four pairs. 100BaseT4 is also called *4T+* or *T2*, which is 2-pair UTP over Category 3 cable.

Table 2-2 lists the cabling specifications for 100-Mbps transmission over 100BaseT, Category 5 UTP and MII connections.

**Table 2-2 Connection Limits for 100-Mbps Transmission**

Parameter	RJ-45	MII
Cable specification	Category 5 <sup>1</sup> UTP <sup>2</sup> , 22 to 24 AWG <sup>3</sup>	Category 3, 4 or 5, 150-ohm UTP or STP or multimode optical fiber
Maximum cable length	–	0.5 m (1.64 ft.) (MII-to-MII cable <sup>4</sup> )
Maximum segment length	100 m (328 ft.) for 100BaseTX	1 m (3.28 ft.) <sup>5</sup> or 400 m (1,312 ft.) for 100BaseFX
Maximum network length	200 m (656 ft.) <sup>5</sup> (with 1 repeater)	–

1. EIA/TIA-568 or EIA/TIA-568 TSB-36 compliant.
2. Cisco Systems does not supply Category 5 UTP RJ-45 or 150-ohm STP MII cables. Both are commercially available.
3. AWG = American Wire Gauge. This gauge is specified by the EIA/TIA-568 standard.
4. This is the cable between the MII port on the FEIP port adapter and the appropriate transceiver.
5. This refers specifically to any two stations on a repeated segment.

Table 2-3 summarizes the characteristics of 100BaseT with respect to IEEE 802.3u physical characteristics.

**Table 2-3 IEEE 802.3u Physical Characteristics**

<b>100BaseT</b>	
Data rate (Mbps)	100
Signalling method	Baseband
Maximum segment length (meters)	100
Media	UTP <sup>1</sup>
Topology	Star

1. UTP = unshielded twisted pair.

### MultiChannel Connections

Following are the MIP T1 specifications:

- Transmission bit rate: 1.544 kilobits per second (kbps)  $\pm$  50 parts per million (ppm)
- Output pulse amplitude: 3.0 volts (V)  $\pm$  0.6V measured at DSX
- Output pulse width: 324 nanoseconds (ns)  $\pm$  54 ns
- Complies with all AT&T Accunet TR 62411 specifications.

Following are the MIP E1 specifications:

- Transmission bit rate: 2.048 kbps  $\pm$  50 ppm
- Output port specifications: see G.703 / Section 6.2 (ITU-T specification)
- Input port specifications: see G.703 / Section 6.3 (ITU-T specification)
- Jitter attenuation starting at 6 hertz (Hz), which meets or exceeds G.823 for E1

### Channel Attachment Connections

Referring to the CIP, the maximum transmission distance for ESCON (with LED) is 1.9 miles (3.1 km) point-to-point or 5.7 miles (9.2 km) with two ESCON Directors. The maximum transmission distance for bus and tag is 400 feet (122 m). The IBM 3044 C/D (host side/remote side) copper-to-fiber repeater can be used to extend the bus and tag distance up to 1.2 miles (2 km).

### E1-G.703/G.704 Connections

Unbalanced G.703 interfaces allow for a longer maximum cable length than those specified for balanced circuits. Table 2-4 lists the maximum cable lengths for each FSIP E1-G.703/G.704 cable type by the connector used at the network (non-FSIP) end.

**Table 2-4 E1-G.703/G.704 Maximum Cable Lengths**

<b>Connection Type</b>	<b>BNC</b>	<b>Twinax</b>
Balanced	–	300 meters (m)
Unbalanced	600m	–

### Token Ring Connections

Currently there is no maximum transmission distance defined for IEEE 802.5 (Token Ring) networks. Shielded twisted-pair cabling is most commonly used for rates of 16 Mbps, and either shielded or unshielded twisted-pair cabling is used for rates of 1 and 4 Mbps. When planning your connections, remember that twisted-pair cabling is more susceptible to interference than other types of cabling, so plan the total network length and repeater spacing accordingly.

### Fiber (FDDI) Connections

The FDDI standard sets the maximum distances between stations to the fiber lengths shown in Table 2-5. The maximum circumference of the FDDI network is only half the specified distance because of signal wrapping or loopback during fault correction. The standard allows a maximum of 500 stations. Both single-mode and multimode transceiver types provide 11 dB of optical power.

**Table 2-5 FDDI Maximum Transmission Distances**

<b>Transceiver Type</b>	<b>Max. Distance Between Stations</b>
Single-mode	6.2 miles (up to 10 km)
Multimode	1.2 miles (up to 2 km)

### Serial Connections

As with all signaling systems, serial signals can travel a limited distance at any given bit rate; generally, the slower the baud rate, the greater the distance. Table 2-6 shows the standard relationship between baud rate and distance for EIA/TIA-232 signals.

**Table 2-6 IEEE Standard EIA/TIA-232C Transmission Speed versus Distance**

Rate (bps)	Distance (Feet)	Distance (Meters)
2400	200	60
4800	100	30
9600	50	15
19200	25	7.6
38400	12	3.7
56000	8.6	2.6

Balanced drivers allow EIA/TIA-449 signals to travel greater distances than EIA/TIA-232.

Table 2-7 shows the standard relationship between bit rate and distance for EIA/TIA-449 signals.

**Table 2-7 IEEE Standard EIA/TIA-449 Transmission Speed versus Distance**

Rate (bps)	Distance (Feet)	Distance (Meters)
2400	4100	1250
4800	2050	625
9600	1025	312
19200	513	156
38400	256	78
56000	102	31
128000	76	23
256000	50	15
1544000 (T1)	50	15
2000000	40	12
4000000	25	8

**Note** The recommended distance limits for EIA/TIA-449 shown in Table 2-7 are also valid for V.35, X.21, and EIA-530. However, you can get good results at distances and rates far greater than these. In common practice, EIA/TIA-449 and EIA-530 support 2-Mbps rates, and V.35 supports 4-Mbps rates without any problems.

### SONET Connections for the AIP

The SONET specification for fiber-optic transmission defines two types of fiber: single mode and multimode. Modes can be thought of as bundles of light rays entering the fiber at a particular angle. Single-mode fiber allows only one mode of light to propagate through the fiber, while multimode fiber allows multiple modes of light to propagate through the fiber. As multiple modes of light propagate through the fiber, they travel different distances depending on the entry angles. This causes them to arrive at the destination at different times (a phenomenon called modal dispersion). As a result, single-mode fiber is capable of higher bandwidth and greater cable run distances than

multimode fiber. The maximum distances for single-mode and multimode transmissions, as defined by SONET, are in Table 2-8. If the distance between two connected stations is greater than these maximum distances, significant signal loss can result, making transmission unreliable.

**Table 2-8 SONET Maximum Fiber-Optic Transmission Distances**

Transceiver Type	Maximum Distance between Stations <sup>1</sup>
Single-mode	Up to 9 miles (14.8 kilometers)
Multimode	Up to 1.5 miles (2.4 kilometers)

1. This table gives typical results. You should use power budget calculations to determine the actual distances.

### Power Budget

To design an efficient optical data link, evaluate the power budget. The power budget is the amount of light available to overcome attenuation in the optical link and to exceed the minimum power that the receiver requires to operate within its specifications. Proper operation of an optical data link depends on modulated light reaching the receiver with enough power to be correctly demodulated.

Attenuation, caused by the passive media components (cables, cable splices, and connectors), is common to both multimode and single-mode transmission.

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

- Chromatic dispersion (spreading of the signal in time because of the different speeds of light wavelengths)
- Modal dispersion (spreading of the signal in time because of 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 the combined dispersion penalty (in decibels [dB]). The power lost over the data link is the sum of the component, dispersion, and modal losses. Table 2-9 lists the factors of attenuation and dispersion limit for typical fiber-optic cable.

**Table 2-9 Typical Fiber-Optic Link Attenuation and Dispersion Limits**

	Single-Mode	Multimode
Attenuation	0.5 dB	1.0 dB/km
Dispersion Limit	No limit	500 MHz/km <sup>1</sup>

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

### Approximating the AIP Power Margin

The LED used for a multimode transmission light source creates multiple propagation paths of light, each with a different path length and time requirement to cross the optical-fiber, causing signal dispersion (smear). Higher order mode 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 assumes minimum transmitter power (PT), maximum link loss (LL), and minimum receiver sensitivity (PR). The worst case analysis provides a margin of error, although not all of the parts of an actual system will operate at the worst case levels.

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

$$PB = PT - PR$$

$$PB = -18.5 \text{ dBm} - (-30 \text{ dBm})$$

$$PB = 11.5 \text{ dB}$$

The power margin calculation is derived from the power budget and subtracts the link loss, as follows:

$$PM = PB - LL$$

If the power margin is positive, as a rule, the link will work.

Table 2-10 lists the factors that contribute to link loss and the estimate of the link loss value attributable to those factors.

**Table 2-10 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	Dependent on fiber and wavelength used
Connector	0.5 dB
Splice	0.5 dB
Fiber attenuation	1 dB/km

After calculating the power budget minus the data link loss, the result should be greater than zero. Results less than zero may have insufficient power to operate the receiver.

For SONET versions of the AIP module, the signal must meet the worst case parameters listed in Table 2-11.

**Table 2-11 AIP Minimum SONET Signal Requirements**

	Single-Mode	Multimode
PT	-18.5	-15
PR	-30	-28
PB	-11.5	-13

### Multimode Power Budget Example with Sufficient Power for Transmission

The following is an example multimode power budget calculation based on the following variables:

Length of multimode link = 3 kilometers (km)

4 connectors

3 splices

Higher order loss (HOL)

Clock recovery module (CRM)

Estimate the power budget as follows:

$$PB = 11.5 \text{ dB} - 3 \text{ km} (1.0 \text{ dB/km}) - 4 (0.5 \text{ dB}) - 3 (0.5 \text{ dB}) - 0.5 \text{ dB (HOL)} - 1 \text{ dB (CRM)}$$

$$PB = 11.5 \text{ dB} - 3 \text{ dB} - 2 \text{ dB} - 1.5 \text{ dB} - 0.5 \text{ dB} - 1 \text{ dB}$$

$$PB = 2.5 \text{ dB}$$

The value of 2.5 dB indicates that this link would have sufficient power for transmission.

### Multimode Power Budget Example of Dispersion Limit

Following is an example with the same parameters as the previous example, but with a multimode link distance of 4 km:

$$PB = 11.5 \text{ dB} - 4 \text{ km} (1.0 \text{ dB/km}) - 4 (0.5 \text{ dB}) - 3 (0.5 \text{ dB}) - 0.5 \text{ dB (HOL)} - 1 \text{ dB (CRM)}$$

$$PB = 11.5 \text{ dB} - 4 \text{ dB} - 2 \text{ dB} - 1.5 \text{ dB} - 0.5 \text{ dB} - 1 \text{ dB}$$

$$PB = 1.5 \text{ dB}$$

The value of 1.5 dB indicates that this link would have sufficient power for transmission. However, due to the dispersion limit on the link ( $4 \text{ km} \times 155.52 \text{ MHz} > 500 \text{ MHzkm}$ ), 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 is an injection laser diode. Single-mode transmission is useful for longer distances, because there is a single transmission path within the fiber and smear does not occur. In addition, chromatic dispersion is also reduced because laser light is essentially monochromatic.

The maximum overload specification on the single-mode receiver is  $-14 \text{ dBm}$ . The single-mode receiver can be overloaded when using short lengths of fiber because the transmitter can transmit up to  $-8 \text{ dB}$ , while the receiver could be overloaded at  $-14 \text{ dB}$ , but no damage to the receiver will result. To prevent overloading the receiver connecting 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 of a two buildings, 11 kilometers apart, connected through a patch panel in an intervening building with a total of 12 connectors.

Length of single-mode link = 11 km

12 connectors

Estimate the power budget as follows:

$$PB = 11.5 \text{ dB} - 11 \text{ km} (0.5 \text{ dB/km}) - 12 (0.5 \text{ dB})$$

$$PB = 11.5 \text{ dB} - 5.5 \text{ dB} - 6 \text{ dB}$$

$$PB = 2.5 \text{ dB}$$

The value of 2.5 dB indicates that this link would have sufficient power for transmission and is not in excess of the maximum receiver input power.

### Statistical Models for Estimating Power Budget

Statistical models more accurately determine the power budget than the worst case method. Determining the link loss with statistical methods requires accurate knowledge of variations in the data link components. Statistical power budget analysis is beyond the scope of this document. For further information, refer to UNI Forum specifications, ITU-T standards, and your equipment specifications.

### For Further Reference

The following publications contain information on determining attenuation and power budget:

- T1E1.2/92-020R2 ANSI, the Draft American National Standard for Telecommunications entitled "Broadband ISDN Customer Installation Interfaces: Physical Layer Specification."
- *Power Margin Analysis, AT&T Technical Note, TN89-004LWP, May 1989.*

## HSSI Connections

The High-Speed Serial Interface (HSSI) standard (EIA/TIA-612/613) specifies a maximum cable length of 50 feet (15 meters) for 52 Mbps HSSI connections. The typical (nominal) cable length between the HIP and the DSU is 6 feet (2 meters). The HSSI interface cable comprises 25 twisted pairs and a 50-pin plug at each end. Both DTE and DCE ports on the HIP and the DSU are 50-pin receptacles. The HSSI interface cable is similar to a SCSI-II-type (small computer systems interface) cable; however, the HSSI cable specification is more stringent than that for a SCSI-II. Substituting a SCSI-type cable to connect the HSSI interface may prevent proper operation of the interface.

## Equipment Racks

The rack-mounting hardware included with the router is suitable for most 19-inch equipment racks or Telco-type 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 2-1 shows the chassis footprint and outer dimensions.

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

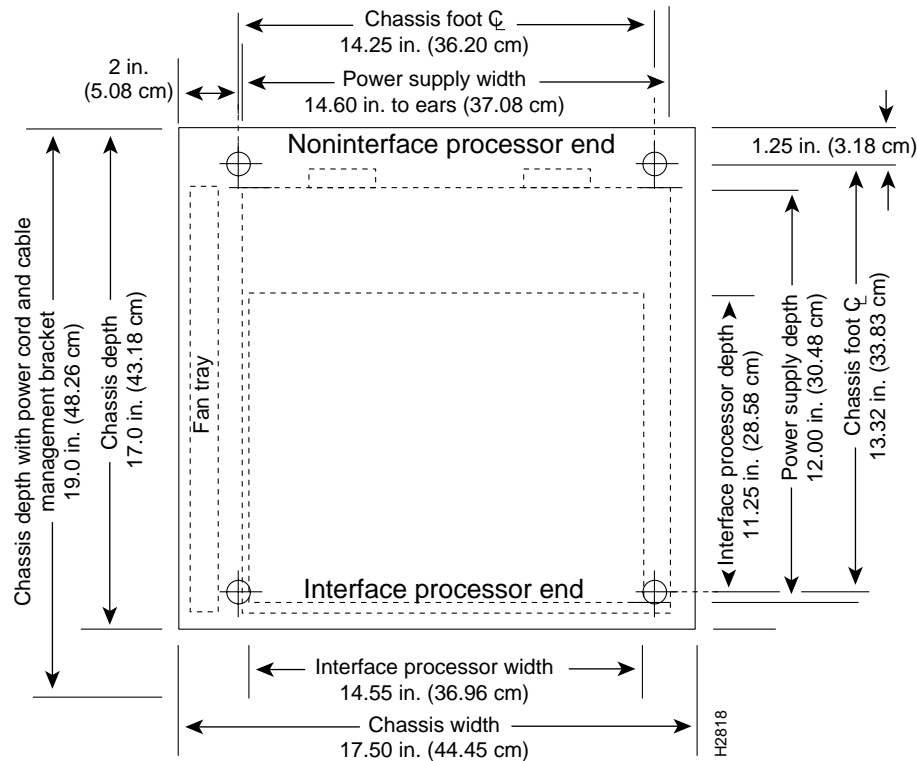
- To mount the router between two posts or rails using the mounting ears, the inner clearance (the width between the *inner* sides of the two posts or rails) must be at least 17.72 inches (45 cm).
- The height of the chassis is 11 inches (27.94 cm) with the chassis feet attached, and 10.5 inches (26.67 cm) when the chassis feet are removed.
- When mounting the router in four-post or Telco-type 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, and the rest of the chassis is cantilevered off of the posts. Less 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. (See Figure 2-1.)

When planning your 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 two inches 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 air 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 2-1 shows the chassis footprint, which you will need if you are designing a customized shelf.
- If you use Telco-type 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 of the posts. Ensure that the weight of the chassis does not make the rack unstable. Some Telco-type racks are also secured to ceiling brackets, if warranted by the weight of the equipment in the rack.

In addition to the preceding guidelines, review the precautions for avoiding overtemperature conditions in the section “Equipment-Rack Ventilation” in this chapter.

**Figure 2-1 Chassis Footprint and Outer Dimensions**



**Caution** Never install the router in an enclosed rack that is not properly ventilated or air-conditioned.

## Site Environment

The router can operate as a standalone system placed on a table or as a rack-mounted system in a data processing or lab environment. The fans operate at 55 percent of capacity when it is possible to do so and maintain an acceptable operating temperature inside the chassis. If the temperature exceeds 23°C, the fan speed increases linearly until it reaches 100 percent. Although the fans support quieter operation under normal conditions (approximately 46 dBa), the noise level when the fans are operating at 100-percent capacity is approximately 58 dBa. Therefore, the router is best suited for unattended or computer room use.

The router requires a dry, clean, well-ventilated, and air-conditioned environment. The internal fan array pulls ambient air through the chassis to cool the internal components. To allow sufficient airflow, maintain a minimum of two inches of clearance on both the inlet and exhaust sides of 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 monitor 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, refer to the section “Environmental Monitoring and Reporting Functions” in the chapter “Product Overview.”

If the temperature of the room air drawn into the chassis is higher than desirable, the air temperature inside the chassis may 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 air flow and create an overtemperature condition.

Because the inlet and exhaust air flows into one side of the chassis and out the other side, other devices can be rack-mounted with little or no 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 side of the chassis. When viewing the router chassis from the interface processor end, the inlet air is drawn in through the right side of the chassis, and the exhaust air is forced out of the left side. (See Figure 1-6.)

Table 2-12 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 following ranges 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.

- Operating temperature range: 32 through 104°F (0 through 40°C).
- Operating humidity range: 10 to 90%, noncondensing.
- Air flow: Cooling air is drawn in through the sides of the chassis. Keep both sides of the chassis clear of obstructions, including dust, and away from the exhaust ports of other equipment.

**Table 2-12 Specifications for Operating and Nonoperating Environments**

	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)
Humidity (RH), ambient (noncondensing) operating	10%	90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5%	95%
Altitude, operating and nonoperating	Sea level	10,000' (3050 m)
Vibration, operating	5–200 Hz, 0.5 g (1 oct./min.)	–
Vibration, nonoperating	5–200 Hz, 1 g (1 oct./min.) 200–500 Hz, 2 g (1 oct./min.)	–

## Preventive Site Configuration: Maintaining Normal Operation

Planning a proper location for the router and the layout of your equipment rack or wiring closet are essential for successful system operation. Equipment placed too close together or inadequately ventilated can cause system overtemperature conditions. In addition, chassis panels made inaccessible by poor equipment placement can make system maintenance difficult. Following are precautions that can help avoid problems during installation and ongoing operation.

## General Precautions

Follow these general precautions when planning your equipment locations and connections:

- Use the **show environment** command regularly to check the internal system status. The environmental monitor continuously checks the interior chassis environment; it provides warnings for high temperature and maximum and minimum voltages, and creates reports on any occurrences. If warning messages are displayed, such as the following, take immediate action to identify the cause and correct the problem.

```
WARNING: Fan has reached CRITICAL level
```

OR

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

(Refer to the section “Environmental Monitoring and Reporting Functions” in the chapter “Product Overview.”)

- Maintain at least 2 inches of clearance on each side of the chassis to allow cooling air to flow through the inlet and exhaust ports. Keep the sides of the chassis free from obstructions and away from the exhaust air of other equipment. Remember that electrical equipment generates heat, and ambient room temperature alone may not be adequate to cool equipment to acceptable operating temperatures.
- Do not place the router directly on the floor or in any area that tends to collect dust.
- Follow ESD-prevention procedures to avoid damage to equipment. Damage from static discharge can cause immediate or intermittent equipment failure.
- Ensure that the chassis cover, backplane cover, interface processors, and any blank interface processor fillers are in place and secure. The fans direct cooling air throughout the chassis interior; a loose panel or empty interface processor slot can redirect the air flow away from active components. Also, the backplane cover shields the high current present on the backplane, and the chassis cover must be in place to maintain the EMI integrity of the system.

## Equipment-Rack Ventilation

If you plan to install the router in an equipment rack, you can avoid overtemperature conditions by following the guidelines in the section “Equipment Racks” in this chapter, in addition to the following precautions:

- There must be at least two inches of clearance between each side of the chassis and the side (or inner wall) of an enclosed rack. (See Figure 2-1.)
- 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 may 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 may 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.

For a functional description of the environmental monitor and the status levels, refer to the section “Environmental Monitoring and Reporting Functions” in the chapter “Product Overview.”

### Power

Follow these precautions when planning power connections to the router:

- 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.
- Install proper grounding to avoid damage from lightning and power surges.

## Preparing Network Connections

When preparing your site for network connections to the router, you must consider a number of factors related to each type of interface, such as the type of cabling required for each type (fiber, thick or thin coaxial, or twisted-pair cabling), distance limitations for each signal type, the specific cables you need to connect each interface, and any additional interface equipment you need, such as transceivers, modems, channel service units (CSUs), or data service units (DSUs). Before installing the router, have all additional external equipment and cables on hand. If you intend to build your own cables, refer to the cable pinouts in the appendix "Cabling Specifications." For ordering information, contact a customer service representative.

### Additional and Optional Connection Equipment

You may need some of the following data communications equipment to complete your installation:

- To install and configure the router, you need a terminal with an EIA/TIA-232 DTE port and an EIA/TIA-232 DCE console cable with DB-25 plugs at both ends. You can detach the terminal (and cable) after the installation and configuration procedures are complete.

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**Note** The console and auxiliary serial ports are asynchronous, and the FSIP serial ports are synchronous. When connecting serial devices such as modems or DSUs, connect only asynchronous devices to the console and auxiliary ports, and synchronous devices to the FSIP serial ports.

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- To use an IEEE 802.3 or Ethernet interface (thick-wire, thin-wire, or unshielded twisted-pair) at your installation, you need an 802.3 media attachment unit (MAU) and an attachment unit interface (AUI), or an Ethernet transceiver and transceiver cable. The AUI or transceiver cable will need an AUI 15-pin plug to connect to the 15-pin AUI receptacle on the EIP. Some interface equipment may use cables with screw-type locks rather than the slide-type locks that are standard on the EIP. A kit for replacing the slide-type locks with screw-type locks is shipped with the EIP.
- For IEEE 802.3u Fast Ethernet (100BaseT) connections to the FEIP, you need Category 5, UTP cable for RJ-45 connections or Media Independent Interface (MII) cables for MII connections. For more detailed Fast Ethernet cable requirements, refer to the section "Fast Ethernet Connection Equipment" in this chapter.
- To connect a 4- or 16-Mbps Token Ring interface, you need an IEEE 802.5 MAU and a Token Ring adapter cable.
- To use the optical bypass feature available with multimode/multimode and single-mode/single-mode FDDI interfaces, you need an optical bypass switch. A DIN-to-mini-DIN control cable for connecting the switch is included with the multimode/multimode FIP (CAB-FMDD).
- To use a low-speed synchronous serial interface, you need a synchronous modem or a (CSU/DSU to connect to the network. Most modems require an EIA/TIA-232 DTE connection.

- To connect serial adapter cables to remote devices that use metric hardware, replace the factory installed 4-40 thumbscrews on the cable's network-end connector with the M3 metric thumbscrews that are included with all serial port adapter cables.
- To connect a serial port to a T1 network, you need a T1 CSU/DSU that converts the High-Level Data Link Control (HDLC) synchronous serial data stream into a T1 data stream with the correct framing and ones density. (The term *ones density* refers to the fact that some telephone systems require a minimum number of 1 bits per time unit in a data stream.) Several T1 CSU/DSU devices are available as additional equipment, and most provide either a V.35, EIA/TIA-449, or EIA-530 electrical interface to the system.

T1 is the term for a digital carrier facility used for transmitting data over a telephone network at 1.554 Mbps. E1 is the European equivalent of T1 and has a line rate of 2.048 Mbps.

- To connect a HSSI port, you need a DSU that can process data at speeds appropriate for the service to which you will connect: T3 (45 Mbps), E3 (34 Mbps), or SONET STS-1 (51.84 Mbps) and a HSSI interface cable (CAB-HS11) to connect the DSU with the HIP.

T3, also known as *DS-3* or *digital signal level 3*, is the U.S. standard for a digital carrier facility used for transmitting data over a telephone network at 44.736 Mbps. T3 is equivalent to 28 T1 (1.544 Mbps) interfaces. E3 is the European equivalent of T3 that operates at 34 Mbps.

SONET (Synchronous Optical NETWORK) is an international standard (ANSI/CCITT) for standardizing the use of optical communications systems. STS-1 (Synchronous Transport Signal level 1) is the basic building block signal of SONET; level 1 is 51.84 Mbps. Faster SONET rates are defined as STS-*n*, where *n* is a multiple of 51.84 Mbps. For example, the rate for SONET STS-3 is 155.52 Mbps, 3 times 51.84 Mbps.

- To connect two routers directly back to back between HSSI ports, you need a null modem cable (CAB-HNUL). The two routers must be in the same location and can be two Cisco 7000 series routers, two AGS+ routers, or one of each; both routers must have a HSSI port available.

## ATM Connection Equipment

All AIP ATM interfaces are full-duplex. You must use the appropriate ATM interface cable to connect the AIP with an external ATM network.

The AIP provides an interface to ATM switching fabrics for transmitting and receiving data at rates of up to 155 Mbps bidirectionally; the actual rate is determined by the physical layer interface module (PLIM). The AIP can support PLIMs that connect to the following physical layers:

- TAXI 4B/5B 100 Mbps multimode optical-fiber
- SONET/SDH 155 Mbps multimode optical-fiber—STS-3C or STM-1
- SONET/SDH 155 Mbps single-mode optical-fiber—STS-3C or STM-1
- E3 34 Mbps coaxial cable
- DS3 45 Mbps ( $\pm 20$  parts per million [ppm]) coaxial cable



**Caution** To ensure compliance with EMI standards, the E3 PLIM connection requires an EMI filter clip (CLIP-E3-EMI) on the receive port (RCVR).

**Note** E3, DS3, and TAXI AIPs shipped after February 1995 require Cisco Internetwork Operating System 10.2(5) or later.

For wide-area networking, ATM is currently being standardized for use in Broadband Integrated Services Digital Networks (BISDNs) by the International Telecommunications Union Telecommunication Standardization Sector (ITU-T) (formerly the Consultative Committee for International Telegraph and Telephone (CCITT)) and the American National Standards Institute (ANSI). BISDN supports rates from E3 (34 Mbps) to multiple gigabits per second (Gbps). The DS3 interface performs physical layer translation from the AIP to a DS3 line interface in accordance with ATM Forum UNI Specification Version 3.1, ACCUNET T45 service specifications, and ANSI T1.107.

The ATM User-to-Network Interface (UNI) specification defines the required MIB functionality for ATM interfaces. Refer to the ATM UNI specification for additional details.

ATM UNI information is arranged into a MIB fashion. MIB attributes are readable and writable across the Interim Local Management Interface (ILMI) using a Simple Network Management Protocol (SNMP). The ILMI uses SNMP, without UDP, and interface processor addressing along with the ATM MIB.

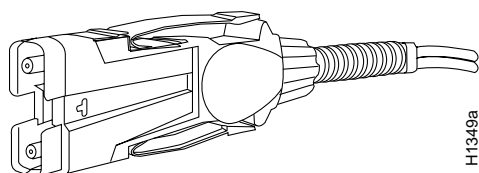
The AIP supports RFC 1213 interface MIBs as specified in the ATM MIB V2 specification.

The ATM interface cable is used to connect your router to an ATM network or to connect two routers back-to-back. Cables can be obtained from the following cable vendors:

- AT&T
- Siemens
- Red-Hawk
- Anixter
- AMP

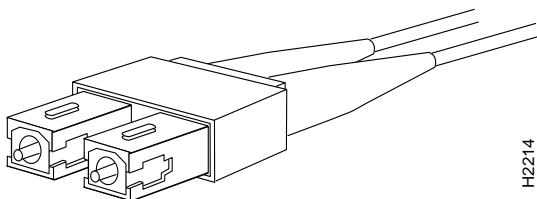
For TAXI 4B/5B traffic over multimode fiber, use the multimode MIC interface cable to connect the AIP with the external ATM switch. (See Figure 2-2.)

**Figure 2-2 Multimode Network Interface Connector (MIC Type)**



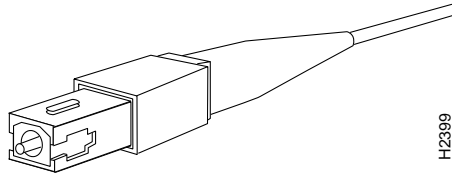
For SONET/SDH multimode connections, use one multimode duplex SC connector (see Figure 2-3) or two single SC connectors. (See Figure 2-4.)

**Figure 2-3 Duplex SC Connector**



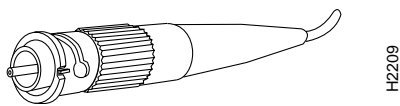


**Figure 2-4 Simplex SC Connector**



For SONET/SDH single-mode connections, use the single-mode (ST2) connector (bayonet-style twist-lock). (See Figure 2-5.)

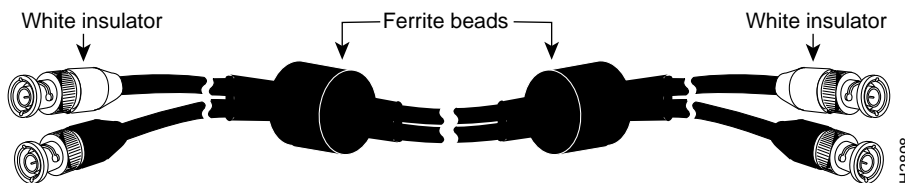
**Figure 2-5 ST2 Connector**



**Warning** Invisible laser radiation can be emitted from the aperture ports of the single-mode ATM products when no fiber-optic cable is connected. *Avoid exposure and do not stare into open apertures.* This product meets the Class 1 Laser Emission Requirement from CDRH FDDI.

For E3 and DS3 connections, use the 75 ohm, RG-59, coaxial cable, CAB-ATM-DS3/E3, which has bayonet-style, twist-lock (BNC) connectors and ferrite beads. (See Figure 2-6.) The E3 and DS3 PLIMs both require cable CAB-ATM-DS3/E3.

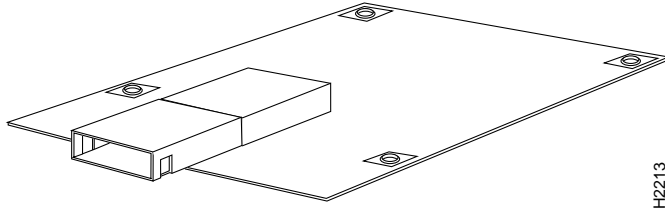
**Figure 2-6 CAB-ATM-DS3/E3 Cable—RG-59 Coaxial Cable with BNC Connectors**



**Caution** To ensure compliance with EMI standards, the E3 PLIM connection requires an EMI filter clip (CLIP-E3-EMI) on the receive port (RCVR); the DS3 PLIM connection does not require this clip.

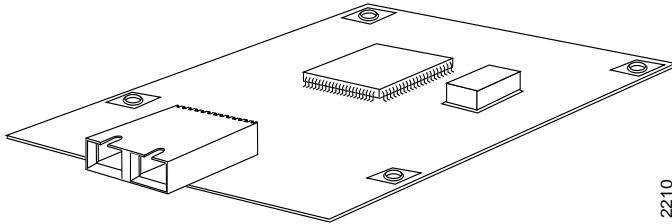
For multimode connections, connect the multimode interface cable to the media interface cable (MIC) connector. (See Figure 2-7.)

**Figure 2-7 MIC Connector on a 4B/5B PLIM**



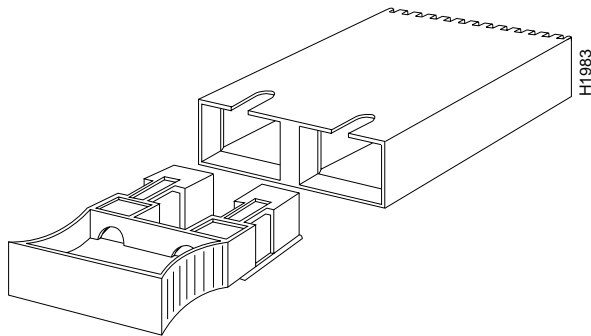
For multimode SONET connections, connect the multimode cable to the SC connector on the PLIM. (See Figure 2-8.)

**Figure 2-8 SONET Multimode SC Duplex PLIM**



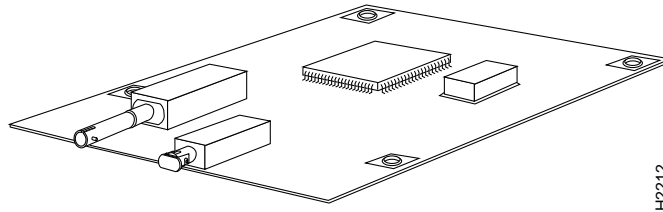
The SONET multimode SC-duplex connector is shipped with a dust plug. (See Figure 2-9.) Remove the plug by pulling on the plug as you squeeze the sides.

**Figure 2-9 SONET ATM Multimode Fiber-Optic Transceiver and Dust Plug**



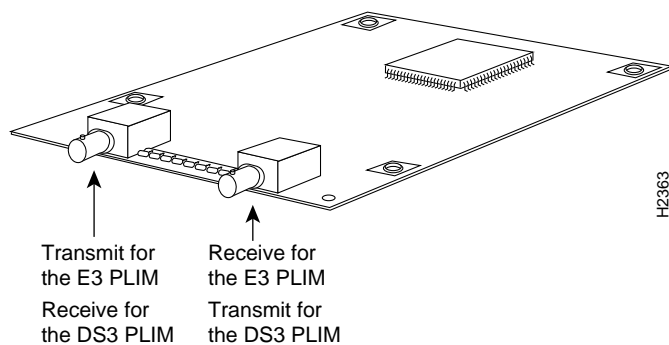
For single-mode SONET connections, connect the single-mode cable to the ST connector on the SONET PLIM. (See Figure 2-10.)

**Figure 2-10 SONET Single-Mode PLIM**



For E3 and DS3 connections, connect the coaxial cable to the BNC connector on the E3 or DS3 PLIM. (See Figure 2-11.) The E3 and DS3 PLIMs require cable CAB-ATM-DS3/E3. Ensure that the transmit and receive portions of the cable are connected to the appropriate PLIM connector. Refer to the chapter “Installing the Router.”

**Figure 2-11 E3 and DS3 PLIM—Representative of Both PLIMs**



**Caution** To ensure compliance with EMI standards, the E3 PLIM connection requires an EMI filter clip (CLIP-E3-EMI) on the receive port (RCVR).

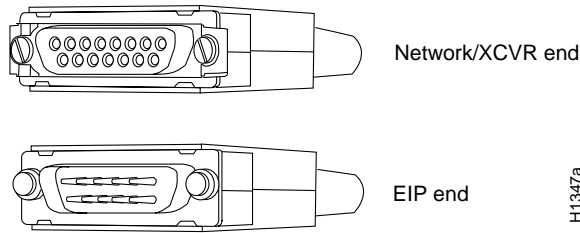
## Channel Attachment Connection Equipment

The ESCON Channel Adapter (ECA) and bus and tag Parallel Channel Adapter (PCA) for the CIP are available as FRUs; however, they are field replaceable by Cisco-certified field service personnel only. For more information on the ECA, PCA, and CIP, refer to the configuration note *Channel Interface Processor (CIP) Installation and Configuration* (Document Number 78-1342-xx, where xx is the latest revision of the document).

## Ethernet Connection Equipment

You will need an IEEE 802.3 MAU and an AUI, or an Ethernet transceiver and transceiver cable between each EIP port and the Ethernet network. The Ethernet connectors on the EIP are standard 15-pin AUI receptacles that require an AUI or transceiver interface cable with a 15-pin AUI plug. (See Figure 2-12.)

**Figure 2-12 Ethernet Interface Cable Connectors**



The term *Ethernet* is commonly used for all carrier sense multiple access/collision detection (CSMA/CD) local-area networks (LANs) that generally conform to Ethernet specifications, including IEEE 802.3. Ethernet Version 2 and IEEE 802.3 were based on, and developed shortly after, Ethernet Version 1. The slight differences between Ethernet and IEEE 802.3 are implemented in hardware, and both are supported automatically by the EIP without any hardware or software configuration changes. Together, Ethernet and IEEE 802.3 are the most widely used local-area network protocol. They are well suited to applications where a local communication medium must carry sporadic, occasionally heavy traffic at high peak data rates.

Stations on a CSMA/CD LAN can access the network at any time. Before sending data, the station *listens* to the network to see if it is already in use. If it is, the station waits until the network is not in use, then transmits. A collision occurs when two stations listen for network traffic, hear none, and transmit simultaneously. When this happens, both transmissions are damaged, and the stations must retransmit them. The stations detect the collision and use backoff algorithms to determine when they should retransmit.

Both Ethernet and IEEE 802.3 are *broadcast* networks, which means that all stations see all transmissions. Each station must examine received frames to determine whether it is the intended destination and, if it is, pass the frame to a higher protocol layer for processing.

IEEE 802.3 specifies several different physical layers, and Ethernet defines only one. Each IEEE 802.3 physical layer protocol has a name that summarizes its characteristics in the format *speed/signaling method/segment length* where *speed* is the LAN speed in Mbps, *signaling method* is the signaling method used (either *Baseband* or *Broadband*), and *segment length* is the maximum length between stations in hundreds of meters. For example, 10Base5 specifies a 10-Mbps Baseband LAN with network segments spaced at 500 meters. Table 2-13 summarizes the characteristics of Ethernet Version 2 and IEEE 802.3.

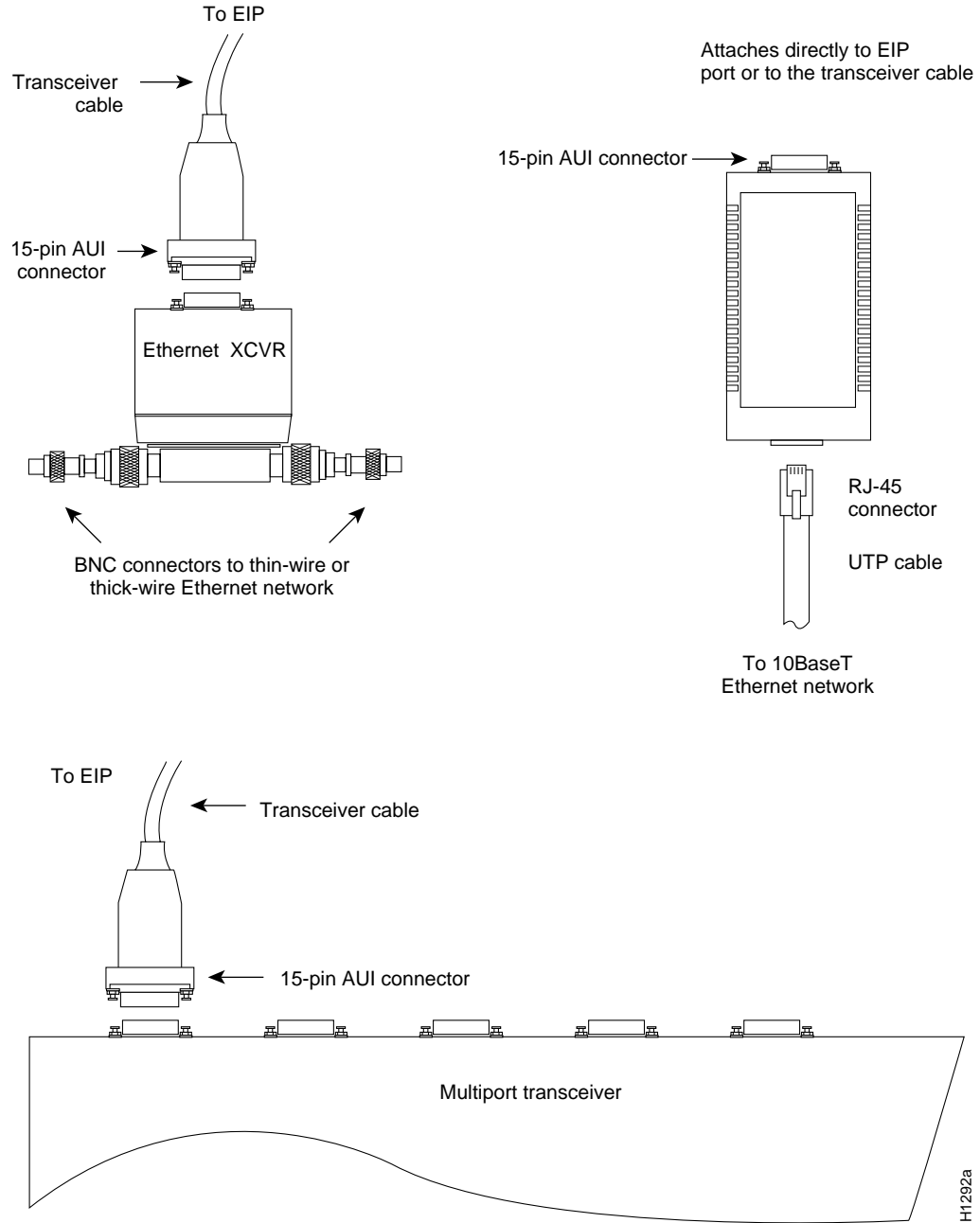
**Table 2-13 Ethernet Version 2 and IEEE 802.3 Physical Characteristics**

	Ethernet	IEEE 802.3		
		10Base5	10Base2	10BaseT
Data rate (Mbps)	10	10	10	10
Signaling method	Baseband	Baseband	Baseband	Baseband
Max. segment length	500m	500m	185m	100m (UTP)
Media	50-ohm coax (thick)	50-ohm coax (thick)	50-ohm coax (thin)	Unshielded twisted pair (UTP)
Topology	Bus	Bus	Bus	Star

Ethernet is most similar to IEEE 802.3 10Base5. Both of these protocols specify a bus topology network with a connecting cable between the end stations and the actual network medium. Both protocols require a device that acts as an interface between the end stations (the EIP) and the actual network medium (cable). The Ethernet specifications call this device a *transceiver*, and it is connected to the station with a *transceiver cable*. The IEEE 802.3 specification refers to the same type of device as a *media attachment unit* (MAU) and to the cable as an *attachment unit interface* (AUI). Both transceiver cables and AUIs can connect to the EIP ports directly.

Transceivers are available from a variety of sources for thick-wire (10Base5), thin-wire (10Base2), or unshielded twisted-pair cabling (10BaseT at 10 Mbps); Figure 2-13 shows examples of transceivers and connection equipment. You can connect either Ethernet Version 1 or Version 2/IEEE 802.3 interfaces; the EIP automatically supports both types.

**Figure 2-13 Ethernet Transceivers**

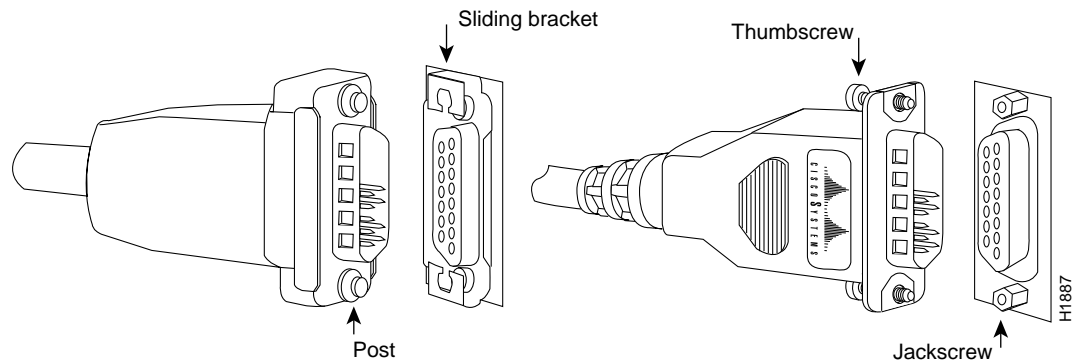


**Note** Some Ethernet transceivers can connect directly to the AUI ports on the EIP and do not require an AUI or transceiver cable. When planning your connections, consider the size and shape of any transceivers that will connect to the EIP ports directly, and avoid connecting transceiver that overlap and impair access to connections on other interface processors.

Typically, Ethernet connectors have either slide-type or jackscrew-type locks. (See Figure 2-14.) The most common are those that use a slide-type lock, which is the type used on the EIP ports. The connector on the left in Figure 2-14 shows a slide-type lock. When the cable is connected to the

15-pin port, a metal bracket snaps up over two posts on the cable connector to secure it in the port and provide strain relief. Instead of the posts and sliding bracket, the jackscrew-type lock (shown on the right in Figure 2-14) uses two thumbscrews or jackscrews, which are usually attached to the cable connector. When the cable is connected to the 15-pin port, you secure it by screwing the thumbscrews into the jackscrews adjacent to the connector.

**Figure 2-14 Ethernet Connector Locks, Slide-Type and Jackscrew-Type**



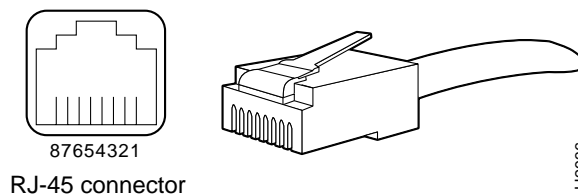
The slide-type locks are standard on the EIP ports; however, conversion kits are included with each EIP to replace the slide-type locks with jackscrews. For specific replacement instructions, refer to the installation document that accompanies the jackscrew kit.

## Fast Ethernet Connection Equipment

The two connectors on the FEIP port adapter are a single MII, 40-pin, D-shell type, and a single RJ-45. You can use either one or the other. Only one connector can be used at one time. The FEIP can have up to two port adapters installed. Each connection supports IEEE 802.3u interfaces compliant with the 100BaseX and 100BaseT standards. The RJ-45 connection does not require an external transceiver; however, the MII connection does, depending on the type of connection you use.

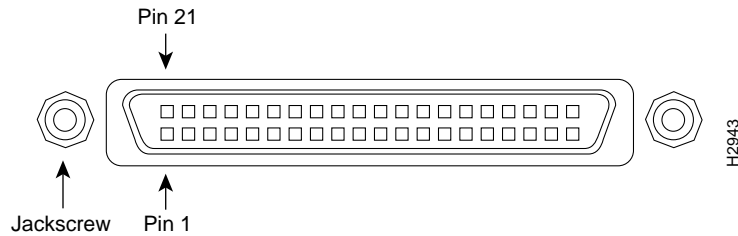
The RJ-45 modular connector (see Figure 2-15) has strain relief functionality incorporated into the design of its standard plastic connector. Figure 2-15 and Figure 2-16 show the RJ-45 and MII connectors.

**Figure 2-15 RJ-45 Connections—Connector and Plug**



Depending on the type of media you use between the MII connection on the port adapter and your switch or hub, the network side of your 100BaseT transceiver should be appropriately equipped: with ST-type connectors (for optical fiber), BNC connectors (for 10Base2 coaxial cable), and so forth. Figure 2-16 shows the pin orientation of the female MII connector on the port adapter.

Figure 2-16 MII Connection—Female



The MII receptacle uses 2-56 screw-type locks, called *jackscrews* (shown in Figure 2-16), to secure the cable or transceiver to the MII port. MII cables and transceivers have knurled thumbscrews (screws you can tighten with your fingers) that you fasten to the jackscrews on the FEIP MII connector. Use the jackscrews to provide strain relief for your MII cable.

### Token Ring Connection Equipment

You will need an 802.5 MAU or a multistation access unit (MSAU) to provide the interface between the TRIP Token Ring interfaces and the external ring, and a Token Ring lobe cable between each TRIP port and the MAU or MSAU. Lobe cables connect each Token Ring station (TRIP port) to the MAU or MSAU, and patch cables can connect adjacent MSAUs to form one large ring.

TRIP ports operate at either 4 or 16 Mbps. The default speed for all TRIP ports is 4 Mbps, which you can change to 16 Mbps on any port with the configuration command **ring-speed n**, where *n* is the speed (4 or 16) in Mbps. The speed of each Token Ring port must match the speed of the ring to which it is connected. Before you enable the Token Ring interfaces, ensure that each is set for the correct speed, or it can bring down the ring.



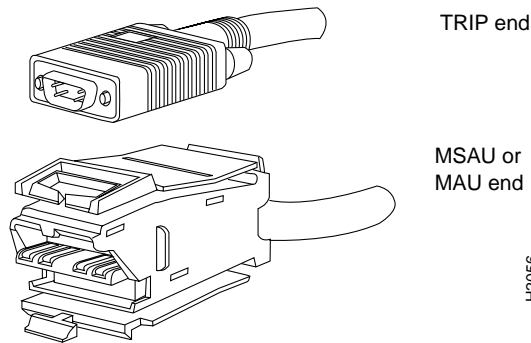
**Caution** Each TRIP port must be configured for the same ring speed as the ring to which it is connected, either 4 or 16 Mbps. If the port is set for a different speed, it will cause the ring to beacon, which effectively brings the ring down and makes it inoperable.



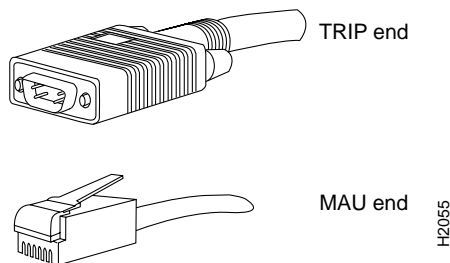
## Token Ring Cables and Connectors

The Token Ring ports on the TRIP are DB-9 (PC type) receptacles that require Type 1 or Type 3 lobe cables. Type 1 lobe cables use shielded twisted pair cable and terminate at the network end with a large MAU plug. (See Figure 2-17.) Type 3 lobe cables use either shielded or unshielded twisted pair (UTP) cable and terminate at the network end with an RJ-11 plug. (See Figure 2-18.) The TRIP end of both cable types is a DB-9 plug.

**Figure 2-17 Token Ring Type 1 Lobe Cable Connectors, DB-9 and MAU Types**



**Figure 2-18 Token Ring Type 3 Lobe Cable Connectors, DB-9 and RJ-11 Types**



## Token Ring Physical Connections

The term Token Ring refers to both IBM's Token Ring Network, which IBM developed in the 1970s, and to IEEE 802.5 networks. The IEEE 802.5 specification was modeled after, and still closely shadows, IBM's network. The two types are compatible, although the specifications differ slightly.

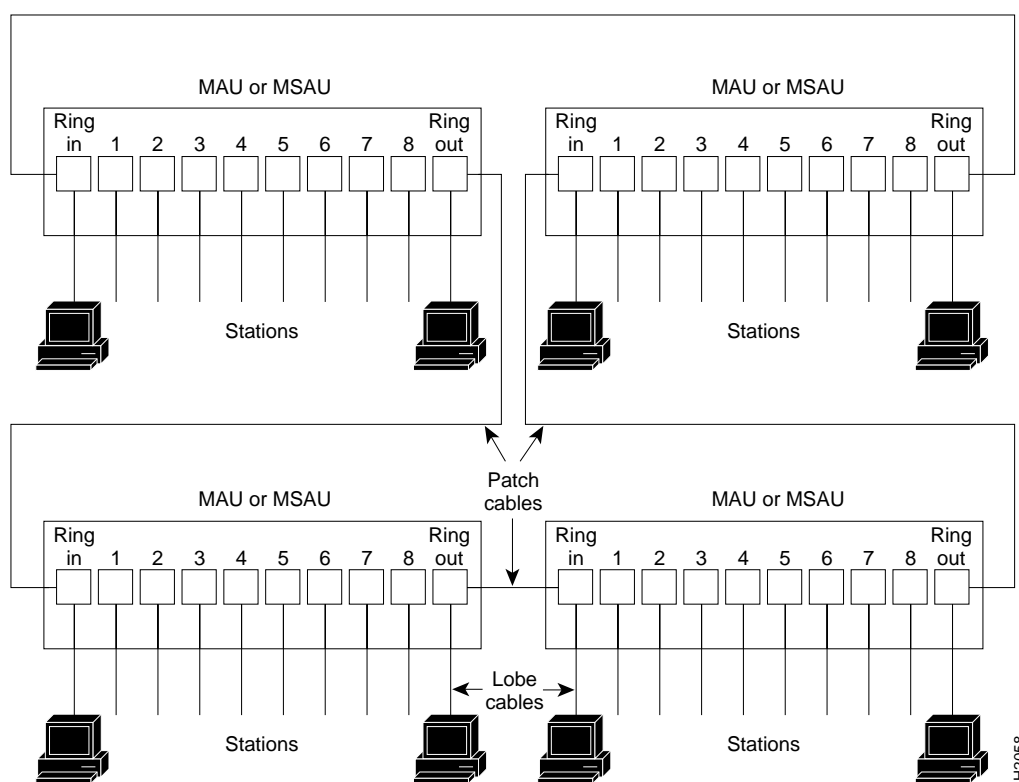
The IBM Token Ring specifies a star topology, with all end stations connected through a device called a multistation access unit (MSAU). IEEE 802.5 does not specify any topology, although most implementations are based on a star configuration with end stations attached to a device called a media access unit (MAU). Also, IBM Token Ring specifies twisted pair cabling, whereas IEEE 802.5 does not specify media type. Most Token Ring networks use shielded twisted pair cabling; however, some networks that operate at 4 Mbps use unshielded twisted pair cable. Table 2-14 shows a comparison of the two types.

**Table 2-14 IBM Token Ring and IEEE 802.5 Comparison**

Network Type	Data Rates	Stations/ Segment	Topology	Media	Signaling	Access Method	Encoding
IBM Token Ring network	4, 16 Mbps	260 shielded twisted pair 72 unshielded twisted pair	Star	Twisted pair	Baseband	Token passing	Differential Manchester
IEEE 802.5 network	4, 16 Mbps	250	Not specified	Not specified	Baseband	Token passing	Differential Manchester

In the typical Token Ring network shown in Figure 2-19, lobe cables connect each Token Ring station (TRIP port) to the MSAU (or MAU), and patch cables connect adjacent MSAUs (or MAUs) to form one large ring.

**Figure 2-19 Token Ring Network Physical Connections**



Token Ring and IEEE 802.5 are token-passing networks, which move a small frame (called a token) around the network. Possession of the token grants the right to transmit; a station with information to transmit must wait until it detects a free token passing by.

When all stations on the ring are idle, the token packet is labeled as a *free* token. If the station receiving the token has no information to send, it simply passes the free token to the next station. A station that does have information to transmit seizes the token, alters a bit of the token frame (which changes the free token to a *busy* token), appends the information it wishes to transmit, and then sends this information to the next station on the ring. The busy token, with the information frame, circulates the ring until it reaches the intended destination station, which copies the information for further processing and passes the busy token and information frame back out to the ring.

The information frame continues to circle the ring until it reaches the original sending station, which checks the returned frame to ensure that the destination station received the information. When the original sending station determines that the receiving station accepted the information, it purges the token and information frame, and transmits a new free token out to the ring.

While the information frame is circling the ring, there is no token on the network (unless *early token release* is enabled, which is described later in this section), so other stations wishing to transmit must wait. Therefore, collisions cannot occur in Token Ring networks.

A priority scheme allows the user to designate any station as high priority, which allows the station to use the ring more frequently than lower-priority stations. Stations cannot seize or reserve a passing token with a higher priority than its own designated priority, which allows highest-priority stations to seize the token as soon as possible. The token frame contains a *priority* field, which is set by the station that generates the token, and a *reservation* field, which can be set by a higher-priority station as it receives and passes the token.

When a token is circulating, only stations with a priority equal to or higher than the priority value in the token fields can seize that token or reserve the next token. Once the token is seized and changed to a busy token with an information frame, a station with a higher priority than the transmitting station can reserve the next token (for the next pass around the network) by setting the reservation field. When the original sending station receives a token with the reservation field set for a higher-priority station, it issues the new free token with the priority field set to that of the reserving station. Only the reserving station or another station with an equal or higher priority can seize the token. After the higher priority station seizes the token and completes its transmission, it must first determine that all other higher-priority stations are finished transmitting then reinstate the previous, lower priority. When the station detects a free token with the higher priority, it assumes that there is no more higher-priority traffic waiting and downgrades the priority of the token before passing it back onto the ring.

Early token release allows a station to release a new token onto the ring immediately after transmitting, instead of waiting for the first frame to return. This feature can help increase the total bandwidth on the ring, but decreases ring reliability. The TRIP supports early token release, but by default it is not enabled on any TRIP ports.

Unlike CSMA/CD networks such as Ethernet, token-passing networks are deterministic. Each station can hold the token for a maximum period of time, so it is possible to calculate the maximum time that will pass before any end station will be able to transmit. This and the fault management mechanisms discussed in the following section make Token Ring networks robust and predictable.

## Token Ring Fault Management

Token Ring networks employ several mechanisms for detecting and compensating for network faults. For example, one station in the Token Ring network is designated as the *active monitor*. This station, which potentially can be any station on the network, acts as a centralized source of timing information for other ring stations and performs a variety of ring maintenance functions. These functions include detecting and correcting a lost or persistently busy (continuously circulating) token on the ring.

To detect a lost token, the active monitor uses a timeout greater than the time required for the longest frame to traverse the ring completely. If the active monitor does not see a token during this time, it assumes that the token is lost, purges the ring of any residual data, and issues a new token.

When a sending device fails, its frame may continuously circle the ring, preventing other stations from transmitting their own frames and essentially locking up the network. To detect a circulating busy token, the active monitor sets a monitor bit to 1 on any passing busy token. If it sees a busy token with a bit already set, it knows that the transmitting station failed to purge its packet. The monitor changes the busy token to a free token, and sends it back out to the ring.

Other stations on the ring have the role of passive monitor; their primary job is to detect failure of the active monitor and assume that role if necessary. A contention-resolution algorithm determines which station takes over if the active monitor fails.

A Token Ring algorithm called *beaconing* detects and tries to repair certain network faults. Whenever a station detects a serious problem with the network (such as a cable break), it sends a beacon frame. The beacon frame defines a failure domain, which includes the station reporting the failure, its nearest active upstream neighbor, and everything in between. Beaconing initiates a process called *autoreconfiguration*, where nodes within the failure domain automatically perform diagnostics and attempt to reconfigure the network around the failed areas. Physically, the MSAU or MAU can accomplish this through electrical reconfiguration.

All information in a Token Ring network is seen by active MSAUs or MAUs. Some of these devices can be programmed to check for problems and automatically remove problem stations from the ring, and some contain bypass relays so that you can selectively remove stations from the ring without affecting traffic on the network.

All TRIP ports support both 4 and 16-Mbps operation and early token release. The default for all ports is for 4 Mbps operation and early token release disabled. Both states are enabled with configuration commands in the configuration mode. To enable 16 Mbps, specify the slot/port address and use the configuration command **ring-speed 16**; to return to 4-Mbps operation, use the command **ring-speed 4**. To enable and disable early token release, specify the slot/port address and use the configuration command **[no] early token release**. For examples of these commands, refer to the section “Token Ring Connections” in the chapter “Installing the Router.” For complete descriptions and examples of software commands, refer to the related software configuration and command reference documentation, which is available on UniverCD.

## FDDI Connection Equipment

Fiber-optic transceivers on the FIP provide a direct interface between the router and the FDDI ring. The FIP supports both single-mode and multimode transceivers and is available with any combination of the two types. Both transceiver types provide a Class A dual-attach interface that can be connected to a Class A or a Class B station. Class A is a dual-attach station (DAS) with primary and secondary rings; Class B is a single-attach station (SAS) with only a primary ring. A detailed description of Class A and B and of DASs and SASs follows the descriptions of FDDI connection equipment.

## FDDI Media

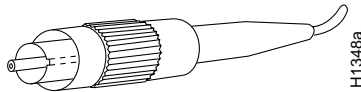
FDDI networks use two types of fiber-optic cable: single-mode (also called *monomode*) and multimode. *Mode* refers to the angle at which light rays (signals) are reflected and propagated through the optical-fiber core, which acts as a waveguide for the light signals. Multimode fiber has a relatively thick core (62.5/125-micron) that reflects light rays at many angles. Single-mode fiber has a narrow core (8.7 to 10/125-micron) that allows the light to enter only at a single angle.

