CHAPTER 5

Maintaining the Router

This chapter provides maintenance procedures for the Cisco 7507 router and its spare parts. Your router is configured to your order and ready for installation and startup when it leaves the factory. 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 such as the system blower, arbiter board, and front panel components. Software and microcode component upgrades require specific part numbers and other frequently updated information; therefore, only basic replacement guidelines are included in this publication. Detailed, up-to-date instructions (called configuration notes) are shipped with the replacement parts and upgrade kits.

The replaceable system components fall into two categories: those that support online insertion and removal (OIR) and those that require you to shut down the system power before replacement. Redundant power supplies, interface processors, and the air filter support OIR and can be replaced while the system is operating.

Note RSP2s can be removed with the system power on, but to prevent crashing the system, they should not be removed while the system is operating.

You must turn off all power supplies before replacing the LED board or system blower. Access to them also requires that you remove the front panels to access the chassis interior, which exposes the power supply wiring and backplane.

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

Note If all power supplies are not shut down, the high current (100A) present in the wiring and on the front of the backplane becomes a hazard; therefore, always make sure that all power supply switches are turned off before removing the front chassis panels and exposing the chassis interior.

This chapter contains information on the following:

- RSP2 and interface processors installation and configuration (including general instructions for installing, replacing, upgrading, and reconfiguring the processor modules and associated components and, when necessary, instructions for using software configuration commands, and includes information on configuring the high system availability [HSA] feature)
- Power supply installation and replacement
- Air filter cleaning and replacement

- Internal chassis component replacement (instructions for removing the front chassis panels and replacing the system blower and LED board)

Configuring the RSP2

This section describes the following maintenance aspects of the RSP2:

- Installing and removing a Flash memory card
- Making changes to the software configuration register
- Replacing DRAM SIMMs

Installing and Removing a Flash Memory Card

It might become necessary for you to replace or install a Flash memory card in your RSP2. The RSP2 has two PCMCIA slots: Slot 0 (left) and Slot 1 (right). (See Figure 5-1 on the following page.) The following procedure is generic and can be used for a Flash memory card in either slot position.

Following is the procedure for installing and removing a Flash memory card:

Step 1 Connect an ESD-preventive strap between you and an unpainted chassis surface.

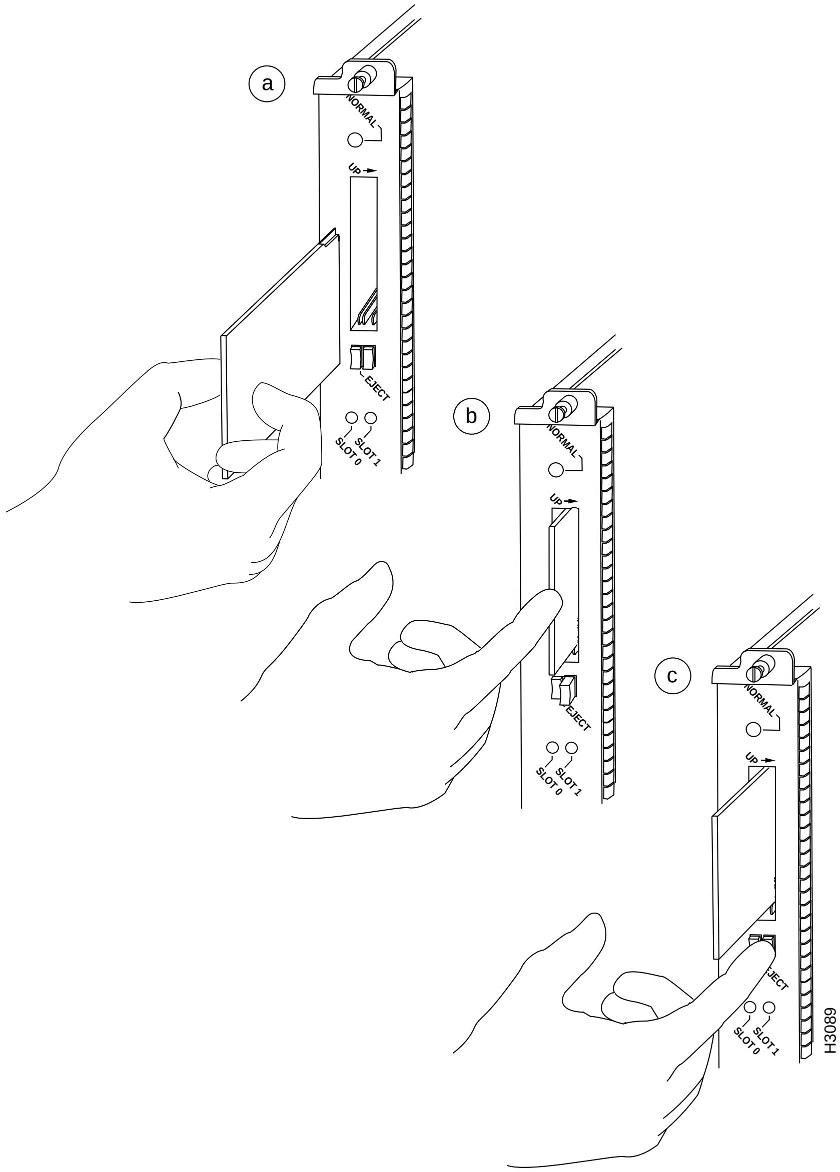
Step 2 Face the front panel of the RSP2 (which should appear as shown in Figure 5-1a), and hold the Flash memory card with the connector end toward the slot and the “Flash” label to the right, with the Flash memory card oriented as shown in Figure 5-1.

Step 3 Insert the card into the appropriate slot until the card completely seats in the connector at the back of the slot and the eject button pops out toward you (See Figure 5-1b.) Note that the card does not insert all the way inside the RSP2; a portion of the card will remain outside of the slot. Do *not* attempt to force the card past this point.

Step 4 To eject a card, press the appropriate ejector button. (See Figure 5-1c.)

Step 5 Remove the card from the slot and place it in an antistatic bag to protect it.

Figure 5-1 Installing and Removing a Flash Memory Card



Making Changes to the Software Configuration Register

This section describes the software (virtual) configuration register that is used with the RSP2.

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 memory
- Copying to Flash memory

Note Software configuration register setting changes take effect *only* after the system restarts.

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:

- 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 Flash memory.
- Enable booting from a Trivial File Transfer Protocol (TFTP) server.
- Recover a lost password.
- Allow you to manually boot the system using the **b** command at the bootstrap program prompt.
- Force the router to boot automatically from the system bootstrap software (boot image) or from its default system image in onboard 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 5-3.)

Table 5-1 lists the meaning of each of the software configuration memory bits, and Table 5-2 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 5-1. For example, the factory default value of 0x0101 is a combination of settings.

Table 5-1 Software Configuration Register Bit Meanings

Bit Number[1]	Hexadecimal	Meaning
00 to 03	0x0000 to 0x000F	Boot field (see Table 5-2)
06	0x0040	Causes system software to ignore NVRAM contents
07	0x0080	OEM bit enabled[2]
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 9600 baud)
13	0x2000	Boot default Flash 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 5-2.)
2. OEM = original equipment manufacturer.

Table 5-2 Explanation of Boot Field (Software Configuration Register Bits 00 to 03)

Boot Field	Meaning
00	Stays at the system bootstrap prompt
01	Boots the first system image in onboard Flash memory
02 to 0F	Specifies a default netboot filename Enables boot system commands that override the default netboot filename

Changing Settings

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# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
```

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 5-1) as in the following:

```
Router(config)# 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.

Bit Meanings

The lowest four bits of the software configuration register (bits 3, 2, 1, and 0) form the *boot field.* (See Table 5-2.) 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:

```
rommon1> b [tftp] flash filename
```

Definitions of the various **b** command options follow:

- **b—**Boots the default system software image from onboard Flash memory
- **b flash**—Boots the first file in onboard Flash memory
- **b slot0:** *filename*—Boots the file *filename* from the Flash memory card in PCMCIA Slot 0
- **b slot1:** *filename*—Boots the file *filename* from the Flash memory card in PCMCIA Slot 1
- **b** *filename [host]*—Netboots from server *host* using TFTP
- **b flash:** *[filename]*—Boots the file *filename* from onboard 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 5-3.)

In the following example, the software configuration register is set to boot the router from onboard Flash memory and to ignore Break at the next reboot of the router:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# config-register 0x102
Router(config)# boot system flash [filename]
Router(config)# ^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 5-3 lists the default boot filenames or actions for the processor.

Note A **boot system** configuration command in the router configuration in NVRAM overrides the default netboot filename.

Table 5-3 Default Boot Filenames

Action/File Name	Bit 3	Bit 2	Bit 1	Bit 0
Bootstrap mode	0	0	0	0
Default software	0	0	0	1
cisco2-RSP2	0	0	1	0
cisco3-RSP2	0	0	1	1
cisco4-RSP2	0	1	0	0
cisco5-RSP2	0	1	0	1
cisco6-RSP2	0	1	1	0
cisco7-RSP2	0	1	1	1
cisco10-RSP2	1	0	0	0
cisco11-RSP2	1	0	0	1
cisco12-RSP2	1	0	1	0
cisco13-RSP2	1	0	1	1
cisco14-RSP2	1	1	0	0
cisco15-RSP2	1	1	0	1
cisco16-RSP2	1	1	1	0
cisco17-RSP2	1	1	1	1

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 5-4 shows the combined effect of bits 10 and 14.

Table 5-4 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 5-5 shows the bit settings for the four available baud rates. (The factory-set default baud rate is 9600.)

Table 5-5 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 determines the server response to a bootload failure. Setting bit 13 causes the server to load operating software from Flash memory 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 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.

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 CNTL/Z.
Router(config)# boot system flash [device:filename]
```

To disable Break and enable the **boot system flash** command, enter the **config-register** command with the value shown in the following example:

```
Router(config)# config-reg 0x2102
Router(config)# ^Z
Router#
```

Copying to Flash Memory

Copying a new image to Flash memory might be required whenever a new image or maintenance release becomes available.

Use the command **copy tftp:***filename* [**bootflash** | **slot0** | **slot1**]:*filename* for the copy procedure, where **tftp:***filename* is the source of the file and [**bootflash** | **slot0** | **slot1**]:*filename* is the destination in onboard Flash memory or on either of the Flash memory cards.

An example of the **copy tftp:***filename* command follows:

```
Router# copy tftp:myfile1 slot0:myfile1
20575008 bytes available on device slot0, proceed? [confirm]
Address or name of remote host [1.1.1.1]?
Loading new.image from 1.1.1.1 (via Ethernet1/0): !!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!![OK - 7799951/15599616 bytes]
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Router#
```

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.

Following are additional commands related to the Flash memory on the RSP2 and on PCMCIA cards. (The following example assumes you are currently in PCMCIA slot 0.) You can determine which PCMCIA slot you are accessing using the **pwd** command as follows:

```
Router# pwd
slot0
```

You can move between Flash memory media using the **cd** [**bootflash** | **slot0** | **slot1**] command as follows:

```
Router# cd slot0
slot0
Router# cd slot1
Router# pwd
slot1
```

You can list the directory of any Flash memory media using the **dir** [**bootflash** | **slot0** | **slot1**] command as follows:

```
Router# dir
-#- -length- -----date/time------ name
1   4601977  May 19 1994 09:42:19 myfile1
6   679      May 19 1994 05:43:56 todays–config
7   1        May 19 1994 09:54:53 fun1
```

You can delete a file from any Flash memory media using the **delete** command as follows:

```
Router# delete slot0:fun1
Router# dir
-#- -length- -----date/time------ name
1   4601977  May 19 1994 09:42:19 myfile1
6   679      May 19 1994 05:43:56 todays–config
```

Files that are deleted are simply marked as deleted, but still occupy space in Flash memory. The **squeeze** command removes them permanently, and pushes all other undeleted files together to eliminate spaces between them.

Following is the syntax of the **squeeze** command:

```
Router# squeeze slot0:
All deleted files will be removed, proceed? [confirm]
Squeeze operation may take a while, proceed? [confirm]
ebESZ
```

To prevent loss of data due to sudden power loss, the "squeezed" data is temporarily saved to another location of Flash memory, which is specially used by the system.

In the previous command display output, the character "e" means this special location has been erased (which must be performed before any write operation). The character "b" means that the data that is about to be written to this special location has been temporarily copied. The character "E" signifies that the sector which was temporarily occupied by the data has been erased. The character "S" signifies that the data was written to its permanent location in Flash memory.

The **squeeze** command operation keeps a log of which of these functions has been performed so that on sudden power failure, it can come back to the right place and continue with the process. The character "Z" means this log was erased after the successful **squeeze** command operation.

The configuration register setting 0x2101 tells the system to boot the default image (the first image) from onboard Flash memory, but does *not* reset the Break disable or checking for a default netboot filename. The configuration register setting 0x2102 tells the system to boot from Flash memory if netboot fails, to disable Break, and to check for a default netboot filename. For more information on the **copy tftp:***filename* [**flash** | **slot0** | **slot1**]:*filename* command, and other related commands, refer to the set of router products configuration and command reference publications.

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.
- Change the configuration register to ignore NVRAM.

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 EXEC.
- Enter the **show startup-configuration** command to display the enable password.
- Change the configuration register value back to its original setting.

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. (To power cycle, turn off the router, 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:

```
rommon 1 >
```

Step 6 Set the configuration register to ignore the configuration file information as follows:

```
rommon 1 > confreg

       Configuration Summary
enabled are:
console baud: 9600
boot: image specified by the boot system command
      or default to : cisco2-RSP

do you wish to change the configuration? y/n [n]: y
enable “diagnostic mode”? y/n [n]:
enable “use net in IP bcast address”? y/n [n]:
enable “load rom after netbootfails”? y/n [n]:
enable “use all zero broadcast”? y/n [n]:
enable “break/abort has effect?” y/n [n]:
enable “ignore system config info?” [n]: y
change console baud rate? y/n [n]:
change boot characteristics? y/n [n]

       Configuration Summary
enabled are:
console baud: 9600
boot: image specified by the boot system command
      or default to : cisco2-RSP

do you wish to change the configuration? y/n [n]

You must reset or power cycle for the new config to take effect
```

Step 7 Initialize the router by entering the **i** command as follows:

```
rommon 1 > i
```

The router will power cycle, the configuration register will be set to ignore the configuration file, and the router will boot the boot 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 prompt appears as follows:

```
Router >
```

Step 10 Enter the **enable** command to enter the enabled mode. The prompt changes to the following:

```
Router #
```

Step 11 Enter the **show configuration** EXEC command to display the enable password in the configuration file.

Step 12 Enter the **configure terminal** command at the EXEC prompt. You are prompted as follows:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
```

Step 13 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 14 Exit the configuration mode by entering **Ctrl-Z**.

Step 15 Reboot the router and enable it using the recovered password.

Replacing SIMMs

The system DRAM resides on up to four single in-line memory modules (SIMMs) on the RSP2. The default DRAM configuration is 16 MB. This section provides the steps for increasing the amount of DRAM by replacing the SIMMs with SIMMs that you obtain from an approved vendor.

Note You must use SIMMs that you obtain from an approved vendor; otherwise, Cisco Systems cannot ensure proper operation. To ensure that you obtain the latest available product and vendor information, contact one of the sources listed in the section "Obtaining Technical Assistance" in the preface "About This Manual."

Although the SIMM specifications are defined in the manufacturers' part numbers, the SIMMs must meet the following requirements:

- DRAM SIMMs must be obtained from an approved vendor.
- Minimum speed is 60 nanoseconds (ns).
- Maximum height is one inch.

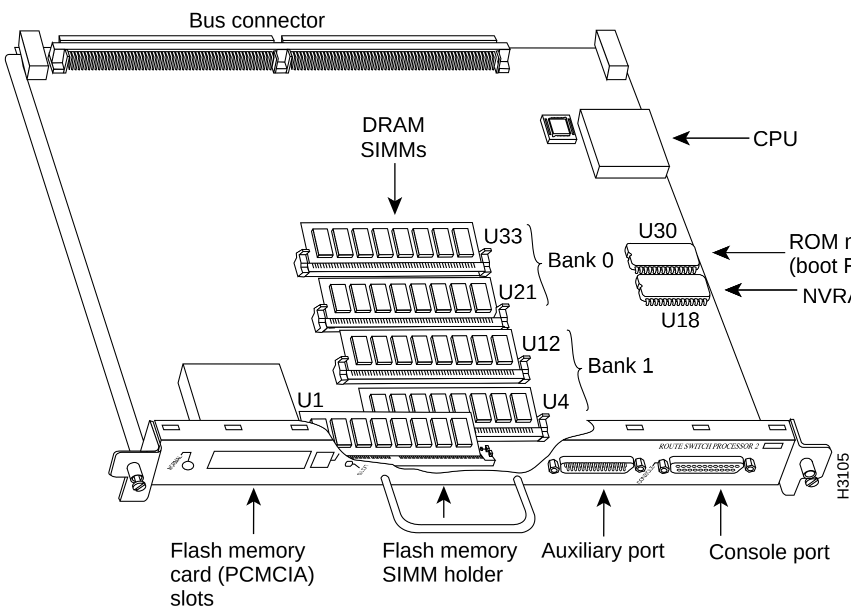
Parts and Tools Required

You need the following parts and tools to replace SIMMs. If you need additional equipment, contact a customer service representative for ordering information.

- Medium flat-blade and number 1 Phillips screwdriver to loosen the captive installation screws on the chassis cover and RSP2
- 60-ns, one-inch high SIMMs from an approved vendor
- ESD-preventive wrist strap and antistatic mat or pad for the removed RSP2

The DRAM SIMM sockets are U33 and U21 for Bank 0, and U12 and U4 for Bank 1. The default DRAM configuration is 16 MB (two 8-MB SIMMs in Bank 0). (See Figure 5-2.)

Figure 5-2 RSP2 DRAM SIMMs



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 RSP2. To be assured that you are using the correct SIMMs, refer to the specific part or product numbers indicated in the approved vendor list (AVL) on CIO and by your DRAM upgrade requirements.

Before proceeding, ensure that you have met the following prerequisites:

- You have the proper tools and ESD-prevention equipment available.
- You have two or four SIMMs of an approved type and speed that you obtained from an approved vendor.