Although multimode fiber allows more light signals to enter at a greater variety of angles (modes), the different angles create multiple propagation paths that cause the signals to spread out in time and limits the rate at which data can be accurately received. This distortion does not occur on the single path of the single-mode signal; therefore, single-mode fiber is capable of higher bandwidth and greater cable run distances than multimode fiber. In addition, multimode transmitters usually use LEDs as a light source, and single-mode transmitters use a laser diode, which is capable of sustaining faster data rates. Both types use a photodiode detector at the receiver to translate the light signal into electrical signals.

## FDDI Transceivers and Cable Connectors

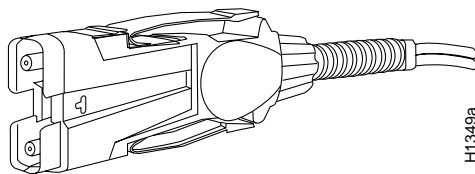
The FIP single-mode interface uses simplex FC-type connectors for the Transmit and Receive ports. (See Figure 2-20.) The connector accepts standard 8.7 to 10/125-micron single-mode fiber-optic cable. The single-mode interface supports connections at distances up to 6 miles (10 kilometers).

**Figure 2-20 Single-Mode FDDI Network Interface Connectors, FC Type**



The multimode transceiver supports distances of up to 1.2 miles (1.9 kilometers). The multimode connector is an FDDI-standard physical sublayer (PHY) connector that encodes and decodes the data into a format acceptable for fiber transmission. The multimode connector accepts standard 62.5/125-micron multimode fiber-optic cable using the media interface cable (MIC) and, with proper cable terminators, can accept 50/125 micron fiber-optic cable. Multimode uses the integrated MIC connector shown in Figure 2-21 at both the FIP and network ends.

**Figure 2-21 Multimode FDDI Network Interface Connector, MIC Type**



The multimode/multimode FIP (CX-FIP-MM) provides a control port for an optical bypass switch, which allows the light signal to pass directly through the bypass switch and completely bypass the FIP transceivers when the interface has failed or is shut down. Most optical bypass switches provide the necessary interface cables for connection to the multimode MIC connectors on the FIP; however, not all manufacturers use the same type of DIN connector for the control port. Some manufacturers use a DIN, and some use a smaller version, a mini-DIN. The optical bypass control port on the FIP requires a mini-DIN connector. A DIN-to-mini-DIN adapter cable (CAB-FMDD) is included with the multimode/multimode FIP to ensure that you can connect to either type.

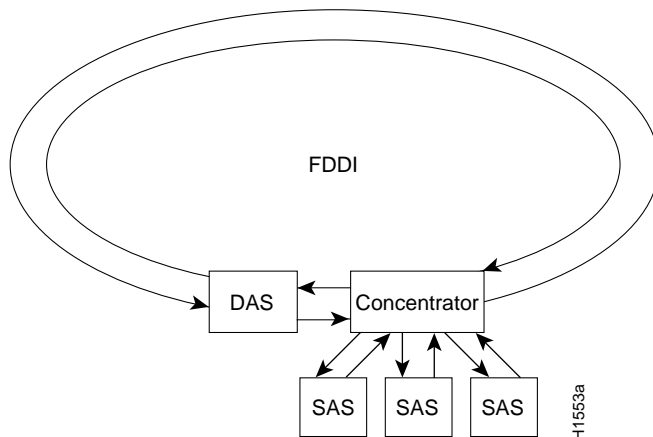
The FIP supports both Class A and Class B station connections and provides an interface for both single-mode and multimode fiber-optic cable. The two physical ports (PHY A and PHY B) are available with either single-mode (FC) or multimode (MIC) port connectors, or with a combination of one of each for matching multimode and single-mode fiber in the same FDDI network.

## FDDI Physical Connections

FDDI, which specifies a 100-Mbps, token-passing dual-ring network using fiber-optic transmission media, is defined by the ANSI X3.1 standard and by ISO 9314, the international version of the ANSI standard. An FDDI *network* comprises two token-passing fiber-optic rings: a primary ring and a secondary ring. An FDDI *ring* consists of two or more point-to-point connections between adjacent stations.

On most networks, the primary ring is used for data communication, and the secondary ring is used as a backup. Class B, or single-attach stations (SAS), attach to one ring and are typically attached through a concentrator; Class A, or dual-attach stations (DAS), attach to both rings. Figure 2-22 shows a typical FDDI configuration with both DAS and SASs.

Figure 2-22 Typical FDDI Configuration with DAS, Concentrator, and SASs



SASs (Class B) typically attach to the primary ring through a concentrator, which provides connections for multiple SASs. The concentrator ensures that a failure or power down of any SAS does not interrupt the ring. SASs use one transmit port and one receive port to attach to the single ring. DASs (Class A) have two physical ports, designated PHY A and PHY B, each of which connects the station to both the primary and secondary rings. Each port is a receiver for one ring and a transmitter for the other. For example, PHY A receives traffic *from* the primary ring, and PHY B transmits *to* the primary ring.

### FDDI Fault Management

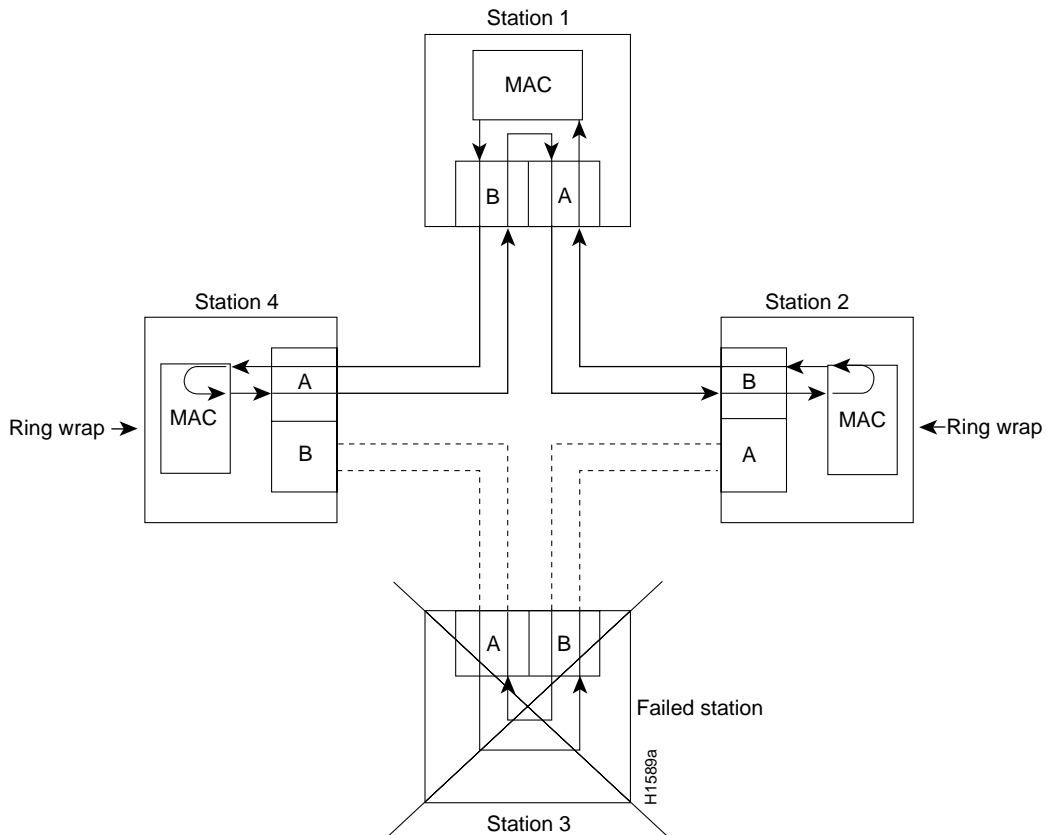
The dual rings in an FDDI network provide fault tolerance. If a station on a dual ring shuts down or fails, such as Station 3 in Figure 2-23, the ring automatically wraps (doubles back on itself) to form a single contiguous ring. This removes the failed station from the ring, but allows the other stations to continue operation. In Figure 2-23, the ring wraps to eliminate Station 3 and forms a smaller ring that includes only Stations 1, 2, and 4.

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**Note** Each station in a ring refers to its neighbor stations as *upstream* or *downstream* neighbors. The *stream* is based on the signal flow on the primary ring. A station receives the primary signal from its upstream neighbor, and transmits the primary signal to its downstream neighbor. For example, Figure 2-23 shows the primary signal flow being transmitted from PHY B on Station 2 to PHY A on Station 1 and from PHY B on Station 1 to PHY A on Station 4. Using Station 1 as a reference, Station 2 is the upstream neighbor of Station 1, and Station 4 is the downstream neighbor of Station 1.

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**Figure 2-23 DAS Station Failure and Ring Recovery Example**



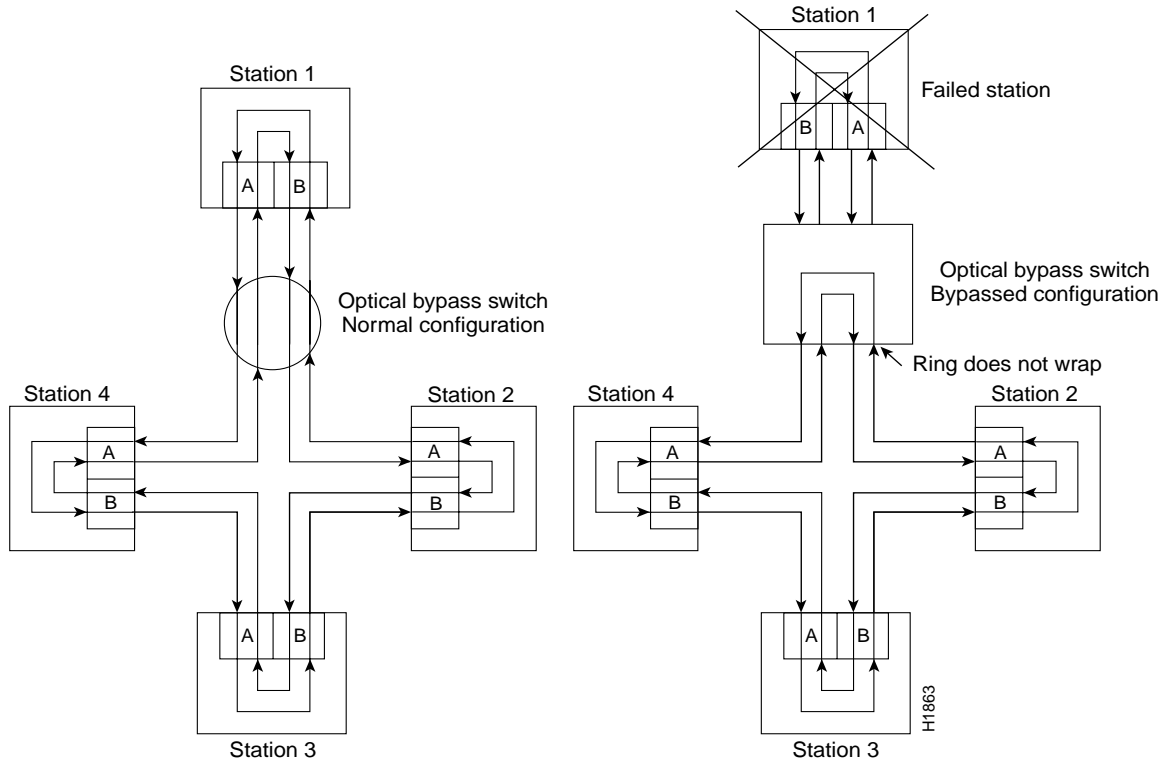
A second failure could cause the ring to wrap in both directions from the point of failure, which would segment the ring into two separate rings that could not communicate with each other. For example, if Station 1 in Figure 2-23 fails after Station 3 fails, Stations 2 and 4 will each be isolated because no path for communication exists between them. Subsequent failures cause additional segmentation.

Optical bypass switches avoid segmentation by eliminating failed stations from the ring. During normal operation, an optical bypass switch allows the light signal to pass directly through itself uninterrupted. When a station with a bypass switch fails, the bypass switch reroutes the signal back onto the ring before it reaches the failed station, so the ring does not have to wrap back on itself.

Figure 2-24 shows an optical bypass switch installed at Station 1. In the normal configuration shown on the left, Station 1 is functioning normally, so the optical bypass switch appears transparent. The switch essentially allows the signals to pass through it without interruption. However, if Station 1 fails, the optical bypass switch enables the bypassed configuration shown on the right in Figure 2-24.

The bypass switch reroutes the light signal by intercepting it before it reaches the failed Station 1 and sends it back out to the ring. This allows the signal to maintain its existing path and direction without wrapping back on itself. However, stations that are operating normally repeat the signal when sending it back out to the ring. Optical bypass switches do not repeat or drive the signal; they just allow the signal to pass through them. Therefore, significant signal loss can occur when the downstream neighbor, the next station on the ring, is far away.

Figure 2-24 Optical Bypass Operation on a DAS

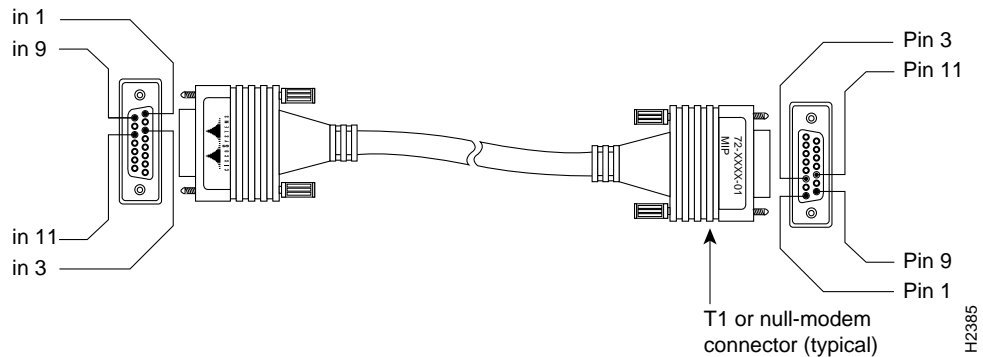


Another technique for fault tolerance is dual homing, whereby critical devices are attached to two concentrators. Only the designated primary concentrator is active unless it (or its link) fails. If the primary does fail, the backup (passive) concentrator is activated automatically and sustains the ring.

## MultiChannel (MIP) Connection Equipment

The MIP T1 interface cable has two 15-pin DB connectors at each end to connect the MIP with the external CSU. Figure 2-25 shows the MIP interface cable, connectors and pin-outs.

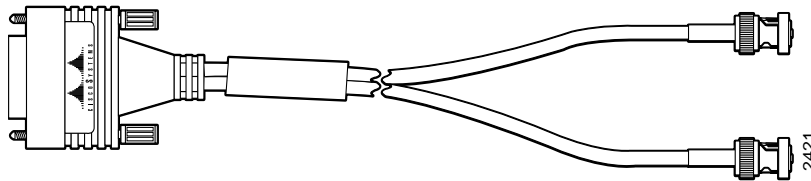
Figure 2-25 MIP Interface Cable Connector



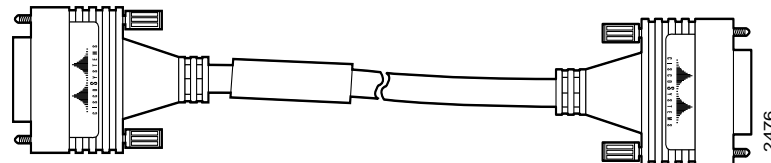


For E1, four serial cables are available from Cisco Systems for use with the MIP. All three have DB-15 connectors on the MIP end and either BNC, DB-15, Twinax, or RJ-45 connectors on the network end. Figure 2-26, Figure 2-27, Figure 2-28, and Figure 2-29 show the E1 interface cables (respectively).

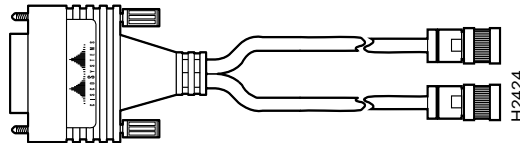
**Figure 2-26 E1 Interface Cable for 75-Ohm, Unbalanced Connections (with BNC Connectors)**



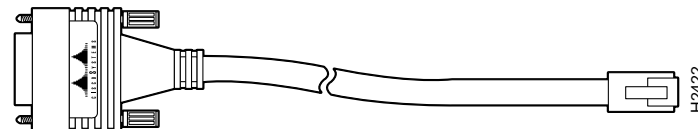
**Figure 2-27 E1 Interface Cable for 120-Ohm, Balanced Connections (with DB-15 Connectors)**



**Figure 2-28 E1 Interface Cable for 120-Ohm, Balanced Connections (with Twinax Connectors)**



**Figure 2-29 E1 Interface Cable for 120-Ohm, Balanced Connections (with RJ-45 Connector)**



## Serial Connection Equipment

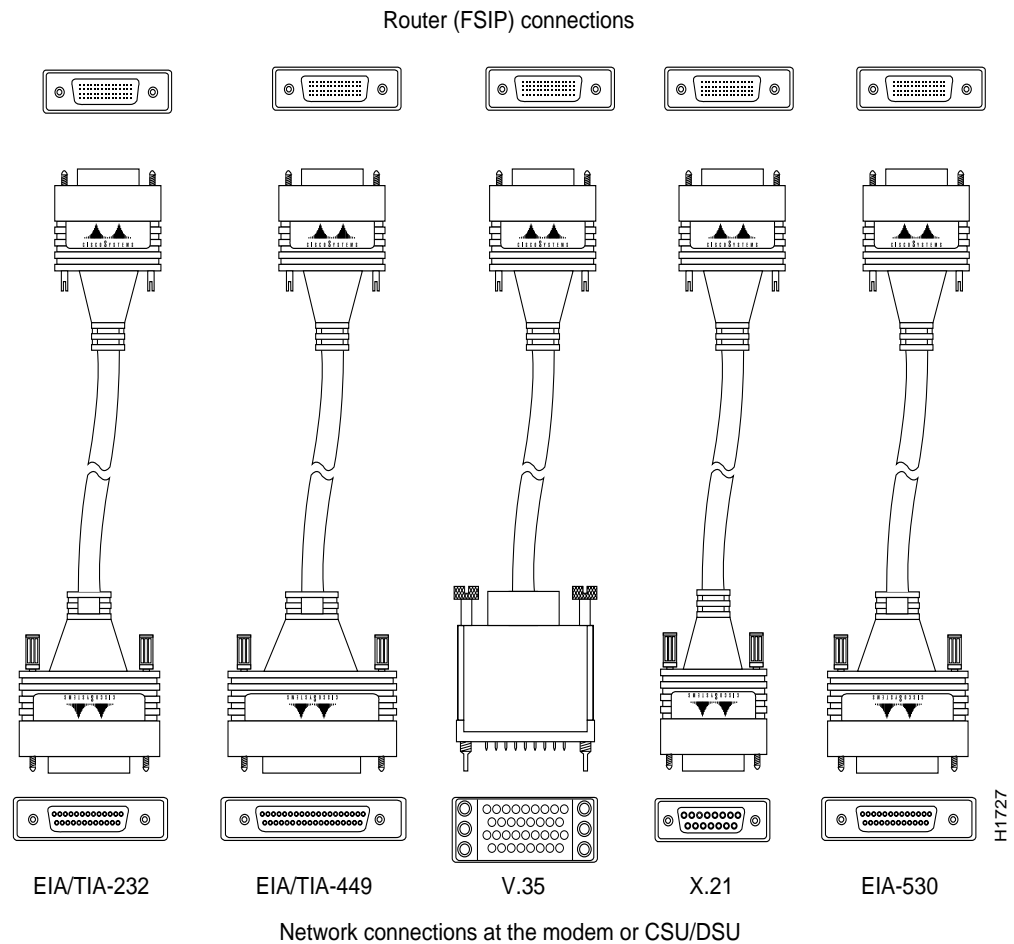
The FSIP supports synchronous serial connections at T1 and E1 speeds; the actual speed depends on the type of electrical interface used, the distances the signals must travel, and the configuration of other ports on the same FSIP module. In general, you should use EIA/TIA-232 for speeds of 64 kbps and below, and use X.21, EIA/TIA-449, V.35, or EIA-530 for higher speeds. (See the section “Replacing RSP7000 DRAM SIMMs” in the chapter “Maintenance.”)

### Universal Serial Cables

The universal FSIP ports for all interface types are 60-pin, D-shell receptacles. Each port requires a serial port adapter cable to connect to the external network or connection device.

On data communications ports, the universal port adapter cable determines the electrical interface type and mode of the port. All universal cables use a 60-pin D-shell plug at the router (FSIP) end. The network end of each cable provides the standard connector used with each respective interface type. (See Figure 2-30.) Cables for all data communications interfaces except EIA-530 are available in DTE mode with a plug at the network end, or in DCE mode with a receptacle at the network end. The mode, DCE or DTE, is labeled on the connectors at both ends of the cables.

**Figure 2-30 Serial Port Adapter Cables**



Metric (M3) thumbscrews are included with each port adapter cable to allow connection to devices that use metric hardware. Following are the available interface cable options for the mode and network-end connectors for each:

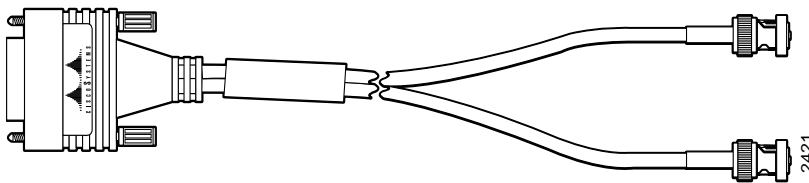
- EIA/TIA-232: DTE mode with DB-25 plug; DCE mode with DB-25 receptacle
- EIA/TIA-449: DTE mode with 37-pin D-shell plug; DCE mode with 37-pin D-shell receptacle
- V.35: DTE mode or DCE mode with 34-pin Winchester-type V.35 plug; DTE mode or DCE mode with 34-pin Winchester-type V.35 receptacle

- X.21: DTE mode with DB-15 plug; DCE mode with DB-15 receptacle
- EIA-530: DTE mode with DB-25 plug

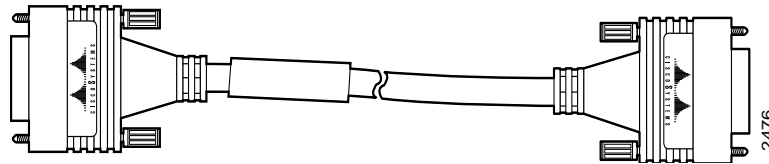
### E1-G.703/G.704 Cables

Figure 2-31, Figure 2-32, and Figure 2-33 show the unbalanced and balanced cables used for connection between the E1-G.703/G.704 port adapter and your network. The port-adaptor end of each cable has a DB-15 connector.

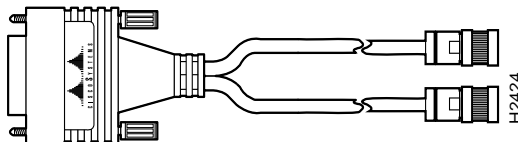
**Figure 2-31 E1-G.703/G.704 Interface Cable for 75-Ohm, Unbalanced Connections (with BNC Connectors and Coaxial Cables)**



**Figure 2-32 E1-G.703/G.704 Interface Cable for 120-Ohm, Balanced Connections (with DB-15 Connectors on Both Ends)**



**Figure 2-33 E1-G.703/G.704 Interface Cable for 120-Ohm, Balanced Connections (with Twinax Connectors and Cables)**



**Caution** It is a requirement of the statutory approval of the E1-G.703/G.704 interface that the jackscrews on the DB-15 connector backshell are securely screwed down while the FSIP is operating.

### NRZ and NRZI Formats

All data communications interfaces support both nonreturn to zero (NRZ) and nonreturn to zero inverted (NRZI) formats. Both formats use two different voltage levels for transmission. NRZ signals maintain constant voltage levels with no signal transitions (no return to a zero voltage level) during a bit interval and are decoded using absolute values (0 and 1). NRZI uses the same constant signal levels but interprets the presence of data at the beginning of a bit interval as a signal transition and the absence of data as no transition. NRZI uses differential encoding to decode signals, rather

than determining absolute values. NRZ, the factory default on all interface types, is most common. All interface types also support NRZI format, which is commonly used with EIA/TIA-232 connections in IBM environments. (See the section “Configuring NRZI Format” in the chapter “Maintenance” for configuration instructions.)

### Cyclic Redundancy Checks (CRCs)

All data communications interfaces use a 16-bit cyclic redundancy check (CRC) by default but also support a 32-bit CRC. CRC is an error-checking technique that uses a calculated numeric value to detect errors in transmitted data. The sender of a data frame divides the bits in the frame message by a predetermined number to calculate a remainder or *frame check sequence* (FCS). Before it sends the frame, the sender appends the FCS value to the message so that the frame contents are exactly divisible by the predetermined number. The receiver divides the frame contents by the same predetermined number that the sender used to calculate the FCS. If the result is not 0, the receiver assumes that a transmission error occurred and sends a request to the sender to resend the frame.

The designators *16* and *32* indicate the number of check digits per frame that are used to calculate the FCS. Sixteen-bit CRC, which transmits streams of 8-bit characters, generates a 16-bit FCS. Thirty-two bit CRC, which transmits streams of 16-bit characters, generates a 32-bit FCS. Because 32-bit CRC transmits longer streams at faster rates, it provides better ongoing error detection with less retransmits. Both the sender and the receiver must use the same setting.

Sixteen-bit CRC is the most widely used method throughout the United States and Europe, and it is used extensively with wide-area networks (WANs). IEEE-802 specifies 32-bit CRC, and some point-to-point transmission standards specify it as an option. It is often used on SMDS networks and LANs. See the section “Configuring 32-Bit Cyclic Redundancy Check (CRC)” in the chapter “Maintenance” for configuration instructions.

### Signal Modes and Timing

Data communications ports operate in either DCE or DTE mode; the mode depends on the source of the clock signal that the port uses, and the mode of the remote device to which the port is connected. In DCE mode, the port supplies its own clock signal. You normally use DCE when connecting the router to a DTE device such as a PC, host, or another router. To set up a port as a DCE interface, you must use a DCE adapter cable and use the **clockrate** configuration command to set the internal clock speed.

In DTE mode, which is the most commonly used mode, the port uses a clock signal supplied by a remote or external device. You normally use DTE when connecting the router to a DCE device such as a modem or CSU/DSU. Most DTE interfaces require an external clock signal, which the remote DCE device provides. To set up a port as a DTE interface, you need only connect a DTE adapter cables. When the port recognizes the DTE cable, it automatically uses the clock signal from the remote DCE device.

Occasionally, systems with long cables may experience high error rates when operating at the higher transmission speeds. Slight variances in cable construction, temperature, and network configuration can cause the clock and data signals to shift out of phase. Inverting the clock can often correct this shift. If an FSIP port is reporting a high number of error packets, suspect a phase shift and invert the clock with the **invert-transmit-clock** command.

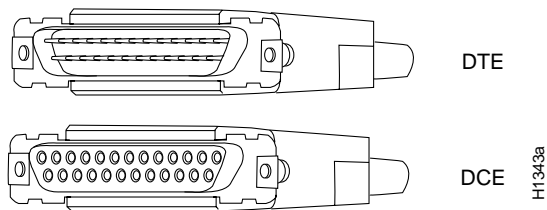
For brief descriptions of the **clockrate** and **invert-transmit-clock** commands, refer to the section “Configuring Timing (Clock) Signals” in the chapter “Maintenance.” For complete command descriptions and instructions, refer to the related software documentation.

All serial signals are subject to distance limits, beyond which a signal degrades significantly or is completely lost. For specific cabling distance limitations, refer to the section “Distance Limitations” in this chapter. The distance and rate limits in these descriptions are the IEEE-recommended maximum speeds and distances for signaling; however, you can usually get good results at speeds and distances far greater than these. For instance, the recommended maximum rate for V.35 is 2 Mbps, but 4 Mbps is commonly used without any problems. If you understand the electrical problems that might arise and can compensate for them, you should get good results with rates and distances greater than those shown here; however, do so at your own risk. We do not recommend exceeding the published speed and distance specifications.

## EIA/TIA-232 Connections

By far the most common interface standard in the U.S., EIA/TIA-232 supports unbalanced circuits at signal speeds up to 64 kbps. The router (FSIP) end of all EIA/TIA-232 adapter cables is a high-density 60-pin plug. The opposite (network) end of the adapter cable is a standard 25-pin D-shell connector (known as a DB-25) that is commonly used for EIA/TIA-232 connections. Figure 2-34 shows the connectors at the network end of the adapter cable. The system Console and Auxiliary ports on the RP also use EIA/TIA-232 connections; however the FSIP ports support synchronous connections, and the Console and Auxiliary ports support only asynchronous connections. For further information on the RP ports, refer to the section “Console and Auxiliary Port Connection Equipment” in this chapter.

**Figure 2-34 EIA/TIA-232 Adapter Cable Connectors, Network End**

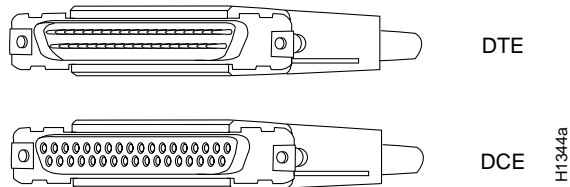


## EIA/TIA-449 Connections

EIA/TIA-449, which supports balanced (EIA/TIA-422) and unbalanced (EIA/TIA-423) transmissions, is a faster (up to 2 Mbps) version of EIA/TIA-232 that provides more functions and supports transmissions over greater distances. The EIA/TIA-449 standard was intended to replace EIA/TIA-232, but it was not widely adopted. Industry’s resistance to convert to EIA/TIA-449 was due primarily to the large installed base of DB-25 hardware and to the larger size of the 37-pin EIA/TIA-449 connectors, which limited the number of connections possible (fewer than possible with the smaller, 25-pin EIA/TIA-232 connector).

The router (FSIP) end of all EIA/TIA-449 adapter cables is a high-density 60-pin plug. The opposite (network) end of the adapter cable provides a standard 37-pin D-shell connector commonly used for EIA/TIA-449 connections. Figure 2-35 shows the connectors at the network end of the adapter cable. EIA/TIA-449 cables are available as either DTE (DB-37 plug) or DCE (DB-37 receptacle).

**Figure 2-35 EIA/TIA-449 Adapter Cable Connectors, Network End**



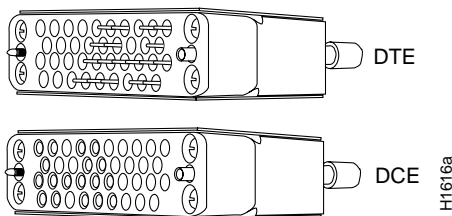
**V.35 Connections**

The V.35 interface is most commonly used in the United States and throughout Europe, and is recommended for speeds up to 48 kbps (although in practice it is used successfully at 4 Mbps).

The router (FSIP) end of all V.35 adapter cables is a high-density 60-pin plug. The opposite (network) end of the adapter cable provides a standard 34-pin Winchester-type connector commonly used for V.35 connections.

Figure 2-36 shows the connectors at the network end of the V.35 adapter cable. V.35 cables are available with a standard V.35 plug (male) for DTE mode or a V.35 receptacle (female) for DCE mode.

**Figure 2-36 V.35 Adapter Cable Connectors, Network End**

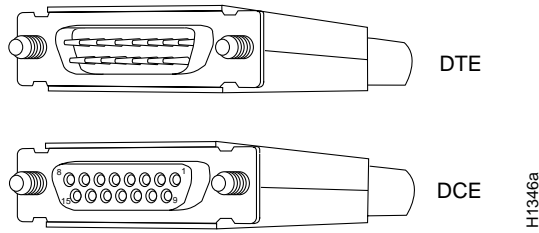


**X.21 Connections**

The X.21 interface uses a 15-pin connection for balanced circuits and is commonly used in the United Kingdom to connect public data networks. X.21 relocates some of the logic functions to the DTE and DCE interfaces and, as a result, requires fewer circuits and a smaller connector than EIA/TIA-232.

The router (FSIP) end of all X.21 adapter cables is a high-density 60-pin plug. The opposite (network) end of the adapter cable is a standard DB-15 connector. Figure 2-37 shows the connectors at the network end of the X.21 adapter cable. X.21 cables are available as either DTE (DB-15 plug) or DCE (DB-15 receptacle).

**Figure 2-37 X.21 Adapter Cable Connectors, Network End**

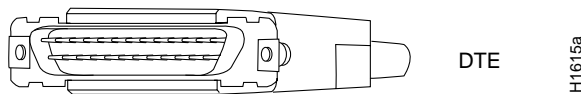


### EIA-530 Connections

EIA-530, which supports balanced transmission, provides the increased functionality, speed, and distance of EIA/TIA-449 on the smaller, DB-25 connector used for EIA/TIA-232. The EIA-530 standard was created to support the more sophisticated circuitry of EIA/TIA-449 on the masses of existing EIA/TIA-232 (DB-25) hardware instead of the larger, 37-pin connectors used for EIA/TIA-449. Like EIA/TIA-449, EIA-530 refers to the electrical specifications of EIA/TIA-422 and EIA/TIA-423. Although the specification recommends a maximum speed of 2 Mbps, EIA-530 is used successfully at 4 Mbps and at even faster speeds over short distances; however, do so at your own risk. We do not recommend exceeding the published speed and distance specifications. EIA-530 is used primarily in the United States.

The EIA-530 adapter cable is available in DTE mode only. The router (FSIP) end of the EIA-530 adapter cable is a high-density 60-pin plug. The opposite (network) end of the adapter cable is a standard DB-25 plug commonly used for EIA/TIA-232 connections. Figure 2-38 shows the DB-25 connector at the network end of the adapter cable.

**Figure 2-38 EIA-530 Adapter Cable Connector, Network End (Available in DTE Only)**



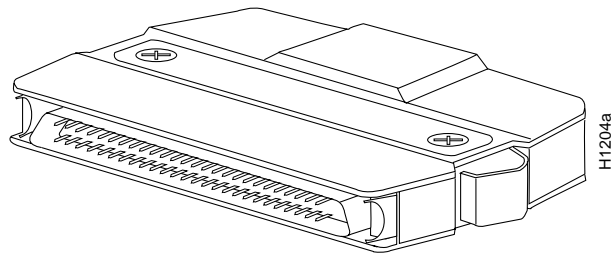
### M3 Metric Thumbscrew Replacements

A pair of metric thumbscrews is included with each port adapter cable except V.35. If you will connect serial cables to remote devices that use metric hardware, replace the standard 4-40 thumbscrews at the network end of those cables with the M3 thumbscrews. Refer to “Connecting to Metric-Based Devices” in the chapter “Installing the Router” for replacement instructions.

### HSSI Connection Equipment

You will need an T3, E3, or SONET STS-1 DSU and HSSI interface cable to connect the HIP with the external network. The HIP HSSI interface port is a 50-pin SCSI-II-type receptacle. The HSSI interface cable comprises 25 twisted pairs and a 50-pin plug at each end; Figure 2-39 shows the connector that is at both ends of the cable. Although the HSSI cable is similar to a SCSI-II cable, it is not identical; you cannot substitute a SCSI-II cable for a HSSI interface cable. (See the following Caution.)

**Figure 2-39 HSSI Interface Cable Connector**



**Caution** Although the HIP connector and the HSSI interface cable are similar to SCSI-II format, the HSSI cable specification is more stringent than that for a SCSI-II. We cannot guarantee proper operation if a SCSI-II cable is used instead of an HSSI interface cable.

A null modem cable (CAB-HNUL) allows you to connect two routers directly back to back between an available HSSI port on each. This setup allows you to verify the operation of the HSSI port or to directly link the routers in order to build a larger node. The null modem cable uses the same 50-pin connectors as the HSSI interface cable, but the signals are wired differently. For instructions for connecting a null modem cable, refer to the section “HSSI Connections” in the chapter “Installing the Router.” The appendix “Cabling Specifications” lists the cable pinouts.

## Console and Auxiliary Port Connection Equipment

The RP (and RSP7000) contain two EIA/TIA-232 ports: a DCE-mode console port (DB-25 receptacle) and a DTE-mode auxiliary port (DB-25 plug). These are asynchronous ports (unlike the synchronous FSIP serial ports), so be sure that any devices you connect to these ports are asynchronous. Synchronous transmission uses precise timing to synchronize transmissions between the transmitter and receiver, and maintains separate clock and data signals. Asynchronous transmission uses control bits to indicate the beginning and end of characters instead of a precise clock signal.

You need a console terminal to configure the interfaces and bring the system online. You also need an EIA/TIA-232 DCE console cable to connect the terminal to the console port on the RP (or RSP7000). After you establish normal operation, you can disconnect the terminal. Both ends of the console cable should be EIA/TIA-232 plugs to enable you to connect to the RP (or RSP7000) DCE console port DB-25 receptacle and to the DB-25 receptacles used on the DTE ports on most terminals.

Before you connect a terminal to the console port, configure the terminal to match the router console port as follows: 9600 baud, 8 data bits, no parity, 2 stop bits (9600 8N2).

The auxiliary port is a DTE DB-25 plug that you can use to connect an asynchronous modem, another router, a CSU/DSU, or other DCE equipment. You also must supply your own interface cable between the auxiliary port and the equipment you are connecting. For console and auxiliary port pinouts, refer to the appendix “Cabling Specifications.”



## Tools for Installation

The chassis is fully assembled at the factory; no assembly is required. Following are the tools and equipment you will need to install the chassis and the rack-mount kit:

- Number 1 Phillips and 3/16-inch flat-blade screwdrivers to tighten the captive installation screws on the interface processors (most interface processor carriers use slotted screws, but some use Phillips-head screws).
- If you are installing the chassis in a rack, you will also need the following tools:
  - Number 2 Phillips screwdriver
  - 1/4-inch flat-blade screwdriver
  - Tape measure
  - Level (if needed)
- If you will connect FSIP EIA/TIA-232, EIA/TIA-449, X.21, or EIA-530 serial interface cables to a connection device that uses metric hardware, you will need a 1/4-inch flat-blade screwdriver to replace the standard thumbscrews with M-3 metric thumbscrews.
- If your Ethernet interface cables use thumbscrews instead of the slide-type locks used on EIP ports, you will need a 3/16-inch flat-blade screwdriver to replace the slide locks with jackscrews.

To perform maintenance on chassis components, or to replace components, you need the following tools:

- Number 1 Phillips and 3/16-inch flat-blade screwdrivers for the captive installation screws on the interface processors
- 3/16-inch flat-blade screwdriver for the captive slotted screws on the chassis cover panel
- Number 1 Phillips screwdriver for the power harness cover and backplane cover (you must remove the backplane cover to remove or replace the power supply or the arbiter)
- Number 2 Phillips screwdriver for the power supply and fan tray
- Antistatic mat or antistatic foam pad if you will remove interface processors or replace components on the board
- Your own ESD grounding strap or the disposable ESD strap included with the system

## Initial Configuration Information

After you install the chassis and verify that all the hardware is operating properly, you must configure the system and individual interfaces before you can connect to external networks. You can use the **setup** command facility or standard configuration commands to enter the configuration information.

Before you begin, you should be prepared with global (system-wide) parameters such as host names, passwords, and routing protocols, and with configuration information for each interface such as addresses, rates or speeds of operation, routing protocol specifics, and so on. Following is some of the information you are likely to need, depending upon your configuration:

- Host name for the router.
- Passwords to prevent unauthorized privileged-level access to the EXEC command interpreter and for individual virtual terminal lines.
- Protocols you plan to route.

- Bridging configuration (whether you will use bridging and, if so, on which interfaces).
- Internet Protocol (IP) addresses and subnet masks if you are routing IP.
- Zone names, network numbers, or node numbers for the new interfaces if required.
- Operating speeds for specific interfaces; for example, Token Ring interfaces operate at either 4 or 16 Mbps, and serial interfaces operate at speeds of up to 2 Mbps. The speed of an interface often depends on the speed of the remote device to which it is attached.

For complete configuration instructions, refer to the related software documentation.

## Installation Checklist

Use the Installation Checklist in Table 2-15 to assist you with your installation and to provide a historical record of what was done, by whom, and when. Make a copy of this checklist and indicate when each procedure or verification is completed. When the checklist is completed, place it in your Site Log (described at the end of this chapter) along with the other records for your new router.

## Checking the Contents of Your Shipment

Following is the procedure for checking the contents of the shipping container. Use the Installation Checklist in Table 2-15, the Component List in Table 2-16, and the record of your order to ensure that you received all the components you ordered.

- Step 1** Verify that the following are included in the shipping container (the accessories box may be separate):
- One Cisco 7010 router, fully assembled
  - One or more accessories boxes (some or all may be shipped separately)
- Step 2** Check the contents of the accessories box against the Installation Checklist and the packing slip and verify that you received all listed equipment, which should include the following:
- One modular power supply cord
  - One rack-mount kit (2 chassis ears and 12 mounting fasteners)
  - One cable management kit (2 cable management brackets and 6 mounting fasteners)
  - One serial port adapter cable for each FSIP port (if your system has serial interfaces), and metric thumbscrews for each interface except V.35 for conversion if necessary
  - One jackscrew conversion kit for each EIP port (if your system has Ethernet interfaces)
  - One optical bypass cable for each FIP (if your system has FDDI interfaces)
  - Optional equipment that you ordered, such as network interface cables, transceivers, or special connectors.
  - Router hardware and software documentation, if ordered (see the following Note)

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**Note** Cisco no longer automatically ships a hard copy of the entire router documentation set with each system. This documentation is available on UniverCD, which can be obtained at no charge when a router order is placed. For a complete list of documentation, see *Ordering Cisco Documentation* in your warranty package.

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- Step 3** Check the processor slots and verify that the top slot contains an RP, and the slot directly below the RP contains an SP (or SSP). (See Figure 1-3.)
- Step 4** Each of the lower three processor slots (the interface processor slots) each contain an interface processor or a blank interface processor filler. Verify that the configuration matches the packing list and that the interface processors are the correct interface types with the correct number of ports.
- Step 5** This step is optional. Complete the Port Configuration Worksheet shown in Table 2-17. Check the interface processors in the rear of the chassis and record the interface type for each populated interface address. You may need to refer to this worksheet during installation.
- Step 6** Proceed to the section “Site Log” in this chapter, then to the chapter “Installing the Router” to begin installation.

## System Components

Table 2-16 lists all of the standard components that are included with the router and the optional equipment available. Check each item on the Component List as you unpack and verify it. Insert the completed checklist into the Site Log, which is described in the following sections.

## Site Log

A site log provides a historical record of all actions relevant to the router operation and maintenance. Keep your site log in a common place near the chassis where anyone who performs tasks has access to it. Site Log entries might include the following:

- Installation progress—Make a copy of the Installation Checklist and insert it into the Site Log. Make entries on the Installation Checklist as each procedure is completed.
- Upgrades and removal/replacement procedures—Use the Site Log as a record of system maintenance and expansion history. Each time a procedure is performed on the system, update the Site Log to reflect the following:
  - Interface processors installed, removed, or replaced.
  - Power supply removed or replaced.
  - Configuration changed (moving interface processors or moving network interface cables between ports).
  - Software or microcode (firmware) upgraded—Insert any documentation that accompanies upgrades, spares, or new components, such as installation procedures, in the Site Log when you complete the procedure.
  - Corrective maintenance procedures performed.
  - Intermittent problems.
  - Related comments.

Table 2-18 shows a sample Site Log page. Make copies of the sample or design your own Site Log to meet the needs of your site and equipment.

**Initial Configuration Information**

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**Table 2-15 Router Installation Checklist**

<b>Task</b>	<b>Verified by</b>	<b>Date</b>
Date router received		
Router and all accessories unpacked		
Types and numbers of interfaces verified		
Safety recommendations and guidelines reviewed		
Installation Checklist copied		
Site Log established and background information entered		
Site power voltages verified		
Site environmental specifications verified		
Required passwords, IP addresses, device names, and so on, available <sup>1</sup>		
Required tools available		
Network connection equipment available		
Cable management brackets installed (optional but recommended)		
Router mounted in rack (optional)		
Flash memory card (if present) inserted all the way into PCMCIA slot		
AC power cord connected to AC source and router; retention clip secured		
DC power cable connected to DC source and router; strain relief secured		
Captive installation screws on RP, SP (or SSP), RSP7000, RSP7000CI, and interface processors checked		
Port Configuration Worksheet completed (optional)		
Network interface cables and devices connected		
ASCII terminal attached to console port		
Console port set for 9600 baud, 8 data bits, 2 stop bits, no parity		
System power turned on (DC OK indicator is on)		
System boot complete (RP Normal LED is on)		
RP and SP (or SSP), or RSP7000, and all interface processors operational (enabled LED indicator on SP [or SSP] and all interface processors is on)		
Console screen displays correct hardware configuration (displayed after system banner)		
System ready for global and interface-specific configuration		

1. Refer to the related software documentation for first-time software configuration requirements.

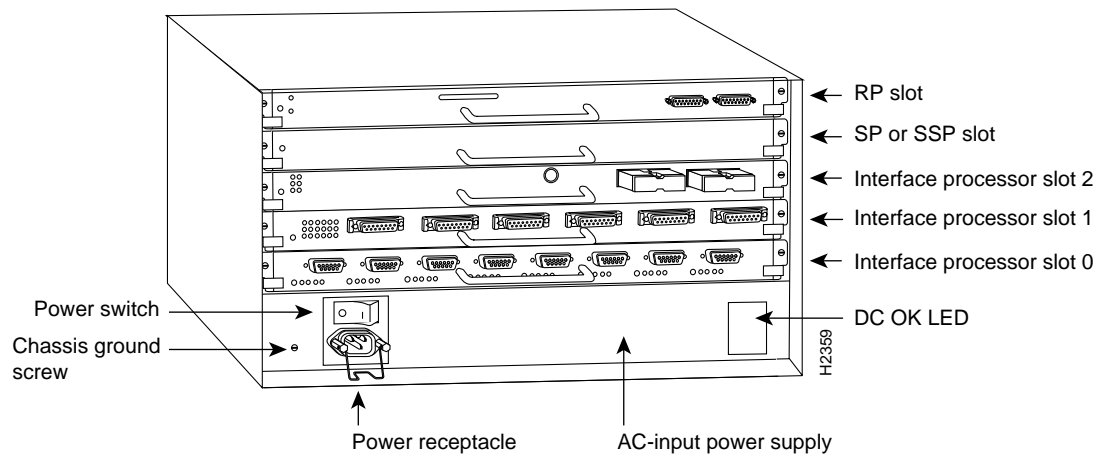
Table 2-16 Component List

Component	Description	Rec'd
Chassis	Router chassis	
Accessories	The following accessories may arrive in separate shipping containers:	
Rack-mount kit	Two chassis ears, four M4 x 10-mm Phillips flathead screws, and eight 10-32 x 3/8" slotted screws	
Cable management kit	Two brackets and six M3 x 6-mm Phillips screws for attaching the brackets to the chassis	
Power cable	One power cable	
EIP port jackscrews	One jackscrew conversion kit for each Ethernet port	
FEIP port jackscrews	One jackscrew conversion kit for each Fast Ethernet port	
FSIP interface cables	Verify that you receive 1 of the following adapter cables for each FSIP port:	
	EIA/TIA-232 DTE or DCE serial port adapter cable, 1 per port required	
	EIA/TIA-449 DTE or DCE serial port adapter cable, 1 per port required	
	V.35 DTE or DCE serial port adapter cable, 1 per port required	
	X.21 DTE or DCE serial port adapter cable, 1 per port required	
	EIA-530 DTE serial port adapter cable, 1 per port required	
	One pair of M-30 metric thumbscrews with each cable type except V.35	
Optional interface cables	AUI or Ethernet transceiver cable, 1 per EIP port required	
	One jackscrew conversion kit for each Ethernet AUI ports (install only if needed)	
	Token Ring interface cable, 1 per TRIP port required	
	FDDI interface cables, 1 or 2 multimode, 2 or 4 single-mode for each FIP	
	HSSI interface cable, 1 per port required	
	Null modem cable for back-to-back HSSI connections	
	MIP cables, 1 per port required	
	AIP cables and types, 1 per AIP port required	
Other optional equipment	Ethernet transceiver or 802.3 attachment unit	
	Fast Ethernet transceiver or 802.3 attachment unit	
	Flash memory card	
	MAU, CSU/DSU for network connections	
Documentation	<i>Cisco 7000 User Guide</i> and <i>UniverCD</i> (ship with chassis), and any printed documentation as ordered	
System components:	Processor slots 5 and 6 should contain an SP (or SSP) and RP, or an RSP7000 (slot 5) and an RSP7000CI (slot 6), and any combination of 5 interface processors or blank interface processor fillers	
RP	Installed in the RP slot (top slot)	
SP	Installed in SP slot instead of SSP (immediately below the RP)	
SSP	Installed in SSP slot instead of SP (immediately below the RP)	
RSP7000	Installs in the SP (or SSP) slot (slot 3) instead of the SP (or SSP). Used with the RSP7000CI.	
RSP7000CI	Installs in the RP slot (slot 4) instead of the RP. Used with the RSP7000.	
AIPs	Enter slot locations and port addresses on Configuration Worksheet	
CIPs	Enter slot locations and port addresses on Configuration Worksheet	
EIPs	Enter slot locations and port addresses on Configuration Worksheet	

Initial Configuration Information

Component	Description	Rec'd
FEIPs	Enter slot locations and port addresses on Configuration Worksheet	
TRIPs	Enter slot locations and port addresses on Configuration Worksheet	
FIPs	Enter slot locations and port addresses on Configuration Worksheet	
FSIPs	Enter slot locations and port addresses on Configuration Worksheet	
HIPs	Enter slot locations and port addresses on Configuration Worksheet	
MIPs	Enter slot locations and port addresses on Configuration Worksheet	
Other optional equipment:		

**Figure 2-40 7010 Interface Processor Slot Locations and Numbering**



**Table 2-17 Port Configuration Worksheet**

	Slot 0—Refer to Figure 2-40	Slot 1—Refer to Figure 2-40	Slot 2—Refer to Figure 2-40
<b>Port 0</b>			
<b>Port 1</b>			
<b>Port 2</b>			
<b>Port 3</b>			
<b>Port 4</b>			



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# Installing the Router

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This chapter provides the following procedures for installing the router, making all external cable connections, turning on the system power, and verifying that the system initializes properly:

- Installing the chassis in an equipment rack (optional) or on a table top
- Installing the cable management brackets (optional but strongly recommended)
- Making external connections
- Starting up the router

The rack-mount kit provides the hardware for mounting the chassis in a standard 19-inch-wide equipment rack or in a Telco-type rack. If you are installing an equipment shelf or using mounting hardware other than that supplied with the chassis, review the guidelines in the section “Equipment Racks” in the chapter “Preparing for Installation,” then proceed to the section “General Installation” in this chapter after the router is installed in the rack. A cable management kit is also included with the chassis. Install these fixtures to keep network interface cables untangled and orderly, and to maintain clear access to interface processors in the lower interface processor slots.

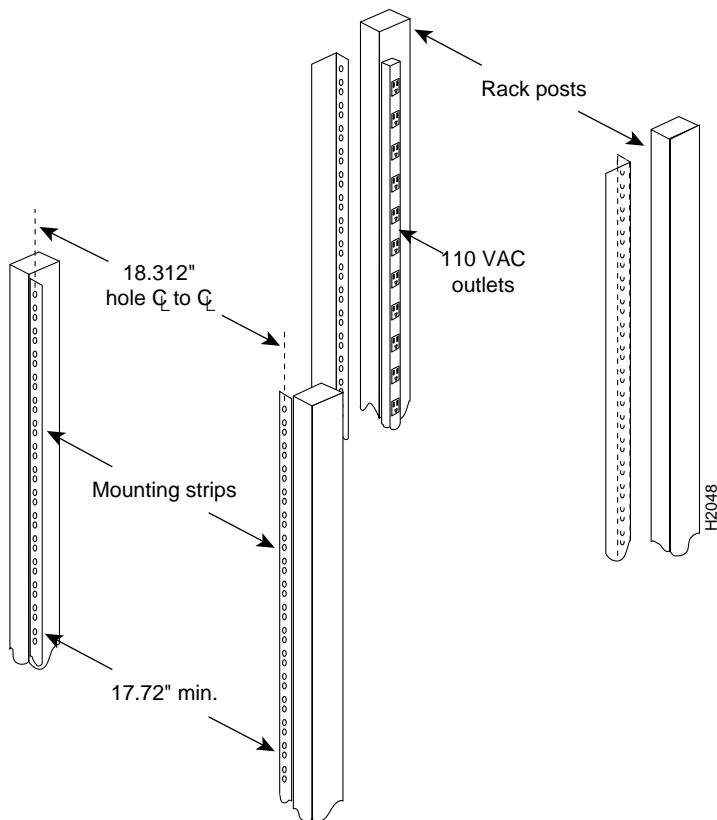
## Rack-Mounting the Chassis

The rack-mounting kit included with the router is for a standard 19-inch, two- or four-post rack or a two-post Telco-type rack. The chassis mounts to two rack posts with ears that attach to the sides of the chassis. The inside width between the two posts or mounting strips (left and right) must be at least 17.72 inches. (See Figure 3-1.) The chassis ears attach to *either* the front or back of the chassis, so that you can position either the interface processor or noninterface processor end at the front of the rack. Install the cable management fixtures after you install the chassis in the rack.

Some equipment racks provide a power strip along the length of one of the mounting strips. Figure 3-1 shows a typical 19-inch equipment rack with a power strip along one of the back posts. If your rack has this feature, consider the position of the strip when planning fastener points and ensure that you will be able to pull processor modules straight out of the slots. Also, if you plan to install the cable management brackets, ensure that the power strip does not block the sides of the brackets and prevent you from routing the cables through them. When possible, install the interface processor end of the chassis away from the power strip to avoid problems accessing cables and interface processors. (See the section “Equipment Racks” in the chapter “Preparing for Installation.”)

The inlet and exhaust ports for cooling air are located in the sides of the chassis, so multiple routers can be stacked in a rack with little or no vertical clearance. If necessary, you can remove the four chassis feet. The chassis is 10.50 inches high when the feet are removed.

Figure 3-1 Typical 19-Inch Equipment Rack Posts and Mounting Strips



## Tools and Equipment

Have the following tools on hand before you begin the rack installation:

- Number 1 and number 2 Phillips screwdrivers
- 1/4-inch and 3/16-inch flat-blade screwdrivers
- Tape measure
- Level (optional)

The rack-mount kit includes the following parts:

- Two chassis ears
- Four M3 x 8-mm Phillips flathead screws to secure the ears to the chassis
- Eight 10-32 x 3/8-inch slotted binderhead screws to secure the chassis ears to the rack rails

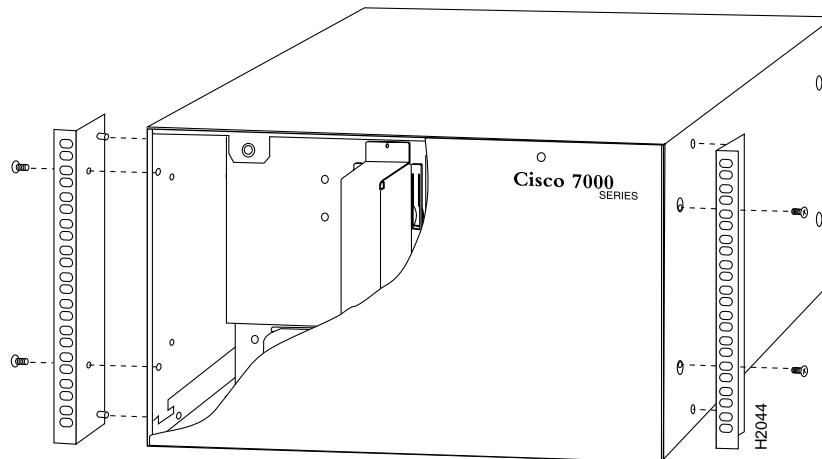
When installing the router in an enclosed rack, removing the door temporarily may provide additional clearance. We recommend that you have someone to assist you by supporting the chassis while you mount it in the rack by securing the chassis ears to the rack-mounting strips.

## Installing the Ears on the Chassis

The chassis should be unpacked, and you should have already verified the router configuration.

Each chassis ear has two studs that fit into holes in the chassis. The chassis has two pairs of holes on each side: one pair near the interface processor end and one pair near the noninterface processor end. Both ears must be installed at the same end on each side. Install the ears near the end of the router that will be in the front of the rack. For example, if you plan to install the chassis with the interface processor end of the router at the front and the noninterface processor end in the back of the rack, install the ears near the interface processor end of the chassis. (See Figure 3-2.)

**Figure 3-2** Installing the Ears on the Chassis



**Warning** After attaching the chassis ears, we recommend that two people install the chassis in the rack. (One person supports the chassis in the rack while the second person installs the fasteners.)

To install the ears on the chassis, follow these steps:

- Step 1** On the rack, measure the space between the inner sides of the left and right front posts or mounting strips to ensure that it is at least 17.72 inches wide. (The chassis is 17.65 inches wide with the ears installed and must fit between the mounting strips.)
- Step 2** Refer to Figure 3-2 and locate the guides in the chassis sides.
- Step 3** While referring to Figure 3-2, turn the chassis so that the end that will be in the front of the rack is facing toward you. For example, Figure 3-2 shows the correct orientation for the router if the noninterface processor end will face out the front of the rack.
- Step 4** On the sides of the chassis, locate the stud holes and tapped holes nearest you.
- Step 5** Attach the first chassis ear to the right side of the chassis. Hold the ear in the orientation shown by the right ear in the Figure 3-2; the studs point toward the chassis and the mounting holes face you.
- Step 6** Insert the studs into the holes on the side of the chassis, as shown in Figure 3-2.

**Step 7** Use a number 2 Phillips screwdriver to secure two M3 x 8-mm Phillips flathead screws to the chassis, and then repeat this procedure for the other ear. Ensure that the strip of mounting holes on each ear is approximately flush with the end of the chassis. (See Figure 3-2.)

**Step 8** Proceed to the next section to install the chassis in the rack.

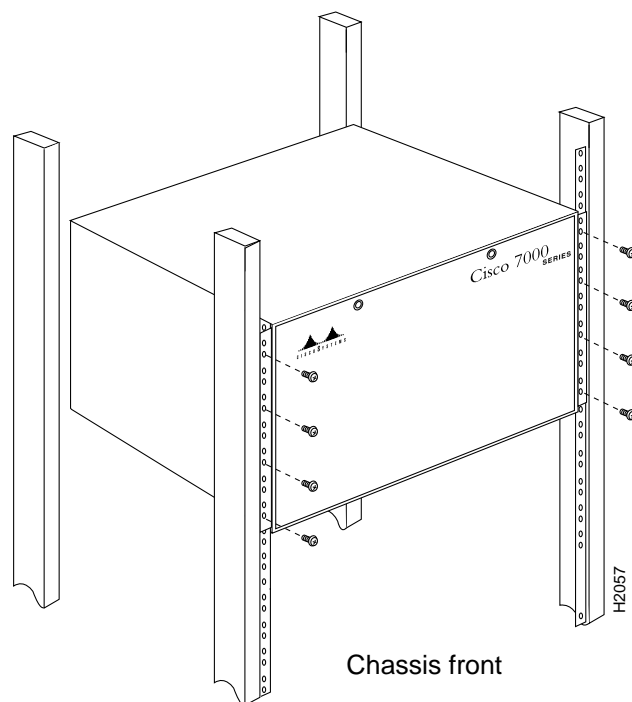


**Warning** Before installing the router in a rack, and to prevent personal injury, review the section “Safety Recommendations” in the chapter “Preparing for Installation.”

### Installing the Chassis in the Rack

The ears secure the chassis to two rack posts, and the rest of the chassis is cantilevered off the ears. After installing the ears on the chassis, mount the router by securing the ears to two posts or mounting strips in the rack with the eight slotted screws provided. Because the ears bear the weight of the entire chassis, be sure to use all eight slotted screws to fasten the chassis ears to the rack posts. Figure 3-3 shows a typical installation in a standard, 19-inch equipment rack with four mounting posts. Figure 3-4 shows a typical installation in a Telco-type rack, which usually has two center posts and is bolted to the floor. If you are mounting the router in a rack with four posts, use all eight slotted screws to mount the chassis on the front posts.

**Figure 3-3** Installing the Chassis in a Four-Post, 19-Inch Rack



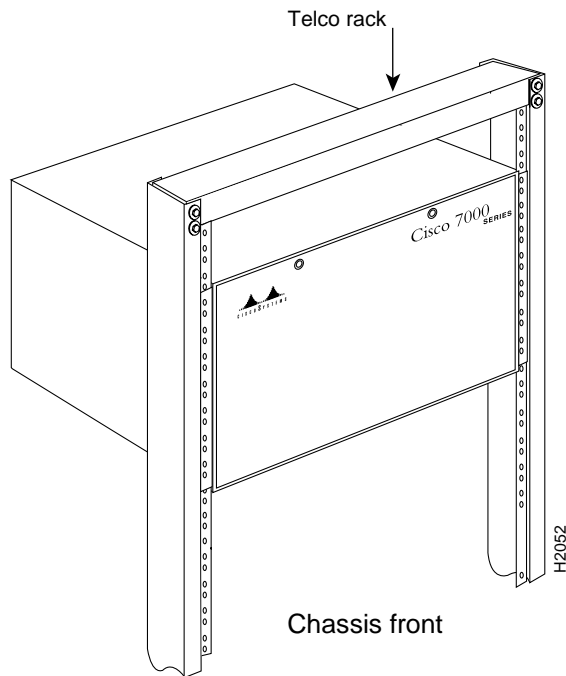
We recommend that you allow at least one or two inches of vertical clearance between the router and any equipment directly above and below it. However, if necessary to save vertical space in the rack, you can remove the four chassis feet either before or after you install the chassis in the rack. (It is easier to grip the underside of the chassis to lift it when the feet are in place). Each rubber foot is secured to the chassis bottom with a slotted screw. If removal is necessary, use a 3/16-inch flat-blade screwdriver to remove the feet, then put the feet in a safe place in case you need them later.