To upgrade DRAM, you install SIMMs in one or both DRAM SIMM banks. Table 5-6 lists the various configurations of DRAM SIMMs that are available to you. This information is also available on CIO. Note which banks are used given the combinations of available SIMM sizes and the maximum DRAM you require. The onboard, default Flash memory is 8 MB.

Table 5-6 DRAM SIMM Configurations

DRAM Bank 0	Quantity	DRAM Bank 1	Quantity	Total	Product Names
U33 and U21	2, 8-MB SIMMs	U12 and U4	–	16 MB	MEM-RSP2-16M=
U33 and U21	2, 16-MB SIMMs	U12 and U4	–	32 MB	MEM-RSP2-32M=
U33 and U21	2, 32-MB SIMMs	U12 and U4	–	64 MB	MEM-RSP2-64M=
U33 and U21	2, 32-MB SIMMs	U12 and U4	2, 32-MB SIMMs	128 MB	MEM-RSP2-128M=

Caution To prevent DRAM errors, each DRAM bank *must* contain no less than two SIMMs of the same type. Also, you must install either two SIMMs in Bank 0 or four SIMMs in both banks. You should *not* install two SIMMs in Bank 1 with no SIMMs in Bank 0; Bank 0 must always contain two SIMMs.

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. 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. To channel ESD voltages to ground, ground the chassis.

Step 2 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 3 Disconnect the console and auxiliary cables from the RSP2.

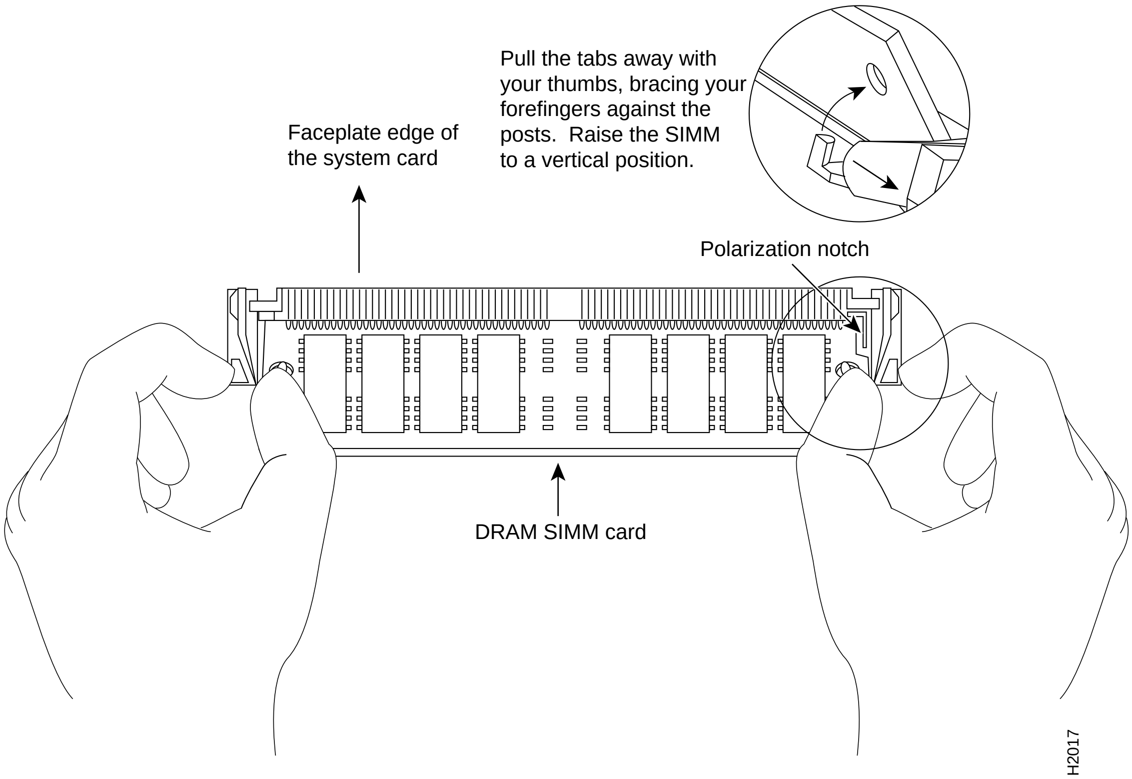
Step 4 Referring to Figure 5-12, loosen the captive installation screws on the RSP2, and remove it from the chassis.

Step 5 Place the RSP2 on an antistatic mat or pad, and ensure that you are wearing an antistatic device, such as a wrist strap. Position the RSP2 so that the handle is away from you, and the edge connector is toward you; this is the opposite of the position shown in Figure 5-2.

Step 6 Locate SIMMs. The DRAM SIMMs occupy U21 and U33 in Bank 0, and U12 and U4 in Bank 1. (See Figure 5-2.)

Step 7 Release the spring clips from the SIMM that you wish to remove, and release the SIMM from the socket. (See Figure 5-3.)

Figure 5-3 Releasing the SIMM Spring Clips



Step 8 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 9 Place the SIMM in an antistatic bag to protect it from ESD damage.

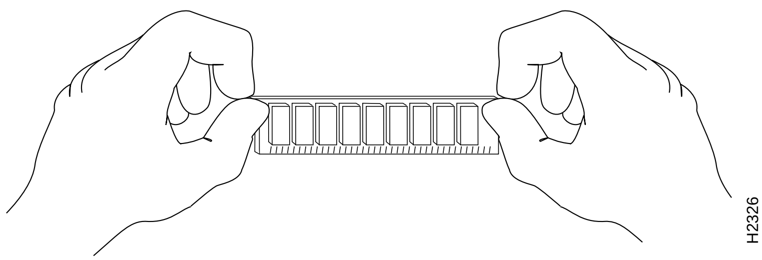
Step 10 Repeat Steps 7 through 9 for the remaining SIMMs as required for your upgrade.

This completes the SIMM removal procedure. Proceed to the next section to install the new SIMMs.

Installing 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 5-4.)

Figure 5-4 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 RSP2 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.

Caution To prevent DRAM errors, each DRAM bank *must* contain no less than two SIMMs of the same type. Also, you must install either two SIMMs in Bank 0 or four SIMMs in both banks. You should *not* install two SIMMs in Bank 1 with no SIMMs in Bank 0; Bank 0 must always contain two SIMMs.

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 5-4.)

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 RSP2 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.

To replace the RSP2 in the chassis, proceed to the section "Installing and Configuring Interface Processors" in this chapter and then restart the system for an installation check.

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 RSP2. 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 from the others, remove the SIMM and reinsert it. Then replace the RSP2 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 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.

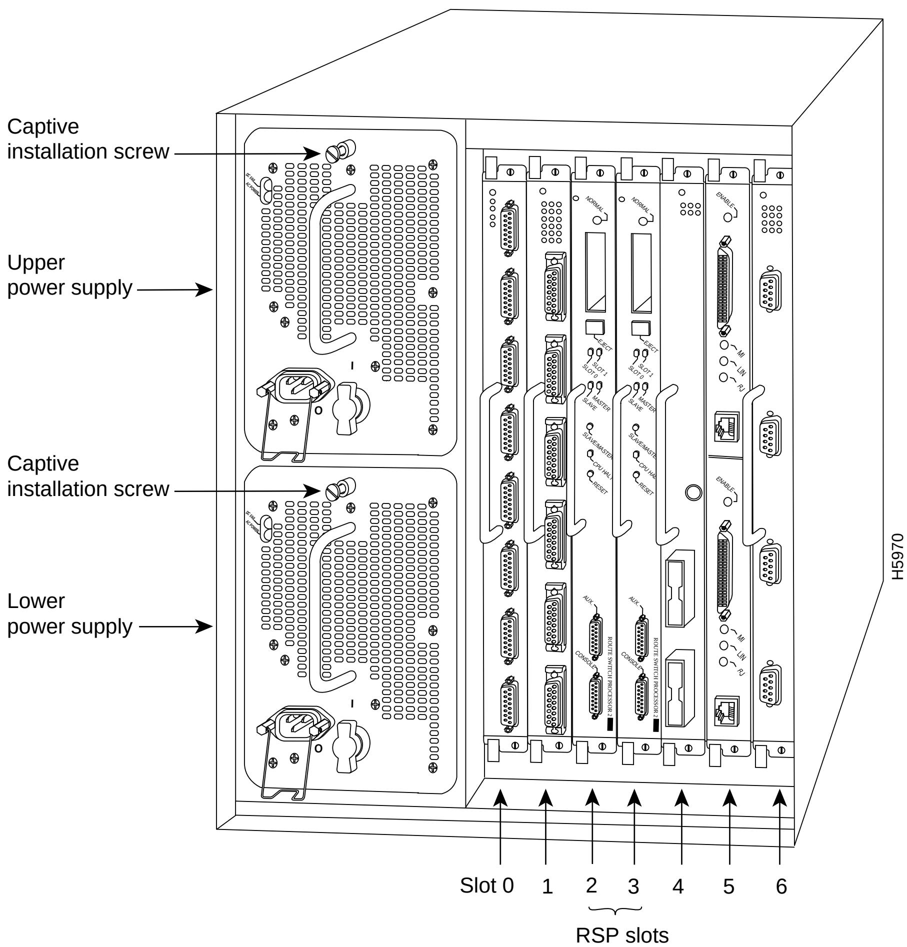
Note The time required for the system to initialize varies with different router configurations. Routers with 128 MB of DRAM will take longer to boot than those with 16 MB of DRAM.

Configuring the High System Availability (HSA) Feature

The RSP2 supports high system availability (HSA), which is a new feature in Cisco Internetwotk Operating System (Cisco IOS) Release 11.1(2) or later (or a Cisco-approved beta version of Release 11.1[2]), which allows two RSP2s to be used simultaneously in a Cisco 7507 router.

One RSP2 operates as system *master* and the other RSP2 operates as the system *slave*, which takes over if the master RSP2 fails. Figure 5-5 shows a Cisco 7507 with two RSP2s installed.

Figure 5-5 Cisco 7507 with Two RSP2s



The HSA feature requires that the boot read-only memory (ROM) device be updated to Version 11.1(2) or later. New RSP2s are shipping with this new boot ROM version; however, to check the boot ROM (*System Bootstrap*) version currently running on your RSP2, use the **show version** command and check the boot ROM's version number as follows:

```
Router# sh version
(display text omitted)
System Bootstrap, Version 11.1(2)
```

Caution To ensure that the slave RSP2 will operate properly with the full system configuration, should the master RSP2 ever fail, the slave RSP2 should have the same DRAM configuration as the master RSP2. In addition, removing the system master RSP2, while the system is operating, will cause the system to crash; however, the system *will* reload with the slave RSP2 as the new system master. To prevent any system problems, *do not* remove the system master RSP2 while the system is operating.

Using the Y-Cables for Console and Auxiliary Connections

For systems with two RSP2s installed (one as master and one as slave in RSP slots 6 and 7, using the HSA feature), you can simultaneously connect to both console or auxiliary ports using a special Y-cable. RSP2 defaults as the system masters if only one is installed. Figure 5-6 shows the console Y-cable and Figure 5-7 shows the auxiliary Y-cable.

Figure 5-6 Console Y-Cable

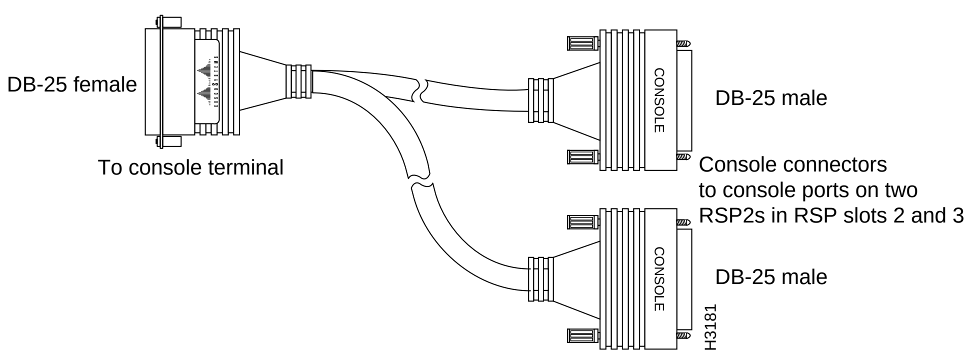
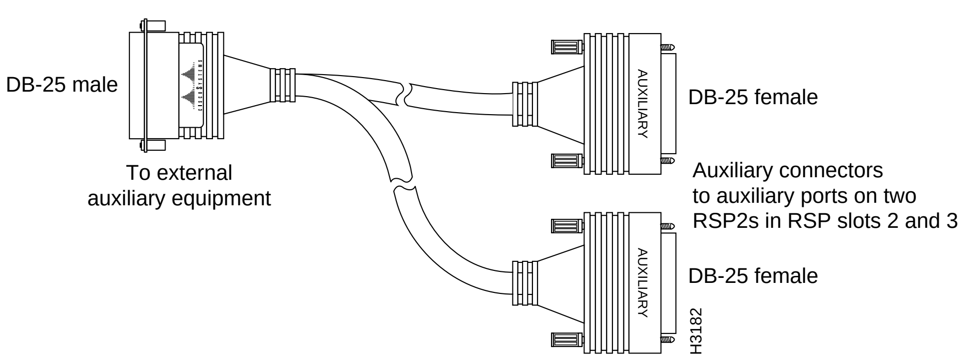


Figure 5-7 Auxiliary Y-Cable



Configuring HSA Operation

High system availability (HSA) (available with Cisco IOS Release 11.1[2] or later) refers to how quickly your router returns to an operational status after a failure occurs. You can install two RSP2 cards in a single router to improve system availability. For more complete HSA configuration information, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.

Two RSP2 cards in a router provide the most basic level of increased system availability through a "cold restart" feature. A "cold restart" means that when one RSP2 card fails, the other RSP2 card reboots the router. In this way, your router is never in a failed state for very long, thereby increasing system availability.

When one RSP2 card takes over operation from another, system operation is interrupted. Such a change is similar to issuing the **reload** command. The following events occur when one RSP2 card fails and the other takes over:

- The router stops passing traffic.
- Route information is lost.
- All connections are lost.
- The backup or "slave" RSP2 card becomes the active or "master" RSP2 card that reboots and runs the router. Thus, the slave has its own image and configuration file to be a complete router that can act as a single processor.

Note HSA does not impact performance in terms of packets per second or overall bandwidth. Additionally, HSA does not provide fault-tolerance or redundancy.

Master and Slave Operation

A router configured for HSA operation has one RSP2 card that is the master and one that is the slave. The master RSP2 card functions as if it were a single processor, controlling all functions of the router. The slave RSP2 card does nothing but actively monitor the master for failure. A system crash can cause the master RSP2 to fail or go into a nonfunctional state. When the slave RSP2 detects a nonfunctional master, the slave resets itself and takes part in *master-slave arbitration*. Master-slave arbitration is a ROM monitor process that determines which RSP2 card is the master and which is the slave upon startup (or reboot).

If a system crash causes the master RSP2 to fail, the slave RSP2 becomes the new master RSP2 and uses its own system image and configuration file to reboot the router. The failed RSP2 card (now the slave) remains inactive until you perform diagnostics, correct the problem, and then issue the **slave reload** command.

Caution To ensure that the slave RSP2 will operate properly with the full system configuration should the master RSP2 ever fail, the slave RSP2 should have the same DRAM configuration as the master RSP2.

With HSA operation, the following items are important to note:

- An RSP2 card that acts as the slave runs a different software version than it does when it acts as the master. The slave mode software is a subset of the master mode software.
- The two RSP2 cards do not have to run the same master software image and configuration file. When the slave reboots the system and becomes the new master, it uses its own system image and configuration file to reboot the router.
- When enabled, automatic synchronization mode automatically ensures that the master and slave RSP2 card have the same configuration file.
- Both hardware and software failures can cause the master RSP2 to enter a nonfunctional state; but, the system does not indicate the type of failure.
- The console is always connected to master. Thus, your view of the environment is always from the master's perspective.
- You must *not* remove the system master RSP2 while the system is operating; however, the system slave RSP2 can be removed while the system is operating.

Caution Removing the system master RSP2 while the system is operating will cause the system to crash; however, the system *will* reload with the slave RSP2 as the new system master. To prevent any system problems, *do not* remove the system master RSP2 while the system is operating.

Implementation Methods

There are two common ways to use HSA as follows:

- Simple hardware backup

  Use this method to protect against an RSP2 card failure. With this method, you configure both RSP2 cards with the same software image and configuration information. Also, you configure the router to automatically synchronize configuration information on both cards when changes occur.

- Software error protection

  Use this method to protect against critical Cisco IOS software errors in a particular release. With this method, you configure the RSP2 cards with different software images, but with the same configuration information.

You can also use HSA for advanced implementations. For example, you can configure the RSP2 cards with the following:

- Similar software versions, but different configuration files
- Different software images *and* different configuration files
- Widely varied configuration files (for example, various features or interfaces can be turned off/on per card)

Note While other, more complex uses are possible, the configuration information in this guide describes tasks for only the two common methods—simple hardware backup and software error protection.

HSA System Requirements

To configure HSA operation, you must have a Cisco 7507 containing two RSP2 processor cards and Cisco IOS Release 11.1(2) or later (or a Cisco-approved beta version of Release 11.1[2]). The slave RSP2 should have the same DRAM configuration as the master RSP2

Configure HSA Operation Task List

When configuring HSA operation, complete the tasks in the following sections. The first is required. Depending on the outcome of the first, the second or third is also required. The fourth is optional.

- "Determining the HSA Implementation Method to Use"
- "Configuring HSA for Simple Hardware Backup"
- "Configuring HSA for Software Error Protection"
- "Setting Environment Variables on the Master and Slave RSP2"

Determining the HSA Implementation Method to Use

Before you can configure HSA operation, you must first decide how you want to use HSA in your internetwork. Do you want to use HSA for simple hardware backup or for software error protection? If you are using new or experimental Cisco IOS software, consider using the software error protection method; otherwise, use the simple hardware backup method.

Once you have decided which method to use, proceed to either the ""Configuring HSA for Simple Hardware Backup"" section or the ""Configuring HSA for Software Error Protection"" section.