Unless you have a way of supporting the chassis in the rack while you install the fasteners, get another person to assist you so that one person can support the chassis while the other installs the fasteners.



**Warning** Ensure that heavier equipment is installed near the bottom of the rack to maintain a low center of gravity. Otherwise, because the two front posts bear the entire weight of the chassis, the rack could become top-heavy and tip over if it is not stabilized with heavier equipment at the bottom or anchored to the floor.

**Figure 3-4** Installing the Chassis in a Telco Rack



**Warning** When installing the router in Telco-type racks, ensure that the rack is bolted to the floor and, if necessary, anchored with appropriate fixtures.

To install the chassis in the rack, follow these steps:

- Step 1** On the chassis, ensure that all captive screws (on the processor modules and on the access cover) are tightened and the components are secure.
- Step 2** Make sure that your path to the rack is unobstructed. If the rack is on wheels, ensure that the brakes are engaged or that the rack is otherwise stabilized.



**Warning** Never attempt to lift or tilt the chassis with the handles on the interface processor carriers or with the cable management brackets. Neither the handles nor the brackets are designed to support the weight of the chassis.

- Step 3** Position the chassis so that the end with the ears attached is closest to you, then lift the chassis and move it to the rack. Avoid sudden twists or moves to prevent injury.
- Step 4** Insert the rear of the chassis into the rack, pushing it back until the ears meet the front mounting strips or posts on both sides of the equipment rack.
- Step 5** While keeping the chassis ears flush against the posts or mounting strips, slide the router up or down until the holes in the ears are aligned with those in the mounting strips.
- Step 6** *Two people should perform this step.* From the front of the rack, insert all eight 8-32 x 3/8 slotted screws (four on each side) through the chassis ears and into the mounting strip.
- Step 7** When all screws are inserted, use a 1/4-inch flat-blade screwdriver to tighten each one.
- Step 8** Skip this step if the cable management brackets are already installed on the router. When the router is secure, install the cable management brackets at the interface processor end of the router. If the router is installed in an enclosed rack, ensure that the rack door will close properly after the device and cables are installed. Refer to the section “Rack-Mounting the Chassis” earlier in this chapter.
- Step 9** You can remove the four chassis feet to gain an extra 1/2-inch of vertical space below the chassis. However, we recommend that you allow at least 1 or 2 inches of vertical clearance above and below the chassis, which is greater than the height of the feet. If necessary, use a 1/4-inch flat-blade screwdriver to remove the feet.
- Step 10** Connect the power cord to the AC input receptacle (below the processor slots at the interface processor end of the router). Snap the cable retention clip up around the connector to secure the cable in the port.

This completes the rack installation. Proceed to the section “Installing the Cable Management Brackets” in this chapter to continue the installation.

## General Installation

The router should already be in the area where you will install it, and your installation location should already be determined; if not, refer to the section “Site Requirements” in the chapter “Preparing for Installation.”

When installing the router on a table top, ensure that you have planned a clean, safe location for the chassis and have considered the following:

- The location does not block the chassis sides, which are the inlet and exhaust vents for cooling air. Allow at least 2 inches of clearance on each side of the chassis.
- Multiple chassis can be installed in equipment racks with only an inch or more of vertical clearance, but do not place them side by side. Allow at least two inches of clearance on each side of the chassis, and avoid placing other devices or equipment nearby that can force heated exhaust air into the router inlet vents.
- Do not place the router on the floor. Floors accumulate dust, which would be drawn into the chassis interior by the fans. Excessive dust inside the chassis interior can cause overtemperature conditions and component failures. A raised platform or sturdy table provides a cleaner environment than the floor.
- When deciding where to install any equipment, consider future maintenance requirements. Allow adequate clearance for maintenance (installing/replacing interface processors, or making/adding network connection cables or equipment).

If you do not mount the router in a rack, follow these steps to install the router on a bench or tabletop:

- Step 1** Make sure that the area where you install the router is free of debris and dust. Also make sure your path between the router and its planned location is unobstructed.
- Step 2** On the chassis, ensure that all captive screws (on the processor modules and on the access cover) are tightened and the components are secure.



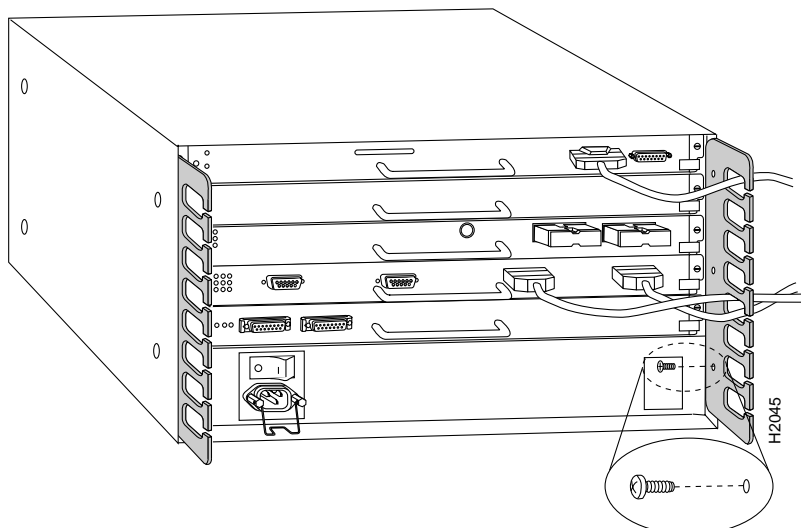
**Warning** To prevent damage, never attempt to lift or tilt the chassis with the handles on the interface processors. These handles are not designed to support the weight of the chassis.

- Step 3** Lift the chassis by placing your hands around the chassis sides and lifting the chassis from underneath. Avoid sudden twists or moves to prevent injury.
- Step 4** Place the router in a location where the air inlet vents on the side of the chassis are not obstructed, nor are they drawing in exhaust air from other equipment.
- Step 5** Ensure that the new location allows adequate clearance around the chassis for maintenance.
- Step 6** After the router is in place, proceed to the next section to connect the interface cables.

## Installing the Cable Management Brackets

The cable management brackets (shown in Figure 3-5) attach to the inner sides of the chassis at the interface processor end. Use the brackets to keep network interface cables untangled and orderly, and to prevent cables from hindering access to interface processors in the lower interface processor slots. Install the brackets before connecting network interface cables to the interface processor ports; otherwise, you will probably need to disconnect the cables to install the screws that secure the brackets. Route interface cables through the cable management brackets as you connect them to the interface processor ports. If necessary, wrap cable ties through the holes provided to secure small-gauge cables.

**Figure 3-5** Cable Management Brackets



### Tools and Equipment

You will need the following tools and parts to install the cable management brackets; the brackets and panhead screws are included with the chassis:

- Number 1 Phillips screwdriver
- Two cable management brackets
- Six M3 x 8-mm Phillips panhead screws.

### Installing the Brackets

Follow these steps to install the two cable management brackets on the router:

- Step 1** Assemble the two cable management brackets and the six M3 x 8-mm Phillips panhead screws.
- Step 2** At the interface processor end of the router, place a bracket on an inner side of the chassis and align the three holes in the bracket with the holes in the chassis. (See Figure 3-5.)
- Step 3** Insert and finger-tighten three M3 Phillips screws from the inner side of the chassis, through the bracket and into the chassis.
- Step 4** When all three screws are inserted, use the number number 1 Phillips screwdriver to tighten the screws.
- Step 5** Repeat Steps 2 through 4 for the second bracket.
- Step 6** When installing the network interface cables, route the cable to the cable management brackets as shown in Figure 3-5. If you are using very thin cables that slip through the bracket openings, insert cable ties through the holes in the bracket and wrap them around the cables to secure them.

This completes the cable management bracket installation. Proceed to the next section to connect the interface cables.

### Connecting Power

Connect an 550W, AC-input power supply as follows:

- Step 1** Push the cable-retention clip down, away from the power cord port, and plug in the power cord.
- Step 2** To secure the cable in the power supply AC receptacle, push the cable-retention clip up until it snaps into place around the connector. The cable-retention clip provides strain relief for the AC power cord.
- Step 3** Connect the power supply cord to the AC source.

Connect a 600W, DC-input power supply as follows:

- Step 1** Before proceeding, make certain the DC-input power cable is disconnected from the DC power source and the power switch on the power supply is in the OFF (O) position.
- Step 2** Loosen the captive screws on the terminal block cover so it is free of the terminal block. (See Figure 3-6a.)
- Step 3** Attach the 10-AWG ground wire to the ground terminal. (See Figure 3-6d.)



**Step 4** Feed the 10-AWG, RTN and -48V wires through the large hole in the face of the terminal block cover. (See Figure 3-6b.) Feed a sufficient length (approximately 3 inches) of these two wires away from you, through the terminal block cover.

**Step 5** Attach and tighten the RTN and -48V leads to the terminal block. (See Figure 3-6d.) Verify that you are connecting the appropriate leads to the correct terminal block posts. The color coding is up to you, but should match the connections at the DC power source.

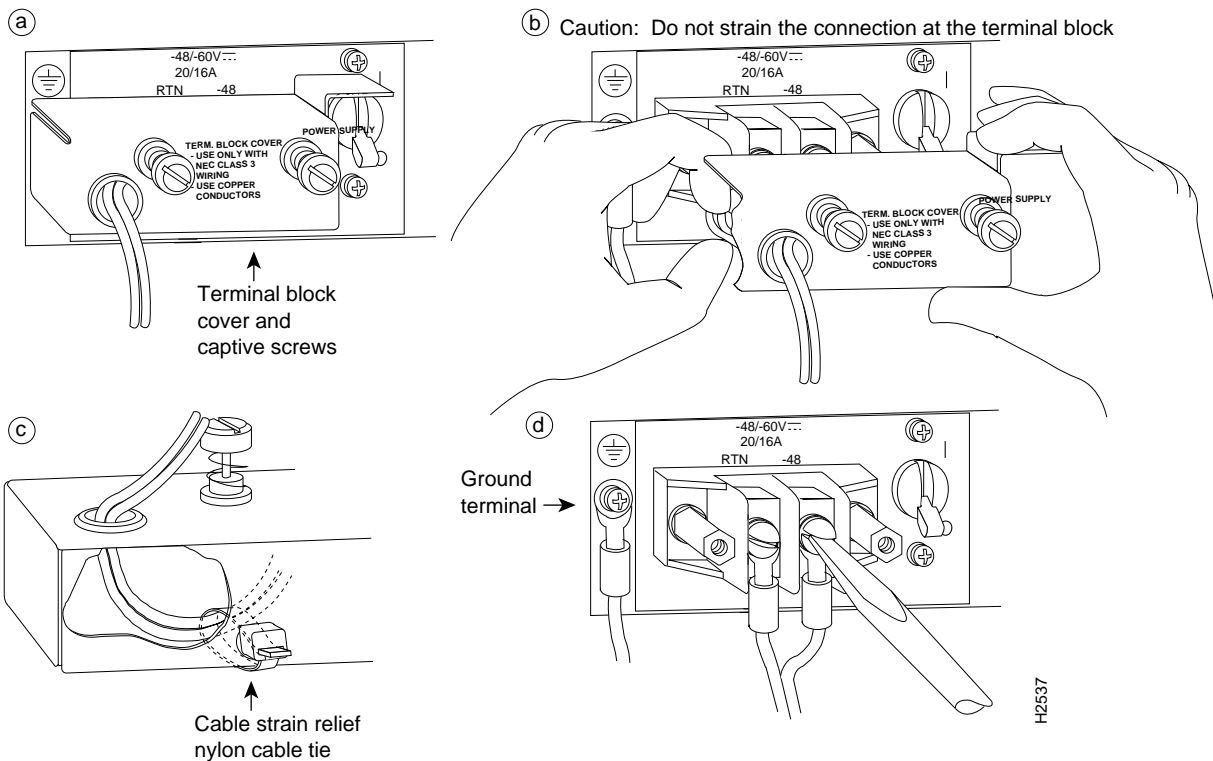


**Warning** Incorrectly wiring the terminal block could create a shock hazard and could damage the power supply, power source, and the Cisco 7010 chassis components. Make certain there are no loose strands that could cause a short circuit of the power supply and power source.

**Step 6** Using a nylon cable tie that you provide, fasten the RTN and -48V leads to the terminal block cover, as shown in Figure 3-6c. Insert the nylon cable tie through the small hole at the bottom of the terminal block cover and around the two leads.

**Step 7** Bundle the RTN and -48V wires behind the terminal block cover so that the cover fits over the wires and the terminal block. (See Figure 3-6b.) Take care not to strain the leads on the terminal block or crimp the wires behind the cover. (See Figure 3-6a.)

**Figure 3-6 Removing and Replacing the Terminal Block Cover and Power Cable Leads**



**Step 8** Position the cover over the terminal block and tighten the captive screws. (See Figure 3-6a.)



**Warning** To prevent a short-circuit or shock hazard after wiring the DC-input power supply, replace the terminal block cover.

**Step 9** Connect the three DC-input power cable leads to the DC power source.

## Connecting Interface Cables

The following sections describe the basic network connections you will make to the router. Using the Configuration Worksheet will help you to make connections and later configure each interface without having to access the rear of the chassis to check port addresses. We recommend that you complete the “Port Configuration Worksheet” in the chapter “Preparing for Installation” (Table 2-17) if you have not already done so.

### External Cabling Guidelines

The following guidelines will assist you in properly connecting the external network cables to the router interface ports.



**Warning** Invisible laser radiation may be emitted from the aperture ports of the single-mode FDDI products when no fiber cable is connected. Avoid exposure and do not stare into open apertures. This product meets the Class 1 Laser Emission Requirement from CDRH FDDI.

- Make certain that you connect the correct interface types.

All FSIP serial ports are a high-density 60-pin receptacle. Each port requires a serial port adapter cable to connect to the external network. The cable determines both the electrical interface type and mode of the port to which it is connected. The network end of each adapter cable type is the industry-standard connector normally used for the interface type. (For example, the EIA/TIA-232 port adapter cable has a standard DB-25 connector at the network end.)

Following are guidelines for connecting serial interface cables:

- A label that identifies the electrical interface type and mode is molded into the cable connectors.
  - EIA/TIA-232 and EIA-530 are the only interface types that use the same type of connector, a DB-25. If you are using both EIA/TIA-232 DTE mode and EIA-530, check the labels carefully.
  - Generally, cables for DTE mode use a plug at the network end, and cables for DCE mode use a receptacle at the network end. An exception is the V.35 cables, which are available with either a plug or receptacle in either mode.
- Verify the interface numbers (also called *port addresses*) on the rear of the chassis and the cables you will connect to each.

Each port has a unique address composed of the interface processor slot number and the port number on the interface processor. For a description of interface addresses, refer to the section “Port Addresses” in the chapter “Product Overview.”

- Avoid crossing high-power cables with interface cables.

Crossing high-power cables with interface cables can cause interference in some interface types. It will not always be possible to avoid this, but try to prevent it whenever possible.

- Install and use the cable management brackets.
- We recommend that you install and use the cable management brackets that are included with the router; these brackets will help keep your cables organized and untangled, and will enable access to interface processors without having to disconnect interface cables from adjacent interface processors unnecessarily. (See the section “Rack-Mounting the Chassis” in this chapter.)
- Do not defeat cable strain-relief systems.

Most interfaces provide some type of strain relief to prevent the cables from being accidentally disconnected. Among these types of strain relief are the slide fasteners on Ethernet cables, the cable retention clip on the power supply cord, and the screw-type fasteners on serial cables. The cable management brackets can also help to provide strain relief, especially when you use cable ties to secure the cables to the brackets. Use all strain-relief devices provided to prevent potential problems caused by inadvertent cable disconnection.

- Verify proper interface cabling before starting the system.

Before applying power to the system, prevent unnecessary problems or component damage by double-checking your cabling.

- Verify all cabling limitations before applying power to the system.

When setting up your system, you must consider a number of factors related to the cabling required for your connections. For example, when using EIA/TIA-232 connections, be aware of the distance and electromagnetic interference limitations. For cabling distances and other requirements, refer to the section “Site Requirements” in the chapter “Preparing for Installation.”

- Check the power cord and power supply for compatibility with your power service.

Check the labels on the equipment and ensure that the power service at your site is suitable for the chassis you are connecting. If you are not sure, refer to the section “AC and DC Power” in the chapter “Preparing for Installation.”



**Warning** A voltage mismatch can cause equipment damage and may pose a fire hazard. If the voltage indicated on the label is different from the power outlet voltage, *do not connect the chassis to that receptacle.*

## Tools and Equipment

Have the following tools on hand to secure interface cables and complete the installation:

- Number 1 Phillips screwdriver
- 3/16-inch flat-head screwdriver
- Cable ties

The sections that follow provide illustrations of the connections between the router interface ports and your network(s). Network interface equipment, such as Ethernet transceivers, MAUs, and CSUs, should be available and in place already. If they are not, refer to the section “Preparing Network Connections” in the chapter “Preparing for Installation” for descriptions of the equipment you need for each interface type to complete the connection to your network.

## ATM Connections

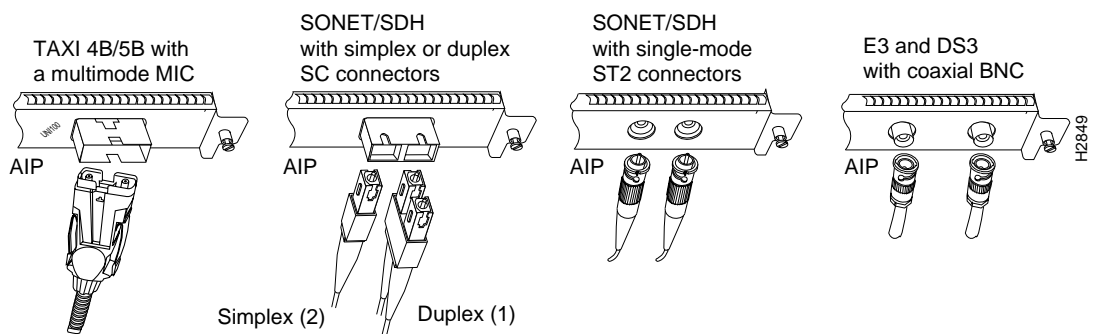
All AIP ATM interfaces are full-duplex. You must use the appropriate ATM interface cable to connect the AIP with an external ATM network. The AIP provides an interface to ATM switching fabrics for transmitting and receiving data up to 155 megabits per second (Mbps) bidirectionally; the actual data rate is determined by the PLIM.

The AIP can support interfaces that connect to the following physical layers:

- TAXI 4B/5B 100 Mbps multimode fiber optic
- SONET/SDH 155 Mbps multimode fiber optic—STS-3C or STM-1
- SONET/SDH 155 Mbps single-mode fiber optic—STS-3C or STM-1
- E3 34 Mbps coaxial cable
- DS3 45 Mbps ( $\pm 20$  parts per million [ppm]) coaxial cable

Connect the AIP interface cables as shown in Figure 3-7. For detailed descriptions of ATM cabling requirements, refer to the section “Distance Limitations” in the chapter “Preparing for Installation” and the section “ATM Connection Equipment” in the chapter “Preparing for Installation.”

**Figure 3-7 ATM (AIP) Connections**



**Caution** To ensure compliance with EMI standards, the E3 PLIM connection requires an EMI filter clip (CLIP-E3-EMI) on the receive port (RCVR); the DS3 PLIM connection does not require this clip. Figure 3-8 shows the EMI filter clip assembly that is required for the E3 PLIM. *Do not* operate the E3 PLIM without this assembly.

The E3 and DS3 PLIMs require cable CAB-ATM-DS3/E3. If you have an E3 PLIM, you must follow Steps 1 through 3 to install the CAB-ATM-DS3/E3 cable and EMI filter assembly. If you do not have an E3 PLIM, proceed to the appropriate section for your configuration.

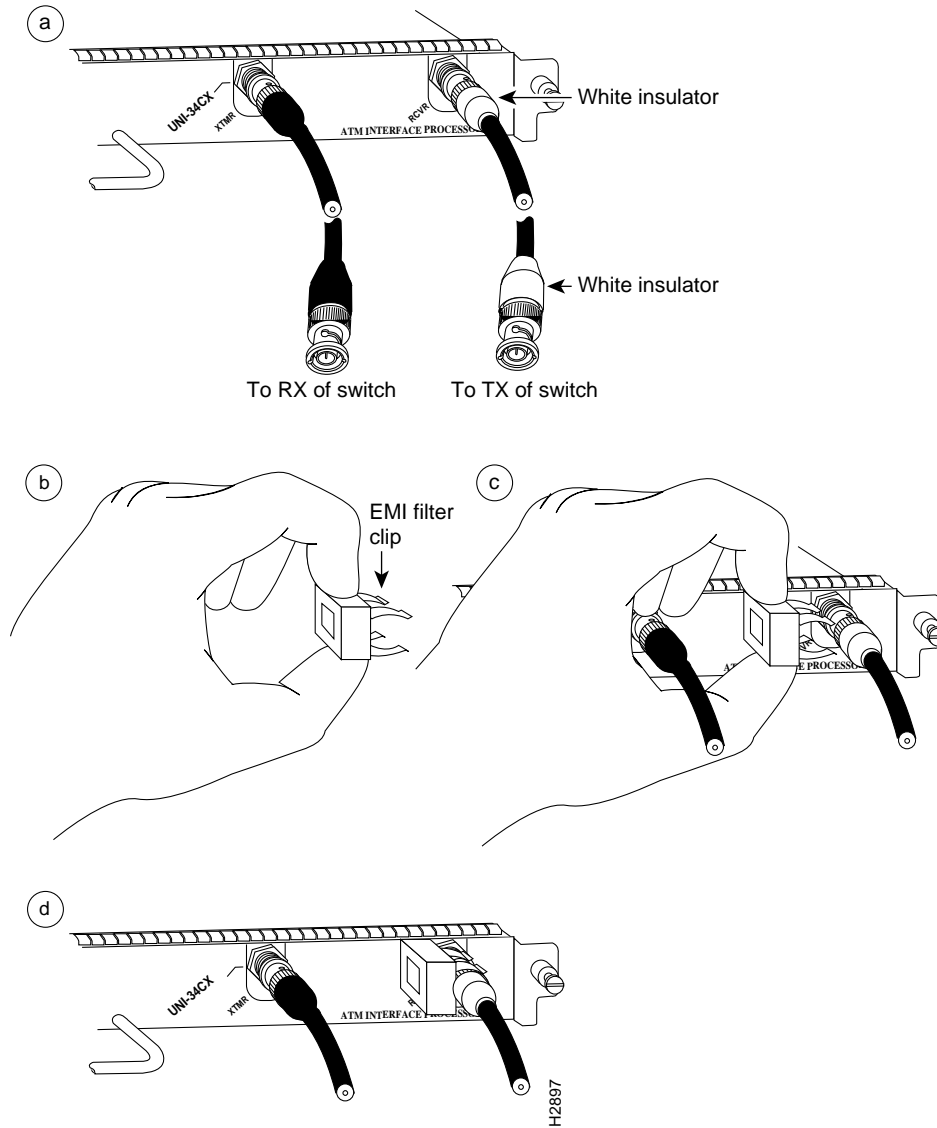
**Step 1** Attach the CAB-ATM-DS3/E3 cable to the transmit (XMTR) and receive (RCVR) ports on the E3 PLIM. (See Figure 3-8a.)

One portion of the cable has a white insulator on both ends to ensure that the receive-to-transmit and transmit-to-receive relationship is maintained between the E3 PLIM and your ATM switch. The portion of the cable with the white insulator should attach between receive and transmit *or* transmit and receive ports of the E3 PLIM and your ATM switch, respectively.

**Step 2** Hold the EMI filter clip as shown in Figure 3-8b and attach it to the receive cable as shown in Figure 3-8c.

**Step 3** To ensure that the clip is not pulled off when adjacent interface processors are removed, position the clip parallel to the orientation of the AIP. (See Figure 3-8d.)

**Figure 3-8** Installing the CAB-ATM-DS3/E3 Cable and EMI Filter Clip Assembly—Horizontal Orientation Shown



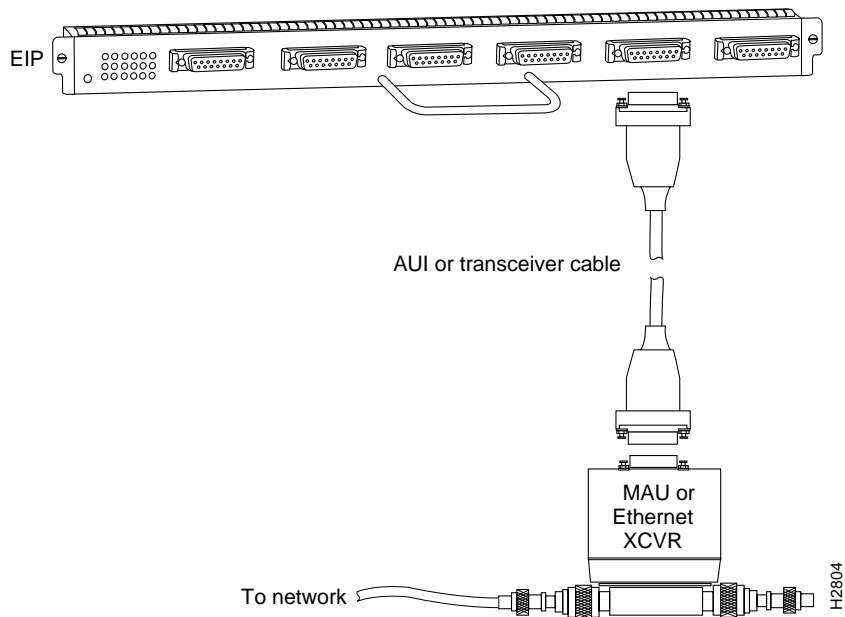
**Note** For additional information, refer to the *Asynchronous Transfer Mode Interface Processor (AIP) Installation and Configuration* configuration note (Document Number 78-1214-xx, where xx is the latest version), which is available on UniverCD or in print.

## Ethernet Connections

An Ethernet transceiver or MAU should already be connected to your network. Connect each Ethernet port on the EIP to an Ethernet transceiver with a transceiver cable, or to an attachment unit with an attachment unit interface (AUI). Figure 3-9 shows an example of a typical connection. Some transceivers connect directly to the Ethernet port on the EIP (usually the 10BaseT type) and do not require an interface cable.

On each EIP port, slide the metal bracket up over two posts on the cable connector, or tighten the thumbscrews to secure the cable in the port and provide strain relief. For descriptions of the connection equipment and connector locks, refer to the section “Ethernet Connection Equipment” in the chapter “Preparing for Installation.”

**Figure 3-9 Ethernet Connections**

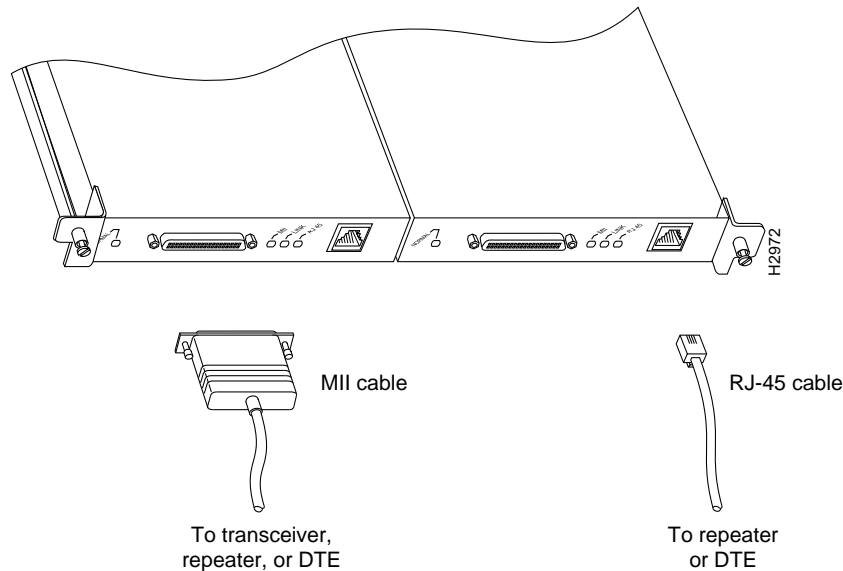


## Fast Ethernet Connections

For an MII connection, a 100BaseT transceiver or MAU should already be connected to your network. The RJ-45 connection does not require an external transceiver. On a single 100BaseT port adapter, you can use *either* the RJ-45 connection *or* the MII connection. If you have two 100BaseT port adapters on your FEIP, you can use the RJ-45 connection on one and the MII connection on the other. RJ-45 and MII cables are not available from Cisco Systems.

If you have RJ-45 connections, attach the Category 5 UTP cable directly to the RJ-45 port on the FEIP. (See Figure 3-10.) If you have MII connections, attach an MII cable directly to the MII port on the FEIP or attach a 100BaseT or 100BaseF transceiver, with the media appropriate to your application, to the MII port on the FEIP. Attach the network end of your RJ-45 or MII cable to your 100BaseT or 100BaseF transceiver, switch, hub, repeater, DTE, or whatever external 100BaseT equipment you have.

**Figure 3-10 Fast Ethernet Connections**



**Caution** To prevent problems on your FEIP and network, do not simultaneously connect RJ-45 and MII cables to one 100BaseT port adapter. On a single 100BaseT port adapter, only one network connection can be used at one time. Only connect cables that comply with EIA/TIA-588 standards.

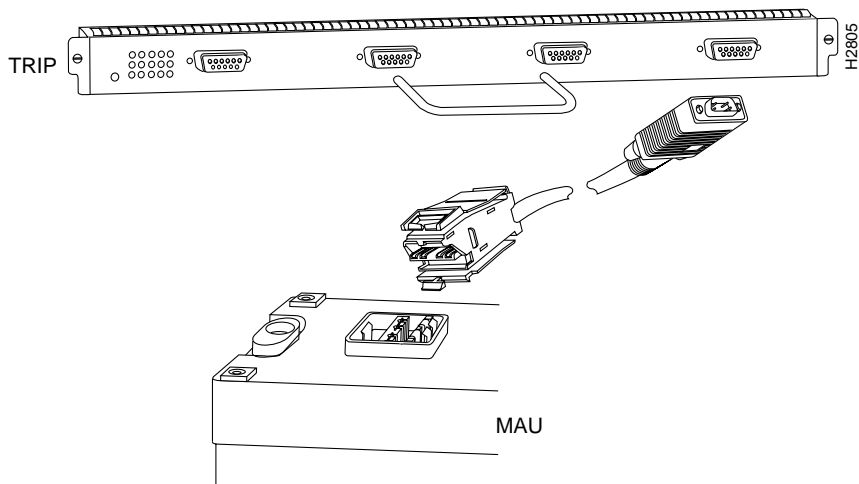
## Channel Attachment Connections

Connecting bus and tag or ESCON cables between the CIP and a host processor is beyond the scope of this publication. The specific CIP connection requirements are discussed in detail in the configuration note *Channel Interface Processor (CIP) Installation and Configuration* (Document Number 78-1342-xx, where xx is the latest version of the document), which ships with the CIP and is also available on UniverCD.

## Token Ring Connections

Each Token Ring interface connects to the ring through a MAU or a multistation access unit (MSAU), which should already be connected to the ring. Connect the Type 1 or Type 3 lobe cables to the appropriate TRIP ports and tighten the thumbscrews to secure the cable in the port and provide strain relief. Then connect the network end of each lobe cable to the MAU or MSAU. For descriptions of the connection equipment, refer to the section “Token Ring Connection Equipment” in the chapter “Preparing for Installation.”

**Figure 3-11** Token Ring Connections



The speed of each Token Ring port must match the speed of the ring to which it is connected. The default speed for all TRIP ports is 4 Mbps, which you can change to 16 Mbps on any port with the configuration command **ring-speed n**, where *n* is the speed (4 or 16) in Mbps. Before you enable the Token Ring interfaces, ensure that each is set for the correct speed, or it can bring the ring down. The following sample session changes the ring speed on Token Ring port 1/2 from the default 4 Mbps to 16 Mbps:

```
7010# configure terminal
int tokenring 1/2
ring-speed 16
^Z
7010# write memory
[OK]
```



**Caution** Each TRIP port must be configured for the same ring speed as the ring to which it is connected, either 4 or 16 Mbps. If the port is set for a different speed, it will cause the ring to beacon, which effectively brings the ring down and makes it inoperable.

## FDDI Connections

Both single-mode and multimode connections are available and can be combined on one FIP. The fiber-optic cable connects directly to the FIP ports. Single-mode uses separate transmit and receive cables. You will need two single-mode cables for a single-attach connection, or four cables for a dual-attach connection. Multimode uses one integrated transmit/receive cable for each physical interface (one for PHY A and one for PHY B). You will need one multimode cable for a single-attach connection, and two cables for a dual-attach connection. Figure 3-17, which shows the connections for a dual-attach connection that uses both single-mode and multimode fiber, illustrates the types of connections used for both fiber modes. For cable and connector descriptions, refer to the section “FDDI Connection Equipment” in the chapter “Preparing for Installation.”

---

**Note** Each station in a ring refers to its neighbor stations as *upstream* or *downstream* neighbors. The *stream* is based on the signal flow on the primary ring. A station receives the primary signal from its upstream neighbor and transmits the primary signal to its downstream neighbor.

---



This section also provides instructions for connecting an optical bypass switch to a dual attachment multimode network connection. Because the method of connecting optical bypass switches varies between different manufacturer's models, refer to the documentation for your particular bypass switch for correct connection instructions. If you are installing an optical bypass switch, proceed to the section "Installing an Optical Bypass Switch" in this chapter.



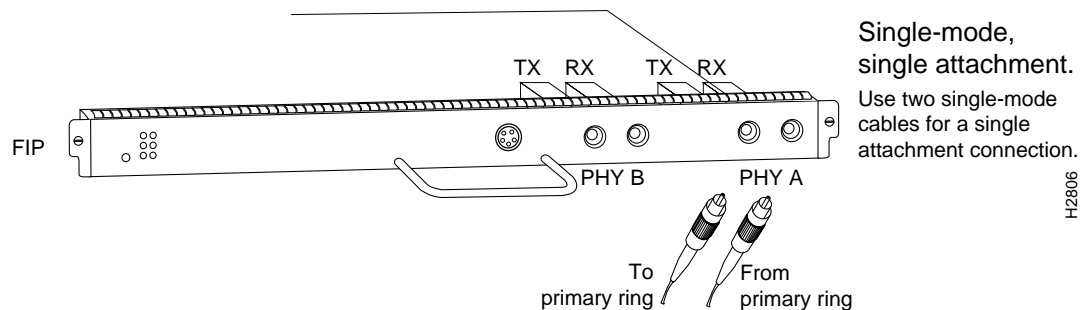
**Warning** Invisible laser radiation may be emitted from the aperture ports of the single-mode FDDI products when no fiber cable is connected. *Avoid exposure and do not stare into open apertures.* This product meets the Class 1 Laser Emission Requirement from CDRH FDDI.

## Single Attach Connections

A FIP that is connected as a single-attach station (SAS) typically is connected to the ring through a concentrator. The FIP receives and transmits the signal through the same physical interface, usually PHY A. Depending on whether you are connecting to a single-mode or multimode fiber network, connect the FIP as follows:

- **Single-mode**—Connect one single-mode interface cable to the PHY A transmit port and one to the PHY A receive port. (See Figure 3-12.) Connect the opposite end of each cable to the concentrator transmit and receive ports as specified by the concentrator manufacturer.

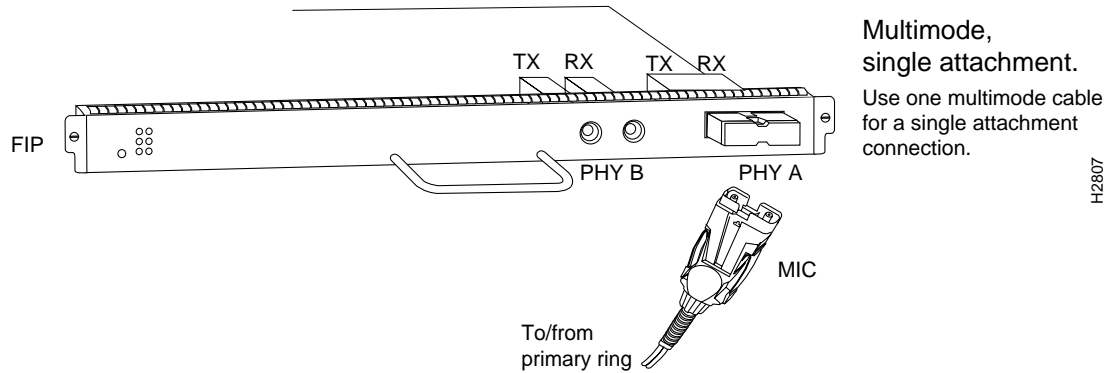
**Figure 3-12 Single Attach Station (SAS), Single-Mode Fiber Network Connections**



- **Multimode**—Connect the multimode interface cable between one of the M ports on the concentrator and the PHY A port on the FIP. (See Figure 3-13.) Be sure to observe and match the port labels on the MIC and the FIP ports; connect receive on the cable to PHY A receive. Follow the concentrator manufacturer's instructions for connecting the opposite end of the cable.

If you are connecting other FIPs as dual attach stations (DASs), proceed to the following section. Otherwise, proceed to "Connecting the Console Terminal" in this chapter.

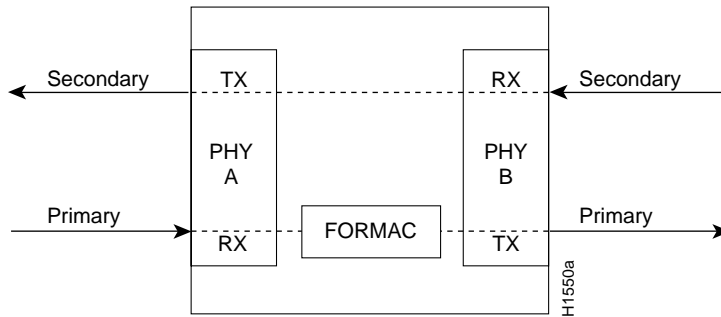
**Figure 3-13 Single Attach Station (SAS), Multimode Fiber Network Connections**



**Dual Attach Connections**

A FIP that is connected as a dual-attach station (DAS) connects to both the primary and secondary rings. The signal for each ring is received on one physical interface (PHY A or PHY B) and transmitted from the other. The standard connection scheme (which is shown in Figure 3-14) for a DAS dictates that the primary ring signal comes into the FIP on the PHY A receive port and returns to the primary ring from the PHY B transmit port. The secondary ring signal comes into the FIP on the PHY B receive port and returns to the secondary ring from the PHY A transmit port. Failure to observe this relationship will prevent the FDDI interface from initializing. Figure 3-17 shows the connections for a dual attachment that uses both multimode and single-mode fiber.

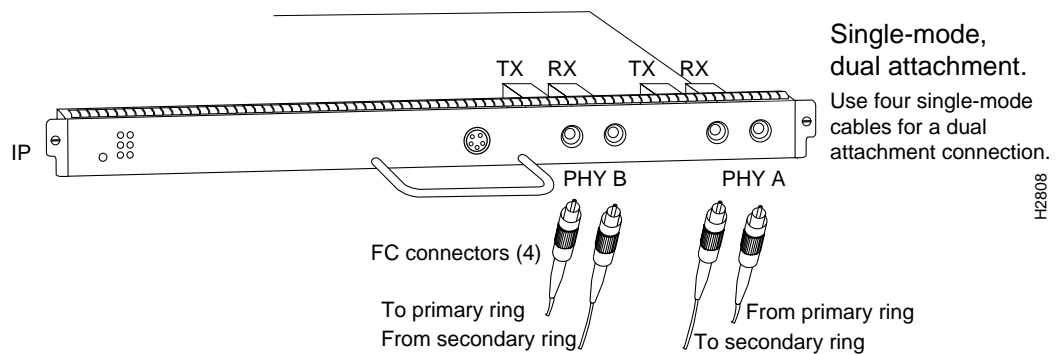
**Figure 3-14 FDDI DAS Ports**



Depending on whether you are connecting to a single-mode or multimode fiber network, connect the FIP as follows:

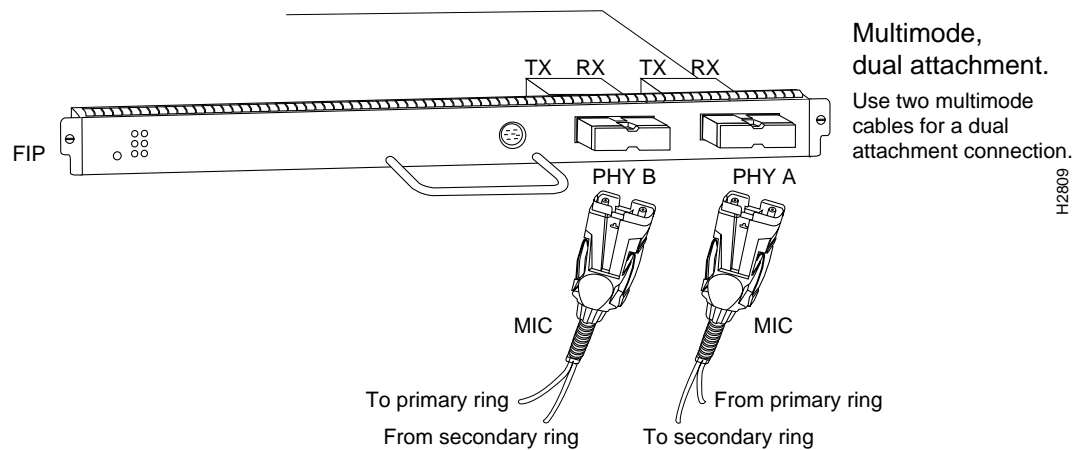
- Single-mode—Observe the standard connection scheme described previously, and refer to Figure 3-15 while you connect the interface cables as follows:
  - Connect the cable coming in from the primary ring (*from* PHY B at the primary ring upstream station) to the FIP PHY A receive port.
  - Connect the cable going out to the primary ring (*to* PHY A at the primary ring downstream station) to the FIP PHY B transmit port.
  - Connect the cable coming in from the secondary ring to the FIP PHY B receive port.
  - Connect the cable going out to the secondary ring to the FIP PHY A transmit port.

**Figure 3-15 Dual Attach Station (DAS), Single-Mode Fiber Network Connections**



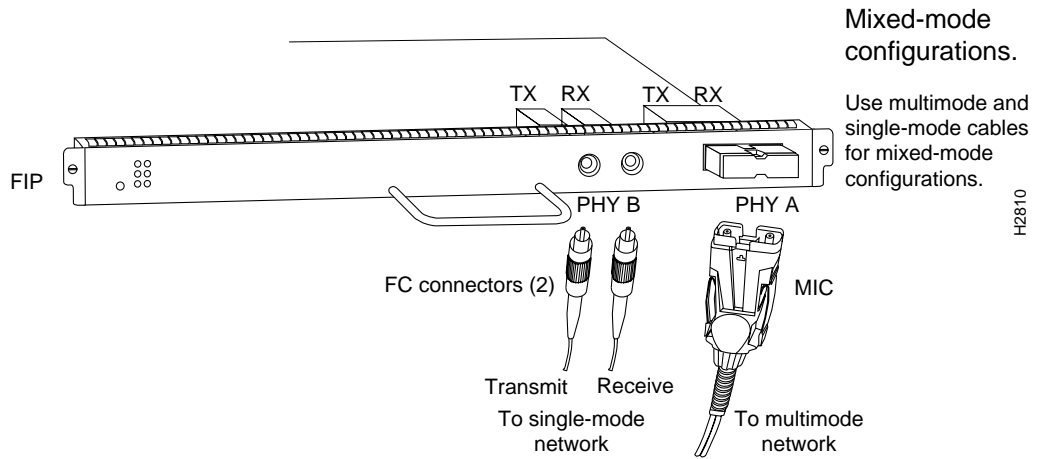
- Multimode—Each of the integrated transmit/receive multimode interface cables attaches to both the primary and secondary ring; each one receives the signal from one ring and transmits to the other ring. (See Figure 3-16.) To help avoid confusion, use the receive label on the cable MIC connector as a key and connect the cables to the FIP ports as follows:
  - Connect the cable coming in from the primary ring to the PHY A receive port. This also connects the signal going out to the secondary ring to the PHY A transmit port.
  - Connect the cable coming in from the secondary ring to the PHY B receive port. This also connects the signal going out to the primary ring to the PHY B transmit port.

**Figure 3-16 Dual Attach Station (DAS), Multimode Fiber Network Connections**



- Mixed mode—Follow the cabling guidelines described previously to connect the multimode and single-mode interface cables. Figure 3-17 shows that the primary ring signal is received on the multimode PHY A receive port and transmitted from the single-mode PHY B transmit port. Your configuration may be the opposite, with multimode on PHY B and single-mode on PHY A. Connect the cables to the FIP ports as follows:
  - Connect the cable coming in from the primary ring to the PHY A receive port, and connect the signal going out to the secondary ring to the PHY A transmit port.
  - Connect the cable coming in from the secondary ring to the PHY B receive port. This also connects the signal going out to the primary ring to the PHY B transmit port.

**Figure 3-17 FDDI Dual Attach Network Connections, Single-Mode and Multimode**



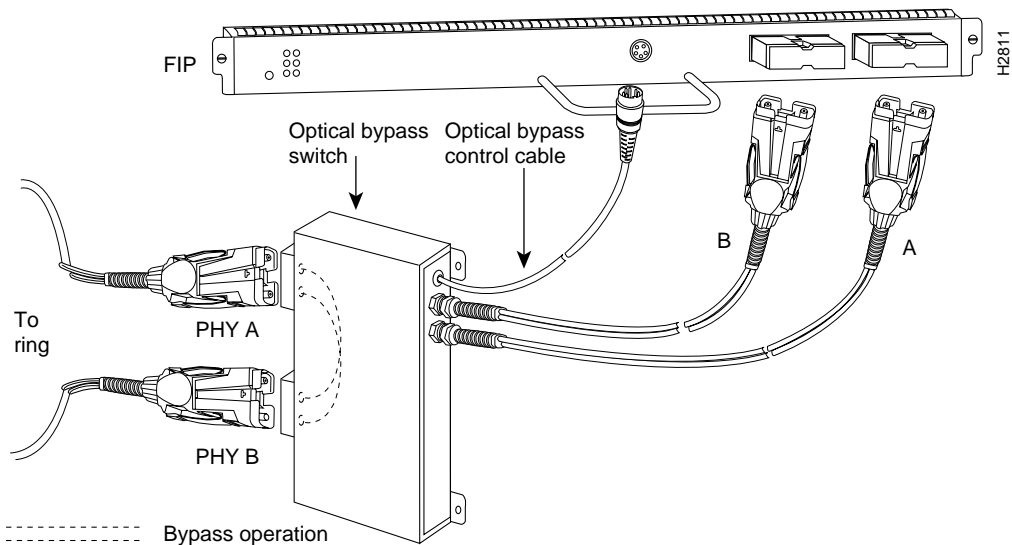
H2810

If you are connecting an optical bypass switch, proceed to the next section. Otherwise, proceed to “Connecting the Console Terminal” in this chapter.

### Installing an Optical Bypass Switch

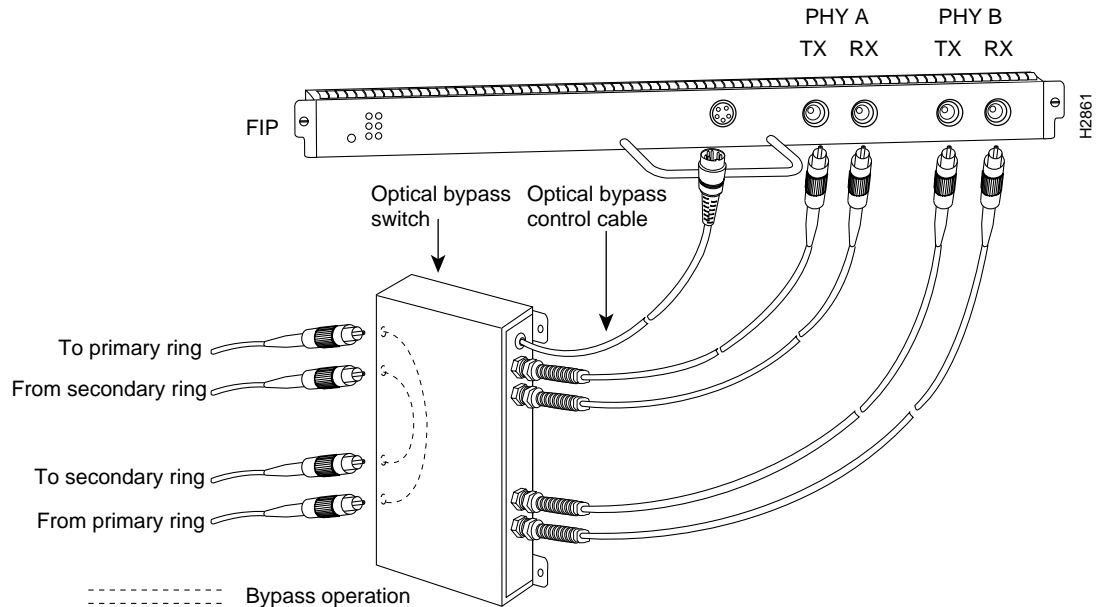
An optical bypass switch is a device installed between the ring and the station that provides additional fault tolerance to the network. If a FIP that is connected to a bypass switch fails or shuts down, the bypass switch activates automatically and allows the light signal to pass directly through it, bypassing the FIP completely. (See Figure 3-18 or Figure 3-19.) A port for connecting an optical bypass switch is provided on the multimode/multimode FIP (CX-FIP-MM) and the single-mode/single-mode FIP (CX-FIP-SS).

**Figure 3-18 CX-FIP-MM Connection with Optical Bypass**



H2811

**Figure 3-19 CX-FIP-SS Connection with Optical Bypass**



The optical bypass control port on the FIP is a six-pin mini-DIN receptacle. Some optical bypass switches use DIN connectors, and some use a mini-DIN. A DIN-to-mini-DIN control cable (CSB-FMDD) is included with the CX-FIP-MM or CX-FIP-SS to connect optical bypass switches that use the larger DIN connector. Up to 100 milliamperes of current can be supplied to the optical bypass switch.

Following are general instructions for connecting an optical bypass switch to the FIP; however, your particular bypass switch may require a different connection scheme. Use these steps as a general guideline, but refer to the instructions provided by the manufacturer of the switch for specific connection requirements.

- Connect the bypass switch to the ring. Unless the documentation that accompanies the bypass switch instructs otherwise, observe the same guidelines for connecting the A/B ports on the bypass switch that you would to connect the ring directly to the FIP ports. Use the receive label on the cable MIC connectors as a key and connect the cables to the network (ring) side of the bypass switch as follows:
  - Connect the cable coming in from the primary ring (*from* PHY B at the preceding station) to the PHY A receive port on the network (ring) side of the bypass switch. This also connects the signal going out to the secondary ring to the PHY A transmit port.
  - Connect the cable coming in from the secondary ring (*from* PHY A at the preceding station) to the PHY B receive port on the network (ring) side of the bypass switch. This also connects the signal going out to the primary ring to the PHY B transmit port.
- Connect the bypass switch to the FIP. Unless the documentation that accompanies the bypass switch instructs otherwise, consider the bypass an extension of the FIP ports and connect A to A and B to B. The network cables are already connected to the bypass switch following the standard B-to-A/A-to-B scheme.
  - Connect an interface cable between the PHY A port on the station (FIP) side of the bypass switch and the FIP PHY A port.
  - Connect an interface cable between the PHY B port on the station (FIP) side of the bypass switch and the FIP PHY B port.

- Connect the bypass switch control cable. If the control cable on your optical bypass switch uses a mini-DIN connector, connect the cable directly to the mini-DIN optical bypass port on the FIP. If the switch uses a standard DIN connector, use the optical bypass adapter cable (CSB-FMDD) supplied with each FIP. Connect the DIN end of the adapter cable to the DIN on the control cable, and connect the mini-DIN end of the adapter cable to the mini-DIN bypass port on the FIP.

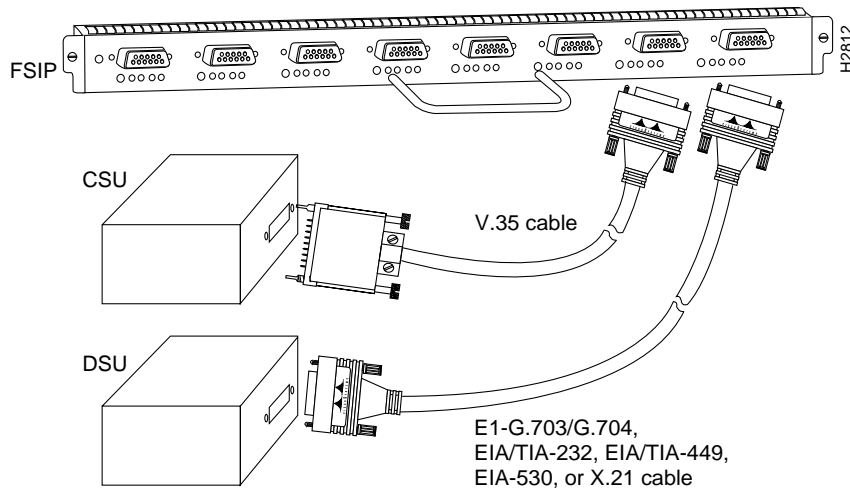
## Serial Connections

All FSIP ports support any available interface type and mode. The serial adapter cable determines the electrical interface type and mode of the port to which it is connected. EIA/TIA-232, EIA/TIA-449, V.35, and X.21 interfaces are available in DTE mode with a plug at the network end and in DCE mode with a receptacle at the network end. EIA-530 is available only in DTE mode with a plug. For descriptions and illustrations of each connector type, refer to the section “Serial Connection Equipment” in the chapter “Preparing for Installation.” For cable pinouts, refer to the appendix “Cabling Specifications.”

## Connecting DTE and DCE Devices

When connecting serial devices, consider the adapter cables as an extension of the router for external connections; therefore, use DTE cables to connect the router to remote DCE devices such as modems or data service units (DSUs), and use DCE cables to connect the router to remote DTE devices such as a host, personal computer (PC), or another router. (See Figure 3-20.) The optional or additional connection equipment required depends on the interface type of each port.

**Figure 3-20 Serial Port Adapter Cable Connections**



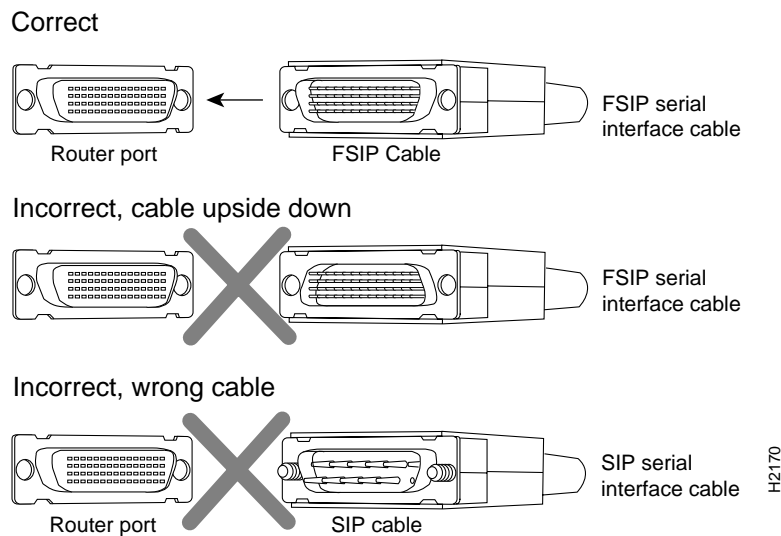
**Note** The serial port adapter cable determines the electrical interface type and mode of the FSIP port. When connecting a remote DTE device (which means that the FSIP port is a DCE interface), you must set the clockrate with the **clockrate** command. For an example configuration using this command, refer to the section “Configuring Timing (Clock) Signals” in the chapter “Maintenance.” For complete command descriptions and instructions, refer to the related software configuration and command reference documentation.



**Caution** The early serial interface processor for the seven-slot Cisco 7000 model, known as the SIP, SX-SIP, or PRE-FSIP, does not operate in the Cisco 7010. (The SIP requires SxBus connectors that are not present on the Cisco 7010 backplane.) The SIP and FSIP each use unique interface cables that are not interchangeable. (The SIP uses DB-15 or DB-25 plugs and receptacles; all FSIP ports are 60-pin receptacles and the cables use 60-pin plugs.)

Also, the backshell on the FSIP universal cable connector is not stiff enough to prevent you from inserting the interface cable connector into the FSIP port upside down. Before forcing the cable into the FSIP port receptacle, ensure that the connector is oriented correctly. Forcing a SIP cable into an FSIP port or forcing an FSIP cable into the port upside down can damage the FSIP. (See Figure 3-21.)

**Figure 3-21 SIP and FSIP Cables Are Not Interchangeable**

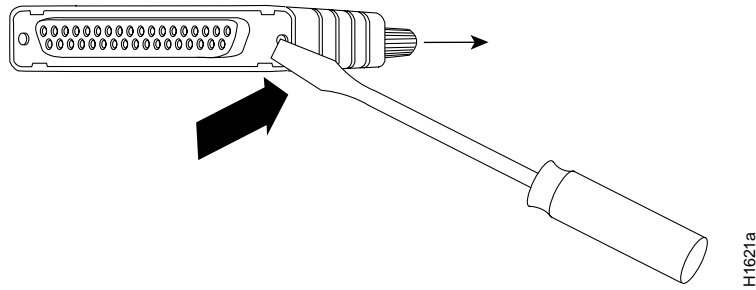


## Connecting to Metric-Based Devices

A pair of metric thumbscrews is included with each port adapter cable except V.35. If you will connect serial cables to a remote device that uses metric hardware, replace the standard 4-40 thumbscrews at the network end of the cable with the M3 thumbscrews.

To remove thumbscrews, use the flat side of a large (1/4-inch) flat-blade screwdriver to push the tip of the screw into the connector housing and out the other side. (See Figure 3-22.) If the screw resists, use pliers to pull it out. Insert the new thumbscrew and push it into the connector housing until it pops into place.

**Figure 3-22 Replacing Standard 4-40 Thumbscrews with M3 Metric Thumbscrews**

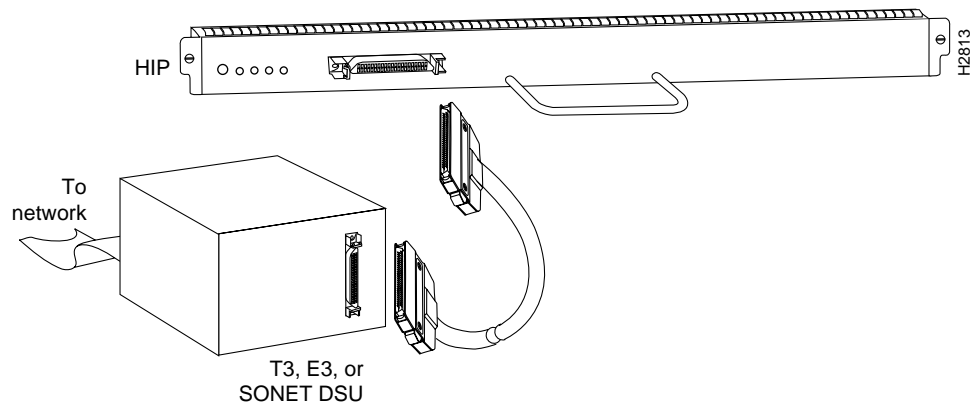


## HSSI Connections

The HIP HSSI port functions as a DTE when it is connected to a DSU for a standard HSSI connection, and it can also be connected to a collocated router with a null modem cable.