Configuring HSA for Simple Hardware Backup

With the simple hardware backup method, you configure both RSP2 cards with the same software image and configuration information. To configure HSA for simple hardware backup, perform the tasks in the following sections. The first is optional.

- "Specifying the Default Slave RSP2"
- "Ensuring That Both RSP2 Cards Contain the Same Images"
- "Ensuring That Both RSP2 Cards Contain the Same Configuration File"

Specifying the Default Slave RSP2

Because your view of the environment is always from the master RSP2's perspective, you define a default slave RSP2. The router uses the default slave information when booting:

- If a system boot is due to powering up the router or using the **reload** command, then the specified default slave will be the slave RSP2.
- If a system boot is due to a system crash or hardware failure, then the system ignores the default slave designation and makes the crashed or faulty RSP2 the slave RSP2.

To define the default slave RSP2, perform the following task, beginning in global configuration mode:

Tasks		Command
Step 1	Enter the configuration mode from the terminal.	**configure terminal**
Step 2	Define the default slave RSP2.	**slave default-slot** *processor-slot-number*
Step 3	Exit configuration mode.	**Ctrl-Z**
Step 4	Save this information to your startup configuration.	**copy running-config startup-config**

Upon the next system reboot, the above changes take effect (if both RSP2 cards are operational). Thus, the specified default slave becomes the slave RSP2 card. The other RSP2 card takes over mastership of the system and controls all functions of the router.

If you do not specifically define the default slave RSP2, the RSP2 card located in the higher number processor slot is the default slave. On the Cisco 7507, processor slot 3 contains the default slave RSP2.

The following example sets the default slave RSP2 to processor slot 3 on a Cisco 7507:

```
Router# configure terminal
Router (config)# slave default-slot 3
Ctrl-Z
Router# copy running-config startup-config
```

Ensuring That Both RSP2 Cards Contain the Same Images

To ensure that both RSP2 cards have the same system image, perform the following tasks in EXEC mode:

Tasks		Command
Step 1	Display the contents of the BOOT environment variable to learn the current booting parameters for the master and slave RSP2.	**show boot**
Step 2	Verify the location and version of the master RSP2 software image.	**dir** [**/all** | **/deleted**] [**/long**] {**bootflash** | **slot0** | **slot1**} [*filename*]
Step 3	Determine if the slave RSP2 contains the same software image in the same location.	**dir** [**/all** | **/deleted**] [**/long**] {**slavebootflash** | **slaveslot0** | **slaveslot1**} [*filename*]
Step 4	If the slave RSP2 does not contain the same system image in the same location, copy the master's system image to the appropriate slave location.	**copy** *file_id* {**slavebootflash** | **slaveslot0** | **slaveslot1**} Note that you might also have to use the **delete** and/or **squeeze** command in conjunction with the **copy** command to accomplish this step.

The following example ensures that both RSP2 cards have the same system image. Note that because no environment variables are set, the default environment variables are in effect for both the master and slave RSP2.

```
Router# show boot
BOOT variable =
CONFIG_FILE variable =
Current CONFIG_FILE variable =
BOOTLDR variable does not exist
Configuration register is 0x0

Slave auto-sync config mode is on

current slave is in slot 7
BOOT variable =
CONFIG_FILE variable =
BOOTLDR variable does not exist

Configuration register is 0x0

Router# dir slot0:
-#- -length- -----date/time------ name
1    3482498  May 4  1993 21:38:04 rsp-k-mz11.2

7993896 bytes available (1496 bytes used)

Router# dir slaveslot0:
-#- -length- -----date/time------ name
1    3482498  May 4  1993 21:38:04 rsp-k-mz11.1

7993896 bytes available (1496 bytes used)

Router# delete slaveslot0:rsp-k-mz11.1
Router# copy slot0:rsp-k-mz11.2 slaveslot0:rsp-k-mz11.2
```

To ensure that both RSP2 cards have the same microcode images, perform the following tasks beginning in privileged EXEC mode:

Tasks		Command
Step 1	Determine the microcode images used on the interface processors. If all interface processors are running from the bundled system microcode, no further action is required.	**show controller cbus**
Step 2	If any interface processors are running from the flash file system, verify the location and version of the master RSP2's supplementary microcode.	**dir** [**/all** | **/deleted**] [**/long**] {**bootflash** | **slot0** | **slot1**} [*filename*]
Step 3	Determine if the slave RSP2 contains the same microcode image in the same location.	**dir** [**/all** | **/deleted**] [**/long**] {**slavebootflash** | **slaveslot0** | **slaveslot1**} [*filename*]
Step 4	If the slave RSP2 does not contain the same microcode image in the same location, copy the master's microcode image to the appropriate slave location.	**copy** *file_id* {**slavebootflash** | **slaveslot0** | **slaveslot1**} Note that you might also have to use the **delete** and/or **squeeze** command in conjunction with the **copy** command to accomplish this step.

The following example ensures that both RSP2 cards have the same microcode image. Notice that slots 0, 1, 4, 9, and 10 load microcode from the bundled software, as noted by the *statement software loaded from system*. Slot 11, the FSIP processor, does not use the microcode bundled with the system. Instead, it loads the microcode from *slot0:pond/bath/rsp_fsip20-1*. Thus, you must ensure that the slave RSP2 has a copy of the same FSIP microcode in the same location.

```
Router# show controller cbus
MEMD at 40000000, 2097152 bytes (unused 416, recarves 3, lost 0)
  RawQ 48000100, ReturnQ 48000108, EventQ 48000110
  BufhdrQ 48000128 (2948 items), LovltrQ 48000140 (5 items, 1632 bytes)
  IpcbufQ 48000148 (16 items, 4096 bytes)
  3571 buffer headers (48002000 - 4800FF20)
  pool0: 28 buffers, 256 bytes, queue 48000130
  pool1: 237 buffers, 1536 bytes, queue 48000138
  pool2: 333 buffers, 4544 bytes, queue 48000150
  pool3: 4 buffers, 4576 bytes, queue 48000158
  slot0: EIP, hw 1.5, sw 20.00, ccb 5800FF30, cmdq 48000080, vps 4096
    software loaded from system
    Ethernet0/0, addr 0000.0ca3.cc00 (bia 0000.0ca3.cc00)
      gfreeq 48000138, lfreeq 48000160 (1536 bytes), throttled 0
      rxlo 4, rxhi 42, rxcurr 0, maxrxcurr 2
      txq 48000168, txacc 48000082 (value 27), txlimit 27
                       .........

  slot1: FIP, hw 2.9, sw 20.02, ccb 5800FF40, cmdq 48000088, vps 4096
    software loaded from system
    Fddi1/0, addr 0000.0ca3.cc20 (bia 0000.0ca3.cc20)
      gfreeq 48000150, lfreeq 480001C0 (4544 bytes), throttled 0
      rxlo 4, rxhi 165, rxcurr 0, maxrxcurr 0
      txq 480001C8, txacc 480000B2 (value 0), txlimit 95
  slot4: AIP, hw 1.3, sw 20.02, ccb 5800FF70, cmdq 480000A0, vps 8192
    software loaded from system
    ATM4/0, applique is SONET (155Mbps)
      gfreeq 48000150, lfreeq 480001D0 (4544 bytes), throttled 0
      rxlo 4, rxhi 165, rxcurr 0, maxrxcurr 0
      txq 480001D8, txacc 480000BA (value 0), txlimit 95
  slot9: MIP, hw 1.0, sw 20.02, ccb 5800FFC0, cmdq 480000C8, vps 8192
    software loaded from system
    T1 9/0, applique is Channelized T1
      gfreeq 48000138, lfreeq 480001E0 (1536 bytes), throttled 0
      rxlo 4, rxhi 42, rxcurr 0, maxrxcurr 0
      txq 480001E8, txacc 480000C2 (value 27), txlimit 27
                    .......

  slot10: TRIP, hw 1.1, sw 20.00, ccb 5800FFD0, cmdq 480000D0, vps 4096
    software loaded from system
    TokenRing10/0, addr 0000.0ca3.cd40 (bia 0000.0ca3.cd40)
      gfreeq 48000150, lfreeq 48000200 (4544 bytes), throttled 0
      rxlo 4, rxhi 165, rxcurr 1, maxrxcurr 1
      txq 48000208, txacc 480000D2 (value 95), txlimit 95
                   .........

  slot11: FSIP, hw 1.1, sw 20.01, ccb 5800FFE0, cmdq 480000D8, vps 8192
    software loaded from flash slot0:pond/bath/rsp_fsip20-1
    Serial11/0, applique is Universal (cable unattached)
      gfreeq 48000138, lfreeq 48000240 (1536 bytes), throttled 0
      rxlo 4, rxhi 42, rxcurr 0, maxrxcurr 0
      txq 48000248, txacc 480000F2 (value 5), txlimit 27
                  ...........
```

```
Router# dir slot0:pond/bath/rsp_fsip20-1
-#- -length- -----date/time------ name
3   10242    Jan 01 1995 03:46:31 pond/bath/rsp_fsip20-1

Router# dir slaveslot0:pond/bath/rsp_fsip20-1
No such file

4079832 bytes available (3915560 bytes used)

Router# copy slot0:pond/bath/rsp_fsip20-1 slaveslot0:
4079704 bytes available on device slaveslot0, proceed? [confirm]

Router# dir slaveslot0:pond/bath/rsp_fsip20-1
-#- -length- -----date/time------ name
3   10242    Mar 01 1993 02:35:04 pond/bath/rsp_fsip20-1

4069460 bytes available (3925932 bytes used)
Router#
```

Ensuring That Both RSP2 Cards Contain the Same Configuration File

With the simple hardware backup and software error protection implementation methods, you always want your master and slave configuration files to match. To ensure that they match, turn on automatic synchronization. In automatic synchronization mode, the master copies its startup configuration to the slave's startup configuration when you issue a **copy** command that specifies the master's startup configuration (**startup-config**) as the target.

Automatic synchronization mode is on by default; however, to turn it on manually, perform the following tasks, beginning in global configuration mode:

Tasks		Command
Step 1	Enter the configuration mode from the terminal.	**configure terminal**
Step 2	Turn on automatic synchronization mode.	**slave auto-sync config**
Step 3	Exit configuration mode.	**Ctrl-Z**
Step 4	Save this information to your startup configuration and copy the configuration to the slave's startup configuration.	**copy running-config startup-config**

The following example turns on automatic configuration file synchronization:

```
Router# configure terminal
Router (config)# slave auto-sync config
Ctrl-Z
Router# copy running-config startup-config
```

Configuring HSA for Software Error Protection

With the software error protection method, you configure the RSP2 cards with different software images, but with the same configuration information. To configure HSA for software error protection, perform the tasks in the following sections. The first is optional.

- "Specifying the Default Slave RSP2" (in the previous section ""Configuring HSA for Simple Hardware Backup".")
- "Ensuring That Both RSP2 Cards Contain the Same Configuration File" (in the previous section ""Configuring HSA for Simple Hardware Backup".")
- "Specifying Different Startup Images for the Master and Slave RSP2" (which follows)

Specifying Different Startup Images for the Master and Slave RSP2

When the factory sends you a new Cisco 7507 with two RSP2s, you receive the same system image on both RSP2 cards. For the software error protection method, you need two different software images on the RSP2 cards. Thus, you copy a desired image to the master RSP2 card and modify the boot system commands to reflect booting two different system images. Each RSP2 card uses its own image to boot the router when it becomes the master.

To specify different startup images for the master and slave RSP2, perform the following tasks, beginning in EXEC mode:

Tasks		Command
Step 1	Verify the location and version of the master RSP2 software image.	**dir** [**/all** | **/deleted**] [**/long**] {**bootflash** | **slot0** | **slot1**} [*filename*]
Step 2	Determine if the slave RSP2 contains the same software image in the same location.	**dir** [**/all** | **/deleted**] [**/long**] {**slavebootflash** | **slaveslot0** | **slaveslot1**} [*filename*]
Step 3	Copy a different system image to the master RSP2.	**copy** *file_id* {**bootflash** | **slot0** | **slot1**} **copy flash** {**bootflash** | **slot0** | **slot1**} **copy rcp** {**bootflash** | **slot0** | **slot1**} **copy tftp** {**bootflash** | **slot0** | **slot1**}
Step 4	Enter configuration mode from the terminal.	**configure terminal**
Step 5	From global configuration mode, configure the master RSP2 to boot the new image from the appropriate location.	**boot system flash bootflash:**[*filename*] **boot system flash slot0:**[*filename*] **boot system flash slot1:**[*filename*]
Step 6	Also, add a **boot system** command that specifies the slave's boot image and location. This is the boot image that the slave uses when it becomes the master RSP2 and boots the system. Note that because the slave will boot this image when the slave is actually the new master RSP2, the command syntax does not use a "**slave**" prefix.	**boot system flash bootflash:**[*filename*] **boot system flash slot0:**[*filename*] **boot system flash slot1:**[*filename*]
Step 7	Configure the master RSP2 to boot from a network server.	**boot system** [**rcp** | **tftp**] *filename* [*ip-address*]
Step 8	Set the configuration register to enable loading of the system image from a network server or Flash.	**config-register** *value* [1]
Step 9	Exit configuration mode.	**Ctrl-Z**
Step 10	Save the configuration file to the master's startup configuration. Because automatic synchronization is turned on, this step saves the **boot system** commands to the master and slave startup configuration.	**copy running-config startup-config**
Step 11	Reset the router with the new configuration information.	**reload**

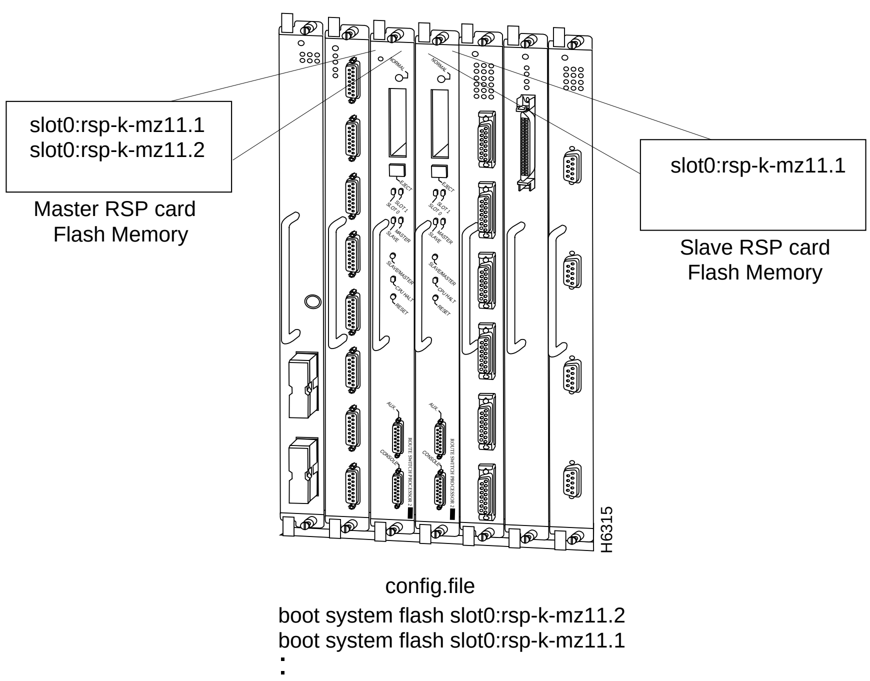
1. Refer to the "Software Configuration Register Settings" section for more information on systems that can use this command to modify the software configuration register.

In the following example scenario, assume the following:

- The master RSP2 is in processor slot 2 and the slave RSP2 is in processor slot 3 of a Cisco 7507.
- The system has the same image, *rsp-k-mz11.1*, in PCMCIA slot 0 of both the master and slave RSP2 card.
- You want to upgrade to Cisco IOS Release 11.2, but you want to guard against software failures. So, you must configure HSA operation for software error protection.

Figure 5-8 illustrates the software error protection configuration for this example scenario. The configuration commands for this configuration follow the figure.

Figure 5-8 Software Error Protection: Upgrading to a New Software Version



Because you always view the environment from the master RSP2's perspective, in the following command you view the master's slot 0 to verify the location and version of the master's software image:

```
Router# dir slot0:
-#- -length- -----date/time------ name
1    3482496  May 4  1993 21:38:04 rsp-k-mz11.1

7993896 bytes available (1496 bytes used)
```

Now view the slave's software image location and version:

```
Router# dir slaveslot0:
-#- -length- -----date/time------ name
1    3482496  May 4  1993 21:38:04 rsp-k-mz11.1

7993896 bytes available (1496 bytes used)
```

Because you want to run the Release 11.2 system image on one RSP2 card and the Release 11.1 system image on the other RSP2 card, copy the Release 11.2 system image to the master's slot 0:

```
Router# copy tftp slot0:rsp-k-mz11.2
```

Enter global configuration mode and configure the system to boot first from a Release 11.2 system image and then from a Release 11.1 system image.

```
Router# configure terminal
Router (config)# boot system flash slot0:rsp-k-mz11.1.2
Router (config)# boot system flash slot0:rsp-k-mz11.1
```

With this configuration, when the slot 6 RSP2 card is master, it looks first in its PCMCIA slot 0 for the system image file *rsp-k-mz11.2* to boot. Finding this file, the router boots from that system image. When the slot 7 RSP2 card is master, it also looks first in its slot 0 for the system image file *rsp-k-mz11.2* to boot. Because that image does not exist in that location, the slot 7 RSP2 card looks for the system image file *rsp-k-mz11.1* in slot 0 to boot. Finding this file in its PCMCIA slot 0, the router boots from that system image. In this way, each RSP2 card can reboot the system using its own system image when it becomes the master RSP2 card.