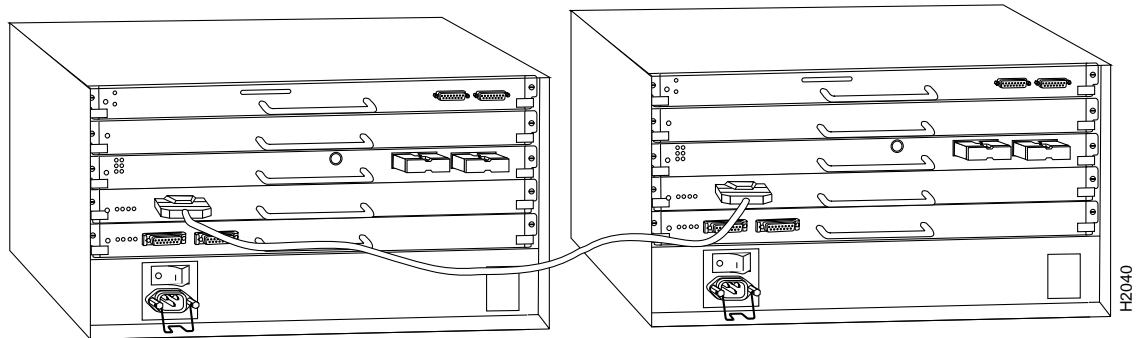
To connect the router to a HSSI network, use a HSSI interface cable between the HIP port and the DSU. Both ends of the HSSI interface cable are the same, so you can connect either end to the HIP or DSU. (See Figure 3-23.)

**Figure 3-23 HSSI Network Connection**



To connect two routers back to back in order to verify the operation of the HSSI port or to build a larger node, use a null modem cable between available HSSI ports in two separate routers. The two routers must be in the same location, and can be two Cisco 7000 series, two AGS+'s, or one of each. When you configure the ports, you must enable the internal transmit clock on in the HSSI interface in *both* routers with the command **hssi internal-clock**. To negate the command when you disconnect the cable, use the command **no hssi internal-clock**. For complete command descriptions and instructions, refer to the related software documentation.

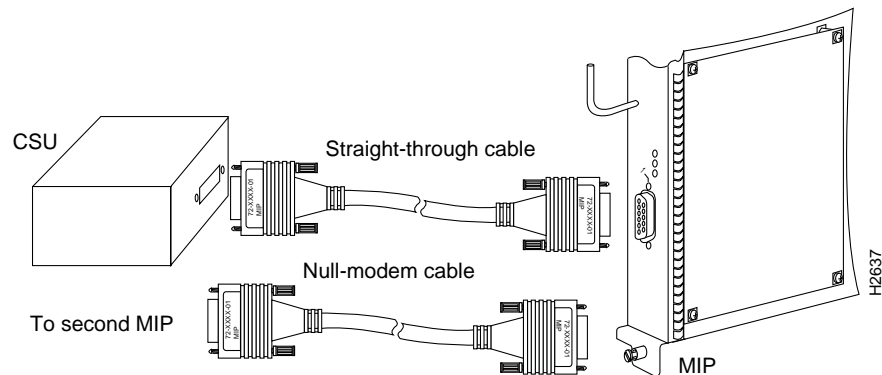


**Figure 3-24 HSSI Null Modem Connection**

## MultiChannel Connections

For the MIP, two standard T1 serial cables are available from Cisco Systems and other vendors for use with the MIP: null-modem and straight-through. These interface cables are used to connect your router to external CSUs.

The cables have male 15-pin DB connectors at each end to connect the MIP with the external CSU. Connect the T1 cable as shown in Figure 3-25.

**Figure 3-25 MIP Connections**

## Connecting the Console Terminal

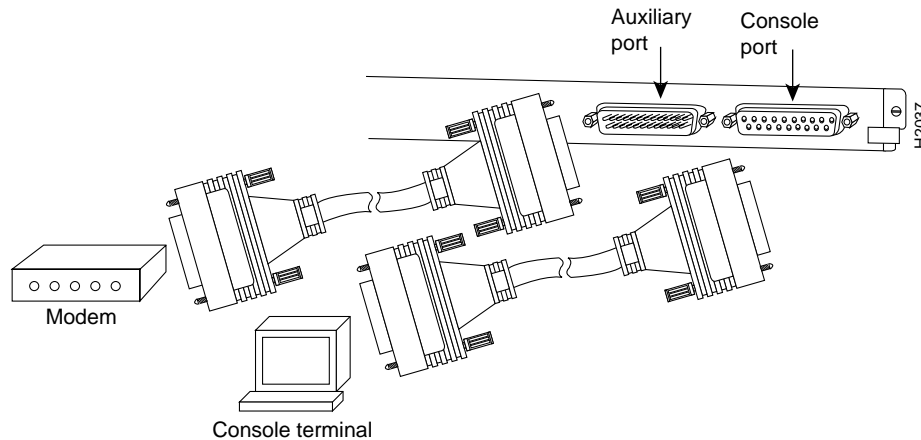
The system console port on the RP (or RSP7000) is a DCE DB-25 receptacle for connecting a data terminal, which you will need to configure and communicate with your system. The port is located on the RP (or RSP7000) below the auxiliary port and is labeled *Console*. (See Figure 3-26.)

---

**Note** Both the console and auxiliary ports are asynchronous serial ports; any devices connected to these ports must be capable of asynchronous transmission. (Asynchronous is the most common type of serial device; for example, most modems are asynchronous devices.)

---

**Figure 3-26 Console and Auxiliary Port Connections**



Before connecting the console port, check your terminal’s documentation to determine the baud rate of the terminal you will be using. The baud rate of the terminal must match the default baud rate (9600 baud). Set up the terminal as follows:

- 9600 baud
- 8 data bits
- No parity
- 2 stop bits

Use the console cable provided to connect the terminal to the console port on the RP (or RSP7000), then follow the steps in the section “Starting the Router” later in this chapter.

## Connecting Auxiliary Port Equipment

The auxiliary port is a DB-25 plug DTE port for connecting a modem or other DCE device (such as a CSU/DSU or other router) to the router. The port is located on the RP (or RSP7000) above the console port and is labeled *Auxiliary*. An example of a modem connection is shown in Figure 3-26.

---

**Note** Both the console and auxiliary ports are asynchronous serial ports; any devices connected to these ports must be capable of asynchronous transmission. (Asynchronous is the most common type of serial device; for example, most modems are asynchronous devices.)

---

## Starting the Router

When all interfaces are connected, perform a final check of all connections, then power up the router as follows:

**Step 1** Check the following components to make sure they are secure:

- Each interface processor is inserted all the way into its slot, and all of the captive installation screws are tightened.
- All interface cable connections are secured.
- The system power cord is connected and secured with the cable retention clip.
- The Flash memory card, if present, is inserted all the way into its slot on the RP (or RSP7000).

- Step 2** Check the console terminal and make sure it is ON.
- Step 3** When you have checked all of the connection points listed previously, turn on the power supply by pushing the system power switch to on (I). The DC OK indicator on the interface processor end of the router should go on.
- Step 4** Listen for the system fans; you should immediately hear them operating.
- Step 5** On the RP, the yellow boot error indicator goes on for about 5 seconds or less, then goes off when the boot is complete. If this indicator stays on longer than 10 seconds, or if it remains on after system initialization, a boot error has occurred. Refer to the chapter “Troubleshooting the Installation” for troubleshooting procedures.
- Step 6** During the boot process, the indicators on most of the interfaces go on and off in irregular sequence. Some may go on, go out, and go on again for a short time. Some will stay on during the entire boot process if an interface is already configured and brought up such as the EIP receive indicator, which stays on as it detects traffic on the line). Wait until the system boot is complete before attempting to verify the status of interface processor indicators.
- Step 7** When the system boot is complete (a few seconds), the RP begins to initialize the interface processors. During this initialization, the indicators on each interface processor behave differently (most flash on and off). The enabled LED on each interface processor goes on when initialization has been completed, and the console screen displays a script and system banner similar to the following:

```
GS Software (GS7), Version 10.3(1)
Copyright (c) 1986-1995 by Cisco Systems, Inc.
Compiled Wed 15-Mar-95 11:06
```

- Step 8** When you start up the router for the first time, the system automatically enters the **setup** command facility, which determines which interfaces are installed and prompts you for configuration information for each one. On the console terminal, after the system displays the system banner and hardware configuration, you will see the following System Configuration Dialog prompt:

```
--- System Configuration Dialog ---
At any point you may enter a questions mark '?' for help.
Refer to the 'Getting Started' Guide for additional help.
Default settings are in square brackets '[']. continue with
configuration dialog? [yes]:
```

You have the option of proceeding with the **setup** command facility to configure the interfaces, or exit from setup and use configuration commands to configure global (system-wide) and interface-specific parameters. You do not have to configure the interfaces immediately; however, you cannot enable the interfaces or connect them to any networks until you have configured them.

Many of the interface processor LEDs will not go on until you have configured the interfaces. In order to verify correct operation of each interface, complete the first-time startup procedures and configuration, then refer to the LED descriptions in the appendix “Reading LED Indicators” to check the status of the interfaces.

Your installation is complete. Proceed to the appropriate software configuration publications to configure your interfaces.

---

**Note** If the system does not complete each of these steps, proceed to the chapter “Troubleshooting the Installation” for troubleshooting procedures.

---

## Using the Flash Memory Card

This section describes installation, removal, and typical operations of the 8- or 16- MB, Intel Series 2+ Flash memory card, which installs in the PCMCIA slot on the RP faceplate.

The Flash memory card is used to store and boot Cisco Internetwork Operating System (Cisco IOS) software images and interface processor microcode images, and can be used as a server to store software and microcode images for other systems.

The spare Flash memory card is shipped blank; you *must* format it before using it. (Formatting instructions are included in this document.) The Flash memory card shipped with a spare RP or shipped with a system is already formatted.

Note that the following sections are in a chronological order typical of many Flash memory card installations: inserting the card, formatting the card, copying an image to the card, and making that image bootable.

---

**Note** To boot from the Flash memory card, a Cisco 7010 router must be using Cisco IOS Release 11.0 or later boot ROMs.

---

## Installing and Removing the Flash Memory Card

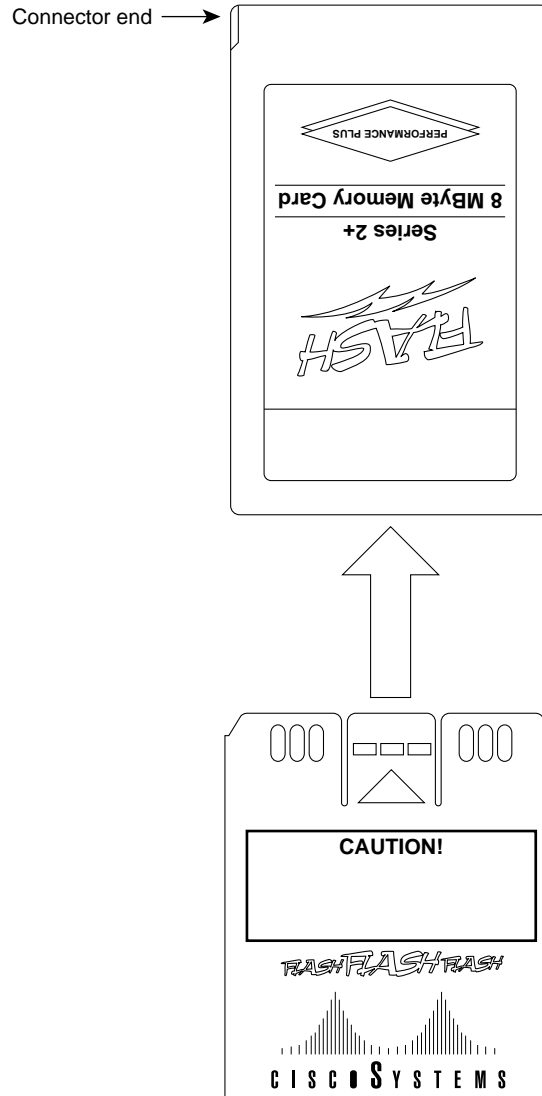
The Flash memory card can be inserted and removed with the power on. Following is the procedure for installing and removing a Flash memory card:

**Step 1** Verify that the metal sleeve is correctly installed on the Flash memory card. (The sleeve must be installed with the connector end exposed, as shown in Figure 3-27.)

---

**Note** A metal sleeve will be provided with all Flash memory cards shipped as a spare or with a new system. Should a replacement metal sleeve be required, consult Customer Engineering through the Technical Assistance Center (TAC).

---

**Figure 3-27 Installing the Metal Sleeve**

- Step 2** Hold the Flash memory card with the connector end of the card toward the PCMCIA slot. The product label should face to the right, as shown in Figure 3-28a.

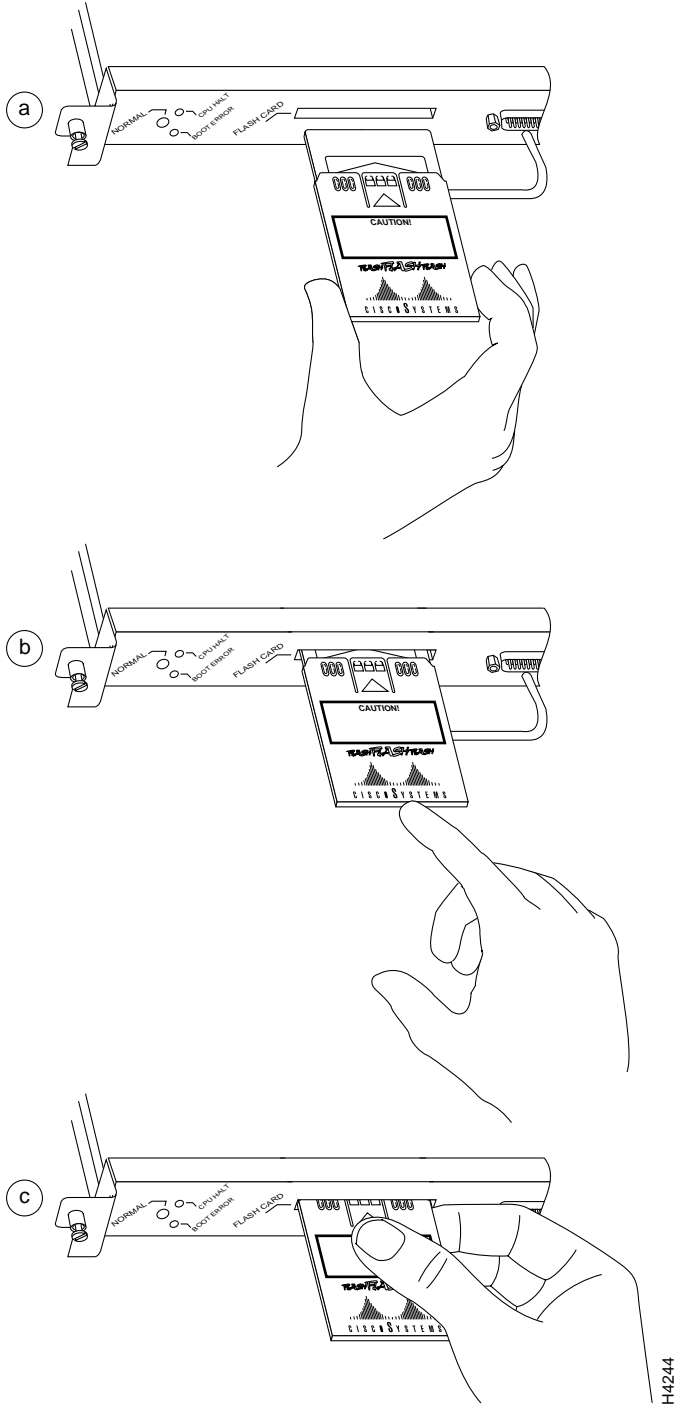
---

**Note** The Flash memory card is keyed and cannot be seated the wrong way.

---

- Step 3** Insert the card into the slot until the card completely seats in the connector at the back of the slot. Note that the card does not insert all the way inside the RP; a portion of the card and sleeve remain outside of the slot. *Do not attempt to force the card past this point.*
- Step 4** To remove the card, grasp the card near the slot and squeeze the sleeve together to release it from the slot. Then pull the card free from the connector at the back of the slot. (See Figure 3-28c.)
- Step 5** Place the removed Flash memory card on an antistatic surface or in a static shielding bag.

Figure 3-28 Installing and Removing a Flash Memory Card



## Formatting the Flash Memory Card

The Flash memory card shipped with a spare RP or shipped with a system is already formatted. However, a spare Flash memory card is shipped blank and must be reformatted before use. Also, if you plan to use a Flash memory card that was formatted on an RSP-based system (Cisco 7500 series), you must first reformat the card on your system.

---

**Note** The following procedure assumes you have already booted your router.

---



**Caution** The formatting procedure erases all information on the Flash memory card. To prevent the loss of important data that might be stored on a Flash memory card, proceed carefully. If you want to save the data on a Flash memory card, copy the data to a server before you format the card.

Use the following procedure to format a new Flash memory card:

**Step 1** Using the procedures in the section “Installing and Removing the Flash Memory Card,” insert the Flash memory card into the PCMCIA slot.

**Step 2** To format the Flash memory card, use the **format slot0** command as follows. (Use only Intel Series 2+ Flash memory cards.)

```
Router# format slot0:
All sectors will be erased, proceed? [confirm]
Enter volume id (up to 30 characters): MyNewCard
Formatting sector 1
Format device slot0 completed
Router#
```

---

**Note** For this example, an 8-MB Flash memory card was used, and at the line “Formatting sector,” the system counted the card’s sectors backwards from 64 to 1 as it formatted them. For 16-MB Flash memory cards, the system counts backwards from 128 to 1.

---

The new Flash memory card is now formatted and ready to use.

---

**Note** For complete command descriptions and configuration information, refer to the *Router Products Command Reference* publication and the *Router Products Configuration Guide*.

---

## Copying an Image into the Flash Memory Card

With the Flash memory card formatted, you can now copy an image into it. To copy an image, use the following procedure, which assumes the following:

- The system is running Cisco IOS Release 11.0 or later.
- The bootable image you wish to copy to the Flash memory card exists on a TFTP server to which you have access (meaning you know its name and have connectivity to it), and at least one interface is available over which you can access this server.





---

**Note** In the previous example, the exclamation points (!!!) appear as the file is downloaded and the “C” characters signify calculation of the checksum, which is a verification that the file has been correctly downloaded to the Flash memory card.

---

## Making the Flash Memory Card Image Bootable

Use the following series of commands to make the image (the file named *new.image*) bootable. Note that, since the configuration register must be set to 0x2102, the **config-register** command is part of the sequence.

```
Router# config terminal
Router(config)# no boot system
Router(config)# boot system flash slot0:new.image
Router(config)# config-register 0x2102
Router(config)# ^z
Router# copy running-config startup-config
Router# reload
```

When the system reloads it will boot the image *new.image* from the Flash memory card in Slot 0.

---

**Note** For complete details about the **boot system flash** command, refer to the next section, “Enabling Booting from the Flash Memory Card.”

---

## Enabling Booting from the Flash Memory Card

To enable booting from Flash memory, set configuration register bits 3, 2, 1, and 0 to a value between 2 and 15 in conjunction with the **boot system flash** [*filename*] configuration command.

Following are definitions of the various Flash memory-related **boot** commands:

**boot system flash**—Boots the first file in onboard Flash memory

**boot system flash herfile**—Boots the file named “herfile” on onboard Flash memory

**boot system flash slot0:**—Boots the first file on Flash memory card in the PCMCIA slot

**boot system flash flash:hisfile** —Boots the file named “hisfile” on onboard Flash memory

**boot system flash slot0:myfile** —Boots the file named “myfile” on the Flash memory card in the PCMCIA slot

To enter configuration mode and specify a Flash memory filename in the PCMCIA slot from which to boot, enter the **configure terminal** command at the enable prompt, as follows:

```
Router# configure terminal
Enter configuration commands, one per line. End with CTRL-Z.
Router(config)# boot system flash slot0:myfile
```

To disable Break and enable the **boot system flash slot0:** command, enter the **config-register** command with the value shown in the following example:

```
Router(config)# config-reg 0x2102

To exit configuration mode, enter Cntl-Z as follows:
Router(config)# ^Z
Router#
```



For complete command descriptions and configuration information, refer to the *Router Products Command Reference* publication and the *Router Products Configuration Guide*.

## Flash Memory Card Compatibility

In order to boot from the Flash memory card, the card must have been formatted on an RP board. Therefore, if you want to boot from a card formatted on an RSP board (Cisco 7500 series), you must first reformat it.

If booting is not necessary, you can still read from and write to a Flash memory card formatted on a Cisco 7500 series router, but this is not recommended.

Any Intel Series 2+ Flash memory card can be used with the RP. However, you must install the card's metal sleeve, and the system must contain Cisco IOS Release 11.0 boot ROMs (SWR-G7-11.0.0=) or later. (The RP requires these boot ROMs in order to boot from the Flash memory card.) In addition, the RP can only read up to 16 MB.



## Troubleshooting the Installation

---

Your router went through extensive testing and burn-in before leaving the factory. However, if you encounter problems starting up, use the information in this chapter to help isolate the cause. Problems with the initial startup will most likely be caused by the source power or an interface processor that has become dislodged from the backplane. Although an overtemperature condition is unlikely at initial startup, the environmental monitoring functions are included because they also monitor internal voltages.

---

**Note** The procedures in this chapter assume that you are troubleshooting the initial system startup, and that the router is in the original factory configuration. If you have removed or replaced components, or changed any default settings (such as configuration register jumpers), refer to the replacement procedures in the chapter “Maintenance” or to the configuration note that accompanies the component for comprehensive troubleshooting procedures.

---

At the initial system boot, you should verify the following:

- The external power cable is connected and proper source power is being delivered to the system.
- The system fans are operating.
- The system software boots successfully.
- The RP, SP (or SSP), and all interface processors are properly installed in their slots, and each initializes (is enabled by the system software) without problems.

When each of these conditions is met, the hardware installation is complete, and you should proceed to the appropriate software configuration documentation to configure the system and the individual interfaces. If the startup sequence fails before these conditions are met, use the procedures in this chapter to isolate and, if possible, resolve the problem.

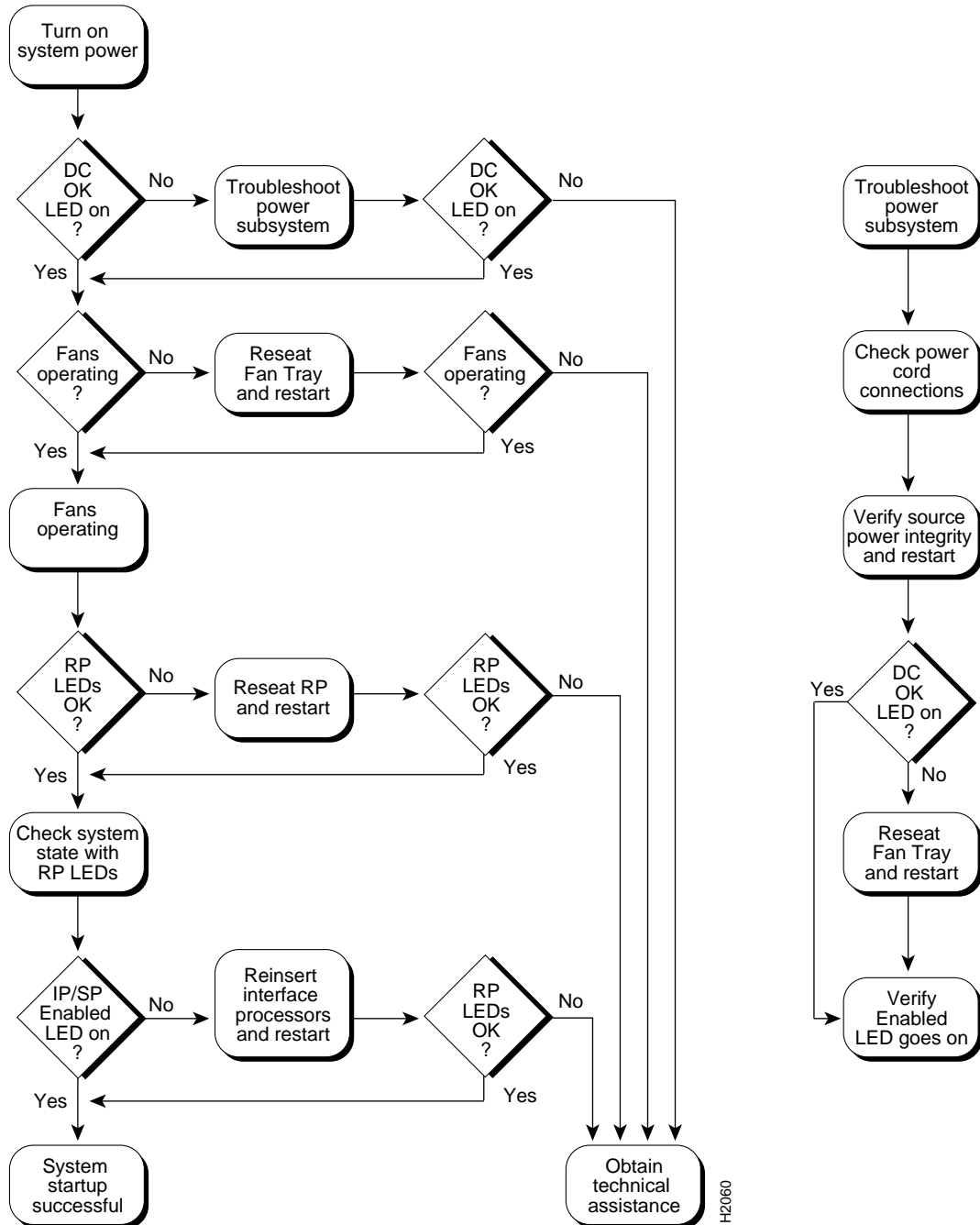
If you are unable to easily solve the problem, contact a customer service representative for assistance and further instructions. Before you call, have the following information ready to help your service provider assist you as quickly as possible:

- Date you received the router
- Chassis serial number (located on a label on the right rear deck of the chassis)
- Type of software and release number
- Brief description of the problem you are having

- Brief explanation of the steps you have already taken to isolate and resolve the problem
- Maintenance agreement or warranty information

Figure 4-1 shows the general troubleshooting strategy described in this chapter. Refer to this chart as necessary to follow the steps to isolate problems to a specific subsystem, and resolve the problem if possible.

**Figure 4-1 Troubleshooting Strategy for Startup Problems**



The rest of this chapter describes troubleshooting methods and defines how the router is divided into subsystems for more efficient problem solving. A description of a normal startup sequence contains pointers to sections in this chapter that contain troubleshooting procedures for specific components so that you can determine where your system is having trouble and then troubleshoot that specific component or subsystem.

## Problem Solving with Subsystems

The key to problem solving the system is to try to isolate the problem to a specific subsystem. The first step in solving startup problems is to compare what the system *is doing* to what it *should be doing*. Since a startup problem is usually attributable to a single component, it is more efficient to first isolate the problem to a subsystem rather than troubleshoot each component in the system. For these troubleshooting procedures, consider the following subsystems:

- Power subsystem—This subsystem comprises the AC-input or DC-input power supply, the external power cord, and the internal power harness that connects to the backplane.
- Cooling subsystem—This subsystem comprises the fan tray assembly, which includes the six individual fans in the array, the fan control board, and the tray itself. All six fans should be operating whenever the system power is on. The system automatically shuts down if any one or more of the fans is operating outside the specified range, or shuts down completely. The variable speed feature allows the fans to operate at a slower speed and provide quieter operation when the internal chassis temperature is within the normal operating range. If the internal temperature exceeds a specified temperature, the fan speed increases to move more cooling air through the chassis. As a result, it may be difficult to determine whether or not the fans are operating in noisy, air-conditioned rooms. When viewing the chassis from the noninterface processor end, the fan array spans the right wall of the chassis interior. If you determine that the fans are not operating, contact a customer service representative immediately. There are no installation adjustments that you should make if it does not function properly at initial startup.
- Processor subsystem—This subsystem includes the RP, SP (or SSP), and all interface processors. The RP contains the system operating software, and the enabled LED on the SP (or SSP) and each interface processor indicates whether or not the RP was able to initialize it. Remember that an interface processor that is partially installed in the backplane will cause the system to hang and crash.

The following sections will help you isolate a problem to one of these subsystems and direct you to the appropriate troubleshooting section.

## Identifying Startup Problems

When you start up the router for the first time, you should observe the startup sequence described in the section “Starting the Router” in the chapter “Installing the Router.” This section contains a more detailed description of the normal startup sequence and describes the steps to take if the system does *not* perform that sequence as expected.

By checking the state of the LEDs on the power supply and processor modules (the RP, SP [or SSP], and interface processors), you can determine when and where the system failed in the startup sequence. Use the following descriptions to isolate the problem to a subsystem, then proceed to the appropriate sections (indicated in each description) to try to resolve the problem.

When you start up the system by turning on the main system power switch on the interface processor end of the power supply, the following should occur:

- The DC OK LED should go on immediately, and it should remain on as long as the system is receiving source power and the power switch is in the on (I) position. If this LED does not go on, or if it goes off while the power switch is still on, there could be a problem with either the source power, the internal DC power that the power supply distributes to the internal components, or the cooling subsystem.

The green DC OK LED indicates the status of the power supply and internal DC voltages. The DC OK LED stays on when all of the following conditions are met:

- AC-input power supply is on and receiving 100 to 240 VAC, 50 to 60 Hz source power *or* the DC-input power supply is on and receiving –40 to –52 VDC (–48 VDC nominal) in North America, or –56 and –72 VDC (–60 VDC nominal) in the European Community.
- Power supply is providing the +5, +12, –12, and +24 VDC to internal components.
- All internal DC voltages are within tolerance.

If the source power or any of the internal DC voltages exceeds allowable tolerances, the DC OK LED will not go on, or will go off shortly after you turn on the power. Because both the RP (which uses +5, +12, –12 VDC), and the fan tray (which uses +24 VDC) are required for operation, a problem with any of the internal DC lines can prevent the system from starting up or continuing operation.

For example, if there is a problem with the +24 VDC line that supplies the fan tray, the system will start up but also recognize that the fans are not operating. The system will initiate a fan failure shutdown sequence, display the appropriate warning messages, then shut down after two minutes. If there is a problem with any of the other internal DC lines, the RP will not be able to initialize the system software, so the system might attempt to start up and fail during the boot sequence.

Depending upon when the DC OK LED goes off, proceed as follows:

- If the DC OK LED stays off (if it never goes on) when you turn on the power switch, there is a problem with either the source power or the DC power that is distributed to the internal components. Proceed to the section “Troubleshooting the Power Subsystem.”
  - If the DC OK LED goes on temporarily, then goes off within 30 seconds, the system is most likely shutting itself down because it detected an out-of-tolerance power or temperature condition within the power supply. Proceed to the section “Troubleshooting the Power Subsystem.”
  - If the DC OK LED goes on, and the system starts up as expected but then displays the following message and shuts down after two minutes, there is a problem with the fan tray. Proceed to the section “Troubleshooting the Cooling Subsystem.”  

```
%ENVM-2-FAN: Fan array has failed, shutdown in 2 minutes
```
  - If the DC OK LED stays off yet the system starts up correctly, displays the preceding message, and shuts down after about two minutes, there is a problem with the +24VDC line to the fan tray. Proceed to the section “Troubleshooting the Power Subsystem.”
- As soon as you turn on the power switch, you should immediately hear the fans operating. If you are in an unusually noisy environment, such as an air-conditioned wiring closet with other equipment noise, place your hand near the left side of the chassis (when facing the interface processor end); you should feel the exhaust air that is being forced out the side of the chassis.
    - If the DC OK LED is on but the fans are not operating, there is a problem with the fan tray or with one of the fans. (The system will shut itself down if it detects that any of the fans are not functioning properly.) Proceed to the section “Troubleshooting the Cooling Subsystem.”



- If the DC OK LED is on at startup and fans are operating, but the system shuts down after two minutes, there is a problem with the fan tray. Proceed to the section “Troubleshooting the Cooling Subsystem.”
- When you turn on the system power, the LEDs on the RP, which is located in the top processor slot (see Figure 1-3) should go on and off as follows:
  - The RP boot error LED goes on and stays on for 1 to 2 seconds when the system boot sequence is initialized, but it should otherwise remain off. If the system software is unable to start up, this LED will go on and stay on.
  - The RP normal LED goes on after the system has completed a successful boot to indicate normal system operation. This LED should remain on during system operation.
  - The halt CPU LED should always remain off. This LED goes on only if the system detects a processor hardware failure.

If the normal LED on the RP does not go on, or if either the boot error or halt CPU LED goes on and stays on, proceed to the section “Troubleshooting the Cooling Subsystem.”

- The enabled LED on the SP (or SSP) and on each interface processor goes on when the RP has completed initialization of the interface processor or SP (or SSP) for operation. This LED indicates that the SP (or SSP) or interface processor is receiving power and has been recognized by the RP; it does not indicate the state of the individual interfaces. It does, however, indicate that an interface processor or SP (or SSP) contains a valid microcode version. If an enabled LED fails to go on, proceed to the section “Troubleshooting the Interface Processors.”

---

**Note** While the system is starting up and initializing the individual interface processors, the status LEDs on the interface processors will flash on and off or light intermittently; this is normal behavior. The LEDs do not indicate the true status of the interfaces until the system has initialized the interface processors and you have enabled the individual interfaces.

---

When the LEDs indicate that the system has initialized successfully, the system banner (similar to the following example) should be displayed on the console screen.

```
System Bootstrap, Version 4.6(5), SOFTWARE
Copyright (c) 1986-1995 by cisco Systems
RP1 processor with 16384 Kbytes of memory
### (text omitted) ###
F3: 2012356+47852+194864 at 0x1000
```

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cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, California 95134-1706

```
GS Software (GS7), Version 10.3(1) [fc3], RELEASE SOFTWARE
Copyright (c) 1986-1995 by cisco Systems, Inc.
```

```
RP1 (68040) processor with 16384K bytes of memory.  
(text omitted)
```

```
Press RETURN to get started!
```

If it is not displayed, refer to the section “Connecting the Console Terminal” in the chapter “Installing the Router” to verify that the terminal is set correctly and that it is properly connected to the RP console port.

## Troubleshooting the Power Subsystem

Check the following to help isolate the problem:

- On the interface processor end of the power supply, is the DC OK LED on?
  - If yes, the power source is good, and the power supply is functional.
  - If no but the fans are operating *and* LEDs on the processor modules are on, suspect a faulty power supply LED. The RP uses +5, +12, -12 VDC, and the fan tray uses +24 VDC; therefore, if both the RP and the fans are operating, all internal DC lines are within tolerance.
  - If no and there is not other obvious activity, first suspect that the power switch is not fully in the on (I) position. Examine the switch and ensure that it is completely pushed into the on (I) position. (Refer to the section “Starting the Router” in the chapter “Installing the Router”)
  - If the system power switch is set correctly and the DC OK LED remains off, suspect the power source or the power cable. Turn off the power switch, connect the power cable to another power source if one is available, and turn the switch back on. If the LED then goes on, the problem is the first power source.
  - If the LED fails to go on after you connect the power supply to a new power source, swap the power cable with a replacement if one is available and turn the switch back on. If the DC OK LED then goes on, the power cable is faulty. (The AC power cable for the Cisco 7000 is compatible with the Cisco 7010. You supply the DC power cable.)
  - Ensure that the fan tray is seated properly. Refer to the section “Replacing the Fan Tray” in the chapter “Maintenance” to remove and reseat the fan tray. Ensure that the fan control board edge connector is inserted fully in the backplane socket. After you replace the chassis cover panel, try starting the system again.
  - If the LED still fails to go on when connected to a different power source with a new power cable, the power supply is probably faulty. If a spare power supply is available, replace the existing power supply with the spare and restart the system. (Refer to the section “Removing and Replacing the Power Harness Cover” in the chapter “Maintenance.”) If the DC OK LED then goes on, return the faulty power supply for replacement.

If you are unable to resolve the problem, or if you determine that either the power supply or power cable is faulty, contact a service representative for instructions.

## Troubleshooting the Cooling Subsystem

Check the following to help isolate the problem:

- When you start up the system, do the fans go on?

To determine whether the fans are operating, listen for the fan motors. In noisy environments, place your hand next to the left side of the chassis (when facing the interface processor end of the router) to feel for air being forced out the side vents.

- If yes, the +24 VDC line to the fan tray is good, but there might be a problem with the software or an individual fan.
- If no, there is a problem with the fan tray or the +24 VDC power. Ensure that the DC OK LED is on. If the LED is off, there could be a problem with the +24 VDC supply to the fan tray. Refer to the section “Troubleshooting the Power Subsystem.”
- If no and the DC OK LED is on, ensure that the fan tray is seated properly. Refer to the section “Replacing the Fan Tray” in the chapter “Maintenance” to remove and reseal the fan tray. Ensure that the fan control board edge connector is inserted fully in the backplane socket. After you replace the chassis cover panel, try starting the system again.
- Do the system and the fans start up but shut down after about two minutes?
  - If you have changed the configuration register boot field jumper settings or altered the configuration file boot instructions, the system could be booting a software image (earlier than Software Release 9.17[6]) that does not recognize the signals from the fan control board (and therefore assumes that the cooling subsystem is not operating).

Use the **show version** command to display the current software version and ensure that the currently running software image is Software Release 9.17(6) or later. You will have to enter this command quickly after the system boot is complete and before the system reaches the two-minute shutdown timeout.

The following message, if displayed, indicates that one or more fans has failed or is operating out of tolerance.

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

If one or more fans or the fan control board fails, you must replace the fan tray.

- The following message, if displayed, indicates that the system has detected an overtemperature condition or out-of-tolerance power inside the chassis.

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

If an environmental shutdown results from an out-of-tolerance power condition, the DC OK LED will go off before the system shuts down. (Refer to the section “Troubleshooting the Power Subsystem.”) Although an overtemperature condition is unlikely at initial startup, ensure that heated exhaust air from other equipment is not entering the inlet vents, and that there is sufficient clearance around the sides of the chassis to allow cooling air to flow. Refer to the guidelines in the chapter “Preparing for Installation” for acceptable site configurations.

This message could also indicate a faulty component or temperature sensor. Before the system shuts down, use the **show environment** or **show environment table** command to display the internal chassis environment. (Refer to the chapter “Product Overview” for detailed descriptions.)

If you are still unable to resolve the problem, contact a service representative for further instructions.

## Troubleshooting the Processor Subsystem

The processor subsystem comprises the RP, SP (or SSP), and interface processors. The RP and SP (or SSP) are required system components; the system cannot operate unless both the RP and SP (or SSP) are installed properly. However, because the CxBus interface processors support OIR, the system can operate without any interface processors installed as long as none are in *partial* contact with the backplane pins; an interface processor that is partially connected to the backplane will send

incomplete signals to the processor, which will fault the bus and cause the system to hang. Therefore, first ensure that the RP and SP (or SSP) are installed properly and the system software has initialized successfully. Then, if necessary, you can troubleshoot individual interface processors.

### Troubleshooting the RP and SP (or SSP)

These procedures assume that the RP and router are in the original factory configuration, and that you have not changed any configuration register settings or made changes to your configuration file. If you have made such changes, refer to the section “RP and RSP7000 Configurations” in the chapter “Maintenance” to ensure that all jumpers are set to the factory default. For example, the configuration register boot field jumper should be set to boot from ROM (0x0001).

If the RP LEDs do not go on as expected, check the following items to help isolate the problem.

- Do all of the RP LEDs remain off when system power switch is turned on?
  - If all RP LEDs stay off, first refer to the sections “Troubleshooting the Power Subsystem” and “Troubleshooting the Cooling Subsystem” to ensure that both the fan and power supply are functioning properly.
  - If the SP (or SSP) enabled LED is off and any of the RP LEDs are on, the SP (or SSP) may not be seated in its slot properly. Turn off the system power, loosen the captive installation screws on the SP (or SSP), and use the ejector levers to eject then reseat the SP (or SSP) in its slot. Retighten the captive screws and restart the system.
  - If the power supply and fans appear operational, but none of the RP LEDs are on, suspect that an improperly connected RP, SP (or SSP), or interface processor has hung the bus. Turn the system power switch off and, on each processor module, loosen the captive installation screws and use the ejector levers to eject and reseat each board. (For a description and illustration of the ejector levers, refer to the section “Ejector Levers” in the chapter “Maintenance.”) Tighten all captive installation screws, then restart the system.
- Is the RP normal LED on?
  - If yes, the system software has initialized successfully, and the system is operational.
- Is the boot error LED on?
  - If yes, the system software is unable to start up. Turn the system power off and then on again.
  - If you have a spare RP with the system software ROMs installed, turn off the system power and replace the installed RP with the spare.
  - If after several attempts the boot error LED continues to go on, try to estimate the amount of time that elapses between power on and when the LED goes on, and contact a service representative for instructions.
- Is the RP CPU halt LED on?
  - If yes, the system has detected a processor hardware failure. Contact a service representative for instructions.

### Troubleshooting the Interface Processors

Check the following to help isolate the problem:

- Are *all* SP (or SSP) and interface processor enabled LEDs on?
  - If yes, the system is operational. Proceed to the instructions for configuring the interfaces in the appropriate software configuration documentation.

- Are *any* SP (or SSP) and interface processor enabled LEDs on?
  - If none of the enabled LEDs are on, first check the RP normal LED, which will be on if the system booted successfully. The normal LED should be on if the system.
  - If the enabled LED on the SP (or SSP) is off, suspect that the SP (or SSP) has pulled away from the backplane. Turn all system power off, then use the ejector levers to eject and then reseal the SP (or SSP). (For a description and illustration of the ejector levers, refer to the section “Online Insertion and Removal Information” in the chapter “Maintenance.”) Tighten the captive installation screws and restart the system.
  - If the enabled LED on an individual interface processor is off, suspect that the interface processor has pulled away from the backplane. You do not have to turn off the system power to remove and replace an interface processor. Use the ejector levers to eject and then reseal the interface processor, then tighten both of the captive installation screws. (For a description and illustration of the ejector levers, refer to the section “Ejector Levers” in the chapter “Maintenance.”) After the system reinitializes the interfaces, the enabled LED on the interface processor should go on.

If you experience trouble with the startup that is not resolved with these procedures, contact a service representative for assistance and further instructions.



# Maintenance

---

This chapter provides maintenance procedures for the Cisco 7010 router and its components. Your Cisco 7010 is configured to your order and ready for installation and startup when it leaves the factory. In the future, as your communication requirements change, you may want to upgrade your system, add components, or change the initial configuration. This chapter describes the procedures for installing, replacing, and reconfiguring interface processors, and for adding and replacing internal system components. Software and microcode component upgrades require specific part numbers and other frequently updated information; therefore, only basic hardware replacement guidelines are included in this publication. Detailed, up-to-date instructions (called *configuration notes*) are shipped with the replacement parts or upgrade kits.

The replaceable system components fall into two categories: those that support online insertion and removal (OIR) and those that require you to shutdown the system power before replacement. Because interface processors support OIR, you can remove and replace them while the system is operating. However, you *must* shutdown the system power before removing the RP, the SP (or SSP), RSP7000, RSP7000CI, or any of the internal components (the fan tray, power supply, and arbiter). Access to the internal components also requires that you remove the chassis cover panel and power harness cover in the noninterface processor end of the router, which exposes the power supply backplane connection. If the power is not shutdown, the high current present in the wiring, and on the backplane if the backplane cover is removed, becomes a hazard. Therefore, always make sure that the system power switch is turned off before removing any internal components or interior chassis panels.

This chapter contains information on the following:

- RP, SP, SSP, RSP7000, RSP7000CI, and interface processor installation and configuration (general instructions for installing, replacing, upgrading, and reconfiguring the processor modules and associated components and, when necessary, instructions for using software configuration commands)
- Internal chassis component replacement (instructions for accessing the chassis interior to replace the following components):
  - Fan tray
  - Power supply
  - Arbiter



**Warning** Before performing any procedures in this chapter, review the section “Safety Recommendations” in the chapter “Preparing for Installation.”

## Installing and Configuring Processor Modules

This section provides installation and removal procedure for all processor modules, which include the RP, SP, SSP, RSP7000, RSP7000CI, and CxBus interface processors. This section also includes instructions for replacing spares on the interface processors, for configuring jumpers, and for using basic configuration commands that you may need when setting up new interfaces.

On the RP, you can change the settings of the hardware configuration register and Flash memory write-protection jumpers to define boot instructions, set broadcast addresses and console baud rates, and set (or remove) write protection for the contents of Flash memory.

On the FSIP, you can replace a port adapter if one fails, and with software commands you can change the rate or direction timing signals, change the default NRZ to NRZI format, or change the default 16-bit error correction cyclic redundancy check (CRC) to 32-bit on individual interfaces.

EPROM replacement procedures are included in this section in case replacement is necessary for some unforeseen reason. An EPROM component on the SP (or SSP) and each interface processor contains a default microcode image. The router supports downloadable microcode, so it is unlikely that you will ever need to replace the microcode EPROM.

Each RP, SP (or SSP), RSP7000, RSP7000CI, and interface processor contains a bus-type connector that mates with the system backplane. Each card connector comprises a set of tiered pins, in three lengths. The pins send specific signals to the system as they make contact with the backplane. The system assesses the signals it receives and the order in which it receives them to determine what event is occurring and what task it needs to perform, such as reinitializing new interfaces or shutting down removed ones. For example, when inserting an interface processor, the longest pins make contact with the backplane first, and the shortest pins make contact last. The system recognizes the signals and the sequence in which it receives them. The system expects to receive signals from the individual pins in this logical sequence, and the ejector levers help to ensure that the pins mate in this sequence.



**Caution** Only CxBus interface processors support online insertion and removal (OIR). Do not remove or install the RP or SP (or SSP) while the system is powered on. Doing so can cause a system crash and can destroy memory files.

System software upgrades also can contain upgraded microcode images, which will load automatically when the new software image is loaded. Although most upgrades support the downloadable microcode feature and are distributed on floppy disk or Flash memory card, some may require ROM replacement. If replacement is necessary, refer to the section “Microcode Component Replacement” in this chapter. Also, specific up-to-date replacement and configuration instructions will be provided with the replacement component in the upgrade kit.

### Online Insertion and Removal Information

All CxBus interface processors (AIP, CIP, EIP, FIP, FSIP, HIP, MIP, and TRIP) support online insertion and removal (OIR), which allows you to install, remove, replace, and rearrange the interface processors without turning off the system power. When the system detects that an interface processor has been installed or removed, it automatically runs diagnostics and discovery routines, acknowledges the presence or absence of the interface processor, and resumes system operation without any operator intervention. You do not need to notify the software or shutdown the system power.

When you remove or insert an interface processor, the backplane pins send signals to notify the system, which then performs as follows:



- 1 Rapidly scans the backplane for configuration changes and does not reset any interfaces.
- 2 Initializes all newly inserted interface processors, noting any removed interfaces and placing them in the administratively shutdown state.
- 3 Brings all previously configured interfaces on the interface processor back to the state they were in when they were removed. Any newly inserted interfaces are put in the administratively shutdown state, as if they were present (but unconfigured) at boot time. If a similar interface processor type has been reinserted into a slot, then its ports are configured and brought online up to the port count of the original interface processor.

OIR functionality enables you to add, remove, or replace interface processors with the system online, which provides a method that is seamless to end users on the network, maintains all routing information, and ensures session preservation.

When you insert a new interface processor, the system runs a diagnostic test on the new interfaces and compares them to the existing configuration.

If this initial diagnostic test fails, the system remains off line for another 15 seconds while it performs a second set of diagnostic tests to determine whether or not the interface processor is faulty and if normal system operation is possible.

If the second diagnostic test passes, which indicates that the system is operating normally and the new interface processor is faulty, the system resumes normal operation but leaves the new interfaces disabled. If the second diagnostic test fails, the system crashes, which usually indicates that the new interface processor has created a problem on the bus and should be removed.

The system brings online only interfaces that match the current configuration and were previously configured as up; all other interfaces require that you configure them with the **configure** command. On interface processors with multiple interfaces, only the interfaces that have already been configured are brought online.

For example, if you replace a single-PCA CIP with a dual-PCA CIP, only the previously configured interface is brought online automatically; the new interface remains in the administratively shutdown state until you configure it and bring it online.



**Caution** When removing or replacing interface processors, you can avoid erroneous failure messages by allowing at least 15 seconds for the system to reinitialize before removing or inserting another interface processor.

## Tools Required

You will need a number 1 Phillips or 3/16-inch flat-blade screwdriver to remove any blank interface processor carriers (fillers) and to tighten the captive installation screws that secure the interface processor in its slot. (Most interface processor carriers use slotted screws, but some were manufactured with Phillips screws.) Whenever you handle interface processors, use a wrist strap or other grounding device to prevent ESD damage. (See the section “Preventing Electrostatic Discharge Damage” in the chapter “Preparing for Installation.”)

### Ejector Levers

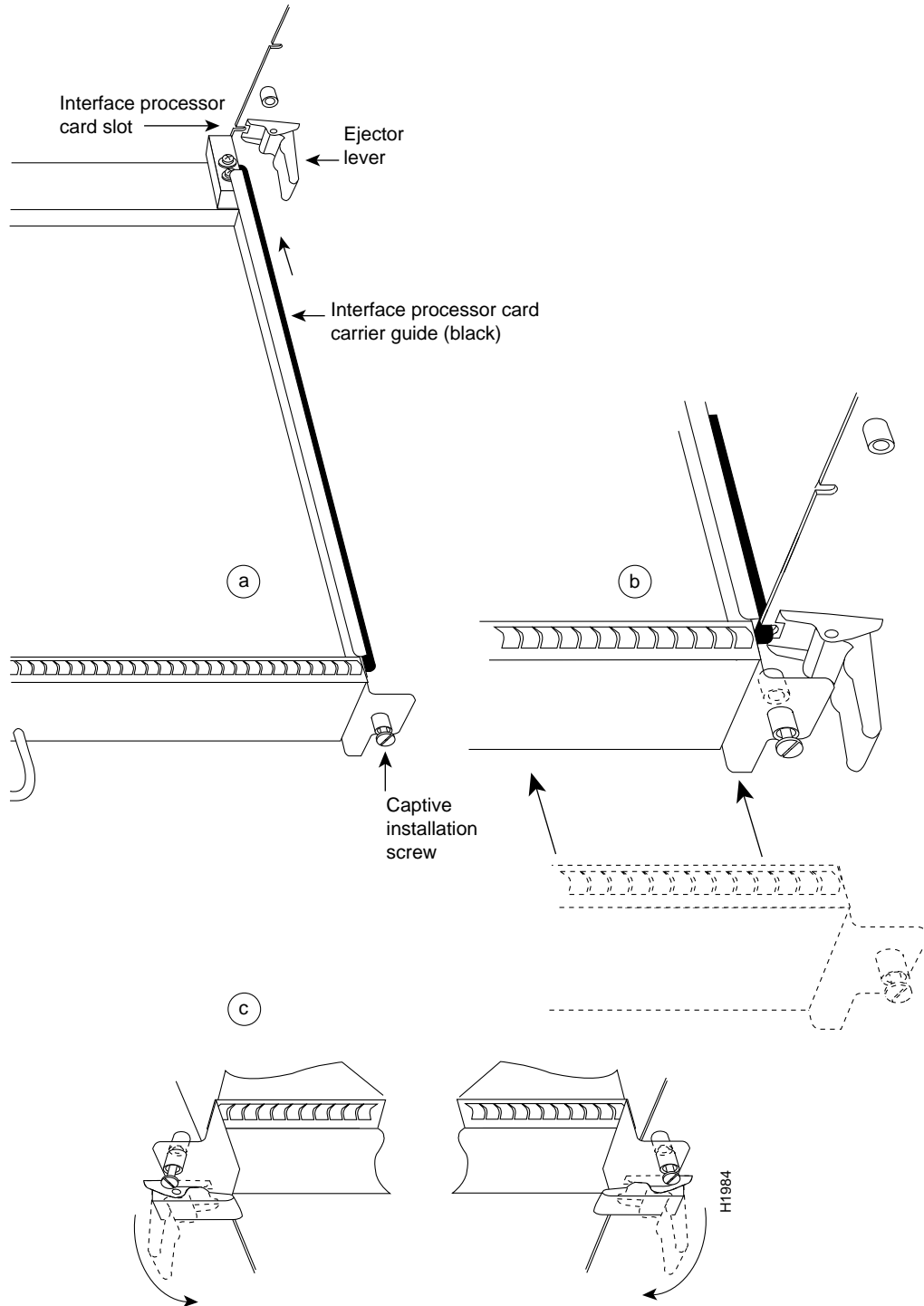
The function of the ejector levers is to align and seat the card connectors in the backplane. Failure to use the ejector levers and insert the interface processor properly can disrupt the order in which the pins make contact with the backplane. Follow the installation and removal instructions carefully, and review the following examples of incorrect insertion practices and results:

- Using the handle to force the interface processor all the way into the slot can pop the ejectors out of their springs. If you then try to use the ejectors to seat the interface processor, the first layer of pins (which are already mated to the backplane) can disconnect and then remate with the backplane, which the system interprets as a board failure.
- Using the handle to force or slam the interface processor all the way into the slot can also damage the pins on the board connectors if they are not aligned properly with the backplane.
- When using the handle (rather than the ejectors) to seat the interface processor in the backplane, you may need to pull the interface processor back out and push it in again to align it properly. Even if the connector pins are not damaged, the pins mating with and disconnecting from the backplane will cause the system to interpret a board failure. Using the ejectors ensures that the board connector mates with the backplane in one continuous movement.
- Using the handle to insert or remove an interface processor, or failing to push the ejectors to the full 90-degree position, can leave some (not all) of the connector pins mated to the backplane, a state which will hang the system. Using the ejectors and making sure that they are pushed fully into position ensures that all three layers of pins are mated with (or free from) the backplane.

It is also important to use the ejector levers when removing an interface processor to ensure that the board connector pins disconnect from the backplane in the logical sequence expected by the system. Any RP, SP (or SSP), or interface processor that is only partially connected to the backplane can hang the bus. Detailed steps for correctly performing OIR are included in the following procedures for installing and removing interface processors.

Following are detailed steps for removing and replacing interface processors and successfully performing OIR. Figure 5-1 shows the functional details of the ejector levers, which you must use properly when inserting or removing interface processors.

Figure 5-1 Ejector Levers and Captive Installation Screws



## Removing and Replacing the RP, SP or SSP, RSP7000, or RSP7000CI

The RP, SP (or SSP), RSP7000, and RSP7000CI do not support OIR, because they are all required system components. Removing these boards without first shutting down the system will cause an abrupt system shutdown and can damage or destroy memory files.

To remove or replace one of these processor modules, first shut down all system power, then follow the procedures in the following sections, “Removing CxBus Interface Processors” and “Installing CxBus Interface Processors.”



**Caution** Before removing the RP, SP or SSP, RSP7000, or RSP7000CI, make sure the system is shut down and the power switch is OFF.

### Removing CxBus Interface Processors

To remove a CxBus interface processor, follow these steps:

- Step 1** If you will not immediately reinstall the interface processor you are removing, or if there is not enough slack in the network interface cables to remove the interface processor without straining the cables, disconnect any cables attached to the interface ports.
- Step 2** You must pull processor modules straight out of the slot. Ensure that there are no obstructions that will prevent you from doing so, such as a power strip on a rack post, network connection devices attached to adjacent interface processors, or extensive cabling in front of the processor slots.
- Step 3** Use a screwdriver to loosen the captive installation screws at the both ends of the interface processor. (See Figure 5-1a.)
- Step 4** Place your thumbs on the ejector levers on both ends of the interface processor (see Figure 5-1c) and simultaneously pull them both outward to release the interface processor from the backplane connector.
- Step 5** Grasp the interface processor handle with one hand and place your other hand under the carrier to support it. Pull the interface processor straight out of the slot keeping it at a 90-degree orientation to the backplane. (See Figure 5-2.)
- Step 6** Place the removed interface processor on an antistatic mat or immediately install it in another slot.
- Step 7** If the slot is to remain empty, install a blank interface processor filler (MAS-7KBLANK) to keep dust out of the chassis, to maintain proper air flow through the interface processor compartment, and to maintain the EMI integrity of the system.



**Caution** Always install blank interface processor fillers in empty processor slots to maintain the proper flow of cooling air through the chassis.



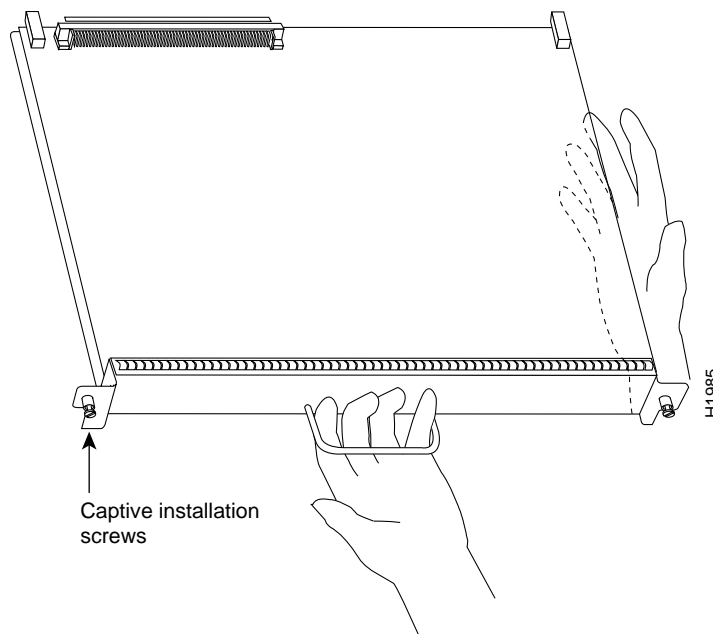
**Caution** The RP, SP (or SSP), RSP7000, and RSP7000CI are required system components; removing any of them without first shutting down the system will cause an abrupt system shutdown and can damage or destroy memory files. To remove or replace them, first shutdown system power, then follow removal and insertion procedures to ensure that the processor module is seated properly.

## Installing CxBus Interface Processors

You can install interface processors in any of the three interface processor slots, numbered 0 through 2 from the bottom slot upward when viewing the chassis from the interface processor end. (See Figure 1-3.) The top slot contains the RP, and the slot directly below the RP contains the SP (or SSP). Blank interface processor fillers are installed in slots without interface processors to maintain consistent air flow through the interface processor compartment.

Following are installation steps for the CxBus interface processors, which support OIR and can be removed and installed while the system is operating. The RP, SP (or SSP), RSP7000, or RSP7000CI are required system components. You must turn off the system power before removing or installing them. After you have turned the system power off, the installation steps for the RP, SP (or SSP), RSP7000, and RSP7000CI are the same as those for the interface processors.

**Figure 5-2 Handling an Interface Processor during Installation**



**Caution** Handle interface processors by the handles and carrier edges only to prevent ESD damage.

- Step 1** Choose a slot for the new interface processor and ensure that there is enough clearance to accommodate any interface equipment that you will connect directly to the interface processor ports. (For example, 10BASE-T Ethernet transceivers that connect directly to EIP ports may be wider than the interface processor and can obstruct connections on adjacent interface processors.)
- Step 2** Interface processors are secured with two captive installation screws. Use a number 1 Phillips or a 1/4-inch flat-blade screwdriver to loosen the two captive installation screws and remove the interface processor filler (or the existing interface processor) from the slot to be filled.
- Step 3** Hold the interface processor handle with one hand, and place your other hand under the carrier to support it. (See Figure 5-2.) Avoid touching the board.

- Step 4** Place the back of the interface processor in the slot and align the carrier guides along the sides of the interface processor with the grooves in the side of the slot. (See Figure 5-1a.)
- Step 5** While keeping the interface processor at a 90-degree orientation to the backplane, carefully slide the interface processor into the slot until the interface processor faceplate makes contact with the ejector levers.
- Step 6** Using your thumbs, simultaneously push both ejector levers inward until they push the interface processor completely into the slot. The ejectors should be in approximately the same orientation as the interface processor faceplate. (See Figure 5-1c.)
- Step 7** Use a screwdriver to tighten both of the captive installation screws.
- Step 8** Attach network interface cables or other devices to the interface ports.
- Step 9** Check the status of the interfaces as follows:
- If this installation is a replacement interface processor, use the **show interface** or **show controllers [type]** command to verify that the system has acknowledged the new interfaces and brought them up.
  - If the interfaces are new, use the **configure** command or the **setup** command facility to configure the new interface(s). This does not have to be done immediately, but the interfaces will not be available until you configure them.

---

**Note** Always use the ejector levers when installing or removing processor modules. A module that is partially seated in the backplane will cause the system to hang and subsequently crash.

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**Caution** You must turn OFF power to the system before removing or installing an RP or SP (or SSP). After the chassis power has been turned OFF, the installation and removal procedure is the same as the preceding steps for replacing interface processors.