Configure the system further with a fault-tolerant booting strategy:

```
Router (config)# boot system tftp rsp-k-mz11.1 192.37.1.25
```

Set the configuration register to enable loading of the system image from a network server or from Flash and save the changes to the master and slave startup configuration file:

```
Router (config)# config-register 0x010F
Ctrl-Z
Router# copy running-config startup-config
```

Reload the system so that the master RSP2 uses the new Release 11.2 system image:

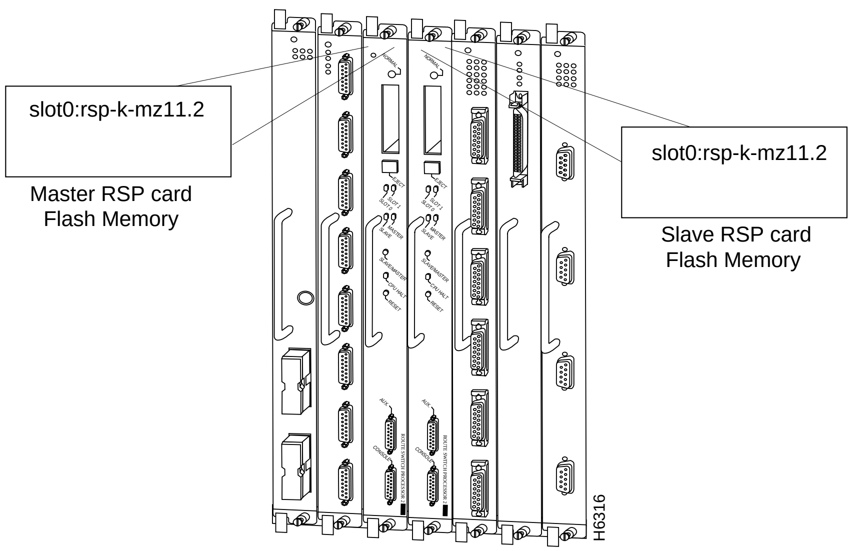
```
Router# reload
```

In the following example scenario, assume the following:

- The master RSP2 is in processor slot 2, and the slave RSP2 is in processor slot 3 of a Cisco 7507.
- The system has the same image, *rsp-k-mz11.2*, in PCMCIA slot 0 of both the master and slave RSP2 card.
- You want to use to Cisco IOS Release 11.1 as backup to guard against software failures. So, you configure HSA operation for software error protection.

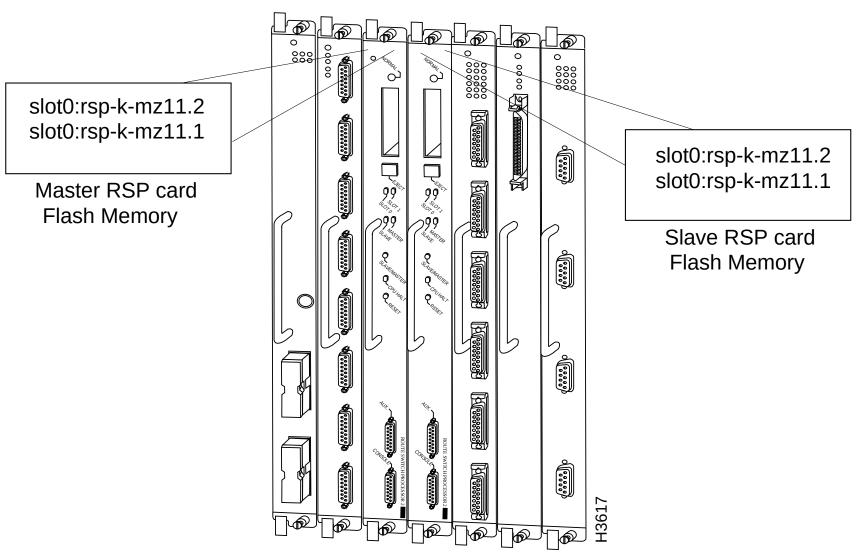
In this scenario, you begin with the configuration shown in Figure 5-9.

Figure 5-9 Software Error Protection: Backing Up with an Older Software Version, Part I



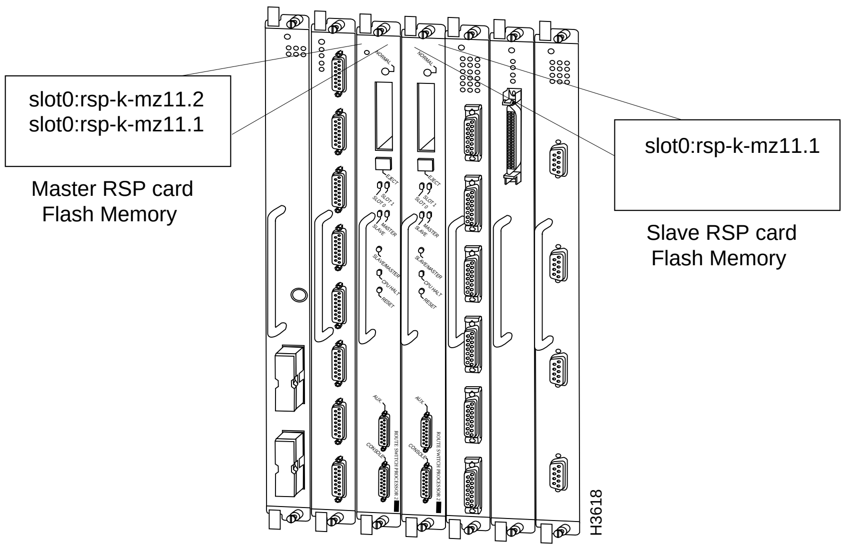
Next, you copy the *rsp-k-mz11.1* image to the master and slave RSP2 card, as shown in Figure 5-10.

Figure 5-10 Software Error Protection: Backing Up with an Older Software Version, Part II



Last, delete the *rsp-k-mz11.2* image from the slave RSP2 card as shown in Figure 5-11.

Figure 5-11 Software Error Protection: Backing Up with an Older Software Version, Part III



The following commands configure software error protection for this example scenario.

View the master and slave slot 0 to verify the location and version of their software images:

```
Router# dir slot0:
-#- -length- -----date/time------ name
1    3482498  May 4  1993 21:38:04 rsp-k-mz11.2

7993896 bytes available (1496 bytes used)

Router# dir slaveslot0:
-#- -length- -----date/time------ name
1    3482498  May 4  1993 21:38:04 rsp-k-mz11.2

7993896 bytes available (1496 bytes used)
```

Copy the Release 11.1 system image to the master and slave slot 0:

```
Router# copy tftp slot0:rsp-k-mz11.1
Router# copy tftp slaveslot0:rsp-k-mz11.1
```

Delete the *rsp-k-mz11.2* image from the slave RSP2 card:

```
Router# delete slaveslot0:rsp-k-mz11.2
```

Configure the system to boot first from a Release 11.2 system image and then from a Release 11.1 system image.

```
Router# configure terminal
Router (config)# boot system flash slot0:rsp-k-mz11.2
Router (config)# boot system flash slot0:rsp-k-mz11.1
```

Configure the system further with a fault-tolerant booting strategy:

```
Router(config)# boot system tftp rsp-k-mz11.1 192.37.1.25
```

Set the configuration register to enable loading of the system image from a network server or from Flash and save the changes to the master and slave startup configuration file:

```
Router(config)# config-register 0x010F
Ctrl-z
Router# copy running-config startup-config
```

Note You do not need to reload the router in this example, because the router is currently running the Release 11.2 image.

Setting Environment Variables on the Master and Slave RSP2

You can optionally set environment variables on both RSP2 cards in a Cisco 7507.

Note When configuring HSA operation, Cisco recommends that you use the default environment variables. If you do change the variables, Cisco recommends setting the same device for equivalent environment variables on each RSP2 card. For example, if you set one RSP2 card's CONFIG_FILE environment variable device to NVRAM, then set the other RSP2 card's CONFIG_FILE environment variable device to NVRAM also.

You set environment variables on the master RSP2 just as you would if it were the only RSP2 card in the system. You can set the same environment variables on the slave RSP2 card, manually or automatically.

The following sections describe these two methods:

- "Manually Setting Environment Variables on the Slave RSP2"
- "Automatically Setting Environment Variables on the Slave RSP2"

For more complete configuration information on how to set environment variables, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.

Manually Setting Environment Variables on the Slave RSP2

Once you set the master's environment variables, you can manually set the same environment variables on the slave RSP2 card using the **slave sync config** command.

To manually set environment variables on the slave RSP2, perform the following steps beginning in global configuration mode:

Tasks		Command
Step 1	Set the master's environment variables. For more complete HSA configuration information, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.	**boot system** **boot bootldr** **boot config**
Step 2	Save the settings to the startup configuration. This also puts the information under that RSP2 card's ROM monitor control.	**copy running-config startup-config**
Step 3	Save the same environment variables to the slave RSP2 by manually synchronizing their configuration files.	**slave sync config**
Step 4	Verify the environment variable settings.	**show boot**

Automatically Setting Environment Variables on the Slave RSP2

With automatic synchronization turned on, the system automatically saves the same environment variables to the slave's startup configuration when you set the master's environment variables and save them.

Note Automatic synchronization mode is on by default.

To set environment variables on the slave RSP2 when automatic synchronization is on, perform the following steps beginning in global configuration mode:

Tasks		Command
Step 1	Set the master's environment variables. For more complete HSA configuration information, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.	**boot system** **boot bootldr** **boot config**
Step 2	Save the settings to the startup configuration. This also puts the information under that RSP2 card's ROM monitor control.	**copy running-config startup-config**
Step 3	Verify the environment variable settings.	**show boot**

Monitoring and Maintaining HSA Operation

To monitor and maintain HSA operation, you can override the slave image that is bundled with the master image. To do so, perform the following task in global configuration mode:

Tasks	Command
Specify which image the slave runs.	**slave image** {**system** | *device***:***filename*}

You can manually synchronize configuration files and ROM monitor environment variables on the master and slave RSP2 card. To do so, perform the following task in privileged EXEC mode:

Tasks	Command
Manually synchronize master and slave configuration files.	**slave sync config**

Caution When you install a second RSP2 card for the first time, you *must* immediately configure it using the **slave sync config** command. This ensures that the new slave is configured consistently with the master. Failure to do so may result in an unconfigured slave RSP2 card taking over mastership of the router when the master fails, rendering the network inoperable.

The **slave sync config** command is also a useful tool for more advanced implementation methods not discussed in this document. Refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.

Verifying HSA Operation

Following are the steps required to verify HSA operation:

Step 1 With HSA configured, verify that the console terminal displays the system banner and startup screen as the system restarts. The master console display should look similar to the following (note the RSP2 slots indicated):

```
System Bootstrap, Version 11.1(2), RELEASED SOFTWARE
Copyright (c) 1986-1996 by cisco Systems, Inc.
SLOT 2 RSP2 is system master
SLOT 3 RSP2 is system slave
RSP2 processor with 16384 Kbytes of main memory

[additional displayed text omitted from this example]

Cisco Internetwork Operating System Software
IOS (tm) GS Software (RSP-K-M), Version 11.1(2) [biff 51096]
Copyright (c) 1986-1996 by cisco Systems, Inc.
Compiled Mon 22-Jan-96 21:15 by biff
Image text-base: 0x600108A0, data-base: 0x607B8000

cisco RSP2 (R4600) processor with 16384K bytes of memory.
R4600 processor, Implementation 32, Revision 2.0

[additional displayed text omitted from this example]

8192K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
8192K bytes of Flash internal SIMM (Sector size 256K).
Slave in slot 3 is halted.

[additional displayed text omitted from this example]
```

Step 2 After the system boots the software and initializes the interface processors (approximately 30 seconds for systems with 16 MB of DRAM, and approximately 2 minutes for systems with 64 MB of DRAM), verify that the RSP2 LEDs are in the following states:

- RSP2 normal LED is on (for each RSP2 installed)
- CPU halt LED is off (for each RSP2 installed)
- Master RSP2's master LED is on (if HSA is configured)
- Slave RSP2's slave LED is on (if HSA is configured)

Step 3 Verify that all the enabled LEDs (on the interface processors) are on.

Step 4 Use the **show version** command to verify that the slave RSP2 is recognized by the system. Following is a sample:

```
Router> show version
Cisco Internetwork Operating System Software
IOS (tm) GS Software (RSP-K-M), Version 11.1(2) [biff 51096]
Copyright (c) 1986-1996 by cisco Systems, Inc.
Compiled Mon 22-Jan-96 21:15 by biff
Image text-base: 0x600108A0, data-base: 0x607B8000

[additional displayed text omitted from this example]

Slave in slot 3 is running Cisco Internetwork Operating System Software

(Note that this could also be "slot 6" depending on which RSP2 is configured as the
slave or the recent crash history of your router.)

IOS (tm) GS Software (RSP-DW-M), Version 11.1(2) [biff 51096]
Copyright (c) 1986-1996 by cisco Systems, Inc.
Compiled Mon 22-Jan-96 20:59 by biff

Configuration register is 0xF

Router>
```

When you have verified all the conditions in Steps 1 through 4, the installation is complete.

Troubleshooting a Failed RSP2

When a new master RSP2 takes over mastership of the router, it automatically reboots the failed RSP2 as the slave RSP2. You can access the state of the failed RSP2 in the form of a stack trace from the master console using the **show stacks** command.

You can also manually reload a failed RSP2 from the master console. To do so, perform the following task from global configuration mode:

Tasks	Command
Reload the inactive slave RSP card.	**slave reload**

You can also display information about both the master and slave RSP2s. To do so, perform any of the following tasks from EXEC mode:

Tasks	Command
Display the environment variable settings and configuration register settings for both the master and slave RSP cards.	**show boot**
Show a list of flash devices currently supported on the router.	**show flash devices**
Display the software version running on the master and slave RSP card.	**show version**
Display the stack trace and version information of the master and slave RSP cards.	**show stacks** [1]

1. This command is documented in the "System Management Commands" chapter of the *Configuration Fundamentals Command Reference* publication.

Installing and Configuring Interface Processors

All interface processors support online insertion and removal (OIR), which allows you to install, remove, replace, and rearrange the interface processors without turning off the system power. (This feature is not supported for the RSP2 because they are required for system operation.) 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. This section provides installation and removal procedure for all interface processors.

This section also includes instructions for replacing spare parts on the chassis and interface processors, and for using basic configuration commands that you may need when setting up new interfaces.

An EPROM component on 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. However, the replacement procedures are included in this section in case replacement is necessary for some unforeseen reason.

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.

Note Before removing or replacing interface processors, refer to the section “Online Insertion and Removal (OIR)” in the chapter “Product Overview.”

Caution Before performing any procedures in this chapter, review the section “Safety Recommendations” in the chapter “Preparing for Installation.”

Note Following are detailed steps for removing and replacing interface processors and successfully performing OIR. Figure 5-12 shows the functional details of the ejector levers, which you must use when inserting or removing processor modules. Refer to Figure 5-12 as you remove and replace processor modules.

Tools Required

You will need a number 1 Phillips or 3/16-inch flat-blade screwdriver to remove any filler (blank) interface processors and to tighten the captive installation screws that secure the interface processor in its slot. (Most systems use Phillips screws, but early systems used slotted screws.) Whenever you handle interface processors, you should use a wrist strap or other grounding device to prevent ESD damage.

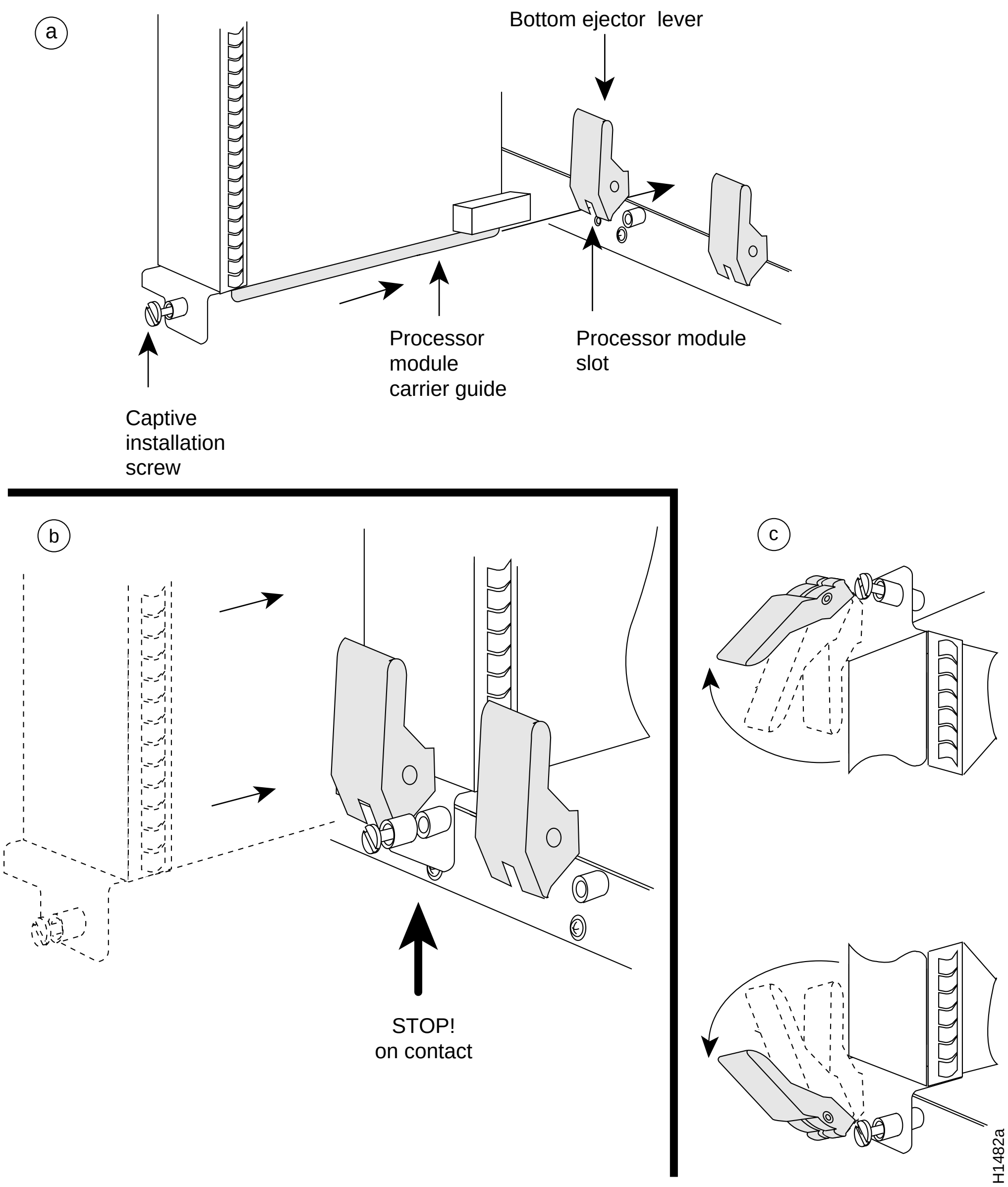
Removing Interface Processors

To remove an interface processor, follow these steps:

Step 1 If you will not immediately reinstall the interface processor you are removing, disconnect any network interface cables attached to the interface processor ports.