### Sample Screen Display for OIR

When you remove and replace CxBus interface processors, the system provides status messages across the console screen. The messages are only informational. In the following sample display, the events logged by the system show that an EIP was removed from slot 0, the system reinitialized the remaining interface processors, and marked the EIP that was removed from slot 0 as *down*. When the EIP was reinserted, the system marked the interfaces as *up* again.

```
7010#

%OIR-6-REMCARD: Card removed from slot 0, interfaces disabled
%LINK-5-CHANGED: Interface TokenRing2/0, changed state to initializing
%LINK-5-CHANGED: Interface Ethernet0/1, changed state to administratively down
%LINK-5-CHANGED: Interface Ethernet0/5, changed state to administratively down
%LINK-5-CHANGED: Interface TokenRing2/0, changed state to up

7010#

%OIR-6-INSCARD: Card inserted in slot 0, interfaces administratively shut down
%LINK-5-CHANGED: Interface TokenRing2/0, changed state to initializing
%LINK-5-CHANGED: Interface Ethernet0/1, changed state to up
%LINK-5-CHANGED: Interface Ethernet0/5, changed state to up
%LINK-5-CHANGED: Interface TokenRing2/0, changed state to up
```

## Microcode Component Replacement

The SP (or SSP) and each interface processor contain default microcode, which is an image of board-specific software instructions on a single ROM device on each board. Microcode operates with the system software and controls features and functions that are unique to an interface processor type. New features and enhancements to the system or interfaces are often implemented in microcode upgrades. Although each processor type contains the latest available microcode version (in ROM) when it leaves the factory, updated microcode images are periodically distributed with system software images to enable new features, improve performance, or fix bugs in earlier versions. The latest available microcode version for each interface processor type is bundled with each new system software maintenance upgrade; the bundled images are distributed as a single image on floppy disk or a Flash memory card.

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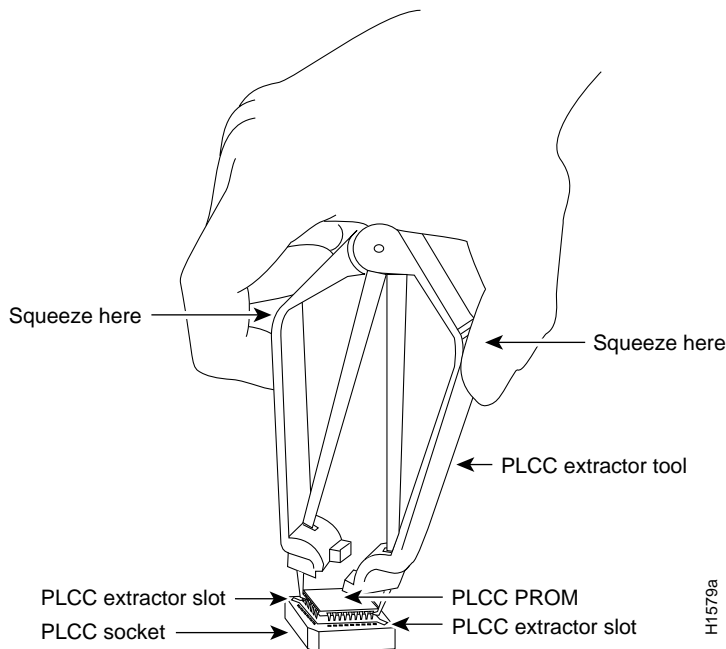
**Note** We strongly recommend that the microcode bundled with the system software be used as a package. Overriding the bundle could possibly result in incompatibility between the various interface processors in the system.

---

Although most upgrades support the downloadable microcode feature and are distributed on floppy disk, some images may require ROM replacement. If necessary, use the following instructions to replace an interface processor EPROM in case Flash memory is damaged or otherwise not available, or to change the default microcode on a board for any other reason. The replacement procedures are the same for each board with the exception of the FSIP, which uses a PLCC-type package for the microcode.

You must use a PLCC extractor to remove the FSIP microcode component. (See Figure 5-3.) You cannot use a small flat-blade screwdriver to pry it out of the socket as with the older type of integrated circuits (ICs). A PLCC IC does not have legs or pins that plug into the socket; instead, the contacts are on the sides of the IC and along the inner sides of the socket. When the IC is seated in the socket, the top of the IC is flush with the top of the socket. Forcing a small screwdriver or other tool between the IC and the sides of the socket to pry out the IC will damage the component or the socket or both, and you will have to replace them.

Figure 5-3 Removing a Microcode Component from a PLCC-Type Package



### Tools Required

You need the following tools to replace the microcode component:

- Chip extractor or puller (you need a PLCC-type extractor to remove the FSIP component)
- Antistatic mat or foam pad
- ESD-preventive grounding strap (a disposable wriststrap is included in microcode upgrade kits)

### Replacing the ROM

Following are the steps for replacing the microcode ROM device on the SP (or SSP) and any interface processor. Refer to the illustrations of the individual interface processors in the section “Interface Processors” in the chapter “Product Overview” for socket locations.



**Caution** Handle interface processors by the handles and carrier edges only, and always use a grounding strap to prevent ESD damage.

- Step 1** If you are replacing the component on an interface processor, check the state of each interface before removing the interface processor and note any that are shutdown.
- Step 2** If you are removing and reinserting the SP (or SSP), shutdown the system.
- Step 3** Follow the steps in a previous section “Removing CxBus Interface Processors” to remove the interface processor or SP (or SSP) from the chassis. You can leave the cables connected if you perform the replacement close to the chassis to avoid straining the interface cables attached to an adjacent interface processor. Otherwise, label the cables before disconnecting them to avoid crossing them later.
- Step 4** Place the removed interface processor on an antistatic mat or foam.



- Step 5** Locate the microcode component; refer to the appropriate SP (or SSP) or interface processor illustrations in the chapter “Product Overview” for socket locations. The socket designators for each interface processor follow:
- AIP: U111
  - CIP: U37 (contains the microcode boot image; the entire microcode image is in the software/microcode bundle)
  - EIP: U101
  - FEIP: U37
  - FIP: U23
  - FSIP: U81
  - HIP: U133
  - MIP: U41
  - SP: U173
  - SSP: U231
  - TRIP: U41
- Step 6** Note the orientation of the notch on the existing microcode component so that you can install the new component with the same orientation.
- Step 7** Use a chip or PLCC-type extractor (for the FSIP) to remove the microcode component from the socket. Place the removed component on antistatic foam or into an antistatic bag.
- Step 8** Insert the new microcode component in the socket with the notched end in the same orientation as the previous component.
- Step 9** Follow the steps in the section “Installing CxBus Interface Processors” in this chapter, to replace the interface processor, SP, or SSP.
- Step 10** Verify that the enabled LED on the interface processor, SP, or SSP goes on and remains on. If it does not, eject the board and reinstall it in the slot. Turn OFF power before ejecting the SP or SSP.
- Step 11** Connect any network interface cables that were removed.
- Step 12** If the system power is OFF, turn it back ON.

## Verifying the Microcode Version

The system automatically reloads the microcode when you insert an interface processor online or restart the system. The system default is to load the ROM microcode for all processor types. However, because microcode upgrades are usually distributed as files to be stored and loaded from Flash memory, the system may be configured to bypass the ROM image for a particular processor type and load an image from a Flash memory file instead. (This can be true for any or all processor types.) To determine whether the interface processor you just upgraded is loading the new ROM microcode or an image from Flash memory, issue the **show controller cxbus** command. The first line of the status display for the SP (or SSP) and for each interface processor displays the currently loaded and running microcode version for that particular processor type. The following example shows that the EIP in slot 0 is running EIP Microcode Version 1.0:

```
7010# show cont cxbus
EIP 0, hardware version 5.1, microcode version 1.0
Interface 0 - Ethernet0/0, station addr 0000.0c02.d0ec (bia 0000.0c02.d0cc)
```

If the microcode version in the display is different from the ROM version you just installed, use the **microcode card-type rom** configuration command to change the configuration so the system loads the ROM microcode for that processor type. Verify that the new microcode version is loading from ROM and, if necessary, correct the configuration with the following steps:

**Step 1** Verify that the system boots correctly. If the enabled LED on the SP (or SSP) or interface processor you just reinstalled does not go on, repeat the steps in the preceding section, “Replacing the ROM.”

- Ensure that the ROM is installed with the notch at the correct end and that none of the pins are bent.
- If a pin is bent, remove the ROM, straighten the pin, and try the installation again.
- If a ROM is installed backwards and power is turned ON, the ROM is damaged and needs replacement.

**Step 2** Check the state of the interfaces with the LEDs and verify that the interfaces return to the same state they were in before you removed the interface processor (some may have been shutdown).

**Step 3** Enter the **show controller cxbus** command to display the status of the SP (or SSP) and all interface processors.

**Step 4** If the display indicates that the new ROM image is the currently running microcode version, your installation is complete. If a different (older) version is displayed, the microcode is still loading from a Flash memory file. Proceed with the following steps to configure the ROM microcode to load.

**Step 5** Enable the privileged level of the EXEC command interpreter (which usually requires a password) and enter the configuration mode from the terminal:

```
7010> enable
Password:
7010# configure terminal
```

**Step 6** Enter the command **microcode card-type rom** to negate the instruction to load from Flash memory, then issue the **microcode reload** command to reload the microcode with the new instructions. The following example shows the command used to load EIP microcode from ROM:

```
microcode eip rom
microcode reload
```

**Step 7** Press **Ctrl-Z (^Z)** to return to the system prompt, and save (write) the new configuration to memory with the **write terminal** command.

```
^Z
write terminal
[OK]
```

**Step 8** Enter the **show controller cxbus** command again. The first line of the display for the interface processor (and for all interface processors of the same type) should show the new ROM microcode version.

The replacement procedure is complete. If the Enabled indicator does not go on after a second installation attempt, or if any of the interfaces fail to return to their previous state, refer to the troubleshooting procedures in the chapter “Troubleshooting the Installation.”

## RP and RSP7000 Configurations

This section describes the following maintenance aspects of the RP and RSP7000, with differences noted:

- Changing RP jumper settings

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**Note** The RSP7000 uses the software configuration register feature exclusively; there are no user-configurable jumpers on the RSP7000. For the RSP7000's configuration register functions, refer to the section "Software Configuration Register," later in this chapter.

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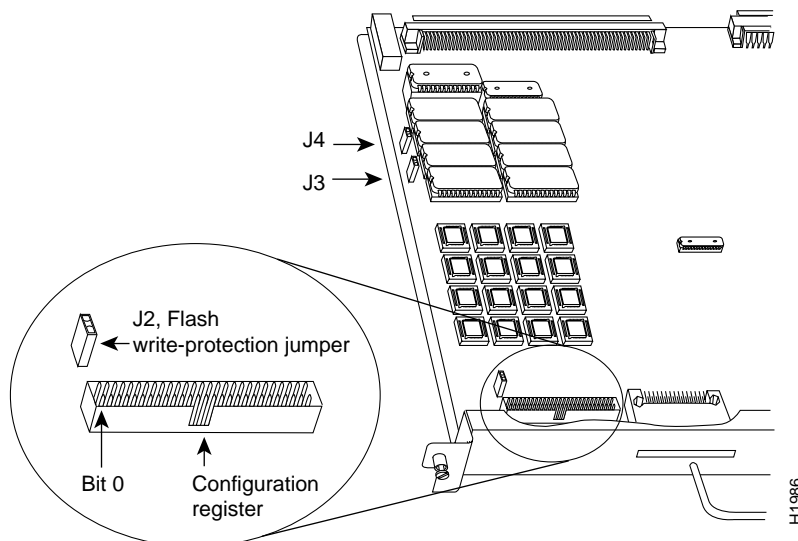
- Changing software configuration register settings
- Replacing system software EPROMs
- Replacing DRAM SIMMs

Most system software upgrades are distributed on floppy disk or Flash memory cards. However, occasionally it might be necessary to replace the system software ROMs to ensure proper operation with a newer software release.

### Configuring Jumpers

The RP contains the hardware configuration register and the Flash memory write-protect jumper, both of which are shown in Figure 5-4. Jumpers installed on the hardware configuration register define boot instructions and set broadcast addresses and console baud rates. Jumper J2, when removed, protects the contents of Flash memory by preventing any information to be written to Flash memory. Jumpers J3 and J4 (see Figure 5-4) are set according to the size of the eight software EPROMs on the RP. These jumpers correspond to the EPROMs only and *not* to the software image size; you do not need to reset the jumpers when loading a larger software image into Flash memory. (See Figure 5-8 for jumper settings.)

**Figure 5-4 RP Jumper Locations**

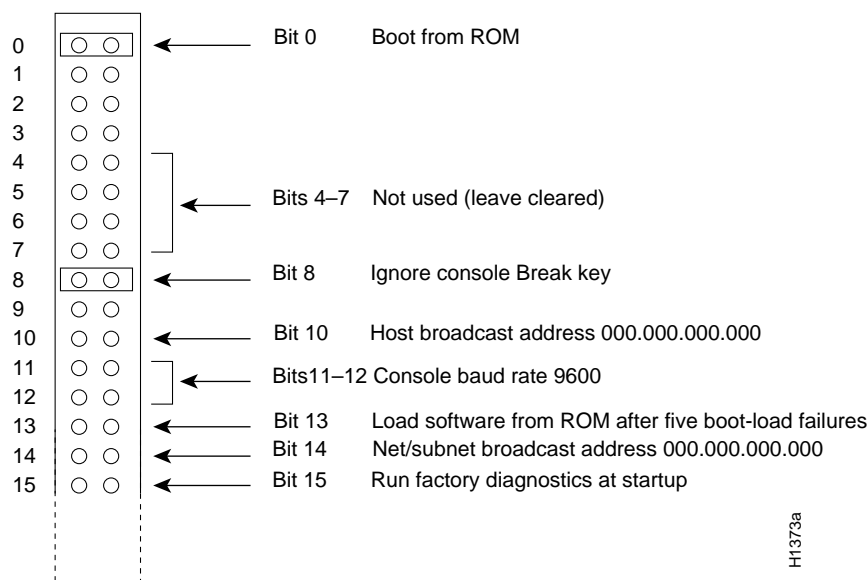


### Hardware Configuration Register Settings

The hardware configuration register (see Figure 5-4) comprises the upper 32 pins of a 50-pin jumper block located above the Flash memory card port on the RP. You can define system boot instructions, set broadcast addresses and console baud rates, or instruct the router to perform factory diagnostics at startup by installing jumpers on specific pins. Jumper bit (or position) 0 is the top pair of pins. To set a bit to 1, insert a jumper. To clear a bit to 0, remove the jumper.

To change configuration register settings, you must turn off the system power and remove the RP. Figure 5-5 shows the configuration register with the factory default setting, with jumpers installed on bits 0 and 8. Bit 0 instructs the system to boot from ROM; bit 8 instructs the system to ignore the Break key on the console terminal keyboard.

**Figure 5-5 Configuration Register Factory Default Settings**



The lowest four bits of the configuration register (bits 3 through 0) form the boot field. The boot field specifies a number in binary. When the boot field is set to either 0 or 1 (0-0-0-0 or 0-0-0-1) the system ignores any boot instructions in the configuration file. When the boot field is set to 0, you must boot the operating system manually by giving a **b** (or **boot**) command to the system bootstrap program or *rom monitor*. You can enter the **boot** command only, or include additional boot instructions with the command such as the name of a file stored in Flash memory or a file that you specify for netbooting. If you use the **boot** command only, without specifying a file or any other boot instructions, the system boots from the ROM image. Otherwise, you can instruct the system to boot from a specific image such as a Flash file (**boot system flash filename**), or to netboot by sending broadcast TFTP requests (**boot system filename**) or a direct TFTP request to a specific server (**boot system filename address**). When the boot field is set to 1 (the factory default), the system boots from ROM. Boot field settings of 0 and 1 both override any boot instructions in the system configuration file.

If you set the boot field to any bit pattern other than 0 or 1, the system uses the resulting number to form a file name for netbooting. To form the file name, the system starts with *cisco* and links the octal equivalent of the boot field value (jumper setting) and the processor type in the format *cisco<jumpervalue>-<processorname>*. (Table 5-1 lists the default boot file names or actions for

the RP.) The system uses the default filename for netbooting. However, if the configuration file contains any boot instructions, the system uses those boot instructions instead of the filename it computed from the jumper settings.

**Table 5-1 Default Boot Filenames—Boot Field Jumpers**

Action/Filename	Bit 3	Bit 2	Bit 1	Bit 0
bootstrap mode	0	0	0	0
ROM software	0	0	0	1
cisco2-rp1	0	0	1	0
cisco3-rp1	0	0	1	1
cisco4-rp1	0	1	0	0
cisco5-rp1	0	1	0	1
cisco6-rp1	0	1	1	0
cisco7-rp1	0	1	1	1
cisco10-rp1	1	0	0	0
cisco11-rp1	1	0	0	1
cisco12-rp1	1	0	1	0
cisco13-rp1	1	0	1	1
cisco14-rp1	1	1	0	0
cisco15-rp1	1	1	0	1
cisco16-rp1	1	1	1	0
cisco17-rp1	1	1	1	1

**Note** The four bits after the boot field (bits 4 through 7) in the configuration register are not used and must be left cleared (0).

Bit 8 in the configuration register controls the console Break key. Setting bit 8 to 1 (the factory default) causes the processor to ignore the console Break key. Clearing bit 8 to 0 causes the processor to interpret Break as a command to force the system into the bootstrap monitor, thereby suspending normal operation.

Bit 9 in the configuration register is not used.

Bit 10 in the configuration register controls the host portion of the Internet broadcast address. Setting bit 10 causes the processor to use all zeros; clearing bit 10 (the factory default) causes the processor to use all ones. Bit 10 interacts with bit 14, which controls the network and subnet portions of the broadcast address. Table 5-2 shows the combined effect of bits 10 and 14.

**Table 5-2 Configuration Register Settings for Broadcast Address Destination**

Bit 14	Bit 10	Address (<net><host>)
out	out	<ones><ones>
out	in	<zeros><zeros>

Bit 14	Bit 10	Address (<net><host>)
in	in	<net><zeros>
in	out	<net><ones>

Bits 11 and 12 in the configuration register determine the console port baud rate. Table 5-3 shows the bit settings for the four available baud rates. (The factory default is 9600.)

**Table 5-3 System Console Terminal Baud Rate Settings**

Baud	Bit 12	Bit 11
9600	0	0
4800	0	1
1200	1	0
2400	1	1

Bit 13 in the configuration register determines the system’s response to a boot-load failure. Setting bit 13 causes the system to load operating software from ROM after five unsuccessful attempts to load a boot file from the network. Clearing bit 13 causes the system to continue attempting to load a boot file from the network indefinitely. By factory default, bit 13 is cleared to 0.

Bit 14 in the configuration register controls the network and subnet portions of the Internet broadcast address. Setting bit 14 causes the system to include the network and subnet portions of its address in the broadcast address. Clearing bit 14 causes the system to set the entire broadcast address to all ones or all zeros, depending on the setting of bit 10. By factory default, bit 14 is cleared to 0. See Table 5-2 for the combined effect of bits 10 and 14.

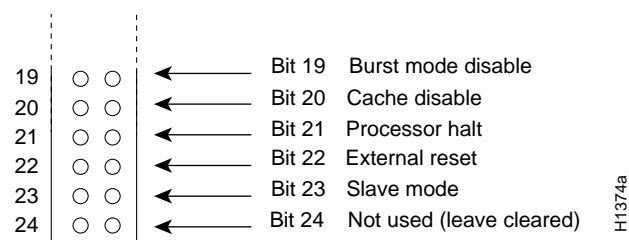
Bit 15 in the configuration register controls factory diagnostic mode in the system. Setting bit 15 causes the system to produce detailed CPU self-check messages, to automatically prompt for interface addresses (not look for addresses on the network), to *not* read configuration files or nonvolatile memory, and to automatically set to diagnostic tracing modes using the debug commands. Clearing bit 15 (the factory default) causes the system to operate normally.

Bits 16 through 18 are not used and should remain cleared.

Bit 19 disables the fast page burst mode from the DRAM to the MC68EC040 processor.

Bits 20 through 23 (the four pairs of pins on the far left of the 50-pin header) are not used in normal operation; however, they can be used to invoke the cache disable, processor halt, external reset, and slave mode functions. (See Figure 5-6.)

**Figure 5-6 Optional Configuration Register Settings**



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**Note** Configuration register setting changes take effect when the system restarts.

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### Flash Memory Write Protection

The Flash memory write-protection option protects the contents of Flash memory against accidental erasure or reprogramming. The factory default, with a jumper installed on J2, is to allow programming (writing) to Flash memory. To protect the contents, remove the jumper from J2. You can later replace the jumper to enable Flash memory programming. The location of J2 is shown in Figure 5-4.

## Software Configuration Register

This section describes the software (virtual) configuration register that is used with the RP in a system running Cisco Internetwork Operating System (Cisco IOS) Release 10.0 or later. Its functions are identical to the hardware configuration register except the settings are changed through the command line interface.

Following is the information included in this section:

- Software configuration register settings
- Explanation of boot field
- Changing configuration register settings
- Software configuration register bit meanings
- Default boot filenames
- Software configuration register settings for broadcast address destination
- System console terminal baud-rate settings
- Enabling booting from Flash
- Copying to Flash

### Software Configuration Register Settings

Settings for the 16-bit software configuration register are written into the NVRAM. Following are some reasons for changing the software configuration register settings:

- Force the system into the bootstrap program.
- Select a boot source and default boot filename.
- Enable or disable the Break function.
- Control broadcast addresses.
- Set the console terminal baud rate.
- Load operating software from ROM.
- Enable booting from a Trivial File Transfer Protocol (TFTP) server.

Table 5-4 lists the meaning of each of the software configuration memory bits, and Table 5-5 defines the boot field.



**Caution** To avoid confusion and possibly halting the router, remember that valid configuration register settings might be combinations of settings and not just the individual settings listed in Table 5-4. For example, the factory default value of 0x0101 is a combination of settings.

**Table 5-4 Software Configuration Register Bit Meanings**

Bit No. <sup>1</sup>	Hexadecimal	Meaning
00 to 03	0x0000 to 0x000F	Boot field (see Table 5-5)
06	0x0040	Causes system software to ignore NVRAM contents
07	0x0080	OEM bit enabled <sup>2</sup>
08	0x0100	Break disabled
09	0x0200	Use secondary bootstrap
10	0x0400	Internet Protocol (IP) broadcast with all zeros
11 to 12	0x0800 to 0x1000	Console line speed (default is 9,600 baud)
13	0x2000	Boot default ROM software if network boot fails
14	0x4000	IP broadcasts do not have network numbers
15	0x8000	Enable diagnostic messages and ignore NVRAM contents

1. The factory default value for the configuration register is 0x0101. This value is a combination of the following: bit 8 = 0x0100 and bits 00 through 03 = 0x0001 (see Table 5-5).  
 2. OEM = original equipment manufacturer.

**Table 5-5 Explanation of Boot Field (Configuration Register Bits 00 to 03)**

Boot Field	Meaning
00	Stays at the system bootstrap prompt
01	Boots system image in system ROM
02 to 0F	Specifies a default netboot filename Enables boot system commands that override the default netboot filename

### Changing Settings

Some common reasons to modify the value of the software configuration register are as follows:

- Recover a lost password.
- Change the console baud rate.
- Enable or disable Break.
- Allow you to manually boot the operating system using the **b** command at the bootstrap program (ROM monitor) prompt.
- Force the router to boot automatically from the system bootstrap software (boot ROM image) or from its system image in Flash memory, and read any **boot system** commands that are stored in the configuration file in NVRAM. If the router finds no **boot system** commands, it uses the configuration register value to form a filename from which to netboot a default system image stored on a network server. (See Table 5-6.)

To change the configuration register while running the system software, follow these steps:

**Step 1** Enter the **enable** command and your password to enter privileged level, as follows:



```
Router> enable
Password:
router#
```

- Step 2** At the privileged-level system prompt (router #), enter the command **configure terminal**. You will be prompted as shown in the following example:

```
Router# conf term
Enter configuration commands, one per line. End with CTRL/Z
```

- Step 3** To set the contents of the configuration register, enter the **config-register value** configuration command where *value* is a hexadecimal number preceded by 0x (see Table 5-4), as in the following:

```
config-register 0xvalue
```

- Step 4** Exit the configuration mode by entering **Ctrl-Z**. The new value settings will be saved to memory; however, the new settings do not take effect until the system software is reloaded by rebooting the router.

- Step 5** To display the configuration register value currently in effect and the value that will be used at the next reload, enter the **show version EXEC** command. The value will be displayed on the last line of the screen display, as in the example following:

```
Configuration register is 0x141 (will be 0x101 at next reload)
```

- Step 6** Reboot the router. The new value takes effect. Configuration register changes take effect only when the server restarts, such as when you switch the power OFF and on or when you issue a **reload** command from the console.

If the boot ROMs do not support the software configuration register (not Release 10.0 or later), the following message will be displayed:

```
Boot ROMs do not support software configuration register.
Value not written to NVRAM.
```

## Bit Meanings

The lowest four bits of the software configuration register (bits 3, 2, 1, and 0) form the boot field. (See Table 5-5.) The boot field specifies a number in binary form. If you set the boot field value to 0, you must boot the operating system manually by entering the **b** command at the bootstrap prompt as follows:

```
> b [tftp] flash filename
```

Definitions of the various **b** command options follow:

- **b**—Boots the default system software from ROM

---

**Note** The RSP7000 does not use ROM devices to run Cisco IOS images.

---

- **b flash**—Boots the first file in Flash memory
- **b slot0: filename**—Boots the file *filename* from the Flash memory card in the PCMCIA Slot on the faceplate
- **b filename [host]**—Netboots using TFTP

- **b flash [filename]**—Boots the file *filename* from Flash *memory*

For more information about the b [tftp] flash filename command, refer to the set of router products configuration publications.

If you set the boot field value to 0x2 through 0xF, and there is a valid system boot command stored in the configuration file, then the router boots the system software as directed by that value. If you set the boot field to any other bit pattern, the router uses the resulting number to form a default boot filename for netbooting. (See Table 5-6.)

In the following example, the software configuration register is set to boot the router from Flash memory and to ignore Break at the next reboot of the router:

```
Router# conf term
Enter configuration commands, one per line. End with CTRL/Z.
config-register 0x102
boot system flash [filename]
^z
Router#
```

The server creates a default boot filename as part of the automatic configuration processes. To form the boot filename, the server starts with the name cisco and adds the octal equivalent of the boot field number, a hyphen, and the processor-type name. Table 5-6 lists the default boot filenames or actions for the processor.

**Table 5-6 Default Boot Filenames—Boot Field Jumpers**

Action/Filename	Bit 3	Bit 2	Bit 1	Bit 0
bootstrap mode	0	0	0	0
ROM software	0	0	0	1
cisco2-rp1	0	0	1	0
cisco3-rp1	0	0	1	1
cisco4-rp1	0	1	0	0
cisco5-rp1	0	1	0	1
cisco6-rp1	0	1	1	0
cisco7-rp1	0	1	1	1
cisco10-rp1	1	0	0	0
cisco11-rp1	1	0	0	1
cisco12-rp1	1	0	1	0
cisco13-rp1	1	0	1	1
cisco14-rp1	1	1	0	0
cisco15-rp1	1	1	0	1
cisco16-rp1	1	1	1	0
cisco17-rp1	1	1	1	1

---

**Note** A **boot system** configuration command in the router configuration in NVRAM overrides the default netboot filename.

---

Bit 8 controls the console Break key. Setting bit 8 (the factory default) causes the processor to ignore the console Break key. Clearing bit 8 causes the processor to interpret the Break key as a command to force the system into the bootstrap monitor, thereby halting normal operation. A break can be sent in the first 60 seconds while the system reboots, regardless of the configuration settings.

Bit 9 controls the secondary bootstrap program function. Setting bit 9 causes the system to use the secondary bootstrap; clearing bit 9 causes the system to ignore the secondary bootstrap. The secondary bootstrap program is used for system debugging and diagnostics.

Bit 10 controls the host portion of the IP broadcast address. Setting bit 10 causes the processor to use all zeros; clearing bit 10 (the factory default) causes the processor to use all ones. Bit 10 interacts with bit 14, which controls the network and subnet portions of the broadcast address. Table 5-7 shows the combined effect of bits 10 and 14.

**Table 5-7 Configuration Register Settings for Broadcast Address Destination**

Bit 14	Bit 10	Address (<net> <host>)
Off	Off	<ones> <ones>
Off	On	<zeros> <zeros>
On	On	<net> <zeros>
On	Off	<net> <ones>

Bits 11 and 12 in the configuration register determine the baud rate of the console terminal. Table 5-8 shows the bit settings for the four available baud rates. (The factory-set default baud rate is 9,600.)

**Table 5-8 System Console Terminal Baud Rate Settings**

Baud	Bit 12	Bit 11
9,600	0	0
4,800	0	1
1,200	1	0
2,400	1	1

Bit 13 determines the server response to a boot-load failure. Setting bit 13 causes the server to load operating software from ROM after five unsuccessful attempts to load a boot file from the network. Clearing bit 13 causes the server to continue attempting to load a boot file from the network indefinitely. By factory default, bit 13 is cleared to 0.

### Enabling Booting from Flash Memory

To enable booting from Flash, set configuration register bits 3, 2, 1, and 0 to a value between 2 and 15 in conjunction with the **boot system flash** *[filename]* configuration command.

To enter configuration mode while in the system software image and specify a Flash filename from which to boot, enter the **configure terminal** command at the enable prompt, as follows:

```
Router# configure terminal
Enter configuration commands, one per line. End with CTRL/Z.
boot system flash [filename]
```



## Recovering a Lost Password

An overview of recovering a lost password follows:

- Enter the **show version** command to note the existing software configuration register value.
- Break to the bootstrap program prompt (ROM monitor).
- Change the configuration register to 0x0141 (ignore Break; ignore NVRAM; boot from ROM).

---

**Note** A key to recovering a lost password is to set the configuration register so that the contents of NVRAM are ignored (0x0040), allowing you to see your password.

---

- Enter privileged level in the system bootstrap program.
- Enter the **show configuration** command to display the enable password.
- Change the configuration register value back to its original setting.

---

**Note** To recover a lost password if Break is disabled on the router, you must have physical access to the router.

---

To recover a lost password, follow these procedures.

**Step 1** Attach an ASCII terminal to the router console port, which is located on the rear panel.

**Step 2** Configure the terminal to operate at 9600 baud, 8 data bits, no parity, 2 stop bits (or to whatever settings the router is set).

**Step 3** Enter the **show version** command to display the existing configuration register value. Note this value for later use in Step 14.

**Step 4** If Break is disabled, power cycle the router. (Turn the router OFF, wait five seconds, and then turn it ON again.) If Break is enabled on the router, press the Break key or send a break and then proceed to Step 5.

**Step 5** Within 60 seconds of turning on the router, press the Break key. This action causes the terminal to display the bootstrap program prompt (>).

**Step 6** To reset the configuration register to boot from the boot ROMs and ignore NVRAM, enter **o/r** at the bootstrap prompt as follows:

```
> o/r
```

---

**Note** If the boot ROMs do not support the software configuration register—that is, they are not Release 10.0 or later—this command will not be recognized and the current hardware configuration register value will display.

---

**Step 7** Initialize the router by entering the **i** command as follows:

```
> i
```

The router will power cycle, the configuration register will be set to 0x141, and the router will boot the boot ROM system image and prompt you with the system configuration dialog as follows:

```
--- System Configuration Dialog ---
```

**Step 8** Enter **no** in response to the system configuration dialog prompts until the following system message is displayed:

```
Press RETURN to get started!
```

**Step 9** Press **Return**. After some interface information, the boot ROM prompt appears as follows:

```
Router>
```

**Step 10** Enter the **enable** command to enter the EXEC mode in the boot ROM image. The prompt changes to the following:

```
Router#
```

**Step 11** Enter the **show configuration EXEC** command to display the enable password in the configuration file and to display any **boot system** commands.

**Step 12** Enter the **configure terminal** command at the EXEC prompt. You are prompted as follows:

```
Router# conf term  
Enter configuration commands, one per line. End with CTRL/Z.
```

**Step 13** Enter **no** in response to any **boot system** command in the configuration file.

**Step 14** Using the **config-register 0x<value>** command, change the configuration register value back to its original value (noted from Step 3) or change it to a value of 0x0101 (factory default).

**Step 15** Exit configuration mode by entering **Ctrl-Z**.

**Step 16** Reboot the router and enable it using the recovered password.

### Saving and Retrieving the Configuration File

This section describes the procedures for saving and retrieving the system configuration using a Trivial File Transfer Protocol (TFTP) server.

The procedures for saving and retrieving the configuration file might be required for the following scenarios:

- Upgrading the Cisco 7000 to operate with the 7000 Series Route Switch Processor (RSP7000), which requires you to remove the RP (and SP or SSP) and replace them with the RSP7000 and 7000 Series Chassis Interface (RSP7000CI). Removing the RP effectively removes the configuration file that is stored in the RP's NVRAM, making it necessary to first save the configuration file to a TFTP server. In addition, you cannot read the RP's Flash card with the RSP7000. This requires that you use a TFTP server to save and retrieve the file.
- Replacing a failed RP (or RSP7000), which requires you to remove the RP (or RSP7000) and install a new processor module. Removing the RP (or RSP7000) effectively removes the configuration file that is stored in NVRAM, making it necessary to first save the configuration file to a TFTP server. You can also use the procedures for copying files between NVRAM and a Flash memory card.

- Troubleshooting a configuration problem, which occasionally requires you temporarily store your configuration file in a safe place, while you test different configuration options to solve a system problem.

Configuration information resides in two places when the router is operating: the default (permanent) configuration in NVRAM, and the running (temporary) memory in RAM. The default configuration always remains available; NVRAM retains the information even when the power is shut down. The current information is lost if the system power is shut down. The current configuration contains all nondefault configuration information that you added with the **configure** command, the **setup** command facility, or by editing the configuration file.

The **copy running-config startup-config** command adds the current configuration to the default configuration in NVRAM, so that it will also be saved when power is shut down. Whenever you make changes to the system configuration, issue the **copy running-config startup-config** command to ensure that the new configuration is saved.

You also replace the entire configuration in NVRAM. If you copy the configuration file to a remote server before removing the RP (or RSP7000), you can retrieve it later and write it back into NVRAM. If you do not copy the configuration file, you will have to use the **configure** command or the **setup** command facility to reenter the configuration information after you install the RP (or RSP7000). This procedure requires privileged-level access to the EXEC command interpreter, which usually requires a password. Refer to the description that follows and contact your system administrator to obtain access, if necessary.

### Using the EXEC Command Interpreter

Before you use the **configure** command, you must enter the privileged level of the EXEC command interpreter using the **enable** command. The system prompts you for a password if one has been set.

The system prompt for the privileged level ends with a pound sign (#) instead of an angle bracket (>). At the console terminal, enter the privileged level as follows:

- Step 1** At the EXEC prompt (>), enter the **enable** command. The EXEC command interpreter prompts you for a privileged-level password, as follows:

```
Router> enable
```

```
Password:
```

- Step 2** Enter the password (the password is case sensitive). For security purposes, the password is not displayed.

- Step 3** When you enter the correct password, the system displays the privileged-level system prompt (#) as follows:

```
Router#
```

The pound sign (#) at the system prompt indicates that you are at the privileged level of the EXEC command interpreter; you can now execute the EXEC-level commands that are described in the following sections.

### Using the ping Command to Verify Server Connectivity

Before you attempt to copy or retrieve a file from a remote host, ensure that the connection is good between the router and the remote server, by using the packet internet groper (ping) program. The ping program sends a series of echo request packets to the remote device and waits for a reply. If the connection is good, the remote device echoes them back to the local device.

The console terminal displays the results of each message sent: an exclamation point (!) indicates that the local device received an echo, and a period (.) indicates that the server timed out while awaiting the reply. If the connection between the two devices is good, the system displays a series of exclamation points (! ! !) or [ok]. If the connection fails, the system displays a series of periods (. . .) or [timed out] or [failed].

To verify the connection between the router and a remote host, issue the **ping** command followed by the name or Internet Protocol (IP) address of the remote server; then press **Return**. Although the **ping** command supports configurable options, the defaults, including interface processor as the protocol, are enabled when you enter a host name or address on the same line as the **ping** command. For a description of the configurable options, refer to the appropriate software documentation.

The following example shows a successful **ping** operation:

```
Router# ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/12/12 ms
Router#
```

The following example shows the results of a failed **ping** operation:

```
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
Router#
```

If the connection fails, check the physical connection to the remote file server and verify that you are using the correct address or name, then ping the server again. If you are unable to establish a good connection, contact your network administrator or refer to the end of this document for instructions on contacting technical assistance.

### Copying the Configuration File

Before you copy the running configuration to the TFTP file server, ensure the following:

- You have a connection to the router either with a console terminal connected to the RP (or RSP7000) console port, or remotely through a Telnet session.
- The router is connected to a network supporting a file server (remote host).
- The remote host supports the TFTP application.
- You have the interface processor address or name of the remote host available.

To store information on a remote host, enter the **copy startup-config tftp** privileged EXEC command. The command prompts you for the destination host's address and a filename, then display the instructions for confirmation. When you confirm the instructions, the router sends a copy of the currently running configuration to the remote host. The system default is to store the configuration in a file called by the name of the router with *-config* appended. You can either accept the default filename by pressing **Return** at the prompt, or enter a different name before pressing **Return**.

Follow these steps to copy the currently running configuration to a remote host:

- Step 1** The system prompt should display a pound sign (#) to indicate the privileged level of the EXEC command interpreter. If it does not, follow the steps in the section "Using the EXEC Command Interpreter on page 25 to enable the privileged level.
- Step 2** Use the **ping** command to check the connection between the router and the remote host. (See the previous section "Using the ping Command to Verify Server Connectivity.")



**Step 3** Issue the **show running-config** (or **write term**) command to display the currently running configuration on the terminal, and ensure that the configuration information is complete and correct. If it is not, use the **configure** command to add or modify the existing configuration. (Refer to the appropriate software documentation for descriptions of the configuration options available for the system and individual interfaces, and for specific configuration instructions.)

**Step 4** Issue the **copy startup-config tftp** command. The EXEC command interpreter prompts you for the name or interface processor address of the remote host that is to receive the configuration file. (The prompt might include the name or address of a default file server.)

```
Router# copy startup-config tftp
Remote host []?
```

**Step 5** Enter the name or interface processor address of the remote host. In the following example, the name of the remote server is *servername*:

```
Router# copy startup-config tftp
Remote host []? servername
Translating "servername"...domain server (1.1.1.1) [OK]
```

**Step 6** The EXEC command interpreter prompts you for the name of the file that will contain the configuration. By default, the system appends *-config* to the router's name to create the new filename. Press **Return** to accept the default filename, or enter a different name for the file before pressing **Return**. In the following example, the default is accepted:

```
Name of configuration file to write [Router-config]?
Write file Router-config on host 1.1.1.1? [confirm]
Writing Router-config .....
```

**Step 7** Before the router executes the copy process, it displays the instructions you entered for confirmation. If the instructions are not correct, enter **n** (no) then **Return** to abort the process. To accept the instructions, press **Return**, or **y** and then **Return**, and the system begins the copy process. In the following example, the default is accepted:

```
Write file Router-config on host 1.1.1.1? [confirm]
Writing Router-config: !!!! [ok]
```

While the router copies the configuration to the remote host, it displays a series of exclamation points (! ! !) or periods (. . .). The !!!! and [ok] indicate that the operation is successful. A display of . . . [timed out] or [failed] indicates a failure, which would probably be due to a network fault or the lack of a writable, readable file on the remote file server.

**Step 8** If the display indicates that the process was successful (with the series of ! ! ! and [ok]), the copy process is complete. The configuration is safely stored in the temporary file on the remote file server.

If the display indicates that the process failed (with the series of . . . as shown in the following example):

```
Writing Router-config .....
```

your configuration was not saved. Repeat the preceding steps, or select a different remote file server and repeat the preceding steps.

If you are unable to copy the configuration to a remote host successfully, contact your network administrator or refer to the end of this document for instructions on contacting technical assistance.

### Retrieving the Configuration File

After you reinstall the RP (or RSP7000), you can retrieve the saved configuration and copy it back to NVRAM. To retrieve the configuration, enter configuration mode and specify that you will configure the router from the network. The system prompts you for a host name and address, the name of the configuration file stored on the host, and confirmation to reboot using the remote file.

You can access the router through a console terminal attached directly to the RP (or RSP7000) console port, or you can configure an interface port and Telnet to the router from a remote terminal.

Follow these steps to retrieve the currently running configuration from a remote host:

- Step 1** On the console terminal, the system prompt should display a pound sign (#) to indicate the privileged level of the EXEC command interpreter. If it does not, follow the steps in the section “Using the EXEC Command Interpreter on page 25” to enable the privileged level.

---

**Note** Until you retrieve the previous configuration, the router will be running from the default configuration in NVRAM. Therefore, any passwords that were configured on the previous system will not be valid until you retrieve the configuration.

---

- Step 2** Use the **ping** command to verify the connection between the router and the remote host. (See the section “Using the ping Command to Verify Server Connectivity on page 25”.)

- Step 3** At the system prompt, issue the **copy tftp startup-config** command and press **Return** to enter the configuration mode and specify that you will configure the system from a network device (instead of from the console terminal, which is the default).

```
Router# copy tftp startup-config
```

- Step 4** The system prompts you to select a host or network configuration file. The default is host; press **Return** to accept the default.

```
Host or network configuration file [host]?
```

- Step 5** The system prompts you for the interface processor address of the host. Enter the interface processor address or name of the remote host (the remote file server to which you copied the configuration file).

```
IP address of remote host [255.255.255.255]? 1.1.1.1
```

- Step 6** The system prompts you for the name of the configuration file. When copying the file, the default is to use the name of the router with the suffix *-config* (*router-config* in the following example). If you specified a different filename when you copied the configuration, enter the filename; otherwise, press **Return** to accept the default.

```
Name of configuration file [router-config]?
```

- Step 7** Before the system reboots with the new configuration, it displays the instructions you entered for confirmation. If the instructions are not correct, enter **n** (no), and then press **Return** to cancel the process. To accept the instructions, press **Return**, or **y**, and then **Return**.

```
Configure using router-config from 1.1.1.1? [confirm]  
Booting router-config from 1.1.1.1: !! [OK - 874/16000 bytes]
```

While the router retrieves and boots from the configuration on the remote host, the console display indicates whether or not the operation was successful. A series of **!!!** and **[OK]** (as shown in the preceding example) indicates that the operation was successful. A series of . . .

and [timed out] or [failed] indicate a failure (which would probably be due to a network fault or an incorrect server name, address, or filename). The following is an example of a failed attempt to boot from a remote server:

```
Booting Router-config ..... [timed out]
```

**Step 8** If the display indicates that the process was successful, proceed to the next step.

If the display indicates that the process failed, verify the name or address of the remote server and the filename, and repeat the preceding steps. If you are unable to retrieve the configuration, contact your network administrator or refer to the end of this document for instructions on contacting technical assistance.

**Step 9** Issue the **copy startup-config tftp** command to display the currently running configuration on the terminal. Review the display and ensure that the configuration information is complete and correct. If it is not, verify the filename and repeat the preceding steps to retrieve the correct file, or use the **configure** command to add or modify the existing configuration. (Refer to the appropriate software documentation for descriptions of the configuration options available for the system and individual interfaces and specific configuration instructions.)

**Step 10** When you have verified that the currently running configuration is correct, issue the **copy running-config startup-config** command to save the retrieved configuration in NVRAM. Otherwise, the new configuration will be lost if you restart the system.

This completes the procedure for retrieving the configuration file.

## Copying Files Between NVRAM and a Flash Memory Card

Copying a configuration file to a Flash memory card in the PCMCIA slot might be required if you do not have access to a TFTP server on which you can temporarily store your configuration file. You can then copy the configuration file back to NVRAM as required. Use the following sections to first copy the configuration file to a Flash memory card, and then to copy the configuration from the Flash memory card back to NVRAM.

### Copying a Configuration File from NVRAM to a Flash Memory Card

Following is the procedure for copying your configuration file in NVRAM, to a Flash memory card. You can use the command **copy startup-config [ slot0 | slot1 ]:filename** for the copy procedure where **startup-config** is the file's source (NVRAM) and **[slot0 | slot1 ]:filename** is the file's destination, in either of the Flash memory cards. However, the environmental variable **CONFIG\_FILE** must be pointing (set) to NVRAM, which is the system default.

Use the **show boot** command to display the current setting for the environmental variable **CONFIG\_FILE** as follows:

```
Router# show boot
(display text omitted)

CONFIG_FILE variable =
Current CONFIG_FILE variable =

(display text omitted)
```

---

**Note** The preceding example shows that the environmental variable **CONFIG\_FILE** is set for NVRAM, by default.

---



maintenance releases for the Cisco 7000 series are distributed on floppy disk instead of on replacement EPROMs, some releases may require ROM replacement. System software images also can be netbooted.

The system software resides on a set of eight EPROMs on the RP. The EPROMs are labeled with a ROM number that corresponds to the RP EPROM socket in which it should be installed. The sockets have labels too, although obscure, on the silk-screen portion of the RP board. Each EPROM has a notch cut on one end to indicate proper orientation. It should be placed so that its notch faces the same direction as the notch in the EPROM socket. Do not rely on the orientation of the EPROM labels to indicate the correct position of the EPROMs on the board. Figure 5-7 shows the location and socket numbers of the EPROMs on the RP.

The jumpers on J3 and J4, which are shown in Figure 5-7, correspond to the size (capacity) of the EPROMs installed on the RP. If you replace the system software ROMs with new EPROMs of a different size (for example, if you replace 2-MB EPROMs with 4-MB EPROMs), you will also need to change the jumper settings on J3 or J4.

Figure 5-7 shows the orientation of J3 and J4 on the RP when set for 2 MB, the factory default. Figure 5-8 shows the jumper settings for each EPROM size with the jumpers oriented as in Figure 5-7. For example, if you are installing a new image that resides on 4-MB EPROMs, you will need to move the jumper on J3 from the upper two posts to the lower two posts. This is not required if you upgrade by downloading a new software image into Flash memory; it is only necessary when you physically replace the EPROMs.

Follow these steps to upgrade the EPROMs in the RP:

- Step 1** Disconnect any devices connected to the RP console and auxiliary ports.
- Step 2** Turn OFF the system power.
- Step 3** Follow the steps in the section “Removing CxBus Interface Processors” to remove the RP from the slot and place it on an antistatic mat or foam pad.
- Step 4** On the RP, locate the eight system software EPROMs. (See Figure 5-7.) The label on each installed EPROM indicates the EPROM number (1 through 8), as shown in Figure 5-7. Note the orientation of the notches on the end of each EPROM to aid in inserting the new ones. Do not rely on the orientation of the labels on the new EPROM for correct positioning.



**Caution** The correct placement of the EPROM is crucial. If improperly positioned, the EPROM could be damaged when the system is powered on. Also, to prevent damage to the board or any of the components from electrostatic discharge, be sure to follow the ESD procedures described in “Preventing Electrostatic Discharge Damage” in the chapter “Preparing for Installation.”

Figure 5-7 System Software EPROM Sockets and Jumpers J3 and J4

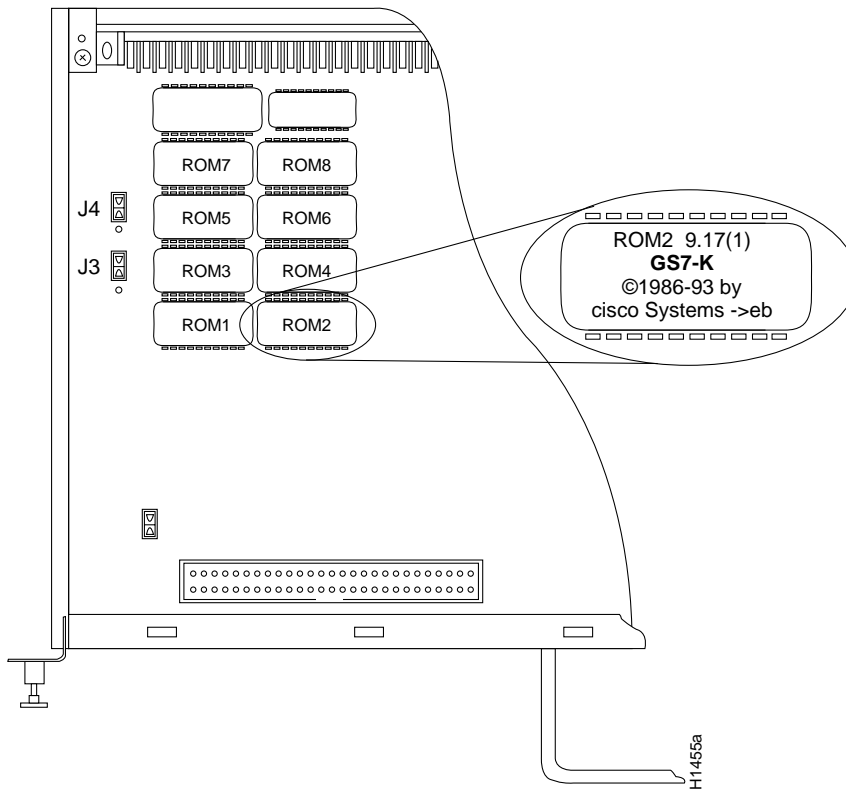


Figure 5-8 Jumper Settings for Software EPROM Sizes

Jumper	EPROM Types	27010	27020	27040	27080
		Memory	1 Mb	2 Mb	4 Mb
J4					
J3					

H11485a

- Step 5** Use a chip extractor to remove the first EPROM from its socket. If you do not have a chip extractor available, use the tip of a screwdriver blade to gently pry the EPROM out of its socket.
- Step 6** Install the new EPROM in the same numbered socket as old EPROM you just removed. Observe the correct notch orientation for the new EPROM.
- Step 7** Repeat Steps 5 and 6 until all new EPROMs are installed. Be careful not to bend or break any of the pins. Use needlenose pliers to straighten a bent pin. If a pin breaks, you must obtain a replacement.

- Step 8** If you installed ROMs of a different capacity than those that were previously installed, check Figure 5-8 and reset jumpers J3 or J4 if necessary (notification of a new ROM size will be included with the replacement EPROMs if applicable).
- Step 9** Follow the Steps in the section “Installing CxBus Interface Processors” to reinstall the RP. Be sure to use the ejector levers to install the RP, then tighten the top and bottom captive installation screws.
- Step 10** Reconnect any console or auxiliary port cables to the connectors on the RP.
- Step 11** Turn ON the system for an installation check, which is described in “Starting the Router” in the chapter “Installing the Router.”

---

**Note** If you power up a system when one or more of the EPROMs is incorrectly inserted, the system may print a message on the console port reporting a checksum error. If this happens, locate the EPROM that might be incorrectly inserted, remove it, straighten pins as required, then reinsert the EPROM and restart the system. If an EPROM is inserted backwards and power is turned ON, the EPROM is damaged and requires replacement.

---

## Replacing RP SIMMs (Upgrading DRAM)

The system DRAM resides on four single inline memory modules (SIMMs) on the RP. The default DRAM configuration is 16 MB (four 4 MB x 9 SIMMs). This section provides the steps for increasing the amount of DRAM from 16 MB to 64 MB by replacing the four 4 MB SIMMs with four 16 MB SIMMs that you obtain from an approved vendor. Some (earlier) RPs do not support 16 MB SIMMs; before upgrading, use the prerequisites in the following section to ensure that your RP will support the larger SIMMs. You must use SIMMs that you obtain from an approved vendor; otherwise, Cisco Systems cannot ensure proper operation.

### Compatibility Requirements

Before replacing SIMMs to increase the amount of DRAM available in your system, ensure that your RP supports 16 MB SIMMs and that you obtain the replacement SIMMs from an approved vendor.

Only RPs that meet the following prerequisites support the larger (16 MB) SIMMs:

- If your system contains Software Release 9.17, the minimum requirements are:
  - System Software Release 9.17(8) (or a later 9.17 image) in ROM
  - System Bootstrap Version 4.6(7.3) (or a later 4.6 bootstrap version)
  - RP board revision B0 or later
- If your system contains Software Release 9.21, the minimum requirements are:
  - System Software Release 9.21(3) (or a later 9.21 image) in ROM
  - System Bootstrap Version 4.7(2.1) (or a later 4.7 bootstrap version)
  - RP board revision B0 or later

Bootstrap Version 4.6 is used exclusively with Software Release 9.17, and Bootstrap Version 4.7 is used exclusively with Software Release 9.21. The revision numbers (indicated within parentheses) for each version are revised independently of other bootstrap versions. Therefore, 4.6(7) can be a later version than 4.7(2).

Software Release 9.17(8), RP board revision B0, and System Bootstrap Version 4.6(7.3) began shipping as the default for Cisco 7000 series systems in March 1994.

RPs that shipped from the factory with Release 9.17(7) or earlier in ROM do *not* support 16 MB SIMMs. To verify that your RP supports the larger SIMMs, issue the following commands:

- Use the **show version** command to display the System Bootstrap Version.

```
7010# show version
GS Software (GS7), Version 9.17(8.1)
Copyright (c) 1986-1994 by cisco Systems, Inc.
Compiled Fri 04-Feb-94
```

```
System Bootstrap, Version 4.6(7.3)
```

If the display indicates that the System Bootstrap Version is an earlier version of 4.6 than 4.6(7.3), or an earlier version of 4.7 than 4.7(2.1), your RP will not support 16 MB SIMMs. Contact a customer service representative for information about the RP upgrade.

- Use the **show diag slot** command to display current hardware and diagnostic information about the processor installed in the slot you specify. Because the RP always resides in the same (RP) slot, specify slot 4 for a Cisco 7010 chassis. The third line of the display shows the current hardware (HW) and board revisions. (Do not confuse the HW revision with the board revision; you need only verify that the *board* revision is B0 or later.)

```
7010# show diag 4

Slot 4:
  EEPROM format version 1
  Route Processor, HW rev 1.1, board revision B0
  Serial number: 00809933 Part number: 73-0877-04
```

If the display indicates that the RP board revision is earlier than B0, your RP will not support 16 MB SIMMs. Contact a service representative for information about the RP upgrade.

- You must obtain the replacement SIMMs from an approved vendor. To ensure that you obtain the latest available product and vendor information, obtain the list from one of the following sources:
  - Customer Information Online (CIO). If you have a CIO account, you can access the list remotely.
  - Technical Assistance Center at 800 553-2447, 408 526-7209, or send an e-mail message requesting the list of approved vendors to [tac@cisco.com](mailto:tac@cisco.com).
  - Customer Response Center at 800 553-6387, 408 526-7208, or send an e-mail message requesting the list of approved vendors to [cs-rep@cisco.com](mailto:cs-rep@cisco.com).
- Although the SIMM specifications are defined in the manufacturers' part numbers, which are included in the list of approved vendors, the SIMMs must meet the following requirements:
  - SIMMs must be obtained from an approved vendor.
  - SIMMs must be the nine-module type, 16 MB x 9.
  - Minimum speed is 70 ns.
  - Maximum height of one inch.

All four SIMM sockets must be filled, and all must contain SIMMs of the same capacity and speed. The RP supports only 4 MB x 9 SIMMs (for a total of 16 MB) or 16 MB x 9 SIMMs (for a total of 64 MB). The RP does not support 32MB of DRAM because 8MB x 9 SIMMs are not available.



## Parts and Tools

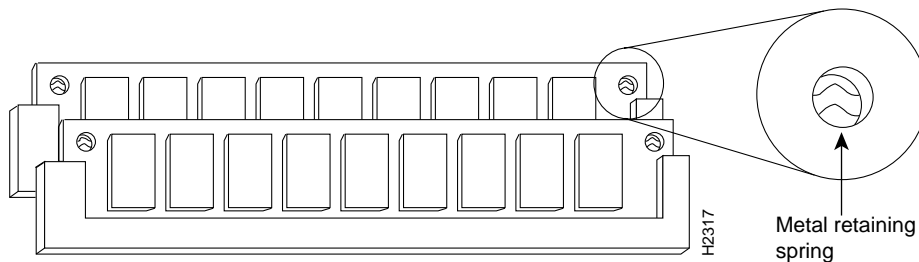
In addition to the tools you need to remove and replace the RP, you will also need the following tools and parts to replace SIMMs. If you need additional equipment, contact a service representative for ordering information.

- Four 16 MB x 9, 70 ns SIMMs from an approved vendor
- Antistatic mat or pad for the removed RP
- SIMM extraction tool manufactured by AMP, Inc. (AMP Part Number 382264-1). The toll-free phone number for AMP product information is 800 526-5142.

## Removing SIMMs

Because the SIMMs on the RP are not intended to be replaced often, if at all, the SIMM sockets do not use the thumb tabs that are often used in PCs and other computer equipment. Each RP SIMM socket has two metal retaining springs, one at each end. (See Figure 5-9.) When a SIMM is fully seated in the socket, the retaining springs snap upward into the holes at the ends of the SIMM to lock it in the socket. You need the AMP extraction tool to remove the SIMMs from this type of socket. The extraction tool has an embossed tip specifically designed to depress the retaining spring while wedging the SIMM out of the socket.

**Figure 5-9 RP SIMM Sockets**



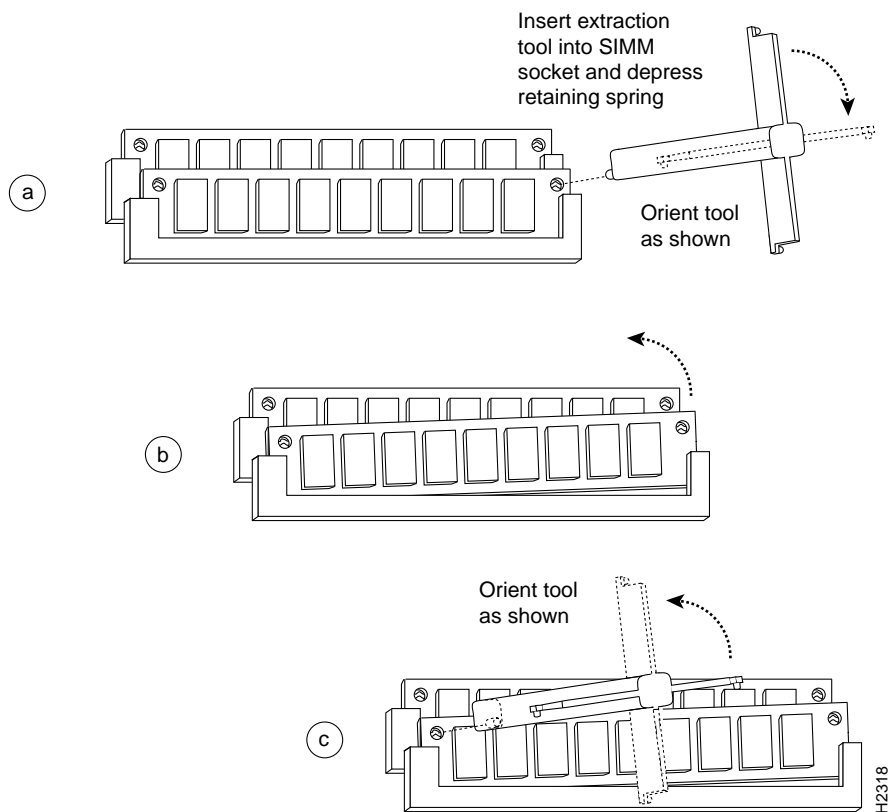
**Caution** Handle SIMMs by the card edges only. SIMMs are sensitive components that can be shorted by mishandling. All four SIMM sockets must be filled, and all must contain SIMMs of the same size (capacity) and speed. You cannot mix SIMMs of different sizes or speeds in the four sockets.

Follow these steps to remove the existing 4 MB SIMMs:

- Step 1** Turn OFF the system power and disconnect any devices connected to the RP console and auxiliary ports.
- Step 2** Follow the steps in the section “Removing CxBus Interface Processors” to remove the RP from the slot and place it on an antistatic mat or foam pad.
- Step 3** Place the RP on an antistatic mat or pad, and ensure that you are wearing an antistatic device, such as a wriststrap. Position the RP so that the backplane edge is closest to you, and the handle is away from you. The RP should be rotated 180 degrees from the orientation shown in Figure 5-7.
- Step 4** Locate SIMMs in sockets U35, U36, U58, and U59. You will remove the SIMM from the socket closest to you first, then work backward to remove the remaining SIMMs.

**Step 5** While holding the extraction tool at the handle (at the top of the *T*), insert the embossed tip into the hole in the right side of the SIMM. (See Figure 5-10a.)

**Figure 5-10 Using the SIMM Extraction Tool**



**Step 6** While pressing the tool downward (to keep the retainer spring depressed), rotate the tool clockwise until the right side of the SIMM is partially released from the socket. (See Figure 5-10b.)

**Step 7** Remove the tool from the right side, and insert the embossed tip into the hole in the left side of the same SIMM.

**Step 8** While pressing the tool downward, rotate the tool counterclockwise until the left side of the SIMM is released from the socket. (See Figure 5-10c.)

**Step 9** When both ends of the SIMM are released from the socket, grasp the ends of the SIMM with your thumb and forefinger and pull the SIMM completely out of the socket. Handle the edges of the SIMM only; avoid touching the memory module or pins, and the metal traces or fingers along the socket edge.