Step 2 Use a screwdriver to loosen the captive installation screws at the top and bottom of the interface processor. (See Figure 5-12a.)

Figure 5-12 Ejector Levers and Captive Installation Screws



Step 3 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 interface processor from the backplane connector. (See Figure 5-12c.) Make sure the levers snap into their spring retainers.

Step 4 Grasp the interface processor handle with one hand and place your other hand under the carrier to support and guide the interface processor out of the slot. Avoid touching the board. (See Figure 5-13.)

Step 5 Carefully pull the interface processor straight out of the slot, keeping your other hand under the carrier to guide it. (See Figure 5-13.) Keep the interface processor at a 90-degree orientation to the backplane.

Step 6 Place the removed interface processor on an antistatic mat or antistatic foam, or immediately install it in another slot.

Step 7 If the slot is to remain empty, install an interface processor filler (MAS7K-BLANK=) or RSP2 filler (MAS-RSPBLANK=) to keep dust out of the chassis and to maintain proper airflow through the interface processor compartment.

Caution Always install interface processor fillers in empty interface processor slots to maintain the proper flow of cooling air across the boards.

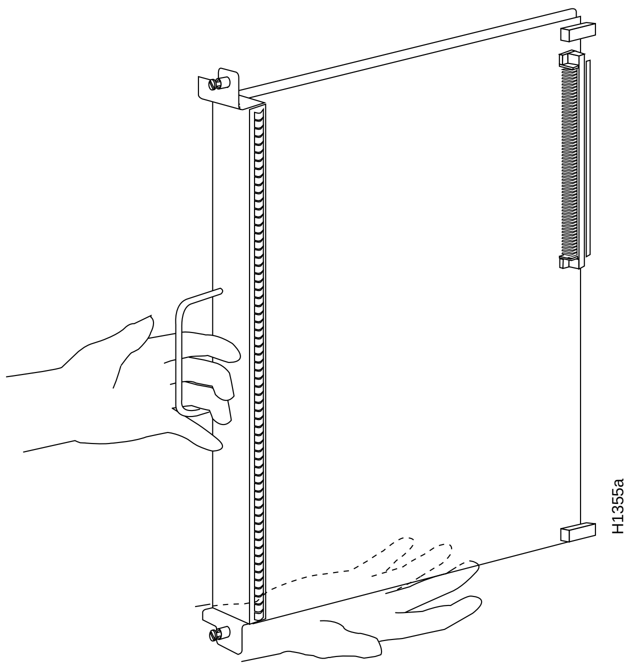
Installing Interface Processors

You can install interface processors in any of the five interface processor slots, numbered 0 and 1, and 4 through 6, from left to right when viewing the chassis from the rear. (See Figure 1-2.)

Slot 2 and 3 are for an RSP2, which is a required system component. Interface processor and RSP2 fillers, which are blank processor carriers, are installed in slots without interface processors or an RSP2 to maintain consistent air flow through the interface processor compartment.

Following are installation steps for the interface processors, which support OIR and can be removed and installed while the system is operating. The installation steps are the same for the RSP2.

Figure 5-13 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). If possible, space interface processors between empty slots that contain only interface processor fillers.

Step 2 Interface processors are secured with two captive installation screws. Use a number 2 Phillips or a 1/4-inch flat-blade screwdriver to loosen the captive installation screws and remove the interface processor filler (or the existing interface processor) from the slot to be filled. (See Figure 5-12.)

Step 3 Hold the interface processor handle with one hand, and place your other hand under the carrier to support the interface processor and guide it into the slot. (See Figure 5-13.) Avoid touching the board.

Step 4 Place the back of the interface processor in the slot and align the notch on the bottom of the interface processor carrier with the groove in the slot. (See Figure 5-12.)

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. (See Figure 5-12b.)

Step 6 Using the thumb and forefinger of each hand, simultaneously push the top lever down and the bottom lever up to fully seat the interface processor in the backplane connector. (See Figure 5-12c.)

Step 7 Use a screwdriver to tighten the captive installation screws on the top and bottom of the interface processor. (See Figure 5-12a.)

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 interfaces** or **show controller** [*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.

Sample Screen Display for OIR

When you remove and replace interface processors, the system provides status messages across the console screen. The messages are for information only. In the following sample display, you can follow the events logged by the system as an EIP was removed from slot 3.The system reinitialized the remaining interface processors and marked the EIP that was removed from slot 3 as *down*. When the EIP was reinserted, the system marked the interfaces as *up* again.

```
Router#

%OIR-6-REMCARD: Card removed from slot 3, interfaces disabled
%LINK-5-CHANGED: Interface Ethernet3/1, changed state to administratively down
%LINK-5-CHANGED: Interface Ethernet3/5, changed state to administratively down

Router#

%OIR-6-INSCARD: Card inserted in slot 3, interfaces administratively shut down
%LINK-5-CHANGED: Interface Ethernet3/1, changed state to up
%LINK-5-CHANGED: Interface Ethernet3/5, changed state to up
```

Microcode Component Replacement

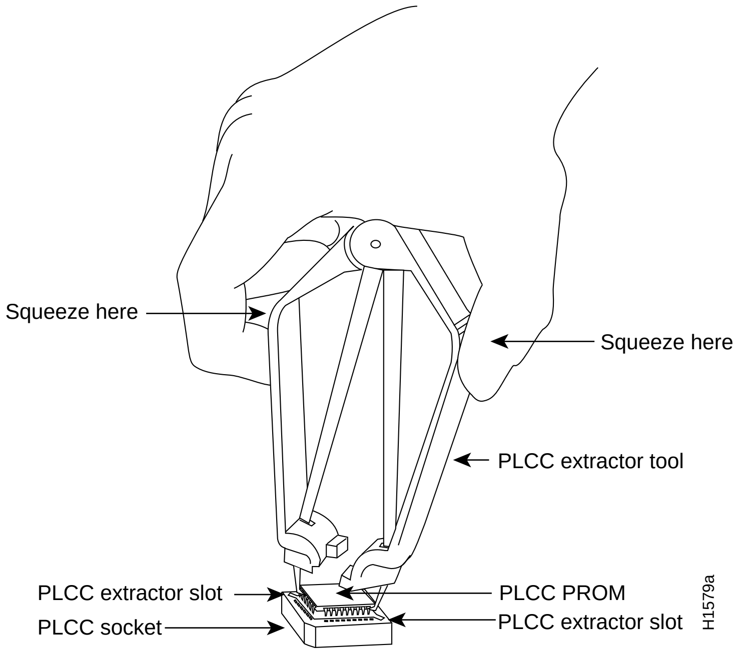
Each interface processor contains default microcode (firmware), which is an image of board-specific software instructions on a single EPROM on each board. Microcode operates with the system software and controls features and functions that are unique to an interface processor type. New features and enhancements to the system or interfaces are often implemented in microcode upgrades. Although each processor type contains the latest available microcode version (in an EPROM) 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.

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 EPROM 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 5-14.) 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 5-14 Removing a PLCC-Type Microcode Component from a Socket



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

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.

Following are the steps for replacing the microcode on any interface processor.

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 shut down.

Step 2 Follow the steps in the section "Removing Interface Processors" earlier in this chapter to remove the interface processor from the chassis. If you perform the replacement close enough to the chassis to avoid straining the interface cables attached to the interface processor (if any), leave the cables connected. Otherwise, label the cables before disconnecting them to avoid crossing them later.

Step 3 Place the removed interface processor on an antistatic mat or foam.

Step 4 Locate the microcode component; refer to the appropriate 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
- FIP: U23
- FEIP: U37 (contains the microcode boot image; the entire microcode image is in the software/microcode bundle)
- FSIP: U81
- HIP: U133
- MIP: U41
- TRIP: U41

Step 5 Note the orientation of the notch on the existing microcode component so that you can install the new component with the same orientation.

Step 6 Use a chip or PLCC-type extractor to remove the microcode component from the socket. Place the removed component on antistatic foam or into an antistatic bag.

Step 7 Insert the new microcode component in the socket with the notched end in the same orientation as the previous component.

Step 8 Replace the interface processor; refer to the section "Installing Interface Processors."

Step 9 Verify that the enabled LED on each interface processor goes on and remains on. If it does not, use the ejector levers to eject the interface processor and reinstall it in the slot.

Step 10 Connect any network interface cables that were removed.

Step 11 If the system power is OFF, turn it back ON.

Verifying the Microcode Version

When you restart the system, the system loads the ROM microcode for each interface processor *unless* you previously set up the system to load microcode from a Flash memory file. You can use the **show controller** command to display the current microcode version and, if necessary, instruct the system to reload the microcode from ROM without restarting the system.

The **show controller** [*token, serial, fddi, or cybus*] command displays the current microcode version on the first line of the display for each card type. The following example shows that the EIP in slot 4 is running EIP Microcode Version 10.0.

```
Router# show cont cybus

 EIP 4, hardware version 5.1, microcode version 10.0
  Interface 32 - Ethernet4/0, station addr 0000.0c02.d0ec (bia 0000.0c02.d0cc)
```

If the display shows that the microcode is loading from a Flash file, you can instruct the system to load the new ROM microcode with the **microcode** *card-type* **rom** command. The command instructs all boards of the specified type to load the microcode stored in their onboard ROM.

Verify that the new microcode version is loaded with the following steps:

Step 1 Verify that the system boots correctly. If the enabled LED fails to light on the interface processor you just reinstalled, repeat the steps in the section "Replacing the ROM" earlier in this chapter.

- Ensure that the EPROM is installed with the notch at the correct end and that none of the pins are bent.
- If a pin is bent, remove the EPROM, straighten the pin, and try the installation again.
- If a ROM is inserted backwards when power is turned ON, the ROM will be damaged and require 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 shut down).

Step 3 Enter the **show controller cybus** command to display the interfaces for all interface processor types.

Step 4 If the new microcode version is displayed, your installation is complete. If a different (older) version is displayed, the microcode is still loading from a Flash file. Proceed with the following steps to configure the ROM microcode to load.

Step 5 Enter the command **microcode** *card-type* **rom** to negate the instruction to load from Flash memory.

Step 6 Enter the command **microcode reload** to load the new ROM microcode.

Step 7 Enter the **show controller cybus** command again. The first line of the display for the interface should show the new microcode version loaded from ROM.

The replacement procedure is complete. If the enabled LED fails to 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."

Configuring the AIP

Configuration of the AIP is a two-step process: you configure the AIP, then you configure the ATM switch. To configure your ATM switch, refer to the appropriate user document. To configure ATM, complete the following tasks. The first two tasks are required, and then you must configure at least one permanent virtual circuit (PVC) or SVC. The VC options you configure must match in three places: on the router, on the ATM switch, and at the remote end of the PVC or SVC connection.

- Enable the AIP and configure the rate queue.
- Change the AIP default values (optional).
- Configure PVCs.
- Configure SVCs.
- Monitor and maintain the ATM interface (optional).

Note AIP debug information is beyond the scope of this publication. For debug information, refer to the configuration note *Asynchronous Transfer Mode Interface Processor (AIP) Installation and Configuration*, which is available on UniverCD or in print (Document Number 78-1214-xx, where xx represents the latest version of this document). For complete information on AIP-related software commands, refer to the software documentation appropriate for your IOS software release.

Initial AIP Configuration

On power up, a new AIP is shut down. To enable the AIP, you must enter the **no shutdown** command in the configuration mode. (See the section "Using the Configure Command" which follows.) If you installed a new AIP or want to change the configuration of an existing interface, you must enter the configuration mode. When the AIP is enabled (taken out of shutdown) with no additional arguments, the default interface configuration file parameters are as listed in Table 5-7.

Table 5-7 AIP Configuration Default Values

Parameter	Configuration Command	Default Value
MTU	**mtu** *bytes*	4470 bytes
Exception queue buffers	**atm exception-queue**	32
ATM virtual path filter	**atm vp-filter hexvalue**	0x7B (hexadecimal)
Receive buffers	**atm rxbuff**	256
Transmit buffers	**atm txbuff**	256
Maximum number of VCs	**atm maxvc**	2048
AAL encapsulation	**atm aal aal5**	AAL5
ATM raw cell queue size	**atm rawq-size**	32
ATM VCs per VP	**atm vc-per-vp**	1024
E3 interface framing	**atm framing g751**	G.804

After you verify that the new AIP is installed correctly (the enabled LED goes on), you can use the **configure** command to configure the new ATM interface. Be prepared with the information you will need, such as the interface IP address, maximum transmission unit (MTU) size, ATM adaptation layer (AAL) mode, and desired rate queues.

Using the Configure Command

Following are instructions for a basic configuration: enabling an interface 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. For complete descriptions of configuration subcommands and the configuration options available for ATM, refer to the *Router Products Configuration Guide* and *Router Products Command Reference* publication.

The router identifies an interface number by its interface processor slot number (slots 0 and 1 and 4 through 6) and port number (port numbers 0 to 7, depending on the interface processor type) in the format *slot/port*. Because each AIP contains a single ATM interface, the port number is always 0. For example, the slot/port address of an ATM interface on an AIP installed in interface processor slot 1 would be *1/0*.

The following steps describe a basic configuration. Before using 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 is set. Press the Return key after each configuration step unless otherwise noted.

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# configure terminal
```

Step 2 At the prompt, specify the new ATM interface to configure by entering the **interface atm** command, followed by the *type* (**ATM**) *and slot/port* (interface processor slot number/port number). The example that follows is for an AIP in interface processor slot 1:

```
Router(config)# interface atm 1/0
```

Step 3 If IP routing is enabled on the system, you can assign an IP address and subnet mask to the interface with the **ip address** configuration subcommand, as in the following example:

```
Router(config)# ip address 1.1.1.1 255.255.255.0
```

Step 4 Change the shutdown state to up and enable the ATM interface as follows:

```
Router(config-if)# no shutdown
```

The **no shutdown** command passes an **enable** command to the AIP, which then begins segmentation and reassembly (SAR) operations. It also causes the AIP to configure itself based on the previous configuration commands sent.

Step 5 Add any additional configuration subcommands required to enable routing protocols and adjust the interface characteristics.

Step 6 When you have included all of the configuration subcommands to complete the configuration, enter **^Z** (hold down the Control key while you press Z) to exit the configuration mode.

Step 7 Write the new configuration to memory as follows:

```
Router# copy running-config startup-config
```

The system will display an OK message when the configuration has been stored.

Step 8 For an explanation of **show** commands that allow you to check the interface configuration, see "Checking the Configuration" later in this section.

Configuring the Rate Queue

A rate queue defines the maximum speed at which an individual virtual circuit (VC) transmits data to a remote ATM host.

There are no default rate queues. Every VC *must* be associated with one rate queue. The AIP supports up to eight different *peak* rates. The peak rate is the maximum rate, in kilobits per second, at which a VC can transmit. After attachment to this rate queue, the VC is assumed to have its peak rate set to that of the rate queue.

You can configure each rate queue independently to a portion of the overall bandwidth available on the ATM link. The combined bandwidths of all rate queues should not exceed the total bandwidth available for the AIP physical layer interface. The total bandwidth depends on the PLIM. (See the section “AIP Connection Equipment” in the chapter “Preparing for Installation.”)

The rate queues are broken into a high (0 through 3) and low (4 through 7) bank. When the rate queues are configured, the AIP will service the high-priority banks until they are empty and then service the low-priority banks.

VCs get the entire bandwidth of the associated rate queue. If oversubscription occurs, the other rate queues in bank A will miss the service opportunities. In the worst case, a 10-Mbps rate queue will take 100 Mbps if there are 10 VCs attached to it and all of them have packets to send at the same time.

Note For E3, rate queues >34 are disallowed. For DS3, rate queues >45 are disallowed.

To configure rate queue 1 at 10 Mbps, use the **atm rate-queue** *queuenumber rate* command in interface configuration mode as follows:

```
Router(config-if)# atm rate-queue 1 10
```

where the queue number is in the range of 0 to 7 and the *rate* (in Mbps) in the range of 1 to 155. The **no** form of the command removes the rate queue.

You must create a rate queue before you can create PVCs or SVCs. If all rate queues are unconfigured, a warning message will appear, as follows:

```
%WARNING:(ATM4/0): All rate queues are disabled
```

If the combined queue rates exceed the AIP physical layer interface bandwidth maximum, a warning message will appear, as follows:

```
%WARNING(ATM4/0): Total rate queue allocation nMbps exceeds maximum of nMbps
```

Changing AIP Default Values

The AIP default values may be changed to match your network environment. Perform the tasks in the following sections if you need to customize the AIP:

- "Selecting an AIP Interface"
- "Setting the MTU Size"
- "Configuring SONET Framing"
- "Configuring an ATM Interface for Local Loopback"
- "Setting the Reassembly Buffers"
- "Setting Framing on the E3 Interface"
- "Setting the Transmit Buffers"
- "Setting the Source of the Transmit Clock"

Selecting an AIP Interface

The AIP interface is referred to as **atm** in the configuration commands. An interface is created for each AIP found in the system at reset time. To select a specific AIP interface, use the **interface atm** command, as follows:

```
interface atm n / i
```

where **n** is the slot number and **i** is the interface number.

Setting the MTU Size

To set the MTU size, use the following command:

```
mtu bytes
no mtu
```

where *bytes* is in the range of 64 through 9188 bytes and the default is 4470 bytes. (the default of 4470 bytes exactly matches FDDI and HSSI interfaces for autonomous switching.) The **no** form of the command restores the default.

Configuring SONET Framing

In STM-1 mode, the AIP sends *idle* cells for cell-rate decoupling. In STS-3C mode, the AIP sends *unassigned* cells for cell-rate decoupling. The default SONET setting is STS-3C. To configure for STM-1, use the following command:

```
atm sonet stm-1
```

To change back to STS-3C, use the **no atm sonet stm-1** command.

Configuring an ATM Interface for Local Loopback

To configure an ATM interface for local loopback (useful for checking that the AIP is working), use the following command:

```
loopback plim
no loopback plim
```

The **no** form of the command turns off loopback.

Setting the Reassembly Buffers

The **atm rxbuff** command sets the maximum number of reassemblies that the AIP can perform simultaneously. The AIP allows up to 512 simultaneous reassemblies; the default is 256. The **no** form of the command restores the default.

Setting Framing on the E3 Interface

The E3 interface supports G.804 and G.751 framing. The default is G.804. To set the framing to G.751, use the following command:

```
atm framing g751
no atm framing g751
```

The **no atm framing g751** command resets the E3 interface to the default G.804 framing.

Setting the Transmit Buffers

To set the number of transmit buffers for simultaneous fragmentation, use the following command:

```
atm txbuff n
no atm txbuff
```

where *n* is in the range 0 to 512. The default is 256.

Setting the Source of the Transmit Clock

By default, the AIP uses the recovered receive clock to provide transmit clocking. To specify that the AIP generates the transmit clock internally for SONET, E3, and DS3 PLIM operation, use the following command:

```
atm clock internal
```

Virtual Circuits (VCs)

A VC is a point-to-point connection between remote hosts and routers. A VC is established for each ATM end node with which the router communicates. The characteristics of the VC are established when the VC is created and includes the following:

- Quality of service (QOS)
- AAL mode (AAL3/4 or AAL5)
- Encapsulation type (LLC/SNAP, MUX, NLPID, and QSAAL)
- Peak and average transmission rates

Each VC supports the following router functions:

- Multiprotocol (AppleTalk, CLNS, DECnet, IP, IPX, VINES, XNS)
- Fast switching of IP, IPX, VINES, CLNS, and AppleTalk packets
- Autonomous switching of IP packets
- Pseudobroadcast support for multicast packets

By default, fast switching is enabled on all AIP interfaces. These switching features can be turned off with interface configuration commands. Autonomous switching must be explicitly enabled for each interface.

Permanent Virtual Circuit (PVC) Configuration

All PVCs, configured into the router, remain active until the circuit is removed from the configuration. The PVCs also require a permanent connection to the ATM switch.

All virtual circuit characteristics apply to PVCs. When a PVC is configured, all the configuration options are passed on to the AIP. These PVCs are writable into the nonvolatile RAM (NVRAM) as part of the system configuration and are used when the software image is reloaded.

Some ATM switches have point-to-multipoint PVCs that do the equivalent of broadcasting. If a point-to-multipoint PVC exists, then that PVC can be used as the sole broadcast PVC for all multicast requests.

To configure a PVC, you must perform the following tasks:

- Create a PVC.
- Map a Protocol Address to a PVC.

PVC Configuration Commands

When you create a PVC, you create a virtual circuit descriptor (VCD*)* and attach it to the VPI and VCI. A VCD is an AIP-specific mechanism that identifies to the AIP which VPI/VCI to use for a particular packet. The AIP requires this feature to manage the packets for transmission. The number chosen for the VCD is independent of the VPI/VCI used.

When you create a PVC, you also specify the AAL and encapsulation. A rate queue is used that matches the *peak* and *average* rate selections, which are specified in kilobits per second. Omitting a *peak* and *average* value causes the PVC to be connected to the highest bandwidth rate queue available. In that case, the *peak* and *average* values are equal.

To create a PVC on the AIP interface, use the **atm pvc** command:

```
Router(config)# interface atm 2/0
Router(config-if)# atm pvc 2048 255 128 aal5snap 10 10 2046
```

To remove a PVC, use the **no** form of this command:

```
atm pvc vcd vpi vci aal-encap [peak] [average] [cell-quota]
no atm pvc vcd
```

vcd—A per-AIP unique index value describing this VC in the range of 1 to MAXVC.

vpi—The ATM network VPI to use for this VC in the range of 0 through 255.

vci—The ATM network VCI to use for this VC in the range of 0 through 65,535.

encapsulation—The encapsulation type to use on this VC from the following:

aal5mux—Specifies the MUX-type for this VC. A protocol type must be specified.
aal5snap—LLC/SNAP precedes the protocol datagram.
aal5nlpid—NLPID precedes the protocol datagram.
aal34smds—SMDS framing precedes the protocol datagram.
qsaal—A signaling type VC.

protocol-type-for-mux—A protocol type compatible with the MUX is required from the following protocols: **ip**, **decnet**, **novell, vines**, **xns**.

peak-rate—(Optional) The maximum rate, in Kbps, at which this VC can transmit.

average-rate—(Optional) The average rate, in Kbps, at which this VC will transmit.

cell quota—(Optional) The **cell-quota** is an integer value, in the range 1 through 2047, describing the maximum number of credits that a VC can accumulate. The AIP makes use of this in multiples of 32 cells. Every cell transfer consumes one cell credit. One cell transfer credit is issued to a VC in the average rate speed.

The **atm pvc** command creates *PVC n* and attaches the PVC to *VPI* and *VCI*. The AAL used is specified by *aal* and encapsulation by *encap*. A rate queue is used that matches the *peak* and average (*avg*) rate selection. The *peak* and *avg* rate selection values are specified in Kbps. Not specifying a *peak* and *avg* value causes the PVC to default to the highest bandwidth rate queue available.

Note For E3, rate queues >34 are disallowed. For DS3, rate queues >45 are disallowed.

The defaults for *peak-rate* and *average-rate* are that peak = average, and the PVC is automatically connected to the highest bandwidth rate queue available. A *VCD* is an AIP specific mechanism that identifies to the AIP which VPI/VCI to use for a particular packet. The AIP requires this feature to manage the packets for transmission.

VP Filter

The vp filter (vp_filter) configures the hex value used in the vp filter register in the reassembly operation. When a cell is received, the right half (most-significant byte) of the filter is exclusively NORed with the incoming VPI. The result is then ORed with the left half (least-significant byte) of the filter (the mask). If the result is all ones, then reassembly is done using the VCI/MID table. Otherwise, reassembly is done using the VPI/VCI table. The vp filter mechanism allows a way of specifying which VPI (or range of VPIs) will be used for AAL3/4 processing; all other VPIs map to AAL5 processing. In the case where only AAL5 processing is desired, the vp filter should be set to the default VPI of 0x7B (hexadecimal). AAL5 processing will be performed on the first 127 VPIs in that case. Currently you can only configure one VPI for all the AAL3/4 packets.

Examples follow:

```
atm vp-filter 1
```

All incoming cells with VPI = 1 will be reassembled via AAL3/4 processing. AAL3/4 is supported with IOS Release 10.2 and later.

```
atm vp-filter 0
```

All incoming cells with VPI = 0 will be reassembled via AAL3/4 processing. All other cells will be reassembled via AAL5 processing.

Mapping a Protocol Address to a PVC

A mapping scheme identifies the ATM address of remote hosts/routers. This address can be specified either as a VCD for a PVC, or an NSAP address for SVC operation.

Enter mapping commands as groups; multiple map entries can exist in one map list. First create a map list, then associate the list with an interface. Enter the **map-list name** command; then enter the protocol, protocol address, and other variables as follows:

```
map-list name
protocol protocol address atm-vc vcd | atm-nsap nsap [broadcast]
```

The **broadcast** keyword specifies that this map entry receives the corresponding protocol broadcast requests to the interface (for example, any network routing protocol updates). If you do not specify **broadcast**, the ATM software is prevented from sending routing protocol updates to the remote hosts.

After you create the map list, specify the ATM interface to which it applies with the interface command as follows:

```
interface atm slot/port
```

Associate the map list to an interface with the following command:

```
map-group name
```

You can create multiple map lists, but only one map list can be associated with an interface. Different map lists can be associated with different interfaces. The following is an example of mapping a list to an interface:

```
interface atm4/0
ip address 1.1.1.1 255.255.255.0
map-group atm
atm rate-queue 1 100
atm pvc 1 0 8 aal5snap
atm pvc 2 0 9 aal5mux decnet
decnet cost 1
!
map-list atm
ip 1.1.1.1 atm-vc 1 broadcast
decnet 10.2 atm-vc 2 broadcast
```

Checking the Configuration

After configuring the new interface, use the **show** commands to display the status of the new interface or all interfaces.

ATM Show Commands

ATM **show** commands are available to display the current state of the ATM network and the connected VCs.

To show current VCs and traffic information, use the following command:

```
show atm vc [vcd]
```

Specifying a VCD will display specific information about that VCD.

To show current information about an ATM interface, use the following command:

```
show atm int interface
```

The **show atm int interface** command will display ATM-specific information about an interface.

To show current ATM traffic, use the following command:

```
show atm traffic
```

The **show atm traffic** command displays global traffic information to and from all ATM networks connected to the router.

To show the current ATM mapping, use the following command:

```
show atm map
```

The **show atm map** command displays the active list of ATM static maps to remote hosts on an ATM xnetwork.

Other Commands That Display AIP Information

Following are descriptions and examples of the **show** commands that display AIP information.

- The **show controllers cbus** command displays the internal status of the interface processor, including the interface processor slot location, the card hardware version, and the currently running microcode version. The **show controllers cbus** command 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 an AIP installed in interface processor slot 4. The running AIP microcode is Version 170.46, the PLIM type is 4B/5B, and the available bandwidth is 100 Mbps:

```
Router# show cont cbus

 AIP 4, hardware version 1.0, microcode version 10.1
  Microcode loaded from system
  Interface 32 - ATM4/0, PLIM is 4B5B(100Mbps)
    15 buffer RX queue threshold, 36 buffer TX queue limit, buffer size 4496
    ift 0007, rql 12, tq 0000 0620, tql 36
    Transmitter delay is 0 microseconds
```

- The **show atm vc** command displays the following types of statistics for all PVCs:

```
Router# show atm vc
Intfc.   VCD   VPI   VCI   Input   Output  AAL/Encaps    Peak  Avg.  Burst
ATM4/0.1 1     1     1     305     0       AAL3/4-SMDS   0     0     0
ATM4/0   2     2     2     951     0       AAL5-SNAP     0     0     0
ATM4/0   3     3     3     0       0       AAL5-SNAP     0     0     0
ATM4/0   4     4     4     162     0       AAL5-MUX      0     0     0
ATM4/0   6     6     6     2722    0       AAL5-SNAP     0     0     0
ATM4/0   7     7     7     733     0       AAL5-SNAP     0     0     0
```

- Use the **show atm vc** *n* command to display statistics for a given PVC, where *n* is the VCD:

```
Router# show atm vc 4
ATM4/0: VCD: 4, VPI: 4, VCI: 4, etype:0xBAD, AAL5 - MUX, Flags: 0x34
PeakRate: 0, Average Rate: 0, Burst: 0 *32cells, Vcmode: 0xE200
InPkts: 164, OutPkts: 0, InFast: 0, OutFast: 0, Broadcasts: 0
```

- The following is sample output from the **show atm vc** command when a VCD is specified, AAL3/4 is enabled, an ATM SMDS subinterface has been defined, and a range of message identifier numbers (MIDs) has been assigned to the PVC:

```
Router# show atm vc 1

ATM4/0.1: VCD: 1, VPI: 0, VCI: 1, etype:0x1, AAL3/4 - SMDS, Flags: 0x35
PeakRate: 0, Average Rate: 0, Burst: 0 *32cells, VCmode: 0xE200
MID start: 1, MID end: 16
InPkts: 0, OutPkts: 0, InFast: 0, Broadcasts: 0
```

- Use the **show interfaces** command without arguments to display statistics for all interfaces in the system. Use the **show interfaces atm** *slot/port* command to display statistics for the ATM interface you specify by its slot/port address as follows:

```
Router# show atm int atm 4/0
ATM interface ATM4/0:
AAL enabled:  AAL5, Maximum VCs: 1024, Current VCs: 6
Tx buffers 256, Rx buffers 256, Exception Queue: 32, Raw Queue: 32
VP Filter: 0x7B, VCIs per VPI: 1024
PLIM Type:4B5B - 100Mbps, No Framing, TX clocking: LINE
4897 input, 2900 output, 0 IN fast, 0 OUT fast
Rate-Queue 1 set to 100Mbps, reg=0x4EA
Config. is ACTIVE
```

- Use the **show atm map** command to display the PVC map as follows:

```
Router# show atm map
Map list atm:
vines 3004B310:0001 maps to VC 4, broadcast
ip 1.1.1.1 maps to VC 1, broadcast
clns 47.0004.0001.0000.0c00.6e26.00 maps to VC 6, broadcast
appletalk 10.1 maps to VC 7, broadcast
decnet 10.1 maps to VC 2, broadcast
```

- Use the **show atm traffic** command to display the interface traffic as follows:

```
Router# show atm traffic
4915 Input packets
0 Output packets
2913 Broadcast packets
0 Packets for non-existent VC
0 Packets with CRC errors
0 OAM cells received
0 Cells lost
```

- Use the **show sscop** command to display SSCOP details for the ATM interface.

- 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 (RSP2-K), Version 10.3(571)
Copyright (c) 1986-1995 by cisco Systems, Inc.
Compiled Wed 10-May-95 14:44

System Bootstrap, Version 4.6(1)

Current date and time is Fri 5-12-1995 2:18:52
Boot date and time is Fri 5-12-1993 11:42:38
Router uptime is 2 hours, 36 minutes
System restarted by power-on
Running default software
Network configuration file is "Router", booted via tftp from 1.1.1.1
RSP2 (Risc 4600) processor with 16384K bytes of memory.
X.25 software.
Bridging software.
1 Route Switch Processor.
1 TRIP controller (4 Token Ring).
4 Token Ring/IEEE 802.5 interface.
1 AIP controller (1(ATM)
1 ATM network interface
8192K bytes of flash memory on embedded flash (in RSP2).
Configuration register is 0x0
   (display text omitted)
```

- The **show protocols** command displays the global (system-wide) and interface-specific status of any configured Level 3 protocol.
- The **show running-config** command displays the currently running AIP configuration in RAM, as follows:

```
Router# show running-config

interface atm2/0
ip address 1.1.1.1 255.255.255.0
atm rate-queue 1 100
atm rate-queue 2 5
atm pvc 1 1 1 aal5mux ip
atm pvc 3 3 3 aal5snap
atm pvc 4 4 5 aal5snap 4000 3000
appletalk address 10.1
appletalk zone atm
```

Configuring the FSIP

The FSIP supports EIA/TIA-232, EIA/TIA-449, 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 shut down and reenable 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 correction. All serial interfaces support nonreturn to zero inverted (NRZI) format and 32-bit error correction, both of which are enabled with a software command.

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.

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 top serial interface on an FSIP in interface processor slot 1 (1/0) is defined as having a clock rate of 2 Mbps.

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface serial 1/0
Router (config-if)# clockrate 2000000
Router (config-if)# ^z
Router#
```

Following are acceptable clock rate settings:

1200, 2400, 4800, 9600, 19200, 38400, 56000, 64000, 72000, 125000, 148000, 500000, 800000, 1000000, 1300000, 2000000, 4000000

Speeds above 64 kbps (64000) are not appropriate for EIA/TIA-232; use EIA/TIA-449 on faster interfaces. The faster speeds might not work if your cable is too long. If you change an interface from DCE to DTE, use the **no clockrate** command to remove the clock rate.

The FSIP ports support full duplex operation at DS-1 (1.544 Mbps) and E-1 (2.048 Mbps) speeds. Each four-port module (see the section “Fast Serial Interface Processor (FSIP)” in the chapter “Product Overview”) is controlled by a dedicated MC68040 processor and can support an aggregate bandwidth of 8 Mbps. For example, you can configure each of the four ports on a module to operate at 2 Mbps, or configure one port to operate at 8 Mbps and leave the remaining three ports idle. The result is a maximum aggregate bandwidth of 8 Mbps on a four-port FSIP (which has one module that comprises ports 0 through 3), and 16 Mbps on an eight-port FSIP (which has two modules that comprise ports 0 through 3 and 4 through 7). 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 other factors 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 top serial port on an FSIP in interface processor slot 3:

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/0
Router(config-if)# invert-transmit-clock
Router(config-if)# ^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/TIA-232 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 top serial port on an FSIP in interface processor slot 3 is configured for NRZI encoding:

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/0
Router(config-if)# nrzi-encoding
Router(config-if)# ^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 the section “NRZ and NRZI Formats” in the chapter “Preparing for Installation.” For complete command descriptions and instructions, refer to the related software configuration and command reference 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. The 32-bit CRC function for the HIP is identical to that used for the FSIP.

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. 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*. 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. CRC-16, which transmits streams of 8-bit characters, generates a 16-bit FCS. CRC-32, which transmits streams of 16-bit characters, generates a 32-bit FCS. CRC-32 transmits longer streams at faster rates, and therefore provides better ongoing error correction with less retransmits. Both the sender and the receiver must use the same setting.

CRC-16, the most widely used throughout the United States and Europe, is used extensively with wide area networks (WANs). CRC-32 is specified by IEEE-802 and as an option by some point-to-point transmission standards. It is often used on SMDS networks and LANs.

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 top serial port on an FSIP in interface processor slot 1 is configured for 32-bit CRC:

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 1/0
Router (config-if)# crc32
Router (config-if)# ^z
```

To disable CRC-32 and return to the default CRC-16 setting, specify the slot and port address 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 configuration and command reference documentation.

Configuring a 4-Bit Cyclic Redundancy Check (CRC)

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 IP slot 1 is configured for CRC:

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 1/0
Router (config-if)# crc4
Router (config-if)# ^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 Port Adapter Cables

The port adapter cable connected to each port determines the electrical interface type and mode of the port. The default mode of the ports is DCE, which allows you to perform a loopback test on any port without having to attach a port adapter cable. Although DCE is the default, there is no default clock rate set on the interfaces. When there is no cable attached to a port, the software actually identifies the port as *Universal, Cable Unattached* rather than either a DTE or DCE interface.

Following is an example of the **show controller cybus** command that shows an interface port (1/0) that has an EIA/TIA-232 DTE cable attached, and a second port (1/1) that does not have a cable attached:

```
Router# show controller cybus

(display text omitted)
  Interface 16 - Serial1/0, 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 - Serial1/1, 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 online, you 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 online. To ensure that the system recognizes the new interface type, shut down and reenable 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. First, replace the cable, then shutdown and bring up the interface with the new cable attached so that the system recognizes the new interface. 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 the 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, shut down the interface, and write the configuration to NVRAM. Add additional configuration commands, if any, before you exit from the configuration mode (before you enter **^z**).