**Step 10** Place the SIMM in an antistatic bag to protect it from ESD damage.

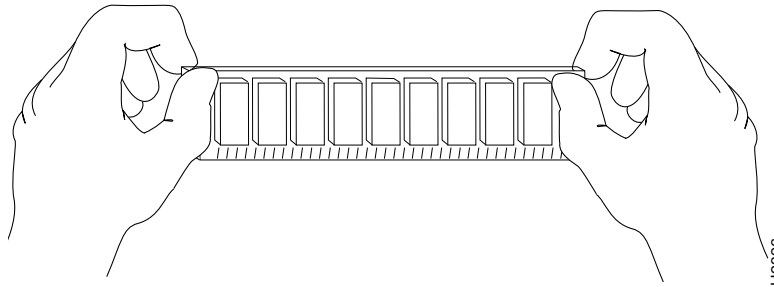
**Step 11** Repeat Steps 4 through 10 for the remaining SIMMs.

This completes the SIMM removal procedure. Proceed to the next section to install the new SIMMs.

## Installing New SIMMs

SIMMs are sensitive components that are susceptible to ESD damage. Handle SIMMs by the edges only; avoid touching the memory modules, pins, or traces (the metal *fingers* along the connector edge of the SIMM). (See Figure 5-11.)

**Figure 5-11 Handling a SIMM**



**Caution** Handle SIMMs by the card edges only. SIMMs are sensitive components that can be shorted by mishandling.

Follow these steps to install the new SIMMs:

- Step 1** With the RP in the same orientation as the previous procedure (with the backplane edge closest to you), install the first SIMM in the socket farthest from you. Then work from front to back, and install the last SIMM in the socket closest to you.
- Step 2** Remove a new SIMM from the antistatic bag.
- Step 3** Hold the SIMM component side up, with the connector edge (the metal *fingers*) closest to you.
- Step 4** Hold the sides of the SIMM between your thumb and middle finger, with your forefinger against the far edge, opposite the connector edge. (See Figure 5-11.)
- Step 5** Tilt the SIMM to approximately the same angle as the socket and insert the entire connector edge into the socket.



**Caution** When inserting SIMMs, use firm but not excessive pressure. If you damage a socket, you will have to return the RP to the factory for repairs.

- Step 6** Gently push the SIMM into the socket until the retaining springs snap into the holes in the SIMM. If necessary, rock the SIMM gently back and forth to seat the SIMM properly.
- Step 7** Repeat Steps 2 through 6 for the remaining SIMMs.
- Step 8** When all four SIMMs are installed, check all eight alignment holes (two on each SIMM), and ensure that the spring retainer is visible. If it is not, the SIMM is not seated properly. If any SIMM appears misaligned, carefully remove it and reseat it in the socket. Push the SIMM firmly back into the socket until the retainer springs snap into place.

**Step 9** Follow the steps in the section “Installing CxBus Interface Processors” to reinstall the RP. Be sure to use the ejector levers to install the RP, then tighten the top and bottom captive installation screws.

**Step 10** Reconnect any console or auxiliary port cables to the connectors on the RP.

**Step 11** Turn ON the system for an installation check, which is described in the section “Starting the Router” in the chapter “Installing the Router.”

If the system fails to boot properly, or if the console terminal displays a checksum or memory error, check the following:

- Ensure that all four SIMMs are installed correctly. If necessary, shutdown the system and remove the RP. Check the SIMMs by looking straight down on them and then at eye level. The SIMMs should all be aligned at the same angle and the same height when properly installed. If a SIMM appears to stick out, or rest in the socket at a different angle than the others, remove the SIMM and reinsert it. Then replace the RP and reboot the system for another installation check.
- All four sockets must contain SIMMs of the same size and speed, or the system will not operate. The SIMMs should have the following characteristics:
  - SIMMs must be the 16 MB x 9 type. Each SIMM should contain nine small memory components, as shown in Figure 5-9. (The actual layout of the SIMM can be different; it is only important that there are nine components.)
  - SIMMs must be 70 ns or faster. The speed is usually silkscreened along one edge of the SIMM.

If after several attempts the system fails to restart properly, contact a service representative for assistance. Before you call, make note of any error messages, unusual LED states, or any other indications that might help solve the problem.

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**Note** The time required for the system to initialize (boot) varies by router configuration. Routers with 64 MB of DRAM will take longer to boot than those with 16 MB of DRAM.

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### Replacing RSP7000 SIMMs (Upgrading DRAM)

The system DRAM resides on up to four SIMMs on the RSP7000. The DRAM SIMM sockets are U4 and U12 for bank 0, and U18 and U25 for bank 1. The default DRAM configuration is 16 MB (two 8-MB SIMMs in bank 0). (See Figure 5-12.)

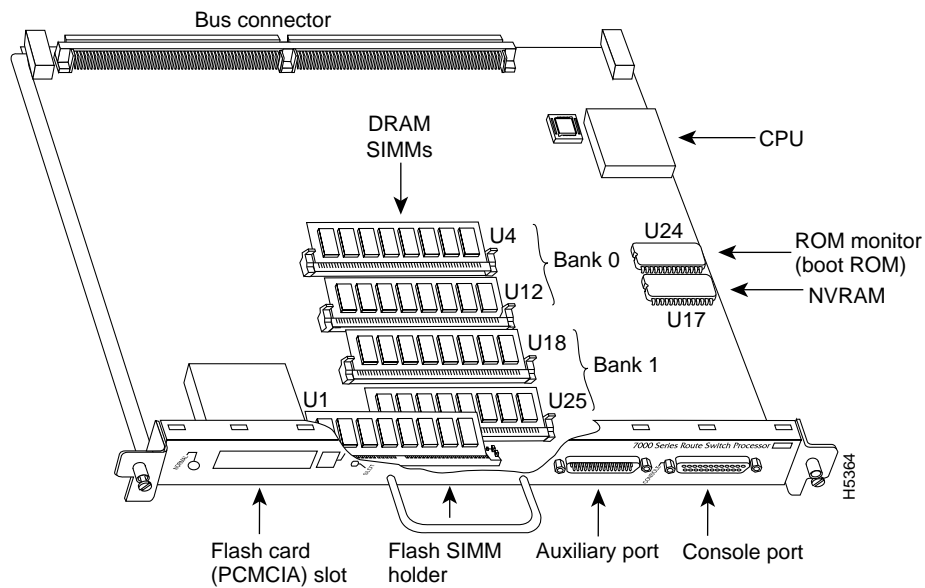
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**Note** The total number of memory devices per SIMM differs for each manufacturer. The SIMMs in the following illustrations are generic representations of the actual DRAM SIMMs for your RSP7000. To be sure that you are using the correct SIMMs, refer to the specific part or product numbers indicated in the approved vendor list (AVL) and by your DRAM upgrade requirements.

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This section describes the steps for increasing the amount of DRAM by replacing up to four SIMMs that you obtain from an approved vendor.

**Figure 5-12 RSP7000 DRAM SIMMs**



The SIMM sockets use the thumb tabs that are often used in PCs and other computer equipment. Each RSP7000 SIMM socket has two metal retaining springs, one at each end. (See Figure 5-13.) When a SIMM is fully seated in the socket, the retaining springs snap over the ends of the SIMM to lock it in the socket.

Before proceeding, ensure that you have the proper tools and ESD-prevention equipment available. To upgrade DRAM, you install SIMMs in one or two banks. Table 5-9 lists the various configurations of DRAM SIMMs that are available. Note which banks are used given the combinations of available SIMM sizes and the maximum DRAM you require. SIMMs must be 60 ns or faster and no taller than one inch.

**Note** Depending on your router configuration, Cisco IOS Release 11.1(1) might require more than 16 MB of DRAM for your RSP7000. Upgrade your system DRAM based on your current configuration and this potential requirement.

**Table 5-9 RSP7000 DRAM SIMM Configurations**

DRAM Bank 0	Quantity	DRAM Bank 1	Quantity	Total DRAM	Product Names
U4 and U12	2 8-MB SIMMs	U18 and U25	–	16 MB	MEM-RSP-16M
U4 and U12	2 8-MB SIMMs	U18 and U25	2 4-MB SIMMs	24 MB <sup>1</sup>	MEM-RSP-24M
U4 and U12	2 16-MB SIMMs	U18 and U25	–	32 MB	MEM-RSP-32M(=)
U4 and U12	2 32-MB SIMMs	U18 and U25	–	64 MB	MEM-RSP-64M(=)
U4 and U12	2 32-MB SIMMs	U18 and U25	2 32-MB SIMMs	128 MB	MEM-RSP-128M(=)

1. The 24-MB DRAM configuration is also available as an 8-MB upgrade to the standard 16-MB configuration, by adding DRAM-Product Number MEM-RSP-8M= (consisting of two, 4-MB DRAM SIMMs), for a total of 24 MB.



**Caution** To prevent DRAM errors, each DRAM bank used must contain no less than two SIMMs of the same type. You must install either two SIMMs in bank 0 or four SIMMs in two banks.

### Removing SIMMs

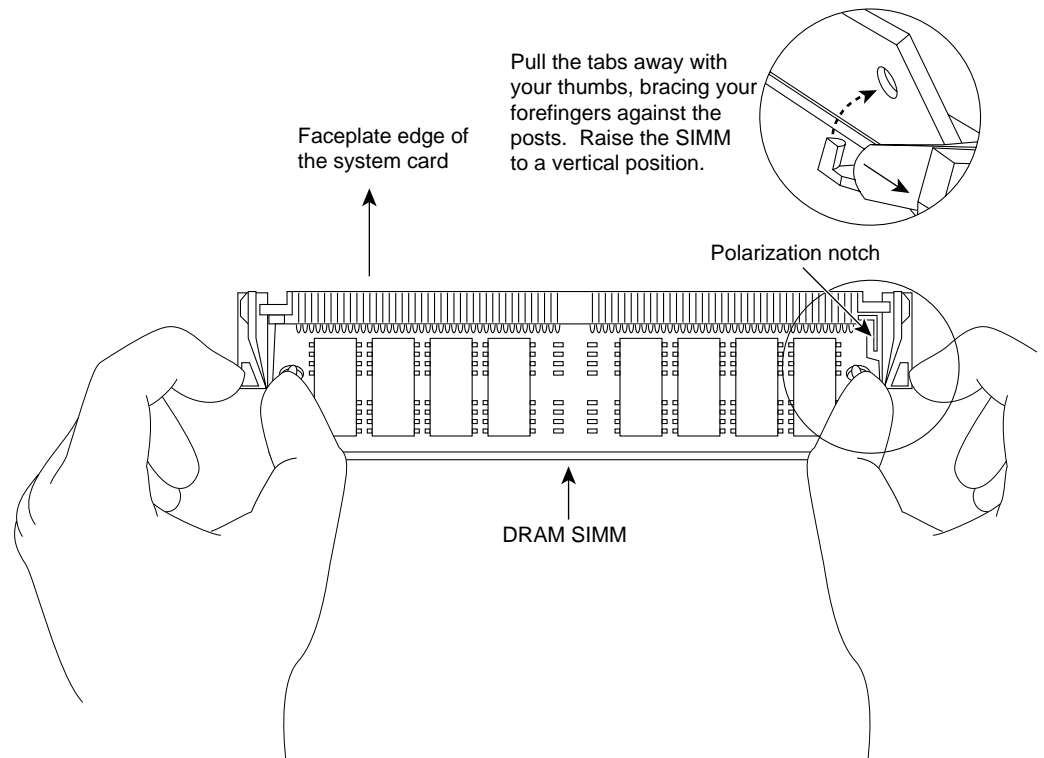
Place removed SIMMs on an antistatic mat and store them in an antistatic bag. You can use the SIMMs that you remove in compatible equipment.



**Caution** To prevent ESD damage, handle SIMMs by the card edges only.

Follow these steps to remove the existing SIMMs:

- Step 1** Turn OFF the system power and follow the steps in the section “Removing and Replacing the RP, SP or SSP, RSP7000, or RSP7000CI.” Note that the RSP7000 does not support OIR.
- Step 2** Place the RSP7000 on an antistatic mat or pad, and ensure that you are wearing an antistatic device, such as a wrist strap. Position the RSP7000 so that the handle is away from you, and the edge connector is toward you; opposite of the position shown in Figure 5-12.
- Step 3** Locate SIMMs. The DRAM SIMMs occupy U4 and U12 in bank 0, and U18 and U25 in bank 1. (See Figure 5-12.)
- Step 4** Release the spring clips from the SIMM that you wish to remove and release the SIMM from the socket. (See Figure 5-13.)

**Figure 5-13 Releasing the SIMM Spring Clips**

**Step 5** When both ends of the SIMM are released from the socket, grasp the ends of the SIMM with your thumb and forefinger and pull the SIMM completely out of the socket. Handle the edges of the SIMM only; avoid touching the memory module or pins, and the metal traces, or *fingers*, along the socket edge.

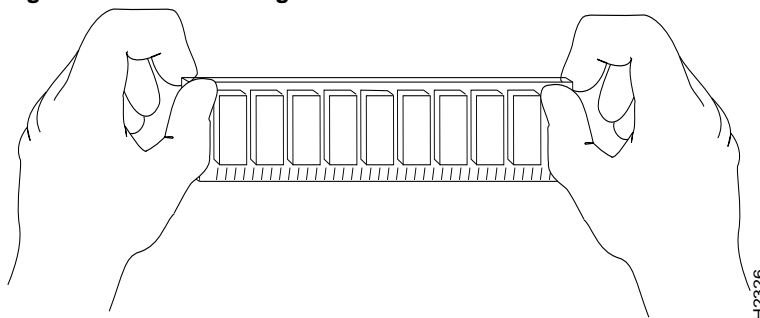
**Step 6** Place the SIMM in an antistatic bag to protect it from ESD damage.

**Step 7** Repeat Steps 4 through 6 for the remaining SIMMs, as required for your upgrade.

This completes the SIMM removal procedure. Proceed to the next section to install the new SIMMs.

### Installing New SIMMs

SIMMs are sensitive components that are susceptible to ESD damage. Handle SIMMs by the edges only; avoid touching the memory modules, pins, or traces (the metal fingers along the connector edge of the SIMM). (See Figure 5-14.)

**Figure 5-14 Handling a SIMM**



**Caution** Handle SIMMs by the card edges only. SIMMs are sensitive components that can be shorted by mishandling.

Follow these steps to install the new SIMMs:

- Step 1** With the RSP7000 in the same orientation as the previous procedure (with the handle away from you and the edge connector toward you), install the first SIMM in the socket farthest from you. Then install the last SIMM in the socket closest to you.
- Step 2** Remove a new SIMM from the antistatic bag.
- Step 3** Hold the SIMM component side up, with the connector edge (the metal fingers) closest to you.
- Step 4** Hold the sides of the SIMM between your thumb and middle finger, with your forefinger against the far edge, opposite the connector edge. (See Figure 5-14.)
- Step 5** Tilt the SIMM to approximately the same an angle as the socket and insert the entire the connector edge into the socket.



**Caution** When inserting SIMMs, use firm but not excessive pressure. If you damage a socket, you will have to return the RSP7000 to the factory for repair.

- Step 6** Gently push the SIMM into the socket until the spring clips snap over the ends of the SIMM. If necessary, rock the SIMM gently back and forth to seat it properly.
- Step 7** Repeat Steps 2 through 6 for the remaining SIMMs.
- Step 8** When all SIMMs are installed, check all alignment holes (two on each SIMM), and ensure that the spring retainer is visible. If it is not, the SIMM is not seated properly. If any SIMM appears misaligned, carefully remove it and reseat it in the socket. Push the SIMM firmly back into the socket until the retainer springs snap into place.

This completes the SIMM replacement procedure.

Proceed to the section “Removing and Replacing the RP, SP or SSP, RSP7000, or RSP7000CI” to replace the RSP7000 in the chassis and restart the system for an installation check. Note that the RSP7000 does not support OIR

If the system fails to boot properly, or if the console terminal displays a checksum or memory error, check the following:

- Ensure that all SIMMs are installed correctly. If necessary, shut down the system and remove the RSP7000. Check the SIMMs by looking straight down on them and then inspecting them at eye level. The SIMMs should all be aligned at the same angle and the same height when properly installed. If a SIMM appears to stick out or rest in the socket at a different angle from the others, remove the SIMM and reinsert it. Then replace the RSP7000 and reboot the system for another installation check.
- Each DRAM SIMM bank must contain SIMMs of the same size and speed or the system will not operate. SIMMs must be 60 ns or faster. The speed is printed along one edge of the SIMM.

If after several attempts the system fails to restart properly, contact a service representative for assistance. Before you call, make note of any error messages, unusual LED states, or any other indications that might help solve the problem.



**Note** The time required for the system to initialize varies with different router configurations. Routers with 128 MB of DRAM will take longer to boot than those with 16 MB of DRAM.

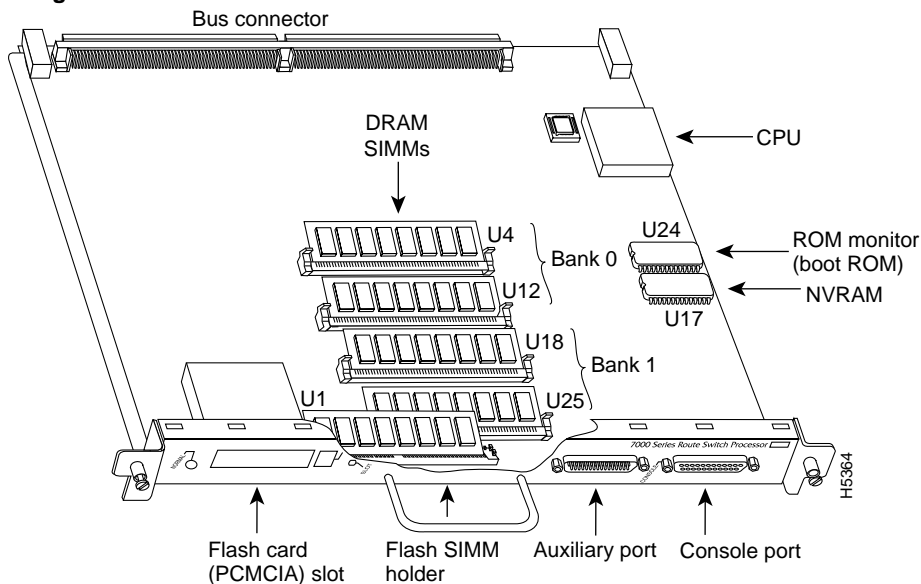
## Replacing RSP7000 DRAM SIMMs

The system DRAM resides on up to four SIMMs on the RSP7000. The DRAM SIMM sockets are U4 and U12 for bank 0, and U18 and U25 for Bank 1. The default DRAM configuration is 16 MB (two 8-MB SIMMs in bank 0). (See Figure 5-15.)

**Note** The total number of memory devices per SIMM differs for each manufacturer. The SIMMs in the following illustrations are generic representations of the actual DRAM SIMMs for your RSP7000. To be sure that you are using the correct SIMMs, refer to the specific part or product numbers indicated in the approved vendor list (AVL) and by your DRAM upgrade requirements.

This section describes the steps for increasing the amount of DRAM by replacing up to four SIMMs that you obtain from an approved vendor.

**Figure 5-15 RSP7000 DRAM SIMMs**



The SIMM sockets use the thumb tabs that are often used in PCs and other computer equipment. Each RSP7000 SIMM socket has two metal retaining springs, one at each end. (See Figure 5-16.) When a SIMM is fully seated in the socket, the retaining springs snap over the ends of the SIMM to lock it in the socket.

Before proceeding, ensure that you have the proper tools and ESD-prevention equipment available. To upgrade DRAM, you install SIMMs in one or two banks. Table 5-10 lists the various configurations of DRAM SIMMs that are available. Note which banks are used given the combinations of available SIMM sizes and the maximum DRAM you require. SIMMs must be 60 ns or faster and no taller than one inch.

**Note** Depending on your router configuration, Cisco IOS Release 11.1(1) might require more than 16 MB of DRAM for your RSP7000. Upgrade your system DRAM based on your current configuration and this potential requirement.

**Table 5-10 DRAM SIMM Configurations**

DRAM Bank 0	Quantity	DRAM Bank 1	Quantity	Total DRAM	Product Names
U4 and U12	2 8-MB SIMMs	U18 and U25	–	16 MB	MEM-RSP-16M
U4 and U12	2 8-MB SIMMs	U18 and U25	2 4-MB SIMMs	24 MB <sup>1</sup>	MEM-RSP-24M
U4 and U12	2 16-MB SIMMs	U18 and U25	–	32 MB	MEM-RSP-32M(=)
U4 and U12	2 32-MB SIMMs	U18 and U25	–	64 MB	MEM-RSP-64M(=)
U4 and U12	2 32-MB SIMMs	U18 and U25	2 32-MB SIMMs	128 MB	MEM-RSP-128M(=)

1. The 24-MB DRAM configuration is also available as an 8-MB upgrade to the standard 16-MB configuration, by adding DRAM-Product Number MEM-RSP-8M= (consisting of two, 4-MB DRAM SIMMs), for a total of 24 MB.



**Caution** To prevent DRAM errors, each DRAM bank used must contain no less than two SIMMs of the same type. You must install either two SIMMs in bank 0 or four SIMMs in two banks.

### Removing SIMMs

Place removed SIMMs on an antistatic mat and store them in an antistatic bag. You can use the SIMMs that you remove in compatible equipment.

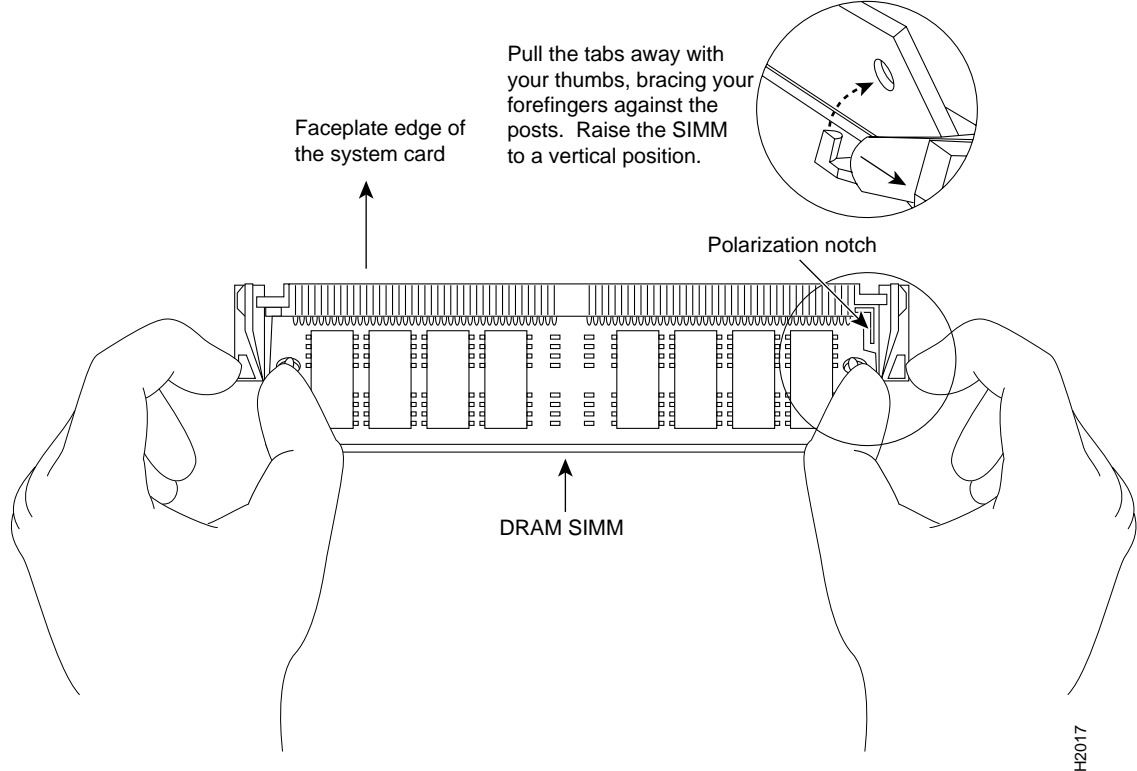


**Caution** To prevent ESD damage, handle SIMMs by the card edges only.

Follow these steps to remove the existing SIMMs:

- Step 1** Turn OFF the system power and follow the steps in the section “Removing and Replacing the RP, SP or SSP, RSP7000, or RSP7000CI.” Note that the RSP7000 does not support OIR.
- Step 2** Place the RSP7000 on an antistatic mat or pad, and ensure that you are wearing an antistatic device, such as a wrist strap. Position the RSP7000 so that the handle is away from you, and the edge connector is toward you, opposite of the position shown in Figure 5-15.
- Step 3** Locate SIMMs. The DRAM SIMMs occupy U4 and U12 in bank 0, and U18 and U25 in bank 1. (See Figure 5-15.)
- Step 4** Release the spring clips from the SIMM that you want to remove and release the SIMM from the socket. (See Figure 5-16.)

Figure 5-16 Releasing the SIMM Spring Clips



**Step 5** When both ends of the SIMM are released from the socket, grasp the ends of the SIMM with your thumb and forefinger and pull the SIMM completely out of the socket. Handle the edges of the SIMM only; avoid touching the memory module or pins, and the metal traces, or *fingers*, along the socket edge.

**Step 6** Place the SIMM in an antistatic bag to protect it from ESD damage.

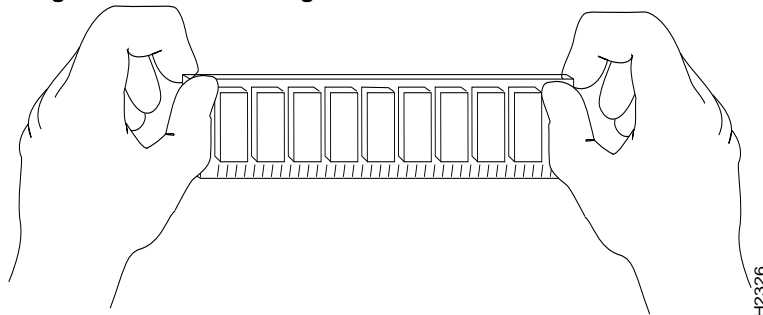
**Step 7** Repeat Steps 4 through 6 for the remaining SIMMs, as required for your upgrade.

This completes the SIMM removal procedure. Proceed to the next section to install the new SIMMs.

### Installing New SIMMs

SIMMs are sensitive components that are susceptible to ESD damage. Handle SIMMs by the edges only; avoid touching the memory modules, pins, or traces (the metal fingers along the connector edge of the SIMM). (See Figure 5-17.)

Figure 5-17 Handling a SIMM



**Caution** Handle SIMMs by the card edges only. SIMMs are sensitive components that can be shorted by mishandling.

Follow these steps to install the new SIMMs:

- Step 1** With the RSP7000 in the same orientation as the previous procedure (with the handle away from you and the edge connector toward you), install the first SIMM in the socket farthest from you. Then install the last SIMM in the socket closest to you.
- Step 2** Remove a new SIMM from the antistatic bag.
- Step 3** Hold the SIMM component side up, with the connector edge (the metal fingers) closest to you.
- Step 4** Hold the sides of the SIMM between your thumb and middle finger, with your forefinger against the far edge, opposite the connector edge. (See Figure 5-17.)
- Step 5** Tilt the SIMM to approximately the same an angle as the socket and insert the entire the connector edge into the socket.



**Caution** When inserting SIMMs, use firm but not excessive pressure. If you damage a socket, you will have to return the RSP7000 to the factory for repair.

- Step 6** Gently push the SIMM into the socket until the spring clips snap over the ends of the SIMM. If necessary, rock the SIMM gently back and forth to seat it properly.
- Step 7** Repeat Steps 2 through 6 for the remaining SIMMs.
- Step 8** When all SIMMs are installed, check all alignment holes (two on each SIMM), and ensure that the spring retainer is visible. If it is not, the SIMM is not seated properly. If any SIMM appears misaligned, carefully remove it and reseat it in the socket. Push the SIMM firmly back into the socket until the retainer springs snap into place.

This completes the SIMM replacement procedure.

Proceed to the section “Removing and Replacing the RP, SP or SSP, RSP7000, or RSP7000CI” to replace the RSP7000 in the chassis and restart the system for an installation check. Note that the RSP7000 does not support OIR

If the system fails to boot properly, or if the console terminal displays a checksum or memory error, check the following:

- Ensure that all SIMMs are installed correctly. If necessary, shut down the system and remove the RSP7000. Check the SIMMs by looking straight down on them and then inspecting them at eye level. The SIMMs should all be aligned at the same angle and the same height when properly installed. If a SIMM appears to stick out or rest in the socket at a different angle from the others, remove the SIMM and reinsert it. Then replace the RSP7000 and reboot the system for another installation check.
- Each DRAM SIMM bank must contain SIMMs of the same size and speed or the system will not operate. SIMMs must be 60 ns or faster. The speed is printed along one edge of the SIMM.

If after several attempts the system fails to restart properly, contact a service representative for assistance. Before you call, make note of any error messages, unusual LED states, or any other indications that might help solve the problem.

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**Note** The time required for the system to initialize varies with different router configurations. Routers with 128 MB of DRAM will take longer to boot than those with 16 MB of DRAM.

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## FSIP Configurations

The FSIP supports EIA/TIA232, EIA/TIA449, V.35, and X.21 electrical interfaces in both DTE and DCE mode, and EIA-530 interfaces in DTE mode. The port adapter cable connected to each port determines the electrical interface type and mode of the port. To change the electrical interface type or mode of a port, you replace the port adapter cable and use software commands to reconfigure the port for the new interface. At system startup or restart the FSIP polls the interfaces and determines the electrical interface type of each port (according to the type of port adapter cable attached). However, it does not necessarily repoll an interface when you change the adapter cable online. To ensure that the system recognizes the new interface type, you must shutdown and reenble the interface after changing the cable. When setting up a new DCE interface or changing the mode of an interface from DTE to DCE, or when setting up a loopback test, you must also set the clock rate on the interface. If necessary, you can also use software commands to invert the clock to compensate for phase shifts caused by circuit delays or variances in cable lengths.

The default configuration for serial ports is DCE mode, NRZ format, and 16-bit CRC error detection. All serial interfaces support nonreturn to zero inverted (NRZI) format and 32-bit error detection, both of which are enabled with a software command.

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**Note** This section contains brief descriptions and examples of software commands that you may need when installing or changing the configuration of serial interface ports. For complete command descriptions and instructions, refer to the related software documentation.

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## Configuring Timing (Clock) Signals

To use an FSIP port as a DCE interface, you must connect a DCE port adapter cable and set the clock speed with the **clockrate** command. You must also set the clock rate to perform a loopback test. This section describes how to use software commands to set the clock rate on a DCE port and, if necessary, how to invert the clock to correct a phase shift between the data and clock signals.

### Setting the Clock Rate

All DCE interfaces require a noninverted internal transmit clock signal, which is generated by the FSIP. The default operation on an FSIP DCE interface is for the DCE device (FSIP) to generate its own clock signal (TxC) and send it to the remote DTE. The remote DTE device returns the clock signal to the DCE (FSIP port). When using DCE interfaces, you must connect a DCE-mode adapter cable to the port and specify the rate of the internal clock with the **clockrate** configuration command followed by the bits-per-second value. In the following example, the first serial interface on an FSIP in interface processor slot 2 (2/0) is defined as having a clock rate of 2 Mbps.

```
7010# configure terminal
interface serial 2/0
clockrate 2000000
^z
```

Following are acceptable clockrate settings:

1200, 2400, 4800, 9600, 19200, 38400, 56000, 64000, 72000, 125000, 148000, 500000, 800000, 1000000, 1300000, 2000000, or 4000000

Speeds above 64 kbps (64000) are not appropriate for EIA/TIA-232; use EIA/TIA-449 on faster interfaces. Note that the faster speeds might not work if your cable is too long. If you change an interface from DCE to DTE, you can use the **no clockrate** command to remove the clock rate although it is not necessary to do so. The port automatically recognizes the DTE cable and ignores the clock rate until a DCE cable is attached to the port again.

The FSIP ports support full duplex operation at DS1 (1.544 Mbps) and E1 (2.048 Mbps) speeds. Each four-port module (see the section “Fast Serial Interface Processor (FSIP)” in the chapter “Product Overview”) can support an aggregate bandwidth of 6.132 Mbps.

Because each four-port module shares a processor, you can delegate bandwidth to a single port and leave the other ports idle to optimize speed and bandwidth on a single interface. For example, you can configure four T1 interfaces on a module (one T1 on each port) such that they do not exceed 6.132 Mbps, or you can configure one port to operate at up to 6.132 Mbps, and leave the remaining three ports shut down. The type of electrical interface, the amount of traffic processed, and the types of external data service units (DSUs) connected to the ports affect actual rates.

### Inverting the Clock Signal

Systems that use long cables may experience high error rates when operating at the higher speeds. Slight variances in cable length, temperature, and network configuration can cause the data and clock signals to shift out of phase. Inverting the clock can often correct this shift. The **invert-transmit-clock** configuration command inverts the TxC clock signal for DCE interfaces. This prevents phase shifting of the data with respect to the clock. To change the clock back to its original phase, use the **no invert-transmit-clock** command. In the example that follows, the clock is inverted for the first serial port on an FSIP in interface processor slot 2:

```
7010# configure terminal
interface serial 2/0
invert-transmit-clock
^z
```

### Configuring NRZI Format

The default for all interface types is for nonreturn to zero (NRZ) format; however, all types also support nonreturn to zero inverted (NRZI). NRZ encoding is most common. NRZI encoding is used primarily with EIA/TIA232 connections in IBM environments. To enable NRZI encoding on any

interface, specify the slot and port address of the interface followed by the command **nrzi-encoding**. In the example that follows, the first serial port on an FSIP in interface processor slot 2 is configured for NRZI encoding:

```
7010# configure terminal
interface serial 2/0
nrzi-encoding
^z
```

To disable NRZI encoding on a port, specify the slot and port address and use the **no nrzi-encoding** command.

For a brief overview of NRZ and NRZI, refer to “NRZ and NRZI Formats” in the chapter “Preparing for Installation.” For complete command descriptions and instructions, refer to the related software documentation.

### Configuring 32-Bit Cyclic Redundancy Check (CRC)

All interfaces (including the HIP) use a 16-bit cyclic redundancy check (CRC) by default but also support a 32-bit CRC.

---

**Note** To determine if your HIP will support a 32-bit CRC, use the **show diag** command. If the resulting display indicates Part Number 81-0050-01, Hardware Version 1.0, you *cannot* use the CRC-32 feature. If the display indicates Part Number 81-0050-02, Hardware Version 1.1, you *can* use the CRC-32 feature.

---

CRC is an error-checking technique that uses a calculated numeric value to detect errors in transmitted data. Because 32-bit CRC transmits longer data streams at faster rates, it provides better ongoing error detection with less retransmits. However, both the sender and the receiver must use the same setting.

The default for all serial interfaces is for 16-bit CRC. To enable 32-bit CRC on an interface, specify the slot and port address of the interface followed by the command **crc32**. In the example that follows, the first serial port on an FSIP in interface processor slot 2 is configured for 32-bit CRC:

```
7010# configure terminal
interface serial 2/0
crc32
^z
```

To disable 32-bit mode and return to the default 16-bit setting on a specific interface, specify the slot and port address of the interface and use the **no crc32** command.

For a brief overview of CRCs, refer to the section “Cyclic Redundancy Checks (CRCs)” in the chapter “Preparing for Installation.” For complete command descriptions and instructions, refer to the related software documentation.

### Configuring 4-Bit Cyclic Redundancy Check

The E1-G.703/G.704 interface supports 4-bit CRC in framed mode only. CRC-4 is not enabled by default.

To enable CRC-4 on the E1-G.703/G.704 interface, specify the slot and port address of the interface followed by the command **crc4**. In the example that follows, the top port on an FSIP in interface processor slot 3 is configured for CRC:

```
Router# configure terminal
interface serial 3/0
crc4
^z
```

To disable CRC-4 and return to the default of no CRC error checking, specify the slot and port address and use the **no crc4** command. For complete command descriptions and instructions, refer to the related software documentation.

### Replacing Serial Port Adapter Cables

The port adapter cable connected to each FSIP port determines the electrical interface type and mode of the port. The FSIP ports are not configured for either DTE or DCE mode by default. When there is no cable attached to a port, the software identifies the port as *Universal, Cable Unattached* rather than either a DTE or DCE interface. When a cable is attached, the port recognizes the mode and automatically uses the clock signal from the appropriate source (external for DTE or internal for DCE).

Although you do not have to configure a clock *source* for the ports, you do have to define the clock *speed* the first time you configure a port as a DCE interface. Because the ports automatically use the appropriate clock source for the type (mode) of cable it detects, you can configure a clock rate for a DCE interface and later replace the DCE cable with a DTE cable; the FSIP will ignore the internal clockrate unless it detects that a DCE cable is attached. This configuration allows you to perform a loopback test on a serial port without a port adapter cable attached.

Following is an example of the **show controller cxbus** command that shows an interface port (2/0) that has an EIA/TIA232 DTE cable attached, and a second port (2/1) that does not have a cable attached:

```
7010# show controller cxbus

Switch Processor 7, hardware version 11.1, microcode version 1.4
 512 Kbytes of main memory, 128 Kbytes cache memory, 299 1520 byte buffers
Restarts: 0 line down, 0 hung output, 0 controller error
FSIP 2, hardware version 3, microcode version 1.0
Interface 16 - Serial2/0, electrical interface is RS-232 DTE
 31 buffer RX queue threshold, 101 buffer TX queue limit, buffer size 1520
Transmitter delay is 0 microseconds
Interface 17 - Serial2/1, electrical interface is Universal (cable unattached)
 31 buffer RX queue threshold, 101 buffer TX queue limit, buffer size 1520
```

To change the electrical interface type or mode of a port on line, replace the serial adapter cable and use software commands to restart the interface and, if necessary, reconfigure the port for the new interface. At system startup or restart, the FSIP polls the interfaces and determines the electrical interface type of each port (according to the type of port adapter cable attached). However, it does not necessarily repoll an interface when you change the adapter cable on line. To ensure that the system recognizes the new interface type, shutdown and reenables the interface after changing the cable.

Perform the following steps to change the mode or interface type of a port by replacing the adapter cable. If you are replacing a cable with one of the same interface type and mode, these steps are not necessary. (Simply replace the cable without interrupting operation.)

- Step 1** Locate and remove the adapter cable to be replaced.
- Step 2** Connect the new cable between the FSIP port and the network connection. Tighten the thumbscrews at both ends of the cable to secure it in the ports.



- Step 3** At the privileged level of the EXEC, specify the port address, shutdown the interface, and write the configuration to NVRAM. Add additional configuration commands, if any, before you exit from the configuration mode (before you press **Ctrl-Z**).

```
7010> en
Password:
7010# configure terminal
int serial 2/5
shutdown
^z

7010# write mem
```

- Step 4** Enter the configuration mode again and bring the port back up.

```
7010# configure terminal
int serial 2/5
no shutdown
^z
```

These steps will prompt the system to poll the interface and recognize the new interface immediately.

When configuring a port for a DCE interface for the first time, or when setting up a loopback test, you must set the clock rate for the port. When you connect a DCE cable to a port, the interface will remain down, the clock LEDs will remain off, and the interface will not function until you set a clock rate (regardless of the DCE mode default).

If you are changing the mode of the interface from DCE to DTE, you do not need to change the clock rate for the port. After you replace the DCE cable with a DTE cable and the system recognizes the interface as a DTE, it will use the external clock signal from the remote DCE device and ignore the internal clock signal that the DCE interface normally uses. Therefore, once you configure the clock rate on a port for either a DCE interface or loopback, you can leave the clock rate configured and still use that port as a DTE interface.

## Replacing Serial Port Adapters

Serial port adapters provide the high-density ports for FSIP serial interfaces. Each port adapter provides two ports, and each port supports any one of the available interface types: EIA/TIA232, EIA/TIA449, V.35, X.21, and EIA-530. The adapter cable connected to the port determines the electrical interface type and mode (DTE or DCE) of the interface. Each FSIP is shipped from the factory with four or eight port adapters installed. Port adapters are field replaceable; if you have spares on hand and have a failure, you can replace interfaces without having to return the FSIP to the factory. You cannot, however, add ports to an FSIP by installing additional port adapters. The four-port FSIP supports only one 4-port module. To change the electrical interface type or mode of a port, you need only replace the adapter cable and reset the interface. When setting up DCE port, you must also set the clock rate. Although DCE is the default mode, you do not need to specify the mode when configuring DTE interfaces. When the port recognizes the DTE interface cable, it automatically uses the clock signal from the remote DCE device.



**Caution** Remove and install port adapters only when it is necessary to replace interfaces. Do not attempt to isolate faults or to troubleshoot FSIPs or serial interfaces by swapping port adapters. The surface-mount circuitry on the port adapters will not tolerate excessive handling.

All serial interface types support NRZI format and 32-bit CRC, both of which you set with software commands. (Refer to the section “Replacing RSP7000 DRAM SIMMs” earlier in this section.) For complete command descriptions and instructions, refer to the related software documentation.

### Tools Required

You need the following tools to complete this procedure:

- Number 1 Phillips or 3/16-inch flat-blade screwdriver
- 3/16-inch nut driver
- Wrist strap or other grounding device to prevent ESD damage

### Removing the FSIP

Two or four port adapters (each port adapter provides two ports) are installed on each FSIP at the factory, so in order to install a new port adapter (or to replace an existing one), you need to remove an existing port adapter. Each four-port module on an FSIP is driven by a CPU; four-port FSIPs contain one processor, and eight-port FSIPs contain two processors. You *cannot* add additional ports to a four-port FSIP to upgrade it to eight ports.

Follow these steps to remove and replace the FSIP:

- Step 1** Disconnect all network interface cables attached to the FSIP ports.
- Step 2** Put on a grounding strap and attach the equipment end to one of the captive installation screws on the rear of the chassis.
- Step 3** Use a screwdriver to loosen the two captive installation screws on the FSIP.
- Step 4** Place your thumbs on the upper and lower ejector levers and simultaneously push the top lever up and the bottom lever down to release the FSIP from the backplane connector.
- Step 5** Grasp the FSIP handle with one hand and place your other hand under the carrier to support and guide the FSIP out of the slot. Avoid touching the board.
- Step 6** Carefully pull the FSIP straight out of the slot, keeping your other hand under the carrier to guide it. (See Figure 5-2.) Keep the FSIP at a 90-degree orientation to the backplane.
- Step 7** Place the removed FSIP on an antistatic mat or antistatic foam and proceed to the section “Removing Port Adapters.”

### Removing Port Adapters

Port adapters are installed on each FSIP at the factory. You must remove an existing port adapter in order to replace or install a new one. Each port adapter is anchored to the FSIP with two double-row vertical board-to-board (BTB) connectors and two Phillips-head screws that extend down into the standoffs. (See Figure 5-18.) The port adapter is also anchored to the carrier faceplate with four jackscrews with lock washers (two per port).



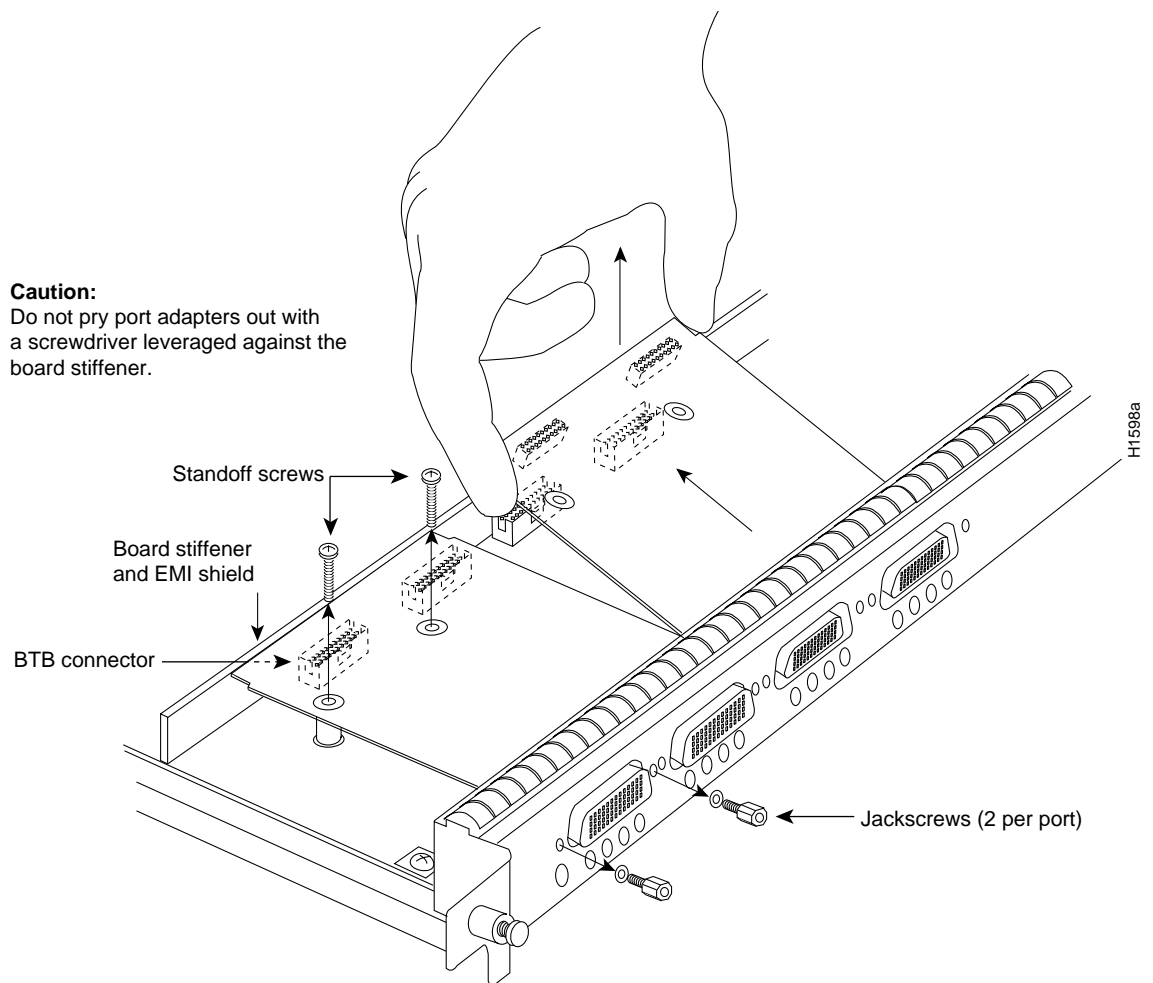
**Caution** The surface-mounted components on the port adapters are extremely susceptible to ESD damage. Keep each port adapter in a separate antistatic bag until you are ready to install it. Always wear a ground strap and handle boards as little as possible. When you must handle the board, limit contact to the board edges only, avoiding contact between the board and clothing.

To remove a port adapter from the FSIP perform the following steps:

- Step 1** Ensure that the FSIP is resting on an antistatic mat or on antistatic foam. You should still be wearing an ESD-prevention ground strap.
- Step 2** Position the FSIP so that it is in the same orientation as shown in Figure 5-18.

- Step 3** Locate the port adapter to be replaced. Use a 3/16-inch nut driver to loosen the four jackscrews, one on either side of both serial connector ports.
- Step 4** Remove the jackscrews and washers and put them aside. You may need them to install the new port adapter.
- Step 5** Use a Phillips screwdriver to loosen and remove the two standoff screws. (See Figure 5-18.) You will need the standoff screws to install the new port adapter.
- Step 6** While avoiding contact with any traces or components on the board, insert your thumb and forefinger into the finger holes on the sides of the port adapter and gently lift it upward to dislodge the BTB connectors. If the port adapter resists, rock it very slightly from side to side until it pulls free of the FSIP connector.

**Figure 5-18 Removing FSIP Port Adapters**



**Caution:**  
Do not pry port adapters out with a screwdriver leveraged against the board stiffener.



**Caution** Do not use a screwdriver or other tool to pry the port adapter up or out of the BTB connectors. In particular, do not use the board stiffener for leverage, or you will damage the FSIP board.

- Step 7** When the port adapter BTB connector is completely disconnected from the BTB connector on the FSIP, tilt the back of the port adapter up at about a 70-degree angle from vertical and slowly pull it upward and outward (up and out using the orientation shown in Figure 5-18) away from the faceplate. The serial port connector will pull out of the cutouts in the faceplate.
- Step 8** Immediately place the removed port adapter into an antistatic bag.
- Step 9** Proceed to the next section to install a new port adapter.



**Caution** Do not reinstall the FSIP in the chassis unless all port adapters are in place. The empty port will allow cooling air to escape freely through the cutouts in the faceplate, which could misdirect the airflow inside the chassis and allow components on other boards to overheat.

### Installing Port Adapters

The FSIP should already be out of the chassis and have an empty space available for the new port adapter. If it is not, refer to the two previous sections to remove the FSIP from the chassis and remove a port adapter from the FSIP. Refer to Figure 5-19 while performing the following steps.

- Step 1** Ensure that the FSIP is resting on an antistatic mat or on antistatic foam, and position it with the same orientation as that shown in Figure 5-19. You should still be wearing an ESD-prevention ground strap.
- Step 2** Carefully remove the new port adapter from its antistatic bag. Handle the port adapter by the board edges only.
- Step 3** If jackscrews are installed on the sides of the connectors, remove them and the four lock washers by turning them counterclockwise. If necessary, use a 3/16-inch nut driver to loosen them. Put the screws and washers aside.
- Step 4** While still handling the board edges only, position the port adapter so that it is in the orientation shown in Figure 5-19: at about a 70-degree angle from vertical, component side down, standoffs on the underside, and the external interface port connectors facing the inside of the carrier faceplate.
- Step 5** As shown in Figure 5-19, *partially* insert the port connectors through the back of the cutouts in the carrier faceplate. Do not force the connectors through the cutouts until the standoffs and BTB connectors are aligned.
- Step 6** With the port connectors partially inserted into the faceplate cutouts, slowly lower the back (opposite) side of the port adapter and continue to ease the port connectors through the cutouts until the BTB connectors on the FSIP and port adapter meet, and the standoffs on the underside of the port adapter are aligned with the standoff holes in the FSIP. Shift the port adapter until the port connectors are fully inserted through the cutouts, and the standoffs are aligned with the standoff holes.

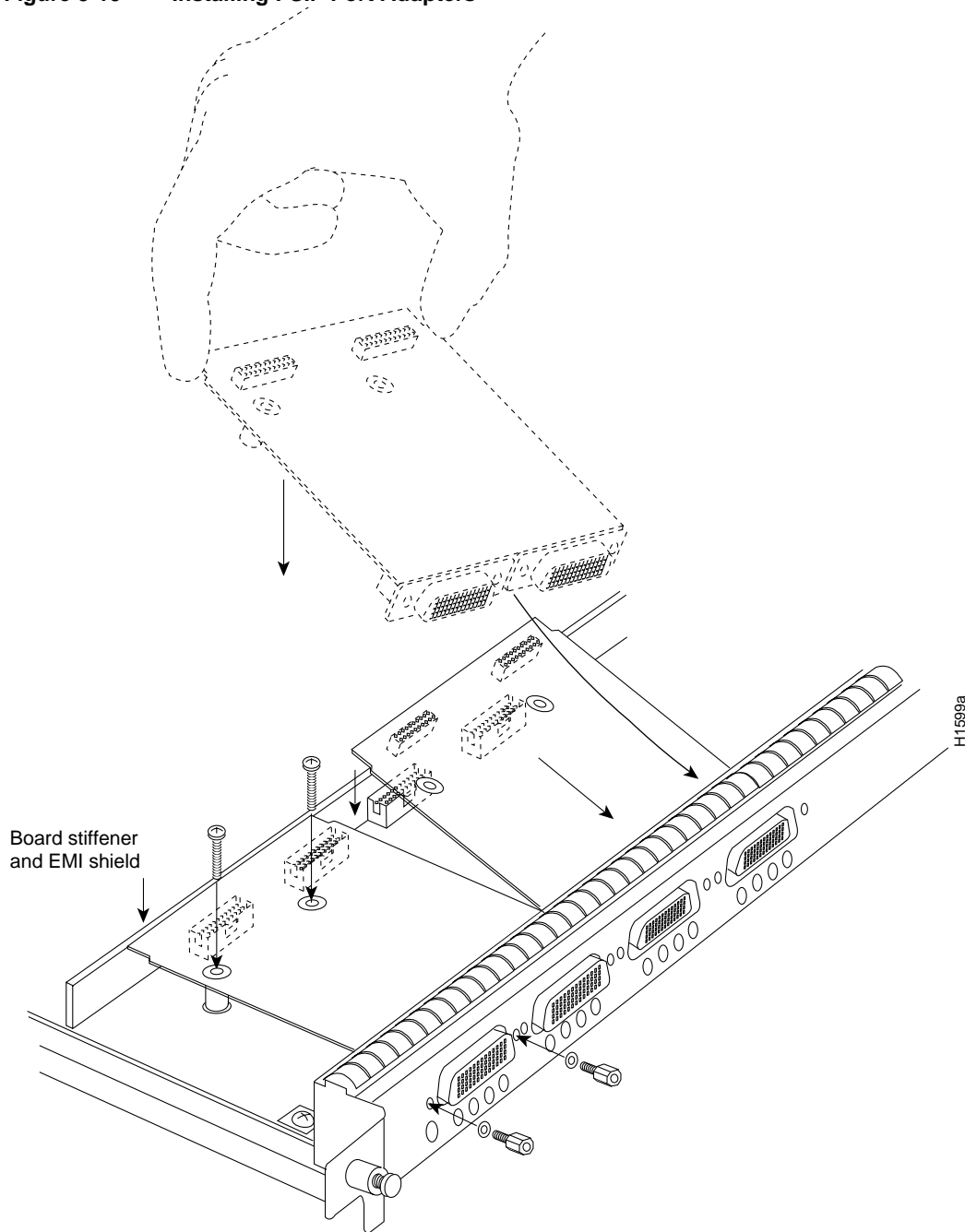


**Caution** Before seating the port adapter onto the FSIP, ensure that the port adapter is aligned properly with the BTB connectors and the standoffs. Forcing a misaligned port adapter into place can damage the port adapter or the FSIP and cause immediate or intermittent failures.

- Step 7** Place your fingers along the back edge of the port adapter board and press down firmly until the BTB connectors mate. If the connectors resist, do not force them. Shift the port adapter around until the connectors mate properly.

- Step 8** Insert the two long Phillips-head screws through the two standoffs and finger-tighten them. These screws extend through the standoffs and the FSIP board and thread into the metal carrier.
- Step 9** Install a lockwasher on each of the four jackscrews.
- Step 10** On the front of the carrier faceplate, insert the four jackscrews through the front of the faceplate and into the holes on either side of both port connectors.
- Step 11** When all screws and connectors are aligned properly, use a Phillips screwdriver to tighten the standoff screws and a 3/16-inch nut driver to tighten the four jackscrews. Do not overtighten any of the screws.
- Step 12** Proceed to the next section to reinstall the FSIP in the chassis.

Figure 5-19 Installing FSIP Port Adapters



### Replacing the FSIP in the Chassis

There should now be four or eight port adapters installed on the FSIP. If there are not, do not install the FSIP until you install all port adapters or until you install a blank interface processor filler in the FSIP slot.



**Caution** Handle interface processors by the handles and carrier edges only to prevent ESD damage.



**Caution** Do not reinstall the FSIP unless all port adapters are installed. The empty port will allow cooling air to escape freely through the cutouts in the faceplate, which could misdirect the airflow inside the chassis and allow components on other boards to overheat.

- Step 1** Grasp the FSIP handle with one hand and place your other hand under the carrier to support the FSIP and guide it into the slot. (See Figure 5-2.) Avoid touching the board.
- Step 2** Place the back of the FSIP in the slot and align the notch on the bottom of the carrier with the groove in the slot. (See Figure 5-1.)
- Step 3** While keeping the FSIP at a 90-degree orientation to the backplane, carefully slide the carrier into the slot until the FSIP faceplate makes contact with the ejector levers. (See Figure 5-1.)
- Step 4** Using the thumb and forefinger of each hand, simultaneously push the top lever down and the bottom lever up (as shown in Figure 5-1) to fully seat the FSIP in the backplane connector.
- Step 5** Use a number 1 Phillips or a 3/16-inch flat-blade screwdriver to tighten the captive installation screws on the top and bottom of the FSIP.
- Step 6** Reconnect the network interface cables or other connection equipment to the FSIP interface ports.
- Step 7** When you insert the new FSIP, the console terminal will display several lines of status information about the OIR as it reinitializes the interfaces. Change the state of the interfaces to up and verify that the configuration matches that of the interfaces you replaced.
- Step 8** Use the **configure** command or the **setup** command facility to configure the new interfaces. You do not have to do this immediately, but the interfaces will not be available until you configure them and bring them up.
- Step 9** After you configure the interfaces, use the **show controller serial** or the **show interfaces** command to display the status of the new interfaces.

This completes the port adapter replacement procedure. For complete command descriptions and instructions, refer to the related software documentation.

## MIP Configurations

Following are procedures for configuring T1 and E1 interfaces on the MIP.

### Configuring the Interfaces

If you installed a new MIP or if you want to change the configuration of an existing controller, you must enter the configuration mode. If you replaced the MIP that was previously configured, the system will recognize the new MIP and bring it up in the existing configuration.

After you verify that the new MIP is installed correctly (the enabled LED is on), use the privileged-level **configure** command to configure the new MIP controller. Be prepared with the information you will need, such as the following:

- T1 or E1 information, for example clock source (for T1), line code, and framing type
- Channel-group information and timeslot mapping
- Protocols and encapsulations you plan to use on the new interfaces

- Internet protocol (IP) addresses if you will configure the interfaces for IP routing
- Whether the new interface will use bridging

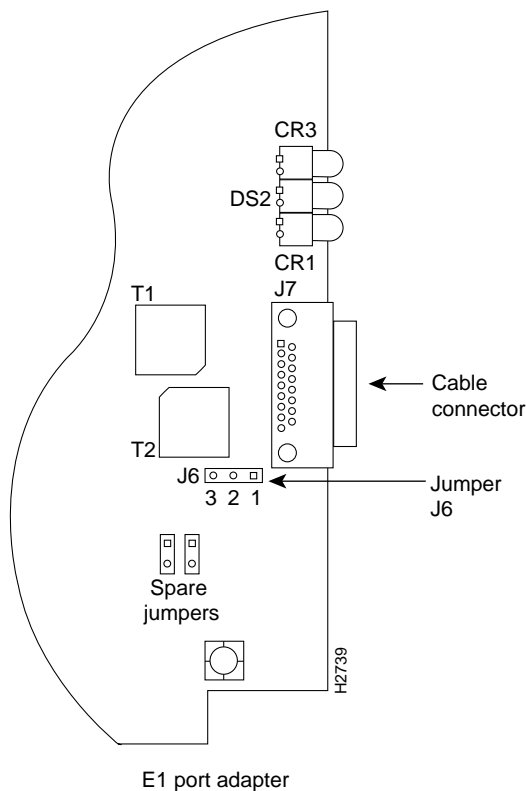
Refer to the *Router Products Configuration Guide* and *Router Products Command Reference* publications for a summary of the configuration options available and instructions for configuring the MIP controller.

### Configuring Jumper J6 on the E1 Port Adapter

By default, channelized E1 port adapters are set with capacitive coupling between the receive (Rx) shield and chassis ground. This provides direct current (DC) isolation between the chassis and external devices, as stated in the G.703 specification. Jumper J6 controls this function. To make changes, remove the E1 port adapter from the mother board, place one of the spare jumpers on J6 pins one and two *or* pins two and three (refer to Table 5-11), and replace the port adapter on the mother board. Pin 1 of J6 is designated with a square. (See Figure 5-20.)

For procedures on removing the E1 port adapter from the MIP, refer to the section “Removing and Replacing MIP Port Adapters” in this chapter.

**Figure 5-20** Location of Jumper J6 on the E1 Port Adapter—Partial View





**Table 5-11 Jumper Settings and Functions**

Jumper	Pins and Impedance	Function
J6	1 and 2 for 120 ohm 2 and 3 for 75 ohm	Controls capacitive coupling for either 120-ohm or 75-ohm operation. An installed jumper directly connects the Rx shield to chassis ground.



**Warning** To prevent problems with the E1 interface and to reduce the potential for injury, jumper J6 should be installed by trained service personnel *only*. For either impedance option, a jumper installed at J6 bypasses the AC-decoupling capacitor to ground, thereby coupling the interface directly to AC. This is a setting that could pose a risk of severe injury. By default and for safety, J6 has no jumper installed.

After you set jumper J6, proceed to the section “Removing and Replacing MIP Port Adapters” in this chapter.

### Using the EXEC Command Interpreter

Before you use the **configure** command, you must enter the privileged level of the EXEC command interpreter with the **enable** command. The system will prompt you for a password if one has been set.