```
Router> en
Password: sshhhhh
Router# configure terminal
int serial 1/5
shutdown
^z

Router# copy running-config startup-config
```

Step 4 Enter the configuration mode again and bring the port back up.

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# int serial 1/5
Router(config-if)# no shutdown
Router(config-if)# ^z
```

These steps will prompt the system to poll the interface and recognize new the 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 command 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/TIA-232, EIA/TIA-449, V.35, X.21, and EIA-530. (See the section “Universal Serial Port Adapters” in the chapter “Product Overview.”) 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 FRUs; 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 four-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, which you set with a software command. (Refer to the section “Configuring the FSIP” in this chapter.) 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. 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 5-13.) 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 following 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 5-15.) 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 that shown in Figure 5-15.

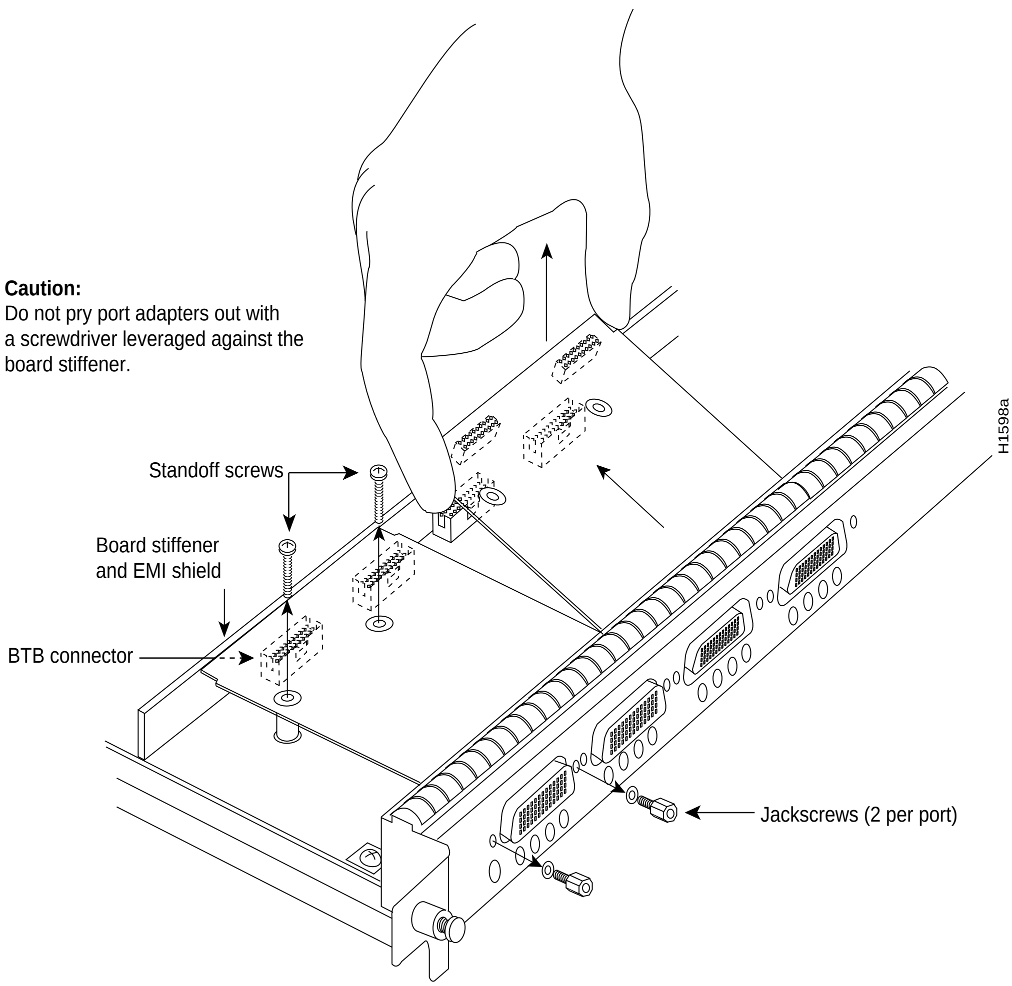
Step 3 Locate the port adapter to be replaced. Use a 3/16-inch nut driver to loosen the four jackscrews, one on either side of both serial connector ports.

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 5-15.) 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 5-15 Removing FSIP Port Adapters



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 5-15), 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.

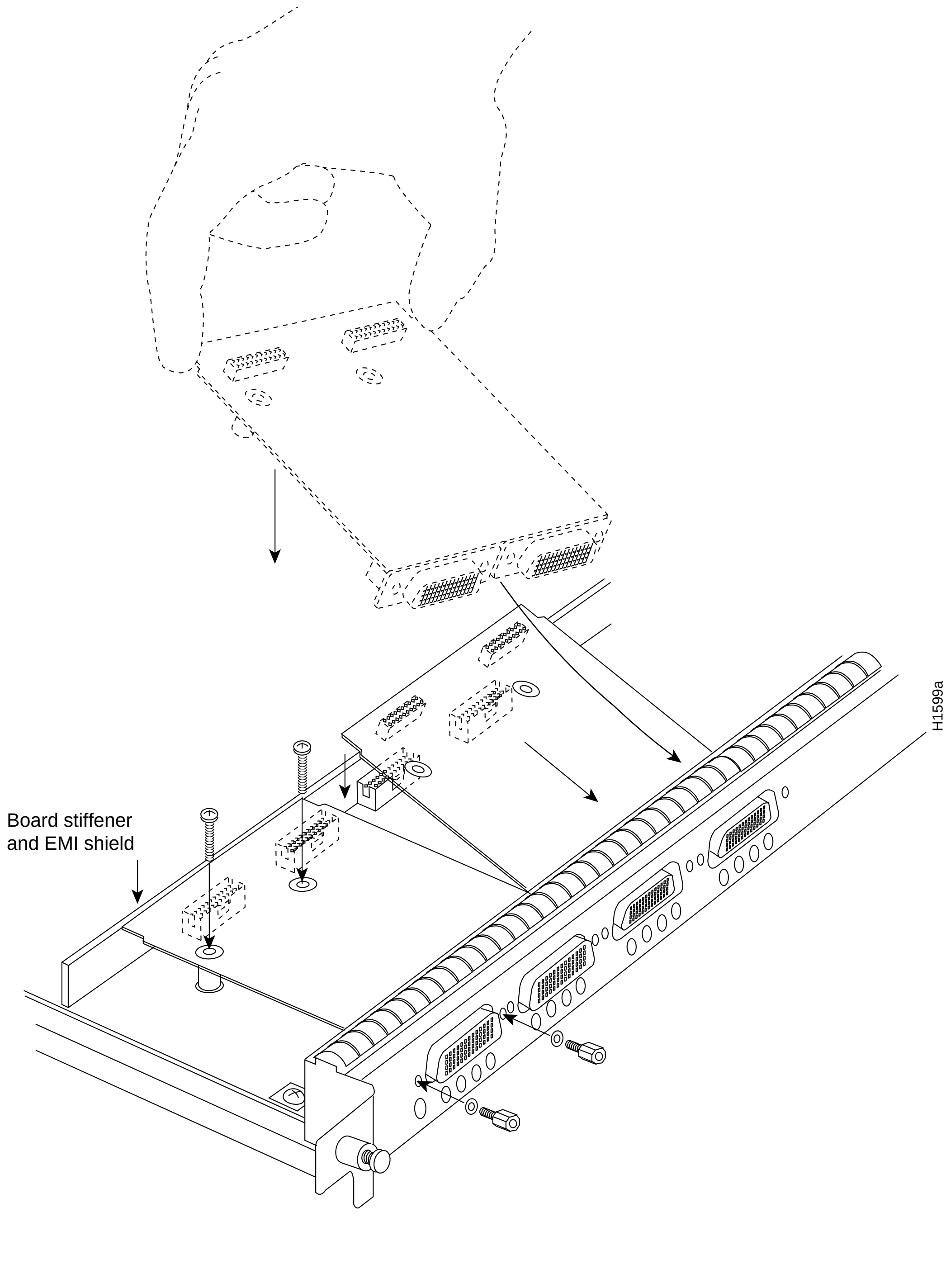
Step 9 Proceed to the next section to install a new port adapter.

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.

Figure 5-16 Installing FSIP Port Adapters



Refer to Figure 5-16 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 5-16. 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 5-16: 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 5-16, *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 may 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.

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 carrier in the FSIP slot.

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.

Caution Handle interface processors by the handles and carrier edges only to prevent ESD damage.

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 5-13.) 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 5-12.)

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 5-12.)

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 5-12) 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** commands 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 configuration and command reference documentation.

Configuring the MIP

Following are procedures for configuring T1 and E1 interfaces on the MIP.

Configuration Overview

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 and/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 motherboard, place one of the spare jumpers on J6 pins one and two *or* pins two and three (refer to Table 5-8), and replace the port adapter on the motherboard. Pin 1 of J6 is designated with a square. (See Figure 5-17.)

For procedures on removing the E1 port adapter from the MIP, refer to the section “Removing and Replacing MIP E1 Port Adapters” in this chapter.

Figure 5-17 Location of Jumper J6 on the E1 Port Adapter (Partial View)

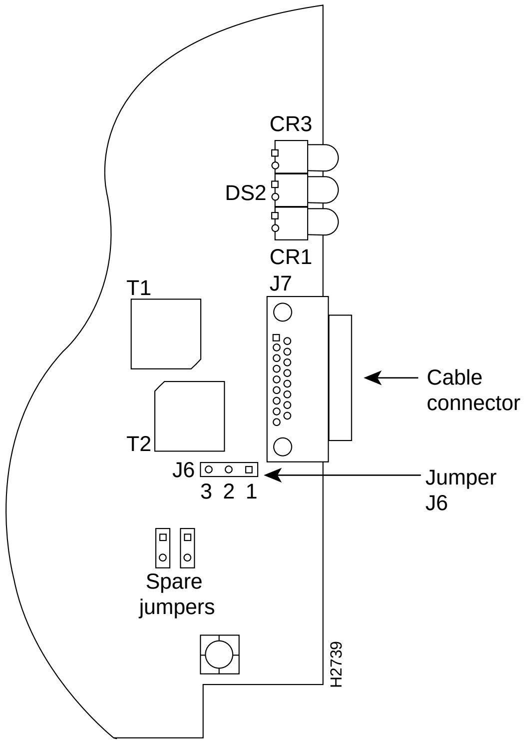


Table 5-8 Jumper Settings and Functions

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.

Caution To prevent problems with the E1 interface, 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 E1 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.

Configuring Interfaces

Following are instructions for a configuration to enable a controller and specify 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* publication. Following are commands used to map the channel-group; the default variable is listed first:

Commands for T1:	Commands for E1:
controller t1 *slot/applique*	**controller e1** *slot/applique*
clock source [*line* | *internal*]	Not required for E1
linecode [*ami* | *b8zs*]	**linecode** [*hdb3* | *ami*]
framing [*sf* | *esf*]	**framing** [*crc4* | *no-crc4*]
loopback [*local* | *remote*]	**loopback**
shutdown	**shutdown**
channel-group *number* **timeslots** *list* [speed {56 | 48 | 64}] For speed, 56 is the default.	**channel-group** *number* **timeslots** *list* [speed {56 | 48 |64}] For speed, 64 is the default.

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 The Cisco 7507 identifies channel-groups as serial interfaces by slot number (interface processor slots 0 and 1, and 4 through 6), 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*.

Configuring T1

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, you complete the configuration by entering **^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# copy running-config startup-config
```

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.

Configuring E1

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 1.1.1.1 255.255.255.0
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, 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# copy running-config startup-config
```

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 (RSP-K), Version 10.3(x)
Copyright (c) 1986-1995 by cisco Systems, Inc.
Compiled Wed 05-May-95 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 1.1.1.1

RSP2 (Risc 4600) processor with 16384K bytes of memory. X.25 software, Version 2.0, NET2,
BFE and GOSIP compliant. Bridging software.
1 Route 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 each 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 slot 1:`

```
Router# show controller cbus

FIP 0, hardware version 2.2, microcode version 10.1
 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
```

- 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 command, **show controller e1** *slot/applique* 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 10.3(x)
!
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 1.1.43.1, 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 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 E1 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*; however, you need to remove an existing E1 port adapter in order to access jumper J6.

Before proceeding, refer to the section "Removing 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 an E1 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 motherboard. (See Figure 5-18.) 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.

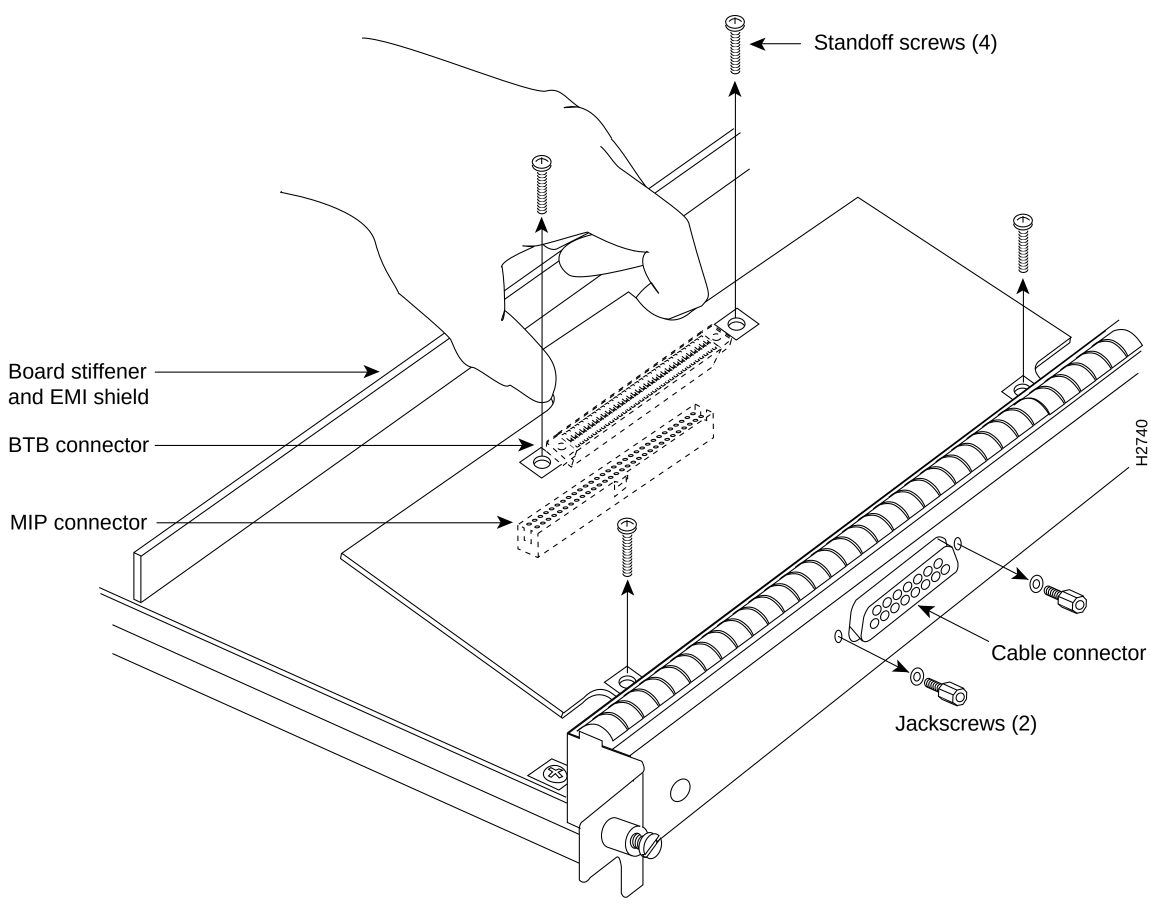
To remove an E1 port adapter from the MIP, refer to Figure 5-18 and perform the following steps:

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 5-18.

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 5-18.)

Figure 5-18 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 5-18.) 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 5-18) 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 section “Replacing an E1 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 an E1 Port Adapter

If necessary, refer to the previous section to remove an E1 port adapter from the MIP. Refer to Figure 5-19 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 5-19. You should still be wearing an ESD-preventive ground strap.