The system prompt for the privileged level ends with a pound sign (#) instead of an angle bracket (>). At the console terminal, enter the privileged level as follows:

**Step 1** At the user-level EXEC prompt, enter the **enable** command. The EXEC prompts you for a privileged-level password, as follows:

```
Router> enable
```

```
Password:
```

**Step 2** Enter the password (the password is case sensitive). For security purposes, the password is not displayed.

**Step 3** When you enter the correct password, the system displays the privileged-mode system prompt (#) as follows:

```
Router#
```

**Step 4** Proceed to the following section to configure the MIP controller.

### Using the Configure Commands

Following are instructions for a configuration: enabling a controller and specifying IP routing. You might also need to enter other configuration subcommands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

The channel-groups must be mapped before the MIP controller can be configured.

For complete descriptions of configuration subcommands and the configuration options available, refer to the *Router Products Configuration Guide* and *Router Products Command Reference* publications, which are available on UniverCD.

Table 5-12 list commands used to map the channel-group, with the default variable is listed first.

**Table 5-12 Channel Group Mapping Commands**

Commands for T1	Commands for E1
<b>controller t1</b> <i>slot/applique</i>	<b>controller e1</b> <i>slot/applique</i>
<b>clock source</b> [ <i>line</i>   <i>internal</i> ]	Not required for E1
<b>linecode</b> [ <i>ami</i>   <i>b8zs</i> ]	<b>linecode</b> [ <i>hdb3</i>   <i>ami</i> ]
<b>framing</b> [ <i>sf</i>   <i>esf</i> ]	<b>framing</b> [ <i>crc4</i>   <i>no-crc4</i> ]
<b>loopback</b> [ <i>local</i>   <i>remote</i> ]	<b>loopback</b>
<b>shutdown</b>	<b>shutdown</b>
<b>channel-group</b> <i>number timeslots list</i> [speed {56   48   64}] For speed, 56 is the default. <sup>1</sup>	<b>channel-group</b> <i>number timeslots list</i> [speed {56   48   64}] For speed, 64 is the default. <sup>1</sup>

1. *Number* is the channel-group 0 to 23 for T1 and 0 to 29 for E1.

**Timeslots** list is a number between 1 to 24 for T1 and 1 to 31 for E1. It conforms to D3/D4 numbering for T1. Timeslots may be entered individually and separated by commas or as a range that is separated by a hyphen (for example, 1-3, 8, 9-18). For E1 and T1, 0 is illegal. Speed specifies the DSO speed of the channel-group: T1 default is 56 kbps and E1 default is 64 kbps.

---

**Note** Cisco 7000 series routers identify channel-groups as serial interfaces by slot number (interface processor slots 0 to 4), applique (0 or 1), and channel-group number (0 to 23 for T1 and 0 to 29 for E1) in the format, *slot/port:channel-group*. For example, the address of the MIP installed in interface processor slot 4, with applique 1 and channel-group 5, would be serial *4/1:5*.

---

### T1 Configuration

The following steps describe a basic T1 configuration. Press the **Return** key after each configuration step.

**Step 1** At the privileged-mode prompt, enter the configuration mode and specify that the console terminal will be the source of the configuration subcommands as follows:

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z. Router(config)#
```

**Step 2** At the prompt, specify the controller to configure by entering the subcommand **cont**, followed by **t1**, and *slot/applique* (interface processor slot number/applique). The example that follows is for the MIP in interface processor slot 4, applique 1:

```
Router(config)# cont t1 4/1
```

**Step 3** At the prompt, specify the clock source for the controller. The **clock source** command will determine which end of the circuit provides the clocking.

```
Router(config-controller)# clock source line
```

---

**Note** The clock source should only be set to use the internal clocking for testing the network or if the full T1 line is used as the channel-group. Only one end of the T1 line should be set to internal.

---

**Step 4** At the prompt, specify the **framing** type.

```
Router(config-controller)# framing esf
```

**Step 5** At the prompt, specify the **linecode** format.

```
Router(config-controller)# linecode b8zs
Router(config-controller)#
%CONTROLLER-3-UPDOWN: Controller T1 4/1, changed state to up
Router(config-controller)#
```

**Step 6** At the prompt, specify the **channel-group** modification command, channel-group and timeslots to be mapped. The example shows channel-group 0 and timeslots 1, 3 through 5, and 7 selected for mapping.

```
Router(config-controller)# channel-group 0 timeslots 1,3-5,7
Router(config-controller)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial4/1:0, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial4/1:0, changed state to up
Router(config-controller)#
Router(config-controller)#
```

**Step 7** At the prompt, specify the interface, serial, slot, applique, and channel-group to modify.

```
Router(config-controller)# int serial 4/1:0
```

**Step 8** At the prompt, assign an IP address and subnet mask to the interface with the **ip address** configuration subcommand as in the following example:

```
Router(config-if)# ip address 1.1.15.1 255.255.255.0
Router(config-if)#
```

**Step 9** Add any additional configuration subcommands required to enable routing protocols and adjust the interface characteristics.

**Step 10** After including all of the configuration subcommands, and to complete the configuration, enter **Ctrl-Z** (hold down the Control key while you press Z) to exit the configuration mode.

**Step 11** Write the new configuration to memory as follows:

```
Router# write memory
```

The system will display an OK message when the configuration is stored.

**Step 12** Exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
```

```
Router>
```

**Step 13** Proceed to the following section to check the interface configuration with **show** commands.

### E1 Configuration

The following steps describe a basic E1 configuration. Press the Return key after each step.

- Step 1** At the privileged-mode prompt, enter the configuration mode and specify that the console terminal will be the source of the configuration subcommands as follows:

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
```

- Step 2** At the prompt, specify the controller to configure by entering the subcommand **cont**, followed by **e1**, and *slot/applique* (interface processor slot number/applique). The example that follows is for the MIP in interface processor slot 4, applique 1:

```
Router(config)# cont e1 4/1
```

- Step 3** At the prompt, specify the **framing** type.

```
Router(config-controller)# framing crc4
```

- Step 4** At the prompt, specify the **linecode** format.

```
Router(config-controller)# linecode hdb3
Router(config-controller)#
%CONTROLLER-3-UPDOWN: Controller E1 4/1, changed state to up
Router(config-controller)#
```

- Step 5** At the prompt, specify the **channel-group** modification command, channel-group and timeslots to be mapped. The example shows channel-group 0 and timeslots 1, 3 through 5, and 7 selected for mapping.

```
Router(config-controller)# channel-group 0 timeslots 1,3-5,7
Router(config-controller)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial4/1:0, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial4/1:0, changed state to up
Router(config-controller)#
Router(config-controller)#
```

- Step 6** At the prompt, specify the interface, serial, slot, applique, and channel-group to modify.

```
Router(config-controller)# int serial 4/1:0
```

- Step 7** At the prompt, assign an IP address and subnet mask to the interface with the **ip address** configuration subcommand as in the following example:

```
Router(config-if)# ip address 1.1.15.1 255.255.255.0
Router(config-if)#
```

- Step 8** Add any additional configuration subcommands required to enable routing protocols and adjust the interface characteristics.

- Step 9** After including all of the configuration subcommands, and to complete the configuration, enter **Ctrl-Z** (hold down the Control key while you press Z) to exit the configuration mode.

- Step 10** Write the new configuration to memory as follows:

```
Router# write memory
```

The system will display an OK message when the configuration is stored.

**Step 11** Exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
Router>
```

**Step 12** Proceed to the following section to check the interface configuration with **show** commands.

## Checking the Configuration

After configuring the new interface, use the **show** commands to display the status of the new interface or all interfaces.

## Command Descriptions and Examples

Following are descriptions and examples of the show commands. Descriptions are limited to fields that are relevant for verifying the configuration.

- The **show version** command displays the configuration of the system hardware (the number of each interface processor type installed), the software version, the names and sources of configuration files, and the boot images.

```
Router> show version

GS Software (GS7), Version 10.0(5187) (for E1, 10.3[1])
Copyright (c) 1986-1994 by cisco Systems, Inc.
Compiled Wed 02-Feb-94 15:52

ROM: System Bootstrap, Version 4.6(1) [fc2], SOFTWARE

Router uptime is 42 minutes
System restarted by reload
System image file is "wmay/gs7-k", booted via tftp from 131.108.13.111

RP (68040) processor with 16384K bytes of memory. X.25 software, Version 2.0, NET2, BFE
and GOSIP compliant. Bridging software.
1 Switch Processor.
1 EIP controller (6 Ethernet).
1 TRIP controller (4 Token Ring).
1 FSIP controller (4 Serial).
1 MIP controller (1 T1). (or 1 E1, and so forth)
6 Ethernet/IEEE 802.3 interfaces.
4 Token Ring/IEEE 802.5 interfaces.
6 Serial network interfaces.
1 FDDI network interface.
128K bytes of non-volatile configuration memory.
4096K bytes of flash memory sized on embedded flash.
Configuration register is 0x100
```

- The **show controllers cbus** command displays the internal status of the SP and each CxBus interface processor, including the interface processor slot location, the card hardware version, and the currently running microcode version. It also lists each interface (port) on each interface processor including the logical interface number, interface type, physical (slot/port) address, and hardware (station address) of each interface.

The following example shows the MIP installed in interface processor slot 1:

```
Router# show controller cbus

Switch Processor 5, hardware version 11.1, microcode version 170.46
Microcode loaded from system
 512 Kbytes of main memory, 128 Kbytes cache memory 105 1520 byte buffers,
 75 4496 byte buffers Restarts: 0 line down, 0 hung output, 0 controller error
FIP 0, hardware version 2.2, microcode version 170.12
Microcode loaded from system
Interface 0 - Fddi0/0, address 0000.0c03.648b (bia 0000.0c03.648b)
 15 buffer RX queue threshold, 37 buffer TX queue limit, buffer size 4496
 ift 0006, rql 13, tq 0000 01A0, tql 37

(text omitted from example)

MIP 2, hardware version 1.0, microcode version 10.0
Microcode loaded from system
Interface 16 - T1 2/0, electrical interface is Channelized T1
 10 buffer RX queue threshold, 14 buffer TX queue limit, buffer size 1580 ift 0001, rql
 7, tq 0000 05B0, tql 14
Transmitter delay is 0 microseconds
Router#
```

- The **show controller t1** command displays the status of the default T1 (which is specified in RFC 1406). The **show controller t1 slot/applique** command displays the verbose information for a particular T1.

```
Router# show cont t1
T1 4/1 is up.
No alarms detected.
Framing is ESF, Line Code is AMI, Clock Source is line
Data in current interval (0 seconds elapsed):
 0 Line Code Violations, 0 Path Code Violations 0 Slip Secs, 0 Fr Loss Secs,
 0 Line Err Secs, 0 Degraded Mins 0 Errored Secs, 0 Bursty Err Secs,
 0 Severely Err Secs, 0 Unavail Secs
Total Data (last 79 15 minute intervals):
 0 Line Code Violations, 0 Path Code Violations, 0 Slip Secs, 0 Fr Loss Secs,
 0 Line Err Secs, 0 Degraded Mins, 0 Errored Secs, 0 Bursty Err Secs,
 0 Severely Err Secs, 0 Unavail Secs
Router#
```

- The **show controller e1** command displays the status of the default E1 (which is specified in RFC 1406). The **show controller e1 slot/applique** command displays the verbose information for a particular E1.

```
Router# show cont e1
E1 4/1 is up.
No alarms detected.
Framing is E1-crc, Line Code is hdb3
Data in current interval (0 seconds elapsed):
 0 Line Code Violations, 0 Path Code Violations 0 Slip Secs, 0 Fr Loss Secs,
 0 Line Err Secs, 0 Degraded Mins 0 Errored Secs, 0 Bursty Err Secs,
 0 Severely Err Secs, 0 Unavail Secs
Total Data (last 79 15 minute intervals):
 0 Line Code Violations, 0 Path Code Violations, 0 Slip Secs, 0 Fr Loss Secs,
 0 Line Err Secs, 0 Degraded Mins, 0 Errored Secs, 0 Bursty Err Secs,
 0 Severely Err Secs, 0 Unavail Secs
Router#
```

- The **show configuration** command displays the contents of the system configuration file stored in NVRAM. This file should reflect all new configuration changes you made and wrote to memory with the **write memory** command.

```
Router# show config

Using 1708 out of 130048 bytes
!
version 10.0 (or 10.3 for E1)
!
hostname Router
!
enable password *****
!
clns routing
!
!
!
controller T1 4/1 (for E1, E1 4/1, and so forth)
framing esf (for E1, crc4, and so forth)
linecode b8zs (for E1, hdb3, and so forth)
channel-group 0 1,3,5,7
channel-group 1 2,4,6,8-10
!
interface Ethernet 1/0
ip address 131.108.43.220 255.255.255.0
no mop enabled
!
interface Ethernet1/1
no ip address
shutdown
!
interface Ethernet1/2
no ip address
shutdown
!
interface Ethernet1/3

(display text omitted)
```

- The **show protocols** command displays the global (system-wide) and interface-specific status of any configured Level 3 protocol.

```
Router> show protocols

Global values:
  Internet Protocol routing is enabled
  CLNS routing is enabled (address 41.0000.0000.0000.0001.0000.0000.00) Fddi0/0 is down,
  line protocol is down
  Internet address is 1.1.20.1, subnet mask is 255.255.255.0
  CLNS enabled
  Ethernet1/0 is up, line protocol is up
  Internet address is 131.108.43.220, subnet mask is 255.255.255.0

(display text omitted)
```

### Using **Show** Commands to Verify the MIP Status

The following procedure describes how to use the **show** commands to verify that the new MIP interface is configured correctly:

- Step 1** Use the **show version** command to display the system hardware configuration. Ensure that the list includes the new MIP network interface.
- Step 2** Display all of the current CxBus interface processors and their interfaces with the **show controllers cbus** command. Verify that the new MIP appears in the correct slot.
- Step 3** Display the T1 and/or E1 alarm condition with the **show controller T1** and/or **show controller E1** command.
- Step 4** Specify the new interface with the **show interfaces serial slot/port:channel-group** command and verify that the first line of the display specifies the serial interface with the correct slot, port and channel-group number. Also verify that the interface and line protocol are in the correct state: up or down.
- Step 5** Display the protocols configured for the entire system and specific interfaces with the command **show protocols**. If necessary, return to the configuration mode to add or remove protocol routing on the system or specific interfaces.
- Step 6** Display the entire system configuration file with the **show configuration** command. Verify that the configuration is accurate for the system and each interface.

If the interface is down and you configured it as up, or if the displays indicate that the hardware is not functioning properly, ensure that the network interface is properly connected and terminated. If you still have problems bringing the interface up, contact a customer service representative for assistance.

This completes the configuration procedure for the new MIP interface.

### Removing and Replacing MIP Port Adapters

Port adapters provide the ports for the E1 and T1 interfaces. Each port adapter provides one port. Each MIP is shipped from the factory with one or two port adapters installed. *You cannot add ports to an MIP by installing an additional port adapter. Port adapters are not field-replaceable units (FRUs); however, you need to remove an existing E1 port adapter in order to access jumper J6.*

Before proceeding, refer to the section “Removing CxBus Interface Processors” in this chapter.



**Caution** To prevent damaging the MIP and port adapters, remove and install port adapters only when it is necessary. Do not attempt to isolate faults or to troubleshoot MIPs or interfaces by swapping port adapters. The surface-mount circuitry on the port adapters will not tolerate excessive handling. *Do not mix T1 and E1 port adapters on the same motherboard.*

### Tools Required

You need the following tools to complete this procedure:

- Number 1 Phillips screwdriver
- 3/16-inch nut driver
- An ESD-preventive wrist strap or other grounding device to prevent ESD damage



### Removing a Port Adapter

Port adapters are installed on each MIP at the factory. Each port adapter is anchored to the MIP with one plastic double-row vertical board-to-board (BTB) connector and four Phillips screws that extend through standoffs, into the mother board. (See Figure 5-21.) The port adapter is also anchored to the carrier faceplate with two jackscrews and two lock washers.

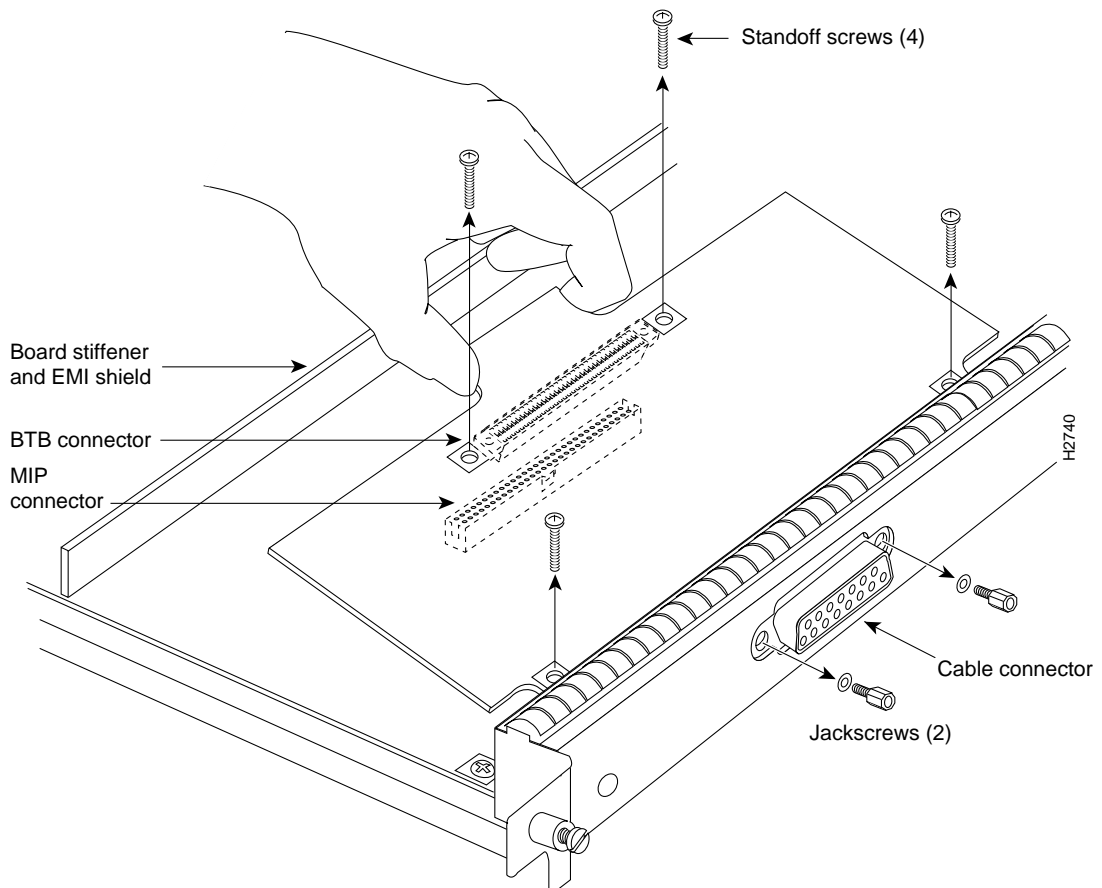


**Caution** The surface-mounted components on the port adapters are extremely susceptible to ESD damage. Keep each port adapter in a separate antistatic bag until you are ready to install it. Always wear an ESD-preventive ground strap and handle boards as little as possible. When you must handle the board, limit contact to the board edges only, avoiding contact between the board and clothing.

To remove an E1 port adapter from the MIP, refer to Figure 5-21 and perform the following steps:

- Step 1** Ensure that the MIP is resting on an antistatic mat or on antistatic foam. You should still be wearing an ESD-preventive strap.
- Step 2** Position the MIP so that it is in the same orientation shown in Figure 5-21.
- Step 3** Locate the E1 port adapter to be removed and use a 3/16-inch nut driver to loosen the two jackscrews, one on either side of the cable connector. (See Figure 5-21.)

**Figure 5-21** Removing an E1 Port Adapter



- Step 4** Remove the jackscrews and washers and put them aside.
- Step 5** Use a number 1 Phillips screwdriver to loosen and remove the four standoff screws. (See Figure 5-21.) The port adapter is now held in place only by the plastic BTB connector.
- Step 6** While avoiding contact with any traces or components on the board, insert your thumb and forefinger under the extension behind the BTB connector and gently lift the adapter upward to dislodge it from the MIP connector. If the port adapter resists, rock it very slightly from side to side until it pulls free of the MIP connector.



**Caution** To prevent damage to the MIP, do not pry the port adapter out with a screwdriver or any other tool. In particular, do not use the board stiffener for leverage.

- Step 7** When the port adapter is completely disconnected from the MIP connector, tilt the back of the port adapter up at about a 70-degree angle from vertical and slowly pull it up and out (using the orientation shown in Figure 5-21) and away from the faceplate. The MIP cable connector will pull out of the cutout in the faceplate.
- Step 8** To reconfigure jumpers on the E1 port adapter, refer to the section “Configuring Jumper J6 on the E1 Port Adapter.” After you have set the jumpers, proceed to the next section “Replacing a Port Adapter.”



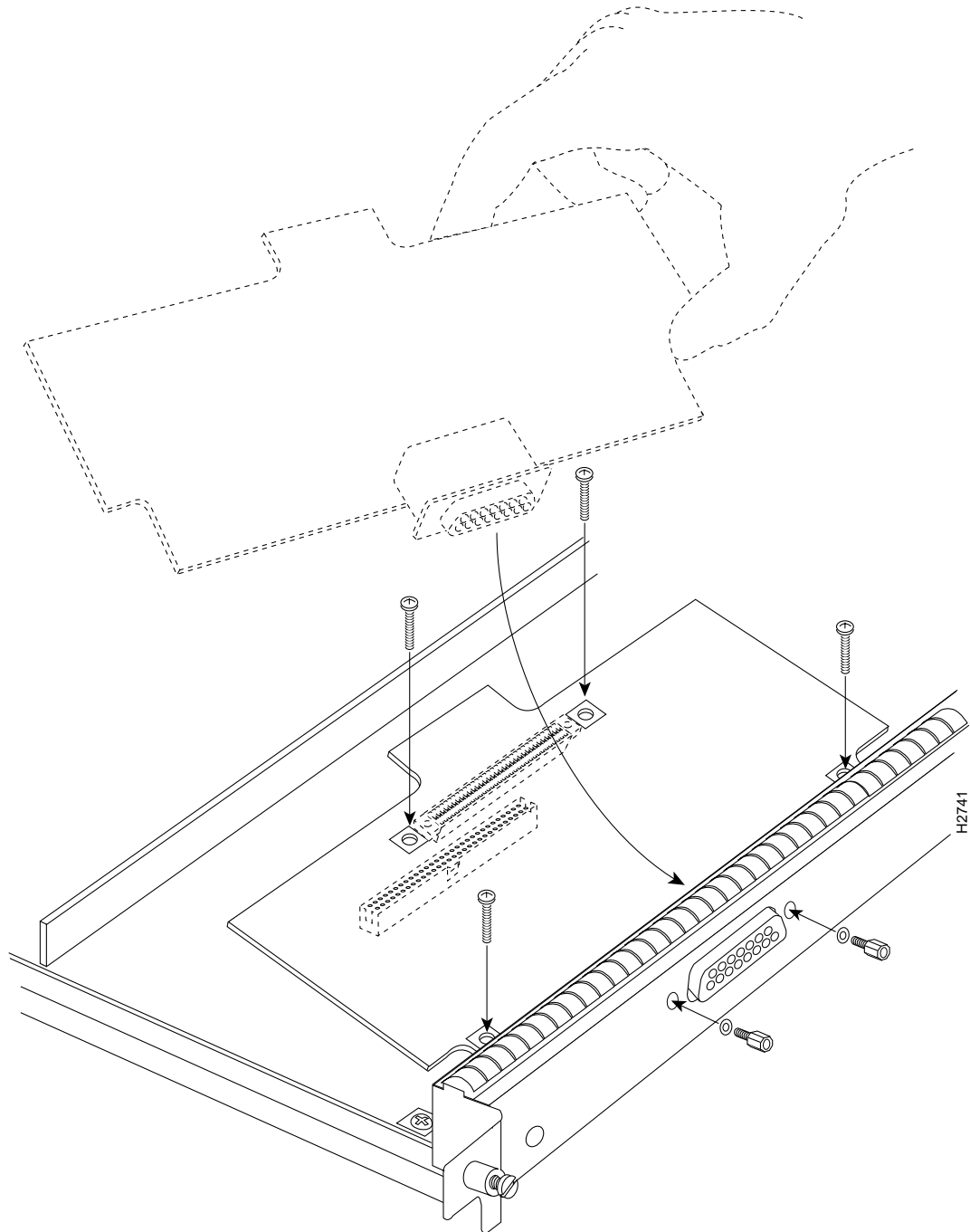
**Caution** To prevent overheating chassis components, do not reinstall the MIP in the chassis unless all port adapters are in place. The empty port will allow cooling air to escape freely through the cutouts in the faceplate, which could misdirect the airflow inside the chassis and allow components on other boards to overheat.

### Replacing a Port Adapter

If necessary, refer to the previous section to remove an E1 port adapter from the MIP. Refer to Figure 5-22 while you perform the following steps:

- Step 1** Ensure that the MIP is resting on an antistatic mat or on antistatic foam and position it with the same orientation as that shown in Figure 5-22. You should still be wearing an ESD-preventive ground strap.
- Step 2** Handle the port adapter by the board edges only.
- Step 3** Position the port adapter so that it is in the orientation shown in Figure 5-22: at about a 70-degree angle from vertical, component-side down, standoffs on the underside, and the external interface cable connector facing the inside of the carrier faceplate.
- Step 4** As shown in Figure 5-22, *partially* insert the cable connector through the back of the cutout in the carrier faceplate. Do not force the cable connector through the cutout until the standoffs and BTB connector is aligned.
- Step 5** With the cable connector partially inserted into the faceplate cutout, slowly lower the back (opposite) side of the port adapter. Continue to ease the cable connector through the cutout until the BTB connector and the MIP and port adapter meet and the standoffs on the MIP are aligned with the standoff holes in the port adapter. Shift the port adapter until the cable connector is fully inserted through the cutouts and the standoffs are aligned with the standoff holes. (See Figure 5-22.)

Figure 5-22 Installing an E1 Port Adapter



- Step 6** Place your fingers over the BTB connector and firmly (but gently) press down until the BTB connector mates with the MIP connector. If the connector resists, do not force it. Shift the port adapter around until the connectors mate properly.
- Step 7** Insert the four long Phillips screws through the four port adapter holes and finger-tighten them. These screws extend through the standoffs and the MIP board and thread into the metal carrier.
- Step 8** Install a lockwasher on each of the two jackscrews.

- Step 9** Insert the two jackscrews through the front of the carrier faceplate and into the holes on either side of the cable connector.
- Step 10** When all screws and connectors are aligned properly, use a Phillips screwdriver to tighten the four standoff screws and a 3/16-inch nut driver to tighten the two jackscrews. *Do not overtighten any of these screws.*
- Step 11** Follow the steps in the section “Installing CxBus IPs” to reinstall the MIP in the chassis.
- Step 12** Reconnect the network interface cables or other connection equipment to the MIP interface ports.



**Caution** To prevent potential EMI and overheating problems, do not replace the MIP in the chassis unless all port adapters are installed. An empty port violates the EMI integrity of the system, and also allows cooling air to escape freely through the cutouts in the carrier faceplate, which could misdirect the airflow inside the chassis and allow components on other boards to overheat.

When you insert the new MIP, the console terminal will display several lines of status information about OIR as it reinitializes the interfaces. Change the state of the interfaces to up and verify that the configuration matches that of the interfaces you replaced.

Use the **configure** command or the **setup** command facility to configure the new interfaces. You do not have to do this immediately, but the interfaces will not be available until you configure them and bring them up.

After you configure the interfaces, use the **show controller cbus**, **show controller T1** and the **show controller E1** commands to display the status of the new interface. For brief descriptions of commands, refer to the section “Using Show Commands to Verify the MIP Status” in this chapter

For complete command descriptions and instructions refer to the appropriate software publications, which are available on UniverCD.

This completes the port adapter replacement procedure.

## Replacing Internal Components

Internal components fall into two categories: those that support online insertion and removal (OIR) and those that require you to shutdown the system power before replacement. Because interface processors support OIR, you can remove and replace them while the system is operating. However, you must shutdown the system power before removing the RP, the SP (or SSP), or any of the internal components (the fan tray, power supply, and arbiter). (See Figure 5-23.)

This section contains replacement procedures for the following components:

- Fan tray (MAS-7010FAN=), the 6-fan array and fan control board on a removable tray that draws cooling air through the chassis interior. Replace this unit if a fan or the control board fails.
- Arbiter (MAS-7KARB=), a printed circuit board that mounts directly to the backplane. It is sandwiched between the backplane and the backplane cover.

- Power supply (PWR-7010AC\*), the 600-watt power supply for the Cisco 7010. Depending upon the type of power cord required, the order number is as follows:
  - PWR-7010AC=, with U.S. cord
  - PWR-7010ACU=, with U.K. cord
  - PWR-7010ACA=, with Australian cord
  - PWR-7010ACE=, with European cord
  - PWR-7010ACI=, with Italian cord

**Figure 5-23 Internal Chassis Components**

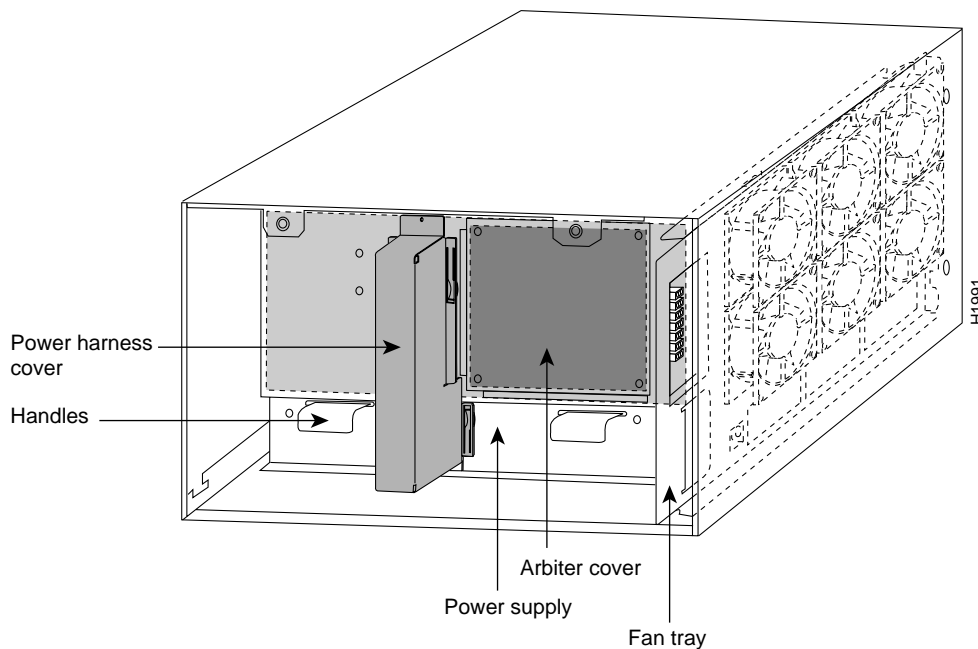


Figure 5-23 shows the locations of each of the internal components inside the service (noninterface processor) end of the chassis. In addition to the internal components, the following assemblies are also available as spares. This document does not include replacement instructions for chassis spares or packing materials. However, specific replacement instructions, called *configuration notes*, accompany all field-replaceable components.

- Chassis without a power supply (MAS-7010=)
- Chassis with power supply (CHAS-7010=)
- Cable management kit (ACS-7010CBLM=); refer to the chapter “Installing the Router” for installation instructions
- Rack-mount kit (ACS-7010RMK=); refer to the chapter “Installing the Router” for installation instructions
- RP, SP (or SSP), and interface processors (various product numbers); refer to “Installing and Configuring Processor Modules” in this chapter for replacement instructions
- Repackaging container and materials (PKG-7010=) for moving or shipping the router safely



**Warning** Before replacing any internal components, review “Safety Recommendations” in the chapter “Preparing for Installation.”

To replace internal components, all of which are inside the service (noninterface processor) end of the router, you must remove the chassis cover panel and expose the chassis interior. To replace some components, you must also remove the power harness cover and the backplane cover, which exposes the backplane power connection. If the power is not shutdown before removing the chassis cover panel, the high current on the fan tray and fan control board becomes a hazard. When the power harness and backplane covers are removed, the high current present in the wiring and on the backplane also becomes a hazard. Removing the cover panel when the system is operating also compromises the EMI integrity of the system. Therefore, always turn off the system power before removing the cover panel, and remove the cover panel only when it is necessary to replace internal components.

The fan tray comprises six individual fans (the fan array) and a fan control printed circuit board mounted on a metal tray; the entire assembly is called the *fan tray*. The fans draw cooling air through the inlet vents on the left side of the chassis (when viewing the chassis from the nonintegrated processor end) and force the air out through the exhaust vents on the right side of the chassis. The fan control board distributes power to the fans, controls the fan speed, and monitors and reports fan failures to the system through the backplane. To remove the fan tray, you need only remove a single pan-head screw that anchors the tray to the interior chassis frame; an edge connector on the fan control board also snaps into a socket connector on the backplane cover. The fan tray slides into the right side of the chassis (when viewing the chassis from the noninterface processor end).

The power harness cover shields the wiring harness that delivers DC power from the power supply to the backplane. A tab at the bottom of the cover fits into a slot in the chassis floor; a single Phillips screw secures the top of the harness cover to the backplane cover. Because the harness cover straddles both the power supply and backplane cover, you must remove it to access the power supply or the arbiter.

An external modular power cord delivers source power to the external AC receptacle on the interface processor end of the power supply. The power harness, which is part of the power supply, carries DC voltages from the power supply to a polarized connector on the backplane. The backplane distributes the operating voltages to all of the internal chassis components. The power supply rests on the floor of the chassis, under the card cage and backplane. Two Phillips-head screws secure the power supply to the interior chassis frame. To remove the power supply, you need to disconnect the modular AC power cord, remove the power harness cover, disconnect the power harness from the backplane, and remove the two Phillips screws. The noninterface processor end of the power supply has handles for pulling the supply out of the chassis. Before inserting a power supply, remove the cable retention clip (or secure it with tape); otherwise, it will catch on the chassis floor and prevent the chassis from sliding into the power supply bay.

The backplane cover shields the noninterface processor side of the backplane and the arbiter (the arbiter cover is integrated with the backplane cover). Fourteen Phillips screws secure the four flanged sides of the cover to the interior chassis frame and, near the center of the cover, two additional screws secure the cover to two standoffs mounted to the backplane (behind the cover). The arbiter standoff screws secure the backplane cover and the arbiter to the four arbiter standoffs mounted to the backplane.

The arbiter mounts directly to the noninterface processor side of the backplane, behind the backplane cover. A bus connector on the arbiter mates with the backplane, and the corners of the arbiter board butt up against four standoffs. When the backplane cover is in place, four long Phillips screws extend through the cover, arbiter, and standoffs to secure the cover and the arbiter to the backplane. To replace the arbiter, you must remove the fan tray, power harness cover, and backplane cover.

## Tools Required

You need the following tools to replace any one of the internal components:

- 3/16-inch flat-blade screwdriver to loosen the captive screws on the chassis cover panel
- Number 1 Phillips screwdriver to remove the M-3 Phillips screws on the power harness cover, backplane cover, and arbiter
- Number 2 Phillips screwdriver for the M-4 Phillips screws on the power supply and the fan tray

## Removing and Replacing the Chassis Cover Panel

The two captive slotted screws are the only fasteners on the cover panel. Five shallow tabs at the bottom edge of the panel fit into slots at the base of the chassis opening. The tabs act as a pivot point for pulling the top of the panel away from the chassis opening, and as guides to align the panel when replacing it.

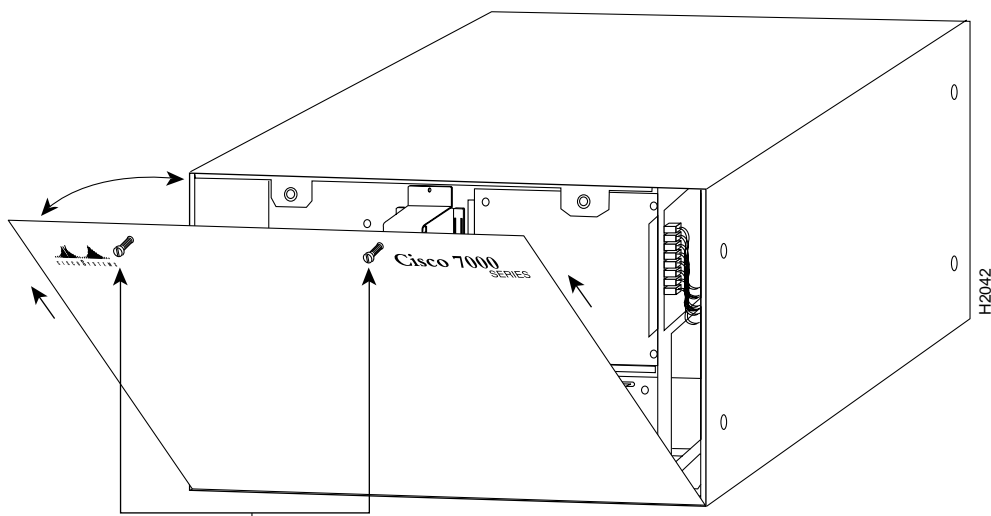


**Warning** Before accessing the chassis interior, turn OFF the system power and unplug the power cord. When the power is ON, high current is exposed on the fan tray and backplane.

Follow these steps to remove and replace the chassis cover panel:

- Step 1** On the front of the cover panel, use a 3/16-inch flat-blade screwdriver to loosen the two captive screws. (See Figure 5-24.)
- Step 2** Pull the top of the panel out about three inches, then grasp the sides of the panel and pull it upward and away from the chassis.
- Step 3** To replace the cover panel, hold the sides of the panel with both hands and tilt the top of the panel back slightly (toward you).
- Step 4** Slide the guide tabs into the slots in the bottom edge of the chassis. (See Figure 5-24.)

**Figure 5-24** Removing and Replacing the Chassis Cover Panel



- Step 5** Using the guides as a pivot point, push the top half of the panel back toward the chassis opening until the panel is flush with the edges of the chassis.
- Step 6** Hold the top front of the panel in place, if necessary, while you tighten the two captive slotted screws with a 3/16-inch flatblade screwdriver.

This completes the chassis cover panel removal and replacement procedure.

## Replacing the Fan Tray

The fan tray provides cooling air to the internal system components. If the system detects that a fan has failed, it will display a 2-minute warning, then shutdown the system until all of the fans are operational. You cannot replace individual fans; if a fan fails, you must replace the whole fan tray assembly.

When viewing the chassis from the noninterface processor end, the fan tray is on the far right. (See Figure 5-23.) A cutout in the front of the tray provides a handle for pulling the tray out of the chassis. An M-4 Phillips-head screw anchors a tab on the lower left side of the tray to the interior chassis frame, just below the right power supply ear. When the fan tray is fully inserted in the chassis, an edge connector on the fan control board snaps into the backplane electrical connector. The bottom of the tray is a metal runner that guides the tray along a metal track on the chassis floor. Also, a bracket on the chassis ceiling helps guide the tray into the chassis.



**Warning** Before accessing the chassis interior, turn OFF the system power and unplug the power cord. When the power is ON, high current is exposed on the fan tray and backplane.

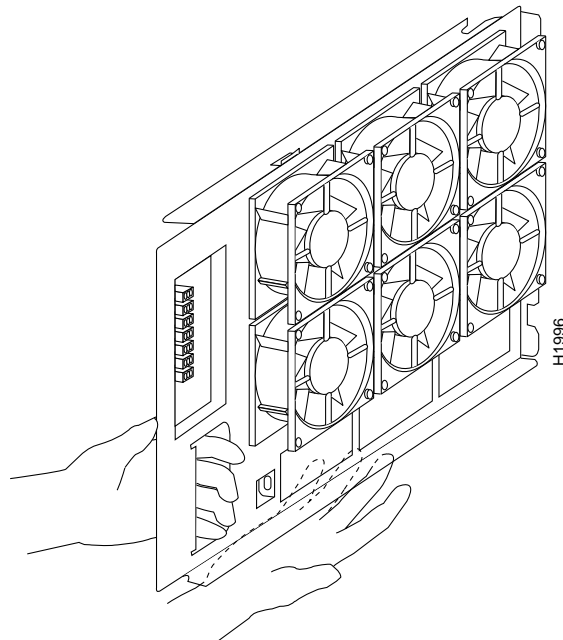
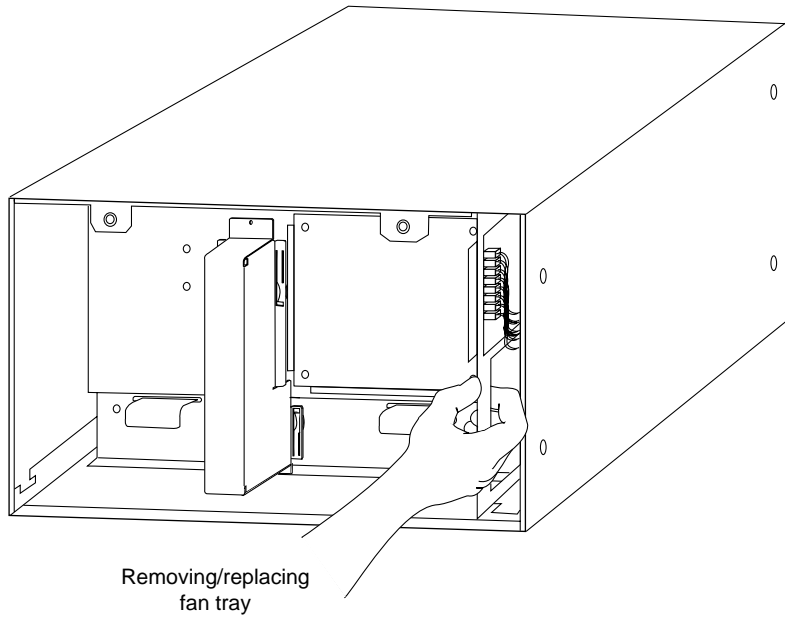
Follow these steps to replace the fan tray.

- Step 1** Turn OFF the system power switch and disconnect the power cable from the power source.
- Step 2** Follow Steps 1 and 2 in the section “Removing and Replacing the Chassis Cover Panel.”
- Step 3** Put on an antistatic strap (your own or the one supplied with the spare fan tray) and connect the equipment end to a power supply handle or any unpainted surface on the chassis body.
- Step 4** Locate the fan tray, which is in the far right of the noninterface processor end of the chassis. (See Figure 5-23.) On the lower left side of the fan tray, locate the tab that is anchored to the chassis frame with an M-4 Phillips screw.
- Step 5** Use a number 2 Phillips screwdriver to remove the M-4 Phillips screw from the tab on the lower left side of the fan tray.
- Step 6** Grasp the cutout handle in the front of the tray and pull the fan tray straight out of the chassis. (See Figure 5-25, top view.) After the fan control board connector frees the backplane socket, the fan tray will slide easily along the track and out of the chassis.
- Step 7** Place the removed fan tray in an antistatic bag for storage or return to the factory.
- Step 8** Hold the assembly in the position shown in Figure 5-25, lower view. You can hold the handle with either your right or left hand as long as you use both hands to handle the tray. However, when inserting the tray, there is little room between the tray and the right side of the chassis. Keep the tray as straight as possible, or you may have trouble inserting it into the chassis.



**Note** Before inserting the fan tray, compare the hardware inside the chassis to Figure 5-26. The runner on the bottom of the fan tray has to slide along in the track on the floor. At the same time, the runner on the top of the tray has to slide through the notch at the top of the chassis opening, then over the top of the card cage while staying to the left of the L-bracket on the chassis ceiling.

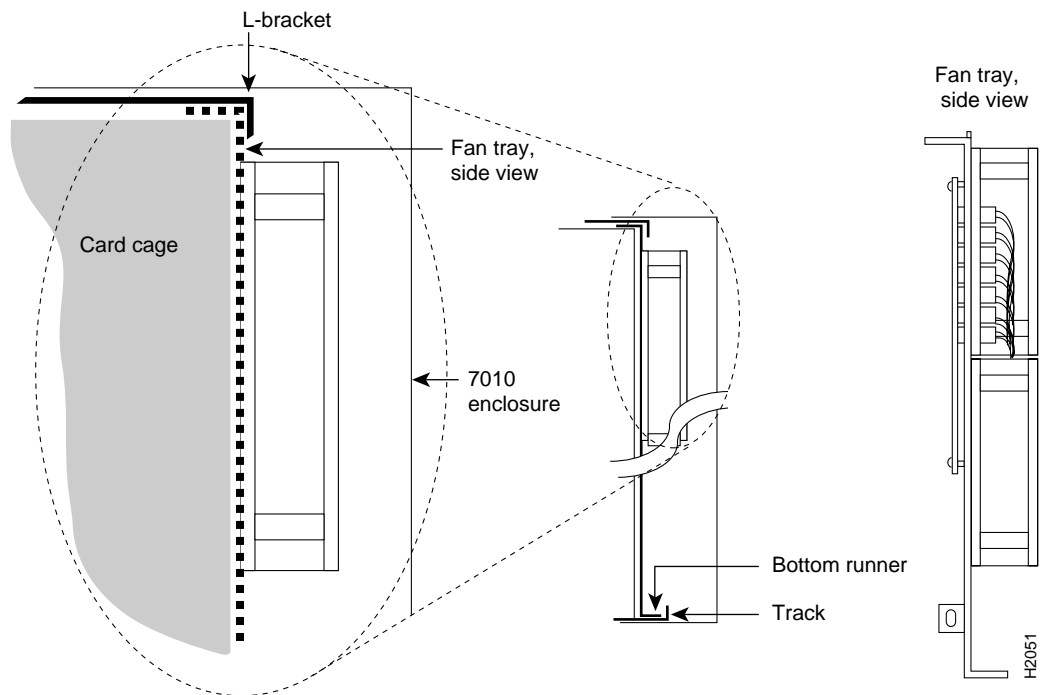
**Figure 5-25** Replacing the Fan Tray



- Step 9** Insert the top runner of the fan tray through the notch in the top of the chassis. Continue pushing the tray into the chassis, and ensure that the bottom runner slides into the track on the floor of the chassis. If the tray hangs up, pull it back out a few inches and try pushing it back in again. If the runners seem to be catching on the brackets, push the tray slightly toward the left when inserting it again.
- Step 10** Slide the tray back into the chassis, pushing it all the way in until the circuit board snaps into the backplane socket.
- Step 11** Replace the M-4 screw in the tab and tighten it with a number 2 Phillips screwdriver.
- Step 12** Follow the steps in the section “Removing and Replacing the Chassis Cover Panel” to replace the cover panel.

This completes the fan tray replacement.

**Figure 5-26 Fan Tray Tracks and Guides**



## Removing and Replacing the Power Harness Cover

You must remove the power harness cover to access either the power supply or the arbiter. A single M-3 Phillips screw secures the power harness cover to the backplane cover.



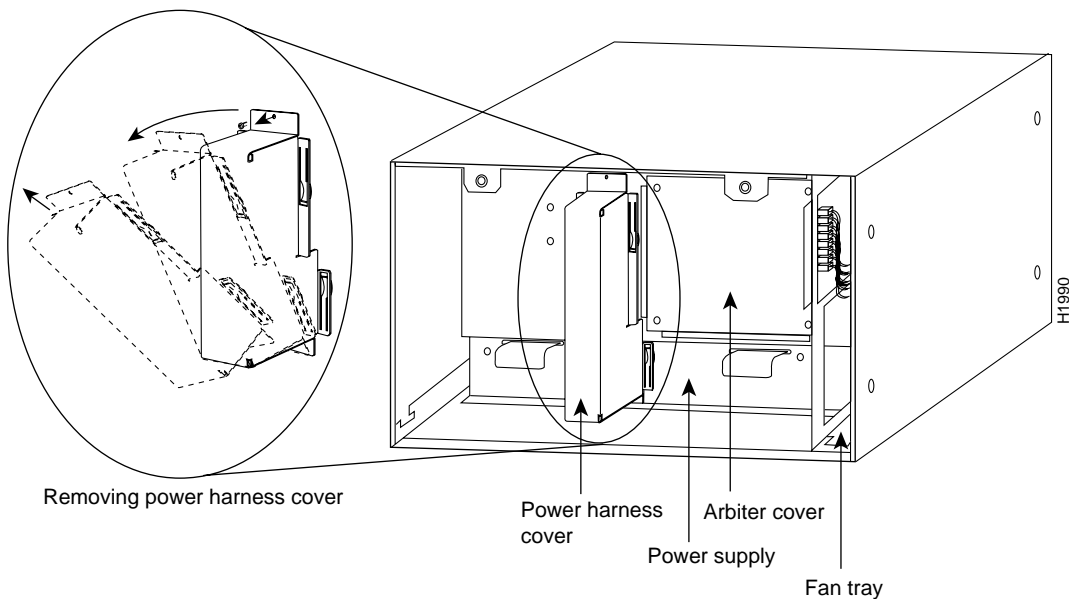
**Warning** Before accessing the chassis interior, turn OFF the system power and unplug the power cord. When the power is ON, high current is exposed on the fan tray and backplane.

Follow these steps to remove and replace the power harness cover:

- Step 1** Turn OFF the system power switch and unplug the power cord from the AC source.
- Step 2** Follow Steps 1 and 2 in the section “Removing and Replacing the Chassis Cover Panel” to open the chassis.
- Step 3** Use a number 1 Phillips screwdriver to remove the M-3 screw that secures the harness cover to the backplane. (See Figure 5-28.)
- Step 4** Holding the cover with one hand, tilt the top of the cover back toward you, then pull it upward slightly so that the tab clears the slot in the chassis floor.
- Step 5** When the tab clears the slot, pull the cover straight back off the harness and out of the chassis.
- Step 6** To replace the power harness cover, hold the cover with one hand, with the tab on the bottom and the open side facing away from you. Tilt the top of the panel back slightly (toward you).
- Step 7** Insert the tab on the bottom of the cover into the slot in the chassis floor. (See Figure 5-27.)
- Step 8** While pushing the cover downward slightly to keep the bottom tab in the slot, push the top of the cover back over the harness wires until the sides are flush against the backplane cover. Ensure that all of the harness wires are under the cover.
- Step 9** Insert the M-3 screw through the top of the harness cover, and use a number 1 Phillips screwdriver to tighten it.
- Step 10** Follow Steps 3 through 6 in the section “Removing and Replacing the Chassis Cover Panel” to replace the chassis cover panel.

This completes the power harness cover removal and replacement procedures.

**Figure 5-27 Removing the Power Harness Cover**



## Removing and Replacing the Power Supply

The power supply rests on the floor of the chassis under the card cage and backplane. To remove the power supply, you must remove the chassis access cover at the noninterface processor end of the router, remove the power harness cover, and disconnect the harness from the backplane receptacle. Always pull the harness out by the connector, not by the wires. Before removing the power harness cover, ensure that the system power is turned off; otherwise, the backplane voltages become a hazard.

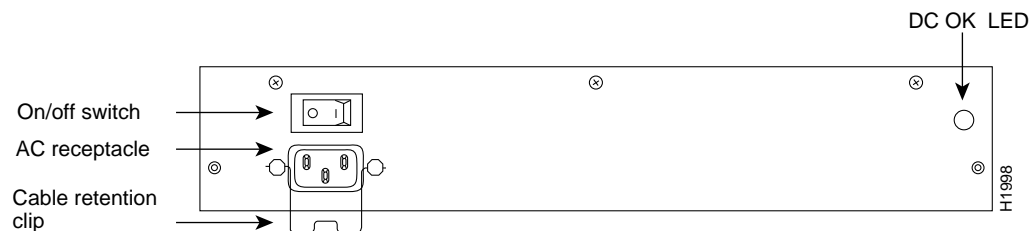
On the AC receptacle on the interface processor end of the 550W power supply, a cable-retention clip snaps up and around the modular AC power cable connector to prevent the cable from accidentally being pulled out or from falling out. (See Figure 5-28.) When inserting the power supply, this clip can get snagged on the chassis floor. Before inserting the supply, remove the clip or tape it up out of the way.

For the DC-input power cable, for the 600W DC-input power supply, strain relief is provided by a nylon cable tie that fastens the power cable to the terminal block cover. You provide this cable tie.



**Caution** To prevent damage, always pull the connector, not the harness wires, to disconnect the power harness.

**Figure 5-28 AC Power Supply, Interface Processor End**



**Warning** Before accessing the chassis interior, turn OFF the system power and unplug the power cable. When the power is ON, high current is exposed on the fan tray and backplane.

## Removing the Power Supply

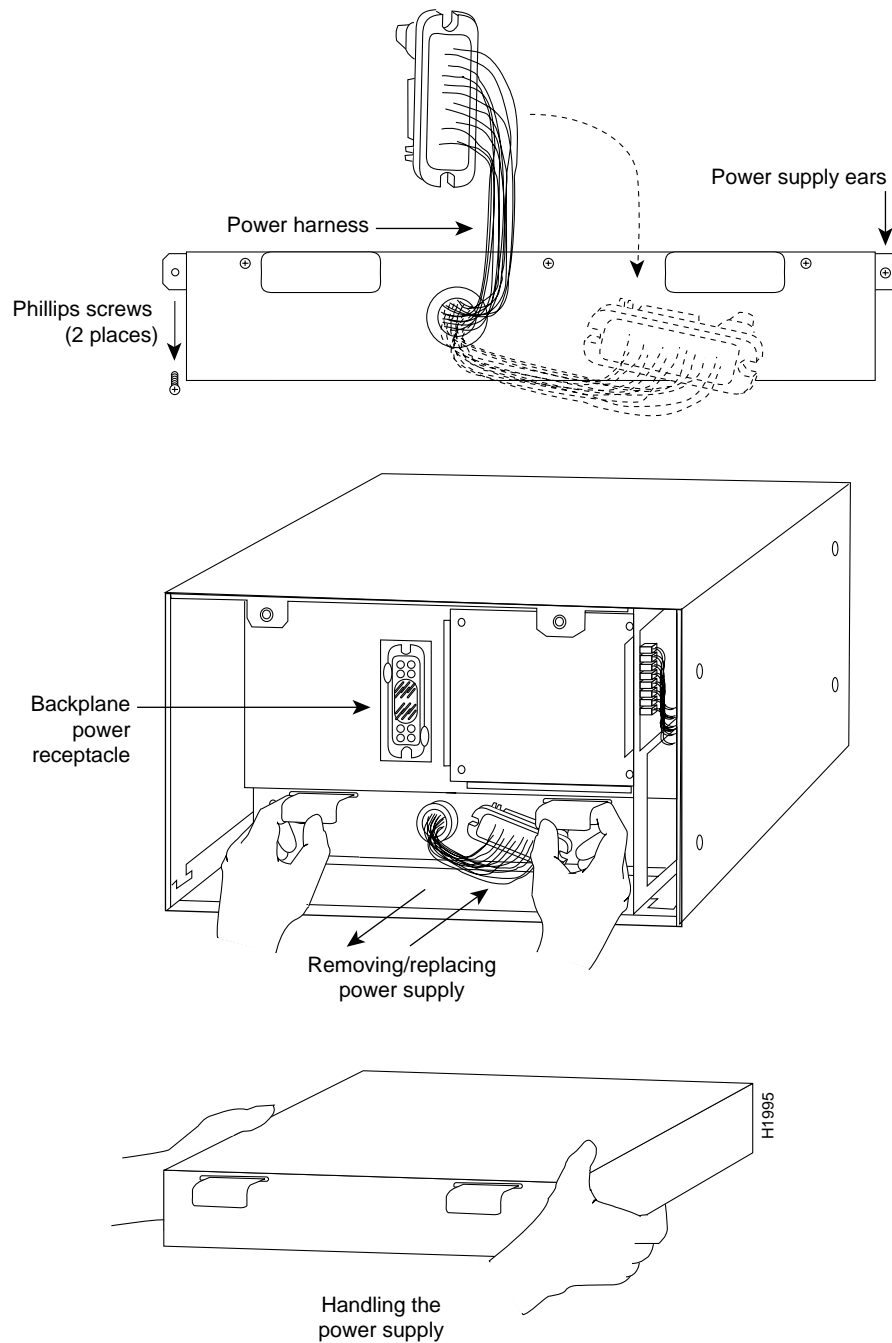
Follow these steps to remove the power supply:

- Step 1** Turn OFF the system power switch and disconnect the power cable from the power source.
- Step 2** Follow Steps 1 and 2 in the section “Removing and Replacing the Chassis Cover Panel.”
- Step 3** Follow Steps 1 through 5 of the section “Removing and Replacing the Power Harness Cover” to remove the power harness cover.
- Step 4** Put on an antistatic strap (your own or the one supplied with the spare fan tray) and connect the equipment end to any unpainted surface on the chassis body.
- Step 5** Disconnect the power harness plug from the backplane receptacle by pulling the polarized plug out of the receptacle; do not pull on the wires. (Figure 5-29 top view.)
- Step 6** Use a number 2 Phillips screwdriver to remove the two M-4 Phillips pan-head screws that secure the power supply ears (one on each side of the power supply) to the chassis frame. (Figure 5-29 middle view.)

**Step 7** Using both hands, grasp both of the power supply handles and pull the power supply about halfway out of the bay (Figure 5-29 middle view), then grab the sides of the supply and pull it out of the chassis. (Figure 5-29 lower view.)

This completes the power supply removal procedure.

**Figure 5-29 Removing and Replacing the Power Supply**





**Warning** Before accessing the chassis interior, turn OFF the system power and unplug the power cord. When the power is ON, high current is exposed on the fan tray and backplane.

### Replacing the Power Supply

Follow these steps to replace the power supply:

- Step 1** Before inserting a power supply, remove the cable retention clip from the AC input port (on the interface processor end); otherwise it can catch on the floor of the chassis during the installation. Pinch the sides together until they clear the jackscrews. (See Figure 5-28.)
- Step 2** To replace a power supply, hold the supply as shown in Figure 5-29c and slide it into the bottom of the chassis. Use the handles to push the supply all the way into the chassis until the ears on both sides are flush against the chassis frame. (See Figure 5-29b.)
- Step 3** Use a number 2 Phillips screwdriver to replace the two M-4 Phillips pan-head screws to secure the two power supply ears to the chassis frame.
- Step 4** Reconnect the power harness plug to the backplane receptacle. The harness plug and backplane receptacle are polarized with notches at the top of both guide tabs (top and bottom) on the plug. Ensure that the plug is fully seated in the receptacle.
- Step 5** Follow Steps 6 through 10 in the section “Removing and Replacing the Power Harness Cover” to replace the power harness cover.
- Step 6** Follow Steps 3 through 6 in the section “Removing and Replacing the Chassis Cover Panel” to replace the chassis cover panel.
- Step 7** On the interface processor side of the AC-input power supply, replace the cable retention clip on the AC-input port by pinching the sides together and letting the ends snap out into holes in the jackscrews. (See Figure 5-28.)

For the DC-input power supply, refer to the section “Connecting Power” in the chapter “Installation” and follow the steps for connecting the DC-input power cable leads.

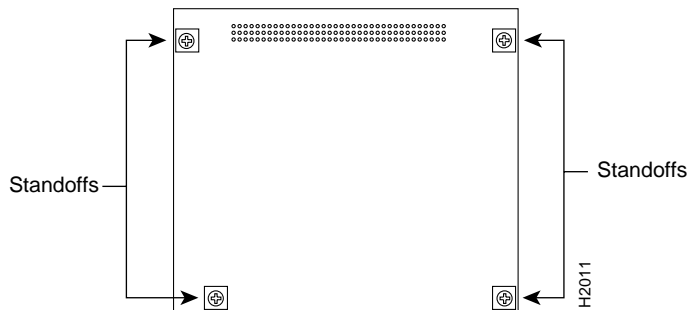
This completes the power supply replacement procedure.

### Replacing the Arbiter

The arbiter provides switching and traffic control assistance to the SP (or SSP). Replace the arbiter board only if it fails.

The arbiter is a printed circuit board mounted to the noninterface processor side of the backplane, behind the backplane cover. (See Figure 5-23.) On the back (backplane side) of the arbiter are four standoffs and a 96-pin connector that plugs directly into the backplane. When the backplane cover is in place, four standoff screws extend through the backplane cover, through each corner of the arbiter, and into the standoffs to keep both the arbiter and cover in place.

You must remove the backplane cover to access the arbiter, and you must remove the power harness cover and the fan tray before you can remove the backplane cover.

**Figure 5-30 Arbiter**

The backplane cover is held in place with the following screws:

- Sixteen 10-mm M3 pan-head screws (two on each flanged side of the cover, five along the top and five along the bottom flanges)
- Two standoff screws near the center to the left of the backplane power connection
- Four 20-mm M3 pan-head standoff screws at each corner of the arbiter cover that extend through the cover, arbiter, and into the backplane to anchor the arbiter

Be careful not to disconnect any backplane screws that are near the cover flanges.

## Removing the Arbiter

Follow these steps to remove the arbiter:

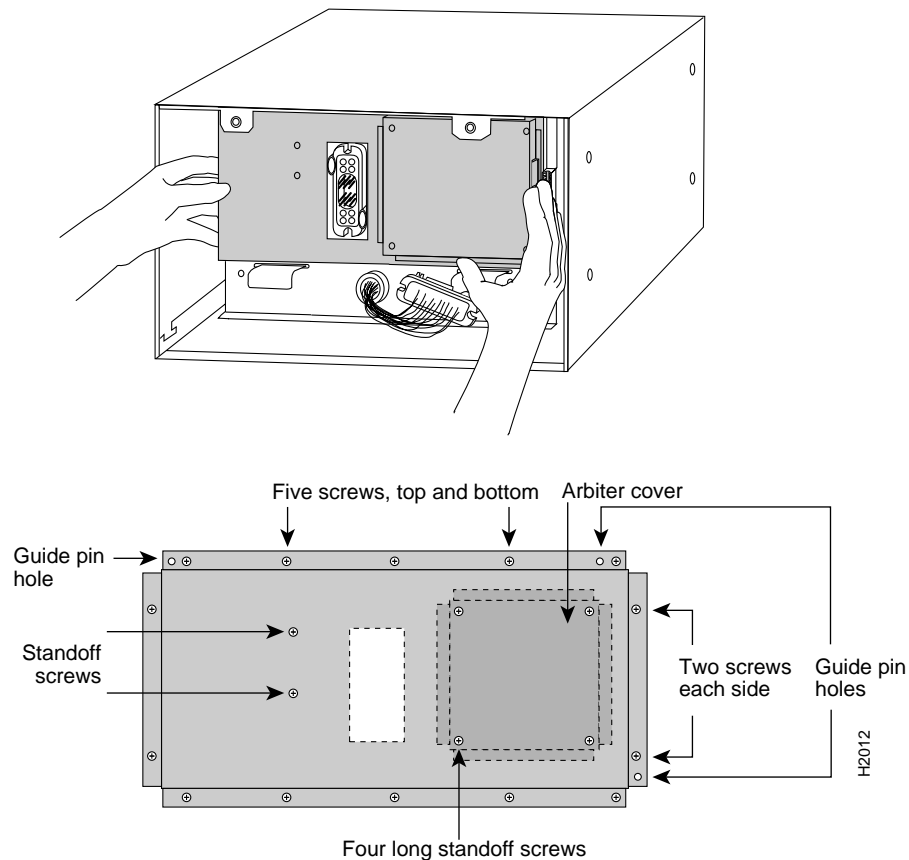
- Step 1** Turn OFF the system power switch and disconnect the power cable from the power source.
- Step 2** Follow Steps 1 and 2 in the section “Removing and Replacing the Chassis Cover Panel” to open the chassis.
- Step 3** Follow Steps 1 through 7 in the section “Replacing the Fan Tray” to remove the fan tray.
- Step 4** Follow Steps 1 through 5 in the section “Removing and Replacing the Power Harness Cover” to remove the power harness cover.
- Step 5** Put on an antistatic strap (your own or the one supplied with the spare fan tray) and connect the equipment end to a power supply handle or any unpainted surface on the chassis body.
- Step 6** Disconnect the power harness from the backplane. (See Figure 5-29.)
- Step 7** Use a number 1 Phillips screwdriver to remove the sixteen 10-mm M-3 Phillips pan-head screws that secure the backplane cover (2 on each side, 5 along the top, 5 along the bottom, and 2 standoff screws near the center to the left of the backplane power connection). Be careful not to disconnect any backplane screws. (The corners of the backplane extend just beyond the corners of the backplane cover.) Remove only the screws from the aluminum cover. (See Figure 5-31.)
- Step 8** Use a number 1 Phillips screwdriver to remove the four longer (20-mm) M-3 standoff screws from the arbiter cover. (See Figure 5-31.) Keep these four longer standoff screws separate so that you can replace all the screws in the proper place.
- Step 9** Holding the cover at the edge of each side with your fingertips, pull the cover straight out, away from the backplane (toward you) until it clears the three guide pins at the top and lower right corners. Put the cover aside.

**Step 10** Because you already had to remove the four long standoff screws to remove the cover, the arbiter is held in place only by the 96-pin connector that is connected to the backplane. Grasp the edges of the board and pull the board straight out at a 90-degree orientation to the backplane to disconnect the board connector from the backplane socket. If necessary, rock it from side to side very slightly to dislodge the pins from the backplane connector.

**Step 11** Place the arbiter in an antistatic bag.

This completes the arbiter removal procedure.

**Figure 5-31** Removing the Backplane Cover



### Replacing the Arbiter

Follow these steps to replace the arbiter:

- Step 1** When replacing the arbiter, hold the board in the orientation shown in Figure 5-30, with the connector along the top and facing the backplane. Position the board over the backplane connector and align the four holes in the corners of the board with the four standoffs.
- Step 2** Place your fingers around the top and side edges of the board and push the board straight in toward the backplane until the 96-pin connector is fully seated in the backplane socket.
- Step 3** To replace the backplane cover, hold the side edges of the cover with your fingertips and slide the cover over the guide pins. (The guide pins are at the top left, top right, and lower right corners of the cover. See Figure 5-31.)



- Step 4** Replace the four longer standoff screws at each corner of the arbiter cover, but do not tighten them until you align the cover and replace the other screws.
- Step 5** Replace the sixteen M-3 screws along the cover edges and in the two standoffs. When all screws are in place, tighten them all.
- Step 6** Reconnect the power harness plug to the backplane receptacle; the plug and receptacle are polarized with notches on the guide tabs. If you have trouble making the connection, ensure that the notch is at the top on both guide tabs (top and bottom) on the plug.
- Step 7** Follow Steps 6 through 10 in the section “Removing and Replacing the Power Harness Cover” to replace the power harness cover.
- Step 8** Follow Steps 8 through 11 in the section “Replacing the Fan Tray” to replace the fan tray.
- Step 9** Follow Steps 3 through 6 in the section “Removing and Replacing the Chassis Cover Panel” to replace the chassis cover panel.

This completes the arbiter replacement procedure.

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**Note** All components are shipped with detailed, up-to-date instructions (called *configuration notes*) for installing and, if applicable, configuring the spare.

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# Cabling Specifications

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This appendix lists the pinouts for ports on the RP (or RSP7000), EIP, TRIP, FIP optical bypass switch, and MIP for the serial interface cables that connect each FSIP and HSSI port to the external network.

All pins not specifically listed are not connected.

Following is a list of the signal summaries contained in this appendix:

- RP (and RSP7000) console port signals
- RP (and RSP7000) auxiliary port signals
- Interface processor port signals and interface cable pinouts
  - EIP Ethernet AUI pinout
  - TRIP Token Ring pinout
  - FIP FDDI optical bypass switch pinout
  - EIA/TIA-232 DTE and DCE serial port adapter cable pinouts
  - EIA/TIA-449 DTE and DCE serial port adapter cable pinouts
  - V.35 DTE and DCE serial port adapter cable pinouts
  - X.21 DTE and DCE serial port adapter cable pinouts
  - EIA-530 DTE serial port adapter cable pinout
  - E1-G.703/G.704 serial port adapter cable pinouts
- HSSI cables
  - HSSI interface cable pinout
  - Null modem cable pinout
- MIP cables

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**Note** All FSIP ports use a universal high-density, 60-pin receptacle (except for the E1-G.703/G.704 port adapter, which uses DB-15 connectors). Each universal port requires a serial port adapter cable, which determines the port's electrical interface type and mode: DTE or DCE. Although all port adapter cables use a universal plug at the FSIP end, the network end of each cable type uses the physical connectors commonly used for the interface. (For example, the network end of the EIA/TIA-232 port adapter cable is a DB-25, the most widely used EIA/TIA-232 connector.)

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## Console Port Signals

The console port on the RP (and RSP7000) is an EIA/TIA-232, DCE, DB-25 receptacle. Both DSR and DCD are active when the system is running. The RTS signal tracks the state of the CTS input. The console port does not support modem control or hardware flow control. Table A-1 lists the signals used on this port. The console port requires a straight-through EIA/TIA-232 cable.

**Table A-1 Console Port Signals**

Pin	Signal	Direction	Description
1	GND	–	Ground
2	TxD	←	Transmit Data
3	RxD	→	Receive Data
6	DSR	→	Data Set Ready (always on)
7	GND	–	Ground
8	DCD	→	Data Carrier Detect (always on)

## Auxiliary Port Signals

The auxiliary port on the RP (and RSP7000) is an EIA/TIA-232, DTE, DB-25 plug to which you attach a CSU/DSU or other equipment in order to access the router from the network. Table A-2 lists the EIA/TIA-232 signals used on this port.

The auxiliary port supports hardware flow control and modem control.

**Table A-2 Auxiliary Port Signals**

Pin	Signal	Direction	Description
2	TxD	→	Transmit Data
3	RxD	←	Receive Data
4	RTS	→	Request To Send (used for hardware flow control)
5	CTS	←	Clear To Send (used for hardware flow control)
6	DSR	←	Data Set Ready
7	Signal Ground	–	Signal Ground
8	CD	←	Carrier Detect (used for modem control)
20	DTR	→	Data Terminal Ready (used for modem control only)

## Ethernet Connector Signals

Most Ethernet transceivers require an attachment unit interface (AUI) or transceiver cable to connect an Ethernet transceiver to the EIP Ethernet ports. Some unshielded twisted-pair (10BaseT) transceivers are compact enough to connect directly to the EIP ports without impeding other connections. For descriptions of Ethernet transceivers, connectors, and cables, refer to the section “Ethernet Connection Equipment” in the chapter “Preparing for Installation.”

Table A-3 lists the signals for the 15-pin Ethernet connector used on the EIP.

**Table A-3 Ethernet Connector Signals**

Pin	Circuit	Description
3	DO-A	Data Out Circuit A
10	DO-B	Data Out Circuit B
11	DO-S	Data Out Circuit Shield
5	DI-A	Data In Circuit A
12	DI-B	Data In Circuit B
4	DI-S	Data In Circuit Shield
7	CO-A	Control Out Circuit A (not used)
15	CO-B	Control Out Circuit B (not used)
8	CO-S	Control Out Circuit Shield (not used)
2	CI-A	Control In Circuit A
9	CI-B	Control In Circuit B
1	CI-S	Control In Circuit Shield
6	VC	Voltage Common
13	VP	Voltage Plus
14	VS	Voltage Shield
Shell	PG	Protective Ground

## Fast Ethernet Connector Signals

The two connectors on the FEIP are a single MII, 40-pin, D-shell type, and a single RJ-45. You can use either one or the other. Only one connector can be used at one time. Each connection supports IEEE 802.3u interfaces compliant with the 100BaseX and 100BaseT standards. The RJ-45 connection does not require an external transceiver; however, the MII connection does.

The RJ-45 modular connector has strain-relief functionality incorporated into the design of its standard plastic connector. Table A-4 and Table A-5 list the pinouts and signals for the RJ-45 and MII connectors.

**Table A-4 FEIP Port Adapter RJ-45 Connector Pinout**

Pin	Description
1	Receive Data + (RxD+)
2	RxD-
3	Transmit Data + (TxD+)
6	TxD-

---

**Note** Referring to the RJ-45 pinout in Table A-4, proper common-mode line terminations should be used for the unused Category 5, UTP cable pairs 4/5 and 7/8. Common-mode termination reduces the contributions to electromagnetic interference (EMI) and susceptibility to common-mode sources. Wire pairs 4/5 and 7/8 are actively terminated in the RJ-45, 100BaseTX port circuitry in the FEIP port adapter.

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**Table A-5 FEIP Port Adapter MII Connector Pinout**

Pin <sup>1</sup>	In	Out	I/O	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	–	–	–	+5.0 volts (V)

1. Any pins not indicated are not used.  
 2. Tx\_CLK and Rx\_CLK are provided by the external transceiver.

## Token Ring Port Signals

A network interface cable provides the connection between the 9-pin Token Ring connectors on the TRIP and a media access unit (MAU). The 9-pin connector at the TRIP end, and the MAU connector at the network end, are described in “Token Ring Connection Equipment” in the chapter “Preparing for Installation.” Table A-6 lists the signals for the DB-9 Token Ring connector used on the TRIP.

**Table A-6**      **Token Ring Connector Signals**

Pin	Signal
1	Ring-In B
5	Ring-Out A
6	Ring-In A
9	Ring-Out B
10 and 11	Ground

## FDDI Optical Bypass Switch Signals

Table A-5 lists the signal descriptions for the mini-DIN optical bypass switch available on the multimode/multimode FIP (CX-FIP-MM) and single-mode/single-mode FIP (CX-FIP-SS). The mini-DIN-to-DIN adapter cable (CAB-FMDD) allows connection to an optical bypass switch that uses a DIN connector (which is larger than the mini-DIN on the FIP). For descriptions of FDDI network configurations and equipment, refer to the section “FDDI Connection Equipment” in the chapter “Preparing for Installation” and to the section “FDDI Connections” in the chapter “Installing the Router.”

**Table A-7**      **Optical Bypass Switch Pinout**

Pin	Description
1	+5V to secondary switch
2	+5V to primary switch
3	Ground to enable primary switch
4	Ground to enable secondary switch
5	Sense circuit—1 kohm to +5V
6	Ground—Sense circuit return

## Serial Adapter Cable Pinouts

The FSIP supports EIA/TIA-232, EIA/TIA-449, X.21, V.35, and EIA-530 serial interfaces.

All FSIP ports use a universal port adapter, which is a 60-pin receptacle that supports all available interface types. (The exception to this is the E1-G.703/G.704 port adapter, which uses a DB-15 connector.) A special serial adapter cable, which is required for each port, determines the electrical interface type and mode of the interface. The router (FSIP) end of all of the adapter cables is a 60-pin plug; the connectors at the network end are the standard connectors used for the respective interfaces.

All interface types except EIA-530 are available in DTE or DCE format: DTE with a plug connector at the network end and DCE with a receptacle at the network end. V.35 is available in either mode with either gender at the network end. EIA-530 is available in DTE only.

The tables that follow list the signal pinouts for both the DTE and DCE mode serial port adapter cables for each FSIP interface type. For descriptions of serial interface connection and equipment, refer to the section “Serial Connection Equipment” in the chapter “Preparing for Installation” and to the section “Serial Connections” in the chapter “Installing the Router.”



Table A-8 EIA/TIA-232 Adapter Cable Signals

FSIP End, HD 60-Position Plug				Network End, DB-25 Plug				FSIP End, HD 60-Position Plug				Network End, DB-25 Receptacle			
DTE Cable		Pin		DCE Cable		Pin		Signal (J1)		Signal (J2)		Signal (J1)		Signal (J2)	
Signal (J1)	Pin	Pin	Signal (J2)	Signal (J1)	Pin	Pin	Signal (J2)	Signal (J1)	Pin	Pin	Signal (J2)	Signal (J1)	Pin	Pin	Signal (J2)
Shield ground	46	1	Shield ground	Shield ground	46	1	Shield ground	Shield ground	46	1	Shield ground	Shield ground	46	1	Shield ground
TxD/RxD	41	→ 2	TxD	RxD/TxD	36	← 2	TxD	RxD/TxD	36	← 2	TxD	RxD/TxD	36	← 2	TxD
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
RxD/TxD	36	← 3	RxD	TxD/RxD	41	→ 3	RxD	TxD/RxD	41	→ 3	RxD	TxD/RxD	41	→ 3	RxD
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
RTS/CTS	42	→ 4	RTS	CTS/RTS	35	← 4	RTS	CTS/RTS	35	← 4	RTS	CTS/RTS	35	← 4	RTS
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
CTS/RTS	35	← 5	CTS	RTS/CTS	42	→ 5	CTS	RTS/CTS	42	→ 5	CTS	RTS/CTS	42	→ 5	CTS
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
DSR/DTR	34	← 6	DSR	DTR/DSR	43	→ 6	DSR	DTR/DSR	43	→ 6	DSR	DTR/DSR	43	→ 6	DSR
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
Circuit ground	45	7	Circuit ground	Circuit ground	45	7	Circuit ground	Circuit ground	45	7	Circuit ground	Circuit ground	45	7	Circuit ground
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
DCD/LL	33	← 8	DCD	LL/DCD	44	→ 8	DCD	LL/DCD	44	→ 8	DCD	LL/DCD	44	→ 8	DCD
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
TxC/NIL	37	← 15	TxC	TxCE/TxC	39	→ 15	TxC	TxCE/TxC	39	→ 15	TxC	TxCE/TxC	39	→ 15	TxC
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
RxC/TxCE	38	← 17	RxC	NIL/RxC	40	→ 17	RxC	NIL/RxC	40	→ 17	RxC	NIL/RxC	40	→ 17	RxC
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
LL/DCD	44	→ 18	LTST	DCD/LL	33	← 18	LTST	DCD/LL	33	← 18	LTST	DCD/LL	33	← 18	LTST
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
DTR/DSR	43	→ 20	DTR	DSR/DTR	34	← 20	DTR	DSR/DTR	34	← 20	DTR	DSR/DTR	34	← 20	DTR
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
TxCE/TxC	39	→ 24	TxCE	RxC/TxCE	38	← 24	TxCE	RxC/TxCE	38	← 24	TxCE	RxC/TxCE	38	← 24	TxCE
Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used	Not used	56	7	Not used
Mode 0	50			Mode 0	50			Mode 0	50			Mode 0	50		
Ground	51		Shorting group	Ground	51		Shorting group	Ground	51		Shorting group	Ground	51		Shorting group
Mode_DCE	52														

**Table A-9 EIA/TIA-449 Adapter Cable Signals**

FSIP End, HD 60-Position Plug		DTE Cable		Network End, DB-37 Plug		FSIP End, HD 60-Position Plug		DCE Cable		Network End, DB-37 Receptacle		
Signal (J1)	Pin	Pin	Signal (J2)	Signal (J1)	Pin	Pin	Signal (J2)	Signal (J1)	Pin	Pin	Signal (J2)	
Shield ground	46	1	Shield ground	Shield ground	46	1	Shield ground	Shield ground	46	1	Shield ground	
TxD/RxD+	11	→	4	SD+	RxD/TxD+	←	4	SD+	28	←	4	SD+
TxD/RxD-	12	→	22	SD-	RxD/TxD-	←	22	SD-	27	←	22	SD-
TxC/RxC+	24	←	5	ST+	TxCE/TxC+	→	5	ST+	13	→	5	ST+
TxC/RxC-	23	←	23	ST-	TxCE/TxC-	→	23	ST-	14	→	23	ST-
RxD/TxD+	28	←	6	RD+	TxD/RxD+	→	6	RD+	11	→	6	RD+
RxD/TxD-	27	←	24	RD-	TxD/RxD-	→	24	RD-	12	→	24	RD-
RTS/CTS+	9	→	7	RS+	CTS/RTS+	←	7	RS+	1	←	7	RS+
RTS/CTS-	10	→	25	RS-	CTS/RTS-	←	25	RS-	2	←	25	RS-
RxC/TxCE+	26	←	8	RT+	TxC/RxC+	→	8	RT+	24	→	8	RT+
RxC/TxCE-	25	←	26	RT-	TxC/RxC-	→	26	RT-	23	→	26	RT-
CTS/RTS+	1	←	9	CS+	RTS/CTS+	→	9	CS+	9	→	9	CS+
CTS/RTS-	2	←	27	CS-	RTS/CTS-	→	27	CS-	10	→	27	CS-
LL/DCD	44	→	10	LL	NIL/LL	→	10	LL	29	→	10	LL
Circuit ground	45	→	37	SC	Circuit ground	→	37	SC	30	→	37	SC
DSR/DTR+	3	←	11	DM+	DTR/DSR+	→	11	DM+	7	→	11	DM+
DSR/DTR-	4	←	29	DM-	DTR/DSR-	→	29	DM-	8	→	29	DM-
DTR/DSR+	7	→	12	TR+	DSR/DTR+	←	12	TR+	3	←	12	TR+
DTR/DSR-	8	→	30	TR-	DSR/DTR-	←	30	TR-	4	←	30	TR-
DCD/DCD+	5	←	13	RR+	DCD/DCD+	→	13	RR+	5	→	13	RR+
DCD/DCD-	6	←	31	RR-	DCD/DCD-	→	31	RR-	6	→	31	RR-
TxCE/TxC+	13	→	17	TT+	RxC/TxCE+	←	17	TT+	26	←	17	TT+
TxCE/TxC-	14	→	35	TT-	RxC/TxCE-	←	35	TT-	25	←	35	TT-
Circuit ground	15		19	SG	Circuit ground	15	19	SG				
Circuit ground	16		20	RC	Circuit ground	16	20	RC				
Mode 1	49		Shorting		Mode 1	49	Shorting					
Ground	48		group		Ground	48	group					
Ground	51		Shorting									
Mode_DCE	52		group									

Table A-10 X.21 Adapter Cable Signals

FSIP End, HD 60-Position Plug	DTE Cable		Network End, DB-15 Plug	Signal (J2)	SIP End, HD 60-Position Plug	DCE Cable		Network End, DB-15 Receptacle	Signal (J2)
	Pin	Pin				Pin	Pin		
Ground	46	1			Shield ground	46	1		Shield ground
TxD/RxD+	11	→ 2		Transmit+	RxD/TxD+	28	← 2		Transmit+
TxD/RxD-	12	→ 9		Transmit-	RxD/TxD-	27	← 9		Transmit-
RTS/CTS+	9	→ 3		Control+	CTS/RTS+	1	← 3		Control+
RTS/CTS -	10	→ 10		Control-	CTS/RTS -	2	← 10		Control-
RxD/TxD+	28	← 4		Receive+	TxD/RxD+	11	→ 4		Receive+
RxD/TxD-	27	← 11		Receive-	TxD/RxD-	12	→ 11		Receive-
CTS/RTS+	1	← 5		Indication+	RTS/CTS+	9	→ 5		Indication+
CTS/RTS -	2	← 12		Indication-	RTS/CTS-	10	→ 12		Indication-
RxC/TxCE+	26	← 6		Timing+	TxC/RxC+	24	→ 6		Timing+
RxC/TxCE-	25	← 13		Timing-	TxC/RxC -	23	→ 13		Timing-
Circuit ground	15	8		Circuit ground	Circuit ground	15	8		Circuit ground
Ground	48			Shorting group	Ground	48			Shorting group
Mode_2	47				Mode_2	47			
Ground	51			Shorting group					
Mode_DCE	52								
Not used	16	8		Not used	Not used	16	8		Not used

**Table A-11 V.35 Adapter Cable Signals**

FSIP End, HD 60-Position Plug		DTE Cable		Network End, 34-Position Plug		FSIP End, HD 60-Position Plug		DCE Cable		Network End, 34-Position Receptacle	
Signal (J1)	Pin	Pin	Signal (J2)	Signal (J1)	Pin	Pin	Signal (J2)	Signal (J1)	Pin	Pin	Signal (J2)
Shield ground	46	A	Shield ground	Shield ground	46	A	Shield ground	Shield ground	46	A	Shield ground
Circuit ground	45	B	Circuit ground	Circuit ground	45	B	Circuit ground	Circuit ground	45	B	Circuit ground
Not used	16	B	Not used	Not used	18	B	Not used	Not used	18	B	Not used
RTS/CTS	42	→ C	RTS	CTS/RTS	35	← C	RTS	CTS/RTS	35	← C	RTS
Not used	16	B	Not used	Not used	18	B	Not used	Not used	18	B	Not used
CTS/RTS	35	← D	CTS	RTS/CTS	42	→ D	CTS	RTS/CTS	42	→ D	CTS
Not used	16	B	Not used	Not used	18	B	Not used	Not used	18	B	Not used
DSR/DTR	34	← E	DSR	DTR/DSR	43	→ E	DSR	DTR/DSR	43	→ E	DSR
Not used	16	B	Not used	Not used	18	B	Not used	Not used	18	B	Not used
DCD/LL	33	← F	RLSD	LL/DCD	44	→ F	RLSD	LL/DCD	44	→ F	RLSD
Not used	16	B	Not used	Not used	18	B	Not used	Not used	18	B	Not used
DTR/DSR	43	→ H	DTR	DSR/DTR	34	← H	DTR	DSR/DTR	34	← H	DTR
Not used	16	B	Not used	Not used	18	B	Not used	Not used	18	B	Not used
LL/DCD	44	→ K	LT	DCD/LL	33	← K	LT	DCD/LL	33	← K	LT
Not used	16	B	Not used	Not used	18	B	Not used	Not used	18	B	Not used
TxD/RxD+	18	→ P	SD+	RxD/TxD+	28	← P	SD+	RxD/TxD+	28	← P	SD+
TxD/RxD-	17	→ S	SD-	RxD/TxD-	27	← S	SD-	RxD/TxD-	27	← S	SD-
RxD/TxD+	28	← R	RD+	TxD/RxD+	18	→ R	RD+	TxD/RxD+	18	→ R	RD+
RxD/TxD-	27	← T	RD-	TxD/RxD-	17	→ T	RD-	TxD/RxD-	17	→ T	RD-
TxCE/TxC+	20	→ U	SCTE+	RxC/TxCE+	26	← U	SCTE+	RxC/TxCE+	26	← U	SCTE+
TxCE/TxC-	19	→ W	SCTE-	RxC/TxCE-	25	← W	SCTE-	RxC/TxCE-	25	← W	SCTE-
RxC/TxCE+	26	← V	SCR+	NIL/RxC+	22	→ V	SCR+	NIL/RxC+	22	→ V	SCR+
RxC/TxCE-	25	← X	SCR-	NIL/RxC-	21	→ X	SCR-	NIL/RxC-	21	→ X	SCR-
TxC/RxC+	24	← Y	SCT+	TxCE/TxC+	20	→ Y	SCT+	TxCE/TxC+	20	→ Y	SCT+
TxC/RxC-	23	← AA	SCT-	TxCE/TxC-	19	→ AA	SCT-	TxCE/TxC-	19	→ AA	SCT-
Mode 1	49		Shorting group	Mode 1	49		Shorting group	Mode 1	49		Shorting group
Ground	48			Ground	48			Ground	48		
Mode 0	50		Shorting group	Mode 0	50		Shorting group	Mode 0	50		Shorting group
Ground	51			Ground	51			Ground	51		
Mode_DCE	52										
TxC/NIL	53		Shorting group	TxC/NIL	53		Shorting group	TxC/NIL	53		Shorting group
RxC/TxCE	54			RxC/TxCE	54			RxC/TxCE	54		
RxC/TxD	55			RxC/TxD	55			RxC/TxD	55		
Ground	56			Ground	56			Ground	56		

**Table A-12 EIA-530 Adapter Cable Signals**

<b>FSIP End, HD 60-Position Plug</b>	<b>DTE Cable<sup>1</sup></b>		<b>Network End, DB-25 Plug</b>
<b>Signal (J1)</b>	<b>Pin</b>	<b>Pin</b>	<b>Signal (J2)</b>
Shield ground	46	1	Shield ground
TxD/RxD+	11	→ 2	TxD+
TxD/RxD-	12	→ 14	TxD-
RxD/TxD+	28	← 3	RxD+
RxD/TxD-	27	← 16	RxD-
RTS/CTS+	9	→ 4	RTS+
RTS/CTS-	10	→ 19	RTS-
CTS/RTS+	1	← 5	CTS+
CTS/RTS-	2	← 13	CTS-
DSR/DTR+	3	← 6	DSR+
DSR/DTR-	4	← 22	DSR-
DCD/DCD+	5	← 8	DCD+
DCD/DCD-	6	← 10	DCD-
TxC/RxC+	24	← 15	TxC+
TxC/RxC-	23	← 12	TxC-
RxC/TxCE+	26	← 17	RxC+
RxC/TxCE-	25	← 9	RxC-
LL/DCD	44	→ 18	LL
Circuit ground	45	7	Circuit ground
DTR/DSR+	7	→ 20	DTR+
DTR/DSR-	8	→ 23	DTR-
TxCE/TxC+	13	→ 24	TxCE+
TxCE/TxC-	14	→ 11	TxCE-
Mode_1	49		
Ground	48		Shorting group
Mode_2	47		
Ground	51		Shorting group
Mode_DCE	52		
Not used	15	7	Not used
Not used	16	7	Not used

1. For EIA-530, DCE mode is not available.

Table A-13 shows the signal pinouts for each type of E1-G.703/G.704 interface cable. All cables use a 15-pin D-shell (DB-15) connector at the FSIP end.

**Table A-13 E1-G.703/G.704 Adapter Cable Connector Pinouts**

FSIP End		Network End				
DB-15 <sup>1</sup>		DB-15	Null Modem DB-15	BNC	Twinax	
Pin	Signal <sup>2</sup>	Pin	Pin	Signal	Pin	Signal
9	Tx tip	1	3	Tx tip	J2-1	Tx
2	Tx ring	9	11	Tx shield	J2-2	Tx
10	Tx shield	2	4	–	J2 shield	Tx shield
8	Rx tip	3	1	Rx tip	J3-1	Rx
15	Rx ring	11	9	Rx shield	J3-2	Rx
7	Rx shield	4	2	–	J3 shield	Rx shield

1. Any pins not described in this table are not connected.  
 2. Tx = transmit. Rx = receive.

## HSSI Connector Signals

Two types of cables are available for use with the HIP: the HSSI interface cable used to connect the HIP HSSI port with an external DSU (and HSSI network) and a null modem cable, which allows you to connect two collocated routers back to back.

### HSSI Interface Cable

The HSSI interface cable (Product Number CAB-HSI1) connects the HIP port with an external DSU. The cable comprises 25 twisted pairs and a 50-pin SCSI-II-type plug at each end. Although the HSSI cable is similar to a SCSI-II cable, it is not identical; you cannot substitute a SCSI-II cable for a HSSI interface cable. (See the following Caution.) Table A-14 lists the pin signals for the connector.



**Caution** Although the HIP connector and the HSSI interface cable are similar to SCSI-II format, the HSSI cable specification is more stringent than that for a SCSI-II. We cannot guarantee proper operation if a SCSI-II cable is used instead of an HSSI interface cable.

**Table A-14 HSSI Interface Cable Signals**

Signal Name	Pin No., + Side (Router End)	Direction <sup>1</sup>	Pin No., – Side (DSU End)
SG - Signal Ground	1	—	26
RT - Receive Timing	2	<—	27
CA - DCE Available	3	<—	28
RD - Receive Data	4	<—	29
Reserved			
LC - Loopback Circuit C	5	<—	30

Signal Name	Pin No., + Side (Router End)	Direction <sup>1</sup>	Pin No., – Side (DSU End)
ST - Send Timing	6	<—	31
SG - Signal Ground	7	—	32
TA - DTE Available	8	—>	33
TT - Terminal Timing	9	—>	34
LA - Loopback Circuit A	10	—>	35
SD - Send Data	11	—>	36
LB - Loopback Circuit B	12	—>	37
SG - Signal Ground	13	—	38
5 - Ancillary to DCE	14–18	—>	39–43
SG - Signal Ground	19	—	44
5 - Ancillary from DCE	20–24	<—	45–49
SG - Signal Ground	25	—	50

1. Router is + side (DTE). DSU is – side (DCE).

## Null Modem Cable

The null modem cable (CAB-HNUL) can connect two routers directly back to back. The two routers must be in the same location and can be two Cisco 7000 series, two AGS+ routers, or one of each. A null modem connection allows you to verify the operation of the HSSI or to link the routers directly in order to build a larger node.

The null modem cable uses the same 50-pin connectors as the HSSI interface cable, but uses the pinouts listed in Table A-15. For null modem cable connection and configuration instructions, refer to the section “HSSI Connection Equipment” in the chapter “Preparing for Installation.”

**Table A-15 HSSI Null Modem Cable Signals**

Signal Name	From Pins	Direction	To Pins	Signal Name
Receive Timing	2, 27	—>	9, 34	Terminal Timing
DCE Available	3, 28	—>	8, 33	DTE Available
Received Date	4, 29	—>	11, 36	Send Data
Loopback C	5, 30	—>	10, 35	Loopback A
Send Timing	6, 31	—>	6, 31	Send Timing
DTE Available	8, 33	—>	3, 28	DCE Available
Terminal Timing	9, 34	—>	2, 27	Receive Timing
Loopback A	10, 35	—>	5, 30	Loopback C
Send Data	11, 36	—>	4, 29	Receive Data

Signal Name	From Pins	Direction	To Pins	Signal Name
Ground	1, 26, 7, 32, 13, 38, 19, 44, 25, 50		1, 26, 7, 32, 13, 38, 19, 44, 25, 50	Ground
Loopback (not connected)	12, 37		12, 37	Loopback (not connected)
Not used	14–18, 20–24, 39–43, 45–49		14–18, 20–24, 39–43, 45–49	Not used

## MIP Interface Cable Pinouts

The MIP T1 interface cables have two, male, 15-pin DB connectors (one at each end) to connect the MIP with the external CSU. Table A-16 lists the pinouts for the null-modem T1 cable, and Table A-17 lists the pinouts for the straight-through T1 cable. Table A-18 lists the pinouts for the E1 interface cables.

**Table A-16 T1 Null-Modem Cable Signals**

15-Pin DB Connector		15-Pin DB Connector	
Signal	Pin	Pin	Signal
Tx tip <sup>1</sup>	1	3	Rx tip
Rx tip <sup>2</sup>	3	1	Tx tip
Tx ring	9	11	Rx tip
Rx tip	11	9	Tx ring

- 1. Tx = transmit.
- 2. Rx = receive.

**Table A-17 T1 Straight-Through Cable Signals**

15-Pin DB Connector		15-Pin DB Connector	
Signal	Pin	Pin	Signal
Tx tip <sup>1</sup>	1	1	Tx tip
Tx ring <sup>2</sup>	9	9	Tx ring
Rx tip	3	3	Rx tip
Rx tip	11	11	Rx tip

- 1. Tx = transmit.
- 2. Rx = receive.



**Table A-18 E1 Interface Cable Pinouts**

MIP End		Network End						
DB-15 <sup>1</sup>		BNC	DB-15		Twinax		RJ-45	
Pin	Signal <sup>2</sup>	Signal	Pin	Signal	Pin	Signal	Pin	Signal
9	Tx tip	Tx tip	1	Tx tip	Tx-1	Tx tip	1	Tx tip
2	Tx ring	Tx shield	9	Tx ring	Tx-2	Tx ring	2	Tx ring
10	Tx shield	–	2	Tx shield	Shield	Tx shield	3	Tx shield
8	Rx tip	Rx tip	3	Rx tip	Rx-1	Rx tip	4	Rx tip
15	Rx ring	Rx shield	11	Rx ring	Rx-2	Rx ring	5	Rx ring
7	Rx shield	–	4	Rx shield	Shield	Rx shield	6	Rx shield

1. Any pins not described in this table are not connected.

2. Tx = transmit. Rx = receive.



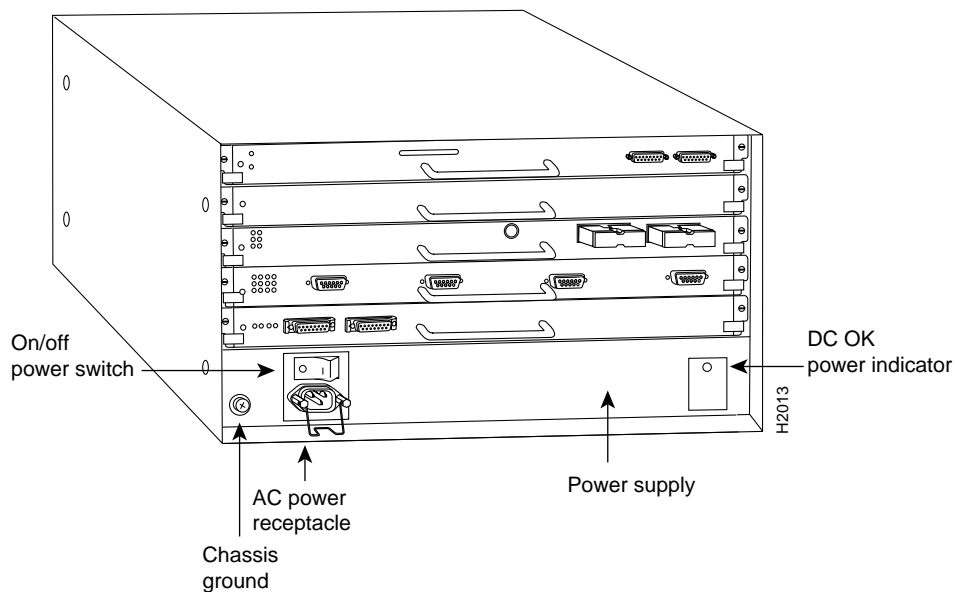
# Reading LED Indicators

This appendix provides a summary of all the LEDs (status indicators) used in the router. The LED on the interface processor end of the router and on the RP indicate the system power and processor status; LEDs on the rest of the interface processors indicate the status of the individual interface processor and its interfaces.

## DC OK LED

The DC OK LED, on the interface processor end of the AC-input and DC-input power supplies, goes on when the power supply is receiving AC or DC source power and providing DC power to the internal system components. The power supply monitors its own temperature and internal voltages. For a description of the power supply shutdown conditions and threshold status levels, refer to the section “Environmental Monitoring and Reporting Functions” in the chapter “Product Overview.”

**Figure B-1 DC OK LED—AC-Input Power Supply Shown**



## SP and SSP LEDs

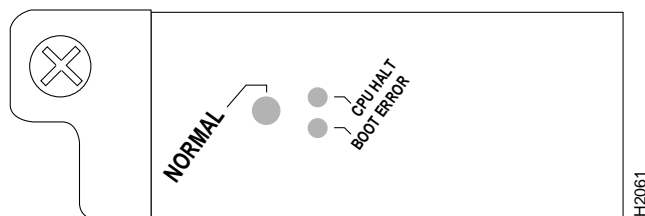
The SP and SSP have an enabled LED. The enabled LED goes on to indicate that the SP or SSP is operational and powered up. All enabled LEDs (on the SP, SSP, and interface processors) go on when the boot sequence is complete. If the enabled LEDs do not come on, one of the following errors is indicated:

- The SP or SSP or interface processor is not installed correctly (not fully seated in the backplane connector).
- The microcode and software that are loading at startup are not compatible.
- The SP or SSP or interface processor has failed.

## RP LEDs

The three LEDs on the RP, which are shown in Figure B-2, indicate the system and RP status. The normal LED goes on to indicate that the system is operational. During normal operation, the CPU halt and boot error LEDs on the RP should be off. When the system is turned on or restarted, the boot error LED goes on for one or two seconds, then goes off. The CPU halt LED, which goes on only if the system detects a processor hardware failure, should stay off. If the boot error LED stays on for more than 5 seconds, the system is unable to boot and should be restarted. A successful boot is indicated when the boot error LED goes out; however, this does not necessarily mean that the system has reached normal operation.

**Figure B-2 RP LEDs**



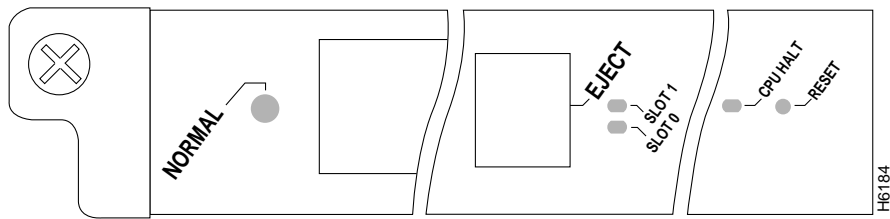
## RSP7000 LEDs

Figure B-3 shows the LEDs on the RSP7000 faceplate. The LEDs on the RSP7000 indicate the system and RSP7000 status and which Flash memory card slot is active. The CPU halt LED, which goes on only if the system detects a processor hardware failure, should remain off. A successful boot is indicated when the normal LED goes on; however, this does not necessarily mean that the system has reached normal operation. During normal operation, the CPU halt LED should be off, and the normal LED should be on. The slot 0 and slot 1 LEDs indicate which PCMCIA (Flash memory) card slot is in use, and each LED blinks when the card is accessed by the system.



**Caution** The reset switch resets the RSP7000 and the entire system. To prevent system errors and problems, use it *only* at the direction of your service representative.

**Figure B-3 RSP7000 LEDs**



## Interface Processor LEDs

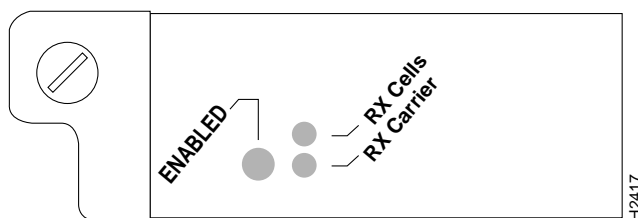
Each interface processor (except the RP, which is not really an interface processor) contains an enabled LED. When on, this LED indicates that the interface processor is operational and that it is powered up. It does not necessarily mean that the interface ports are functional or enabled. The following sections describe the LEDs for each interface processor. The SP has no LEDs other than the enabled LED to indicate that it is operational.

### AIP LEDs

The three LEDs above the ATM port (see Figure B-4) indicate the following:

- Enabled—When on, indicates that the AIP is enabled for operation; however, the interface ports might not be functional or enabled.
- RX cells —When on, indicates that the AIP has received an ATM cell. This LED will flicker in normal operation, indicating traffic.
- RX carrier —When on, indicates that the AIP has detected carrier on the RX cable. For a fiber-optic interface, this means simply that light is detected.

**Figure B-4** AIP LEDs



### CIP LEDs

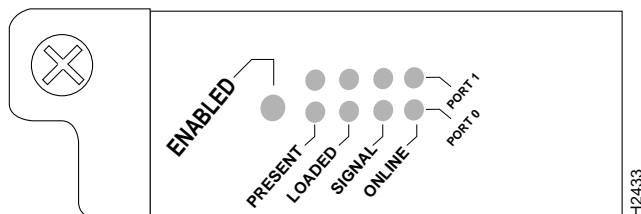
Following are the functions of the CIP LEDs. (See Figure B-5.)

- Enabled—Indicates that the CIP has been enabled for operation by the system.
- Present—Indicates that the adapter (ECA or PCA) has been detected by the CIP.
- Loaded—Indicates that the adapter (ECA or PCA) firmware has been completely loaded.
- Signal—For the ECA, this LED indicates that the Sync signal has been detected.

For the PCA, this LED indicates that the Operational Out signal has been detected. Note that even though a system reset and selective reset both cause the Operational Out signal to drop, the signal LED will still be on during those sequences.

- Online—For the ECA, this LED indicates that an establish-logical-path request has been received from the channel.  
For the PCA, this LED indicates that the PCA is ready to establish connection to the host channel.

**Figure B-5 CIP LEDs**



Following are the sequences for the CIP LED indicators. The enabled LED is not part of the following sequences. On cold boots, the following four LED sequences apply:

	<b>Present</b>	<b>Loaded</b>	<b>Signal</b>	<b>Online</b>
Port 1	On	On	Off	Off
Port 0	Off	Off	Off	Off

	<b>Present</b>	<b>Loaded</b>	<b>Signal</b>	<b>Online</b>
Port 1	On	On	On	On
Port 0	On	On	Off	Off

	<b>Present</b>	<b>Loaded</b>	<b>Signal</b>	<b>Online</b>
Port 1	On	On	On	On
Port 0	On	On	On	On

The following sequence indicates that the CIP is waiting for commands from the RP.

	<b>Present</b>	<b>Loaded</b>	<b>Signal</b>	<b>Online</b>
Port 1	Off	Off	Off	Off
Port 0	Off	Off	Off	Off

On warm boots, the LEDs flash briefly. On downloads, the following three LED sequences apply; the first indicates that the system is downloading volatile programmable logic device (VPLD) code:

	<b>Present</b>	<b>Loaded</b>	<b>Signal</b>	<b>Online</b>
Port 1	On	On	On	On
Port 0	On	On	On	Off

The following sequence indicates that the CIP is downloading microcode:

	<b>Present</b>	<b>Loaded</b>	<b>Signal</b>	<b>Online</b>
Port 1	Off	Off	Off	Off
Port 0	On	On	On	On

The following sequence indicates that the CIP is starting to execute the microcode:

	Present	Loaded	Signal	Online
Port 1	Off	Off	Off	Off
Port 0	Off	Off	Off	Off

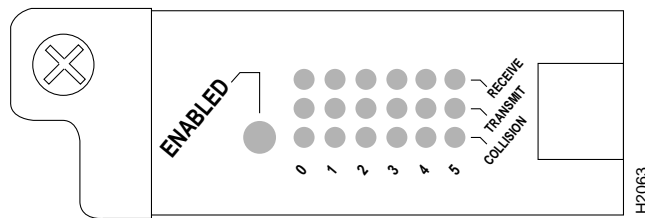
## EIP LEDs

The EIP contains a bank of 18 LEDs: one horizontal row of three LEDs for each of the six Ethernet interfaces, as shown in Figure B-6.

As with the other interface processors, the enabled LED goes on when the EIP is enabled for operation. Three LEDs for each port indicate the following:

- Collision—A frame collision has been detected.
- Transmit—Frames are being transmitted.
- Receive—Frames are being received.

**Figure B-6** EIP LEDs



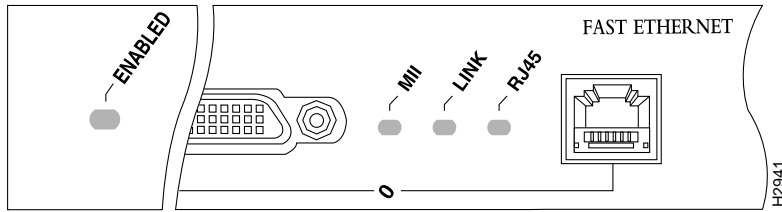
## FEIP LEDs

The FEIP contains the enabled LED, standard on all interface processors, and a bank of three status LEDs for the ports. After system initialization, the enabled LED goes on to indicate that the FEIP has been enabled for operation. (The LEDs are shown in Figure B-7.) The following conditions must be met before the enabled LED goes on:

- The FEIP is correctly connected to the backplane and receiving power.
- The FEIP contains a valid microcode version that has successfully been downloaded.
- The bus recognizes the FEIP.

If any of these conditions is not met, or if the initialization fails for other reasons, the enabled LED does not go on.

**Figure B-7** FEIP LEDs



A bank of three LEDs indicates the following:

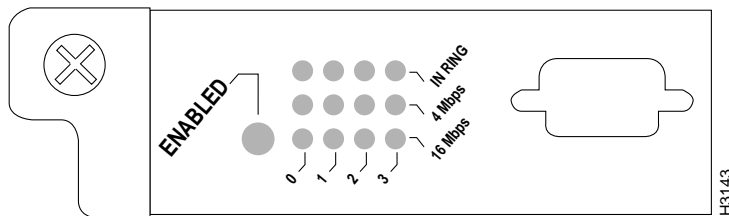
- MII—Lights when the MII port is selected as the active port by the controller.
- Link—Lights when the FEIP is receiving a carrier signal from the network.
- RJ-45—Lights when the RJ45 port is selected as the active port by the controller.

Either the MII LED *or* the RJ-45 LED should be on at one time; never both.

## TRIP LEDs

The TRIP LEDs are shown in Figure B-8. Each horizontal row of three LEDs, one for each Token Ring interface, indicates the speed (4 or 16 Mbps) of the interface and whether the interface is inserted into the ring.

**Figure B-8** TRIP LEDs



All TRIP interface processors, regardless of whether they provide two or four ports, contain the bank of LEDs shown in Figure B-8. As with the other interface processors, the enabled LED goes on when the TRIP is enabled for operation. Three LEDs for each port indicate the following:

- 16 Mbps—On when the interface is operating at 16 Mbps.
- 4 Mbps—On when the interface is operating at 4 Mbps.
- In Ring—When on, indicates that the interface is currently active and inserted into the ring. When off, indicates that the interface is not active and is not inserted into a ring.

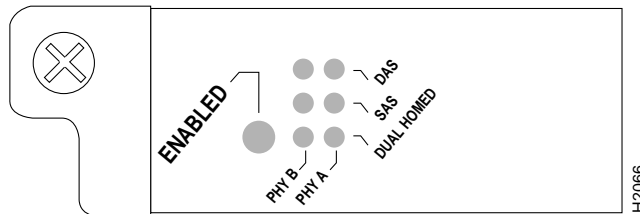
## FIP LEDs

The FIP LEDs are shown in Figure B-9. The LEDs on the left indicate the state of PHY B, and those on the right indicate the state of PHY A. (The PHY B interface is also to the left of the PHY A interface on the face of the FIP.) As with the other interface processors, the enabled LED goes on when the FIP is enabled for operation.



The state of each B/A pair of LEDs indicates the status of one type of three possible station connections: dual attachment station (DAS), single attachment station (SAS), or dual homed. The states of the FIP LED combinations, and the meanings of each are described and illustrated in Table B-1.

**Figure B-9 FIP LEDs**



**Table B-1 FIP LED States—Refer to Figure B-9**

LED Pattern <sup>1</sup>	State	Indication
B A	DAS	Both LEDs off means <i>not connected</i> .
- -	Both LEDs off	Not connected
X X		
X X		
O O	Both LEDs on	Through A
X X		
X X		
O -	B on and A off	Wrap B
X X		
X X		
- O	B off and A on	Wrap A
X X		
X X		
B A	SAS	
X X		
- -	Both LEDs off	Not connected
X X		
X X		Single attachment B (PHY A shut down)
O -	B on and A off	
X X		
X X		Single attachment A (PHY B shut down)
- O	B off and A on	
X X		
B A	Dual Homed	

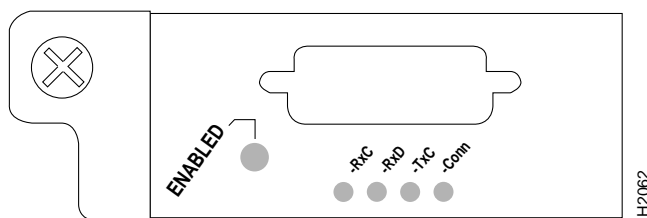
LED Pattern <sup>1</sup>	State	Indication
X X		Not connected
X X		
- -	Both B and A off	
X X		Dual homed with A active; not a normal condition; indicates potential problem on B
X O	Single attachment A on	
O O	plus both B and A on	
X X		Dual homed with B active, which is a normal condition
O X	Single attachment B on	
O O	plus both B and A on plus	
X X		Single attachment B, Dual homed A failed
O X	Single attachment B on	
O X	plus B on	
X X		Single attachment A, Dual homed B failed
X O	Single attachment A on	
X O	plus A on	

1. For the LED patterns, “-” means off, “O” means on, and “X” means does not apply.

## FSIP LEDs

The FSIP LEDs are shown in Figure B-10. As with the other interface processors, the enabled LED goes on when the FSIP is enabled for operation. However, unlike the LED cluster on other interface processors, the LEDs for each serial port are adjacent to the connector. Table B-2 lists descriptions of each LED.

**Figure B-10 FSIP LEDs**



The conn (connected) LED goes on when the interface is connected to the network. During normal operation, the three other LEDs go on to indicate data and timing signal traffic, or an idle pattern that is commonly sent across the line during idle time.

**Table B-2 FSIP LEDs**

LED	DTE Signal	DCE Signal
RxC	Receive clock (from DTE)	(TxC) Transmit clock (to DTE)
RxD	Receive data (from DTE)	(TxD) Transmit data (from DTE)
TxC	Send timing (from DCE)	(RxC) Receive timing (to DTE)

LED	DTE Signal	DCE Signal
Conn	Connected	Connected

The labels on each LED indicate the signal state when the FSIP port is in DTE mode. However, the direction of the signals is reversed when the FSIP port is in DCE mode. For example, a DCE device usually generates a clock signal, which it sends to the DTE device.

Therefore, when the Receive Clock (RxC) LED goes on, on a DTE interface, it indicates that the DTE is receiving the clock signal from the DCE device. However, when the RxC LED goes on, on a DCE interface, it indicates that the DCE is sending a clock signal (RxC) to the DTE device. Because of limited space on the FSIP faceplate, only DTE mode states are labeled on each port.

Figure B-11 shows the signal flow between a DTE and DCE device and the LEDs that correspond to signals for each mode. The following LED state descriptions include the meanings for both DTE and DCE interfaces.

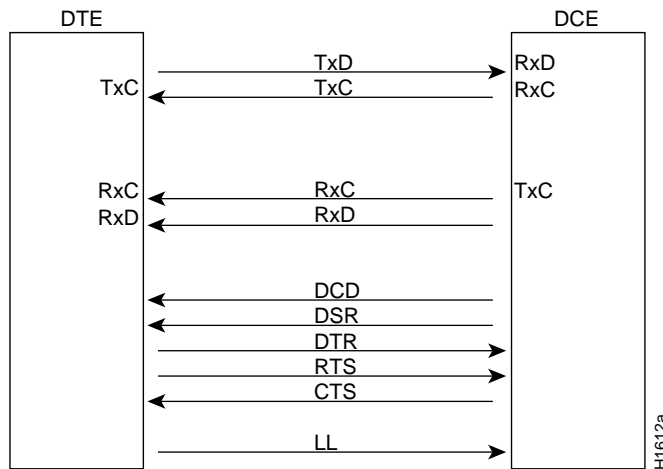
- RxC**— On DTE interfaces, this LED is on when the port is receiving a transmit clock signal (TxC) from the remote DCE device, which is usually a DSU or modem.

On DCE interfaces, this LED indicates TxC (Transmit Clock). This LED is on when the DCE port is sending a transmit clock (TxC) signal to the remote DTE device.
- RxD (Receive Data)**—On DTE interfaces, this LED is on when the port is receiving data signals (packets) from the network through the remote DCE device. This LED is also on when it detects an idle pattern that is commonly sent across the network during idle time.

On DCE interfaces, this LED indicates TxD (transmit data). During normal DCE operation, this LED is on when the DCE port is receiving data packets from the network through the remote DTE device.
- TxC (Transmit Clock)**—On DTE interfaces, this LED is on when the port is receiving the transmit clock signal from the remote DCE.

On DCE interfaces, this LED indicates receive clock (RxC). During normal DCE operation, this LED is on when the DCE port is *sending* the internal clock signal (which the FSIP generates) to the remote DTE device, which is usually a host, PC, or another router.
- Conn (connected or loopback)**—On both DTE and DCE interfaces, this LED is on to indicate normal operation: the FSIP is properly connected to the external device, and TA (DTE available) and CA (DCE available) are active. When this LED is off, the FSIP is in loopback mode or is not connected to the network or external device. (See Table B-2.)

**Figure B-11 DTE to DCE Signals**

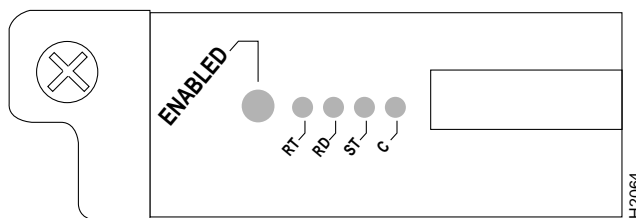


The default mode for all interface ports *without a port adapter cable attached* is DCE, although there is no default clockrate set on the interfaces. The DCE default allows you to perform local loopbacks without having to terminate the port or connect a cable. Because the serial adapter cables determine the mode and interface type, the FSIP port becomes a DTE when a DTE cable is connected to it. If a DTE cable is connected to a port with a clockrate set, the DTE will ignore the clockrate and use the external clock signal that is sent from the remote DCE.

## HIP LEDs

Four LEDs on the HIP indicate different states of the HSSI interface. As with the other interface processors, the enabled LED goes on when the HIP is enabled for operation. The four LEDs above the HSSI port (see Figure B-12) indicate the following.

**Figure B-12** HIP LEDs

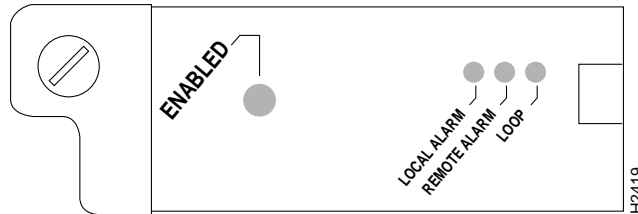


- **RT (Receive Timing)**—When on, indicates that the HIP has detected a Receive Clock signal. During normal operation, this signal is received from the external DSU. During loopback, this signal is generated internally.
- **RD (Receive Data)**—When on, indicates that the HIP has detected and is able to receive packets from the external DSU.
- **ST (Send Timing)**—When on, indicates that the HIP is transmitting a Transmit Clock signal to the external DSU. During normal operation, this signal is derived from the Receive Timing (RT) signal from the external DSU. During loopback, this signal is generated internally.
- **C (connected)**—When on, indicates normal operation; the HIP is properly connected to the external DSU, and TA (DTE available) and CA (DCE available) are active. When off, indicates that the HIP is in loopback mode or is not connected to the DSU.

## MIP LEDs

After system initialization, the enabled LED (shown in Figure B-13), which is present on all interface processors, turns on to indicate that the MIP has been enabled for operation.

**Figure B-13** MIP LEDs



The following conditions must be met before the MIP is enabled:

- The MIP contains a valid microcode version that has successfully been downloaded.
- The MIP is correctly connected to the backplane and receiving power.
- The CxBus recognizes the MIP card.

If any of these conditions is not met, or if the initialization fails for other reasons, the enabled LED does not turn on.

There are three LEDs associated with each MIP port that indicate alarm or loop conditions on that port. The three LEDs above each MIP port indicate the following:

- Local alarm—Indicates a loss of signal, a loss of frame, or unavailability due to excessive errors.
- Remote alarm—Indicates a remote alarm is received from the remote end due to a local alarm at the remote end.
- Loop—Indicates controller local loopback.



# Industry-Standard Wiring Plans

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When you install more than a few terminals, you face the problem of organizing the wiring. AT&T has devised for the telephone industry a uniform scheme for dealing with large numbers of wires. The scheme uses two color codes—one for large numbers of wires organized in pairs and the other for smaller numbers of wires which may also be organized in pairs. We recommend the use of this wiring scheme whenever possible.

For large numbers of wires, each pair is assigned a two-color code. The colors are selected from two groups of five, resulting in what is called a *binder-group* of 25 pairs. The colors used for a group are white, red, black, yellow, and violet. The colors used for “pair within group” are blue, orange, green, brown, and slate.

Each pair must have a unique color combination. One wire within each pair has a solid background of its group color and stripes of the “pair within group” color, and the second wire has the colors reversed. Table C-1 lists the sequences. Note that red-brown and red-orange wires can be easily confused.

**Table C-1 Telephone Industry 25-Pair Color Code and Pin Numbers**

Pair Number	Wire Number	Solid Color	Stripe Color	Pin Number
1	1	White	Blue	26
1	2	Blue	White	1
2	1	White	Orange	27
2	2	Orange	White	2
3	1	White	Green	28
3	2	Green	White	3
4	1	White	Brown	29
4	2	Brown	White	4
5	1	White	Slate	30
5	2	Slate	White	5
6	1	Red	Blue	31
6	2	Blue	Red	6
7	1	Red	Orange	32
7	2	Orange	Red	7
8	1	Red	Green	33
8	2	Green	Red	8

---

Pair Number	Wire Number	Solid Color	Stripe Color	Pin Number
9	1	Red	Brown	34
9	2	Brown	Red	9
10	1	Red	Slate	35
10	2	Slate	Red	10
11	1	Black	Blue	36
11	2	Blue	Black	11
12	1	Black	Orange	37
12	2	Orange	Black	12
13	1	Black	Green	38
13	2	Green	Black	13
14	1	Black	Brown	39
14	2	Brown	Black	14
15	1	Black	Slate	40
15	2	Slate	Black	15
16	1	Yellow	Blue	41
16	2	Blue	Yellow	16
17	1	Yellow	Orange	42
17	2	Orange	Yellow	17
18	1	Yellow	Green	43
18	2	Green	Yellow	18
19	1	Yellow	Brown	44
19	2	Brown	Yellow	19
20	1	Yellow	Slate	45
20	2	Slate	Yellow	20
21	1	Violet	Blue	46
21	2	Blue	Violet	21
22	1	Violet	Orange	47
22	2	Orange	Violet	22
23	1	Violet	Green	48
23	2	Green	Violet	23
24	1	Violet	Brown	49
24	2	Brown	Violet	24
25	1	Violet	Slate	50
25	2	Slate	Violet	25

Cables with more than 25 pairs of wires are constructed from 25-pair groups. Very large cables have other variations generally not encountered inside terminal wire plants.



For smaller numbers of wires, such as wires for an individual telephone station or terminal, you may use a second color code scheme. Table C-2 lists this color code and the usual correspondence with the paired-wire color code. The alternate color code is included because sometimes the station wire uses the first three pairs of the standard color code (white-blue, blue-white, and so on), while other times it uses the six alternate colored wires.

**Table C-2      Second Color Code Scheme for Smaller Numbers of Wires**

<b>Pair Number</b>	<b>Wire Number</b>	<b>Solid Color</b>	<b>Stripe Color</b>	<b>Alternate Color</b>	<b>Pin Number</b>
1	1	White	Blue	Green	4
1	2	Blue	White	Red	3
2	1	White	Orange	Black	2
2	2	Orange	White	Yellow	5
3	1	White	Green	White	1
3	2	Green	White	Blue	6



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  - See Ethernet network descriptions
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