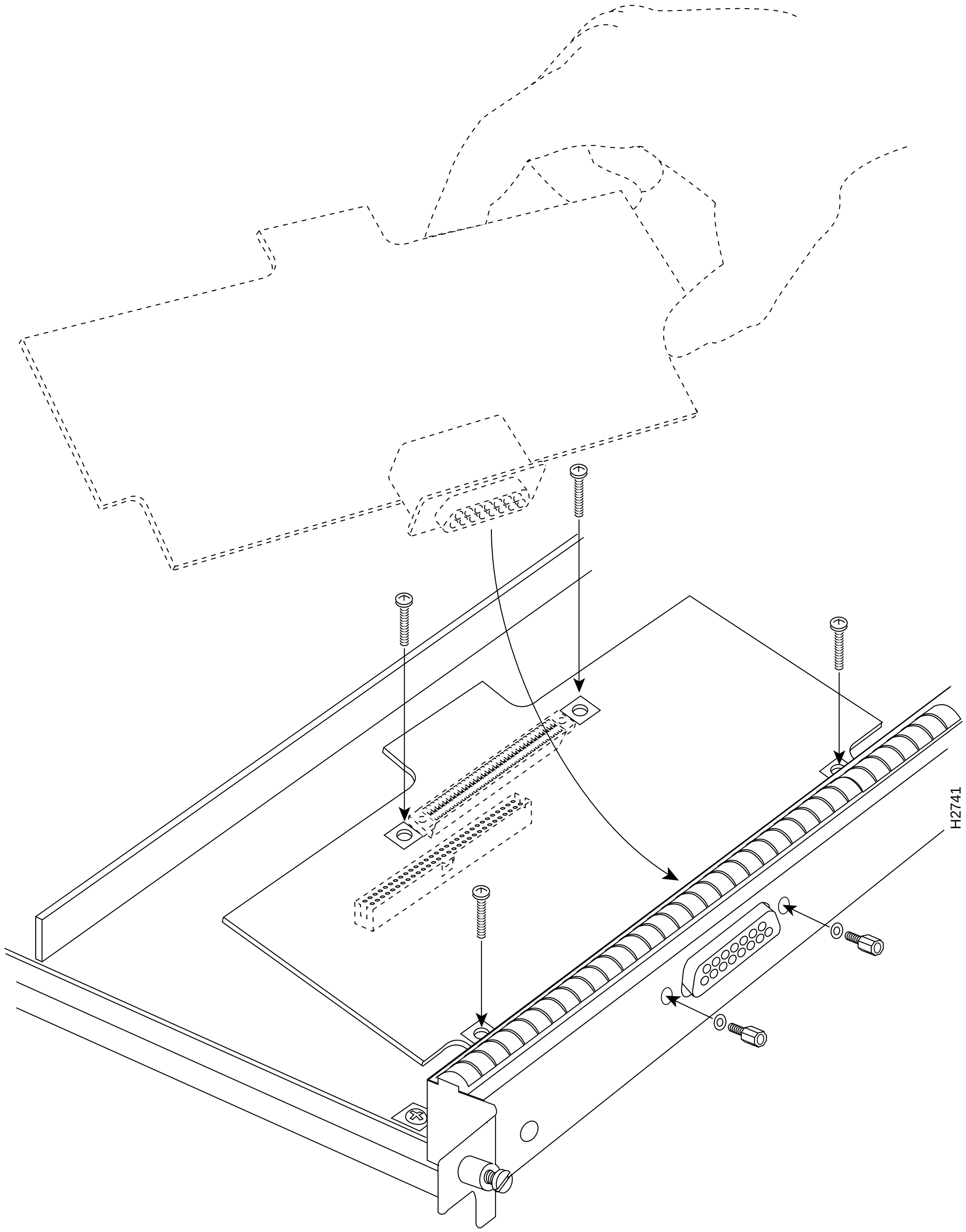
Step 2 Handle the port adapter by the board edges only.

Step 3 Position the port adapter so that it is in the orientation shown in Figure 5-19: 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 5-19, *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 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 5-19.)

Figure 5-19 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 Interface Processors" 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 **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 *Router Products Command Reference* publication.

This completes the port adapter replacement procedure.

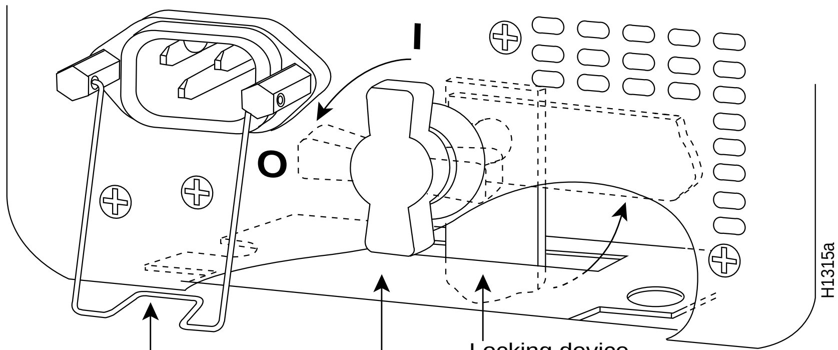
Installing and Replacing Power Supplies

The 700W (AC-input or DC-input) power supplies used in the router support redundant hot swap. When two power supplies are installed, you can install, remove, or replace one of the supplies without affecting system operation. When power is removed from one supply, the redundant power feature causes the second supply to ramp up to full power and maintain uninterrupted system operation. In systems with dual power supplies and when separate power sources are available, connect each power supply to separate input lines so that, in case of a line failure, the second source will most likely still be available. Always install the first power supply in the lower power supply bay and the second, if any, in the upper bay.

The power supply switch is also a locking device. (See Figure 5-20.) When the switch is on, the locking device extends into a slot in the chassis to prevent the power supply from being removed.

A power cable connects each power supply to the site power source. On the AC-input supply, a cable-retention clip, which snaps up and around the power cable connector after the cable is connected to the AC receptacle on the power supply, prevents the cable from accidentally being pulled out or from falling out. On the DC-input supply, nylon cable ties that you provide are used for strain relief on the DC-input power cable connected to the terminal block.

Figure 5-20 Power Supply Interlock—AC-Input Power Supply Shown



Tools Required

You will need a number 2 Phillips or 1/4-inch flat-blade screwdriver (whichever is appropriate) to remove and install filler plates and to loosen or tighten the captive screw on the power supply. For the DC-input power supply, you will need two 4-inch nylon cable ties to attach the DC-input power cable to the bracket beneath the terminal block, and a small wire cutter to remove the old ties.

Installing Power Supplies

At initial installation, you will install the power supplies after you place the chassis in its permanent location to avoid moving an extra 20 or 40 pounds around while setting up the chassis. Steps for installing the power supplies are included as part of the initial installation procedure and are not duplicated here. For power-supply installation procedures, refer to the section "Inserting Power Supplies" in the chapter "Installing the Router." For power-supply removal procedures, refer to the procedure that follows.

Removing Power Supplies

Redundant power supplies support OIR. If you remove one power supply, the second supply immediately ramps up to supply full power to the system to maintain uninterrupted operation. Always install a filler plate over an empty power supply bay to protect the connectors from contamination.

Follow these steps to remove a power supply:

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

Warning Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position.

Warning The illustration shows the DC power supply terminal block. Wire the DC power supply using the appropriate lugs at the wiring end, as illustrated. The proper wiring sequence is ground to ground, positive to positive (line to L), and negative to negative (neutral to N). Note that the ground wire should always be connected first and disconnected last.

Step 1 If you are replacing the DC-input power supply, turn off the power supplies' DC power source.

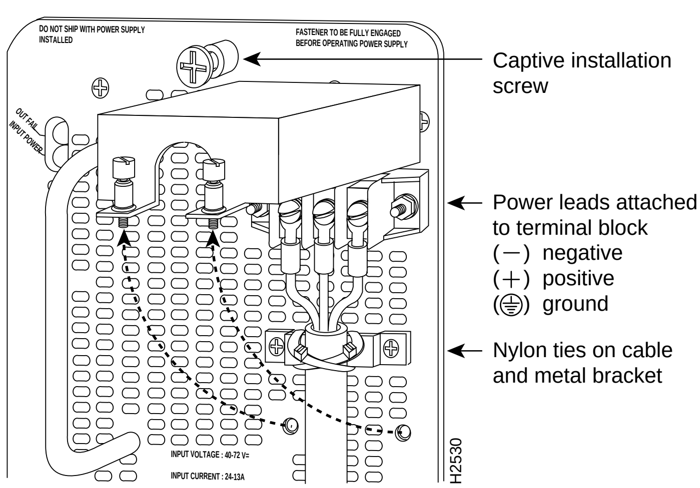
Step 2 On the power supply to be removed, turn OFF the switch. The interlock tab will retract into the unit. (See Figure 5-20.)

Step 3 Disconnect the power cable from the power source.

Step 4 For the AC-input power supply, lift up the cable retention clip and remove the power cable from the AC receptacle.

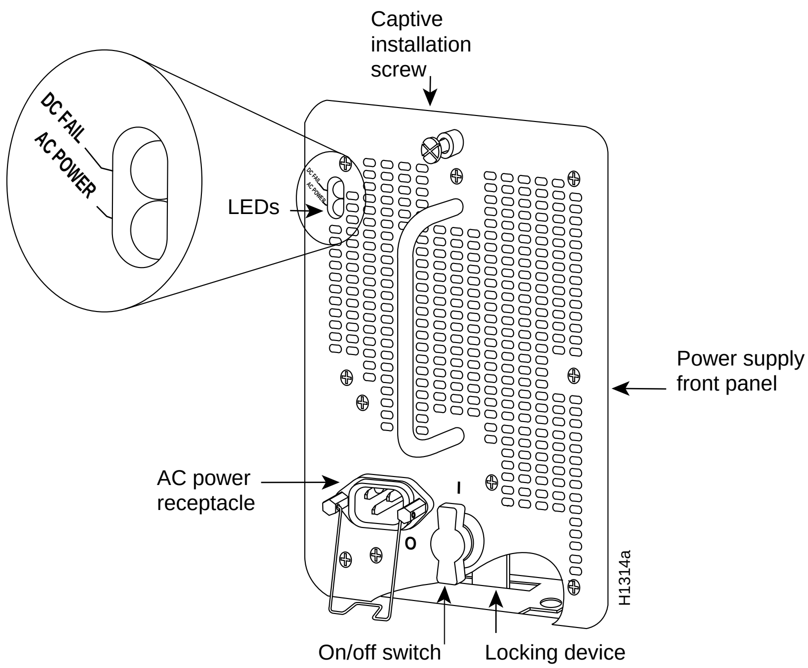
For the DC-input power supply, loosen the captive installation screws on the terminal block cover, lift the cover, use the wire cutters to cut the nylon ties (used for strain relief), and then remove the three power leads (remove the ground lead last) from the terminal block. (See Figure 5-21.)

Figure 5-21 Removing Nylon Cable Ties and Power Leads from DC-Input Power Supply



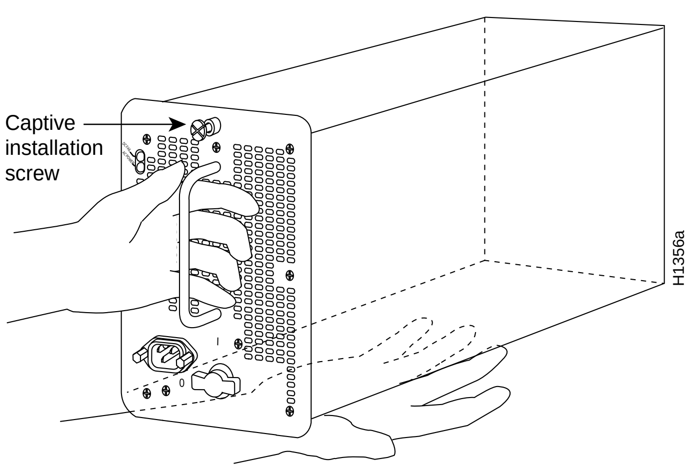
Step 5 Use a screwdriver to loosen and remove the captive installation screw on the top of the supply. (See Figure 5-22.)

Figure 5-22 Power Supply Captive Installation Screw (AC-Input Power Supply Shown)



Step 6 Grasp the power supply handle and place your other hand underneath to support the bottom of the supply as shown in Figure 5-23.

Figure 5-23 Handling a Power Supply (AC-Input Power Supply Shown)



Step 7 Pull the supply out of the bay and put it aside.

Step 8 If the power supply bay is to remain empty, install a power-supply filler plate over the opening and secure it with a mounting screw. This not only protects the inner chassis from dust, but also the connectors in the rear of the bay, which expose current levels when the chassis is powered on.

Warning After wiring the DC power supply, remove the tape from the circuit breaker switch handle and reinstate power by moving the handle of the circuit breaker to the ON position.

Step 9 If you replaced the DC-input power supply, turn on its DC power source.

Warning Keep hands and fingers out of the power supply bays. High voltage is present on the power backplane when the system is operating.

Removing and Replacing the Front Chassis Panels

This section provides the procedures for removing and replacing the chassis top front panel and bottom front panel in order to access the internal chassis components and to replace the panels that have been damaged.

The air filter and replaceable internal components are accessible by removing the top and bottom front panels of the chassis. The bottom front chassis panel is vented and works with the chassis blower to draw cooling air into the chassis. If the bottom panel is not installed correctly, or if it is cracked or broken, the flow of cooling air can be redirected and may cause overheating inside the chassis. Replace panels if they are cracked or broken, or if damage prevents them from fitting on the chassis properly.

You must remove the bottom front panel before you can remove the top front panel. The plastic bottom front panel is attached to the chassis with ball studs. The top front panel is attached to the chassis with two screws. If you are cleaning the air filter, you do not have to shut down the system if you can remove the filter, vacuum it, and replace it in less than five minutes. Always shut down the system before removing the chassis top front panel. With the top front panel removed, 100A of current is exposed on the front of the backplane and around the power supply wiring harnesses.

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

Tools Required

You need a 3/16-inch flat-blade or number 1 Phillips screwdriver to remove the top front chassis panel. Earlier chassis (the first several hundred shipped) use slotted screws, and later chassis use Phillips screws to secure the top front panel to the chassis. No tools are required to remove the bottom front chassis panel.

Removing the Panels

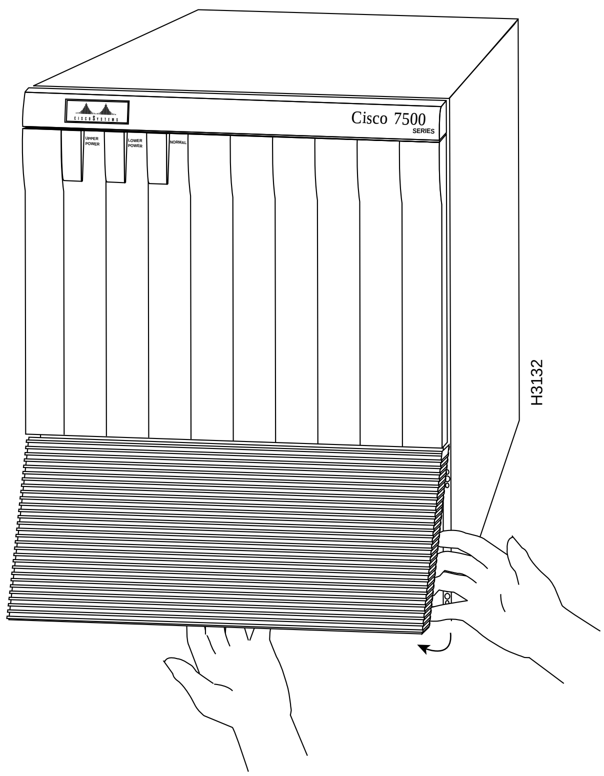
You must remove the bottom front panel before you can remove the top front panel. The plastic bottom front panel is attached to the chassis with ball studs. The top front panel is attached to the chassis with two screws. The EMI shielding around the outer edge of the top front panel acts as a spring and compresses when you push the panel into the chassis to keep the panel fitted tightly into the chassis opening.

To remove the front panels, perform the following steps:

Step 1 Grasp the bottom edge of the bottom chassis panel.

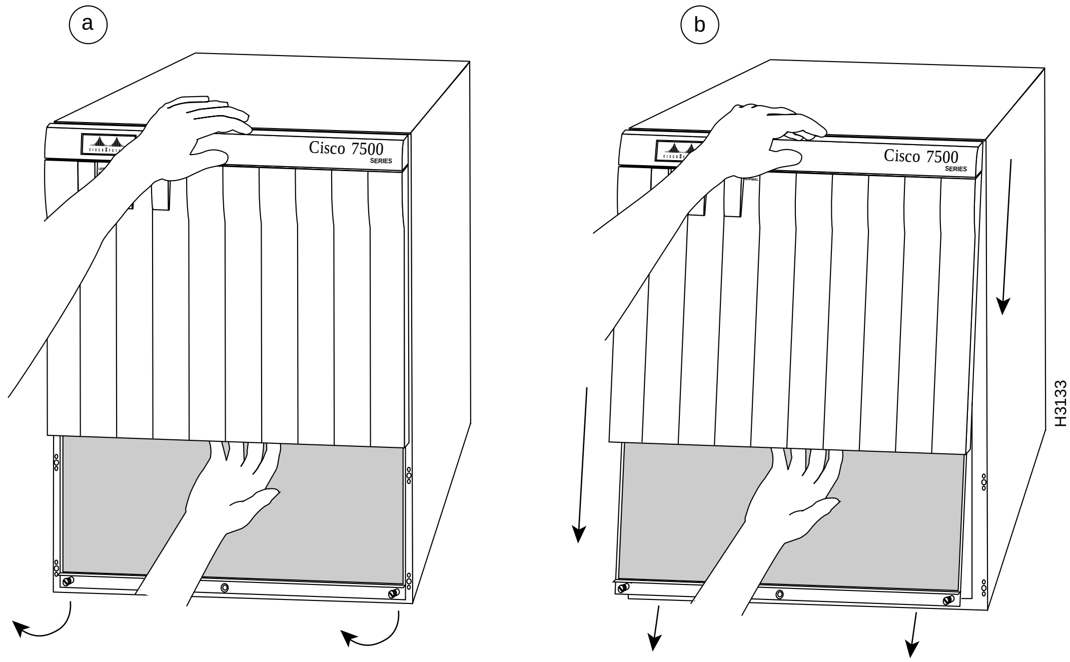
Step 2 Pull the bottom of the panel out about one inch, then place your fingers behind the sides of the panel and pull it off the chassis. (See Figure 5-24.)

Figure 5-24 Removing the Bottom Front Panel



Step 3 On the top front panel, use a number 1 Phillips or a 3/16-inch flat-blade screwdriver to loosen the two captive screws at the bottom edge of the panel frame. (See Figure 5-25.)

Figure 5-25 Removing the Top Front Panel



Step 4 Place one hand against the top front center of the panel to brace it. (See Figure 5-25a.) The top of the panel acts as a pivot point when you pull the bottom out and away from the chassis.

Step 5 With your other hand, grasp the front of the panel by inserting your fingers into the opening on the underside of the front plastic panel. (See the right hand in Figure 5-25a.)

Step 6 While pushing slightly against the top of the panel to constrain it, pivot the bottom edge of the frame outward about 2 inches. (See Figure 5-25a.) Because of the tightly compressed EMI shielding, you will have to use significant force to pull the bottom of the panel outward. However, be careful that you do not pull the panel more than 2 inches away from the chassis, or you may damage the inner bezel or LED board.

Step 7 When the bottom of the frame clears the chassis opening, keep your hands in the same positions and pull the panel down and off the chassis. (See Figure 5-25b.)

Replacing the Panels

Follow these steps to replace the front chassis panels.

Step 1 Grasp the sides of the top panel with both hands. (See Figure 5-26a on the following page.)

Step 2 Two guide tabs at the top edges of the panel fit into two slots in the top edges of the chassis opening. Tilt the top of the panel back (away from you) about 30 degrees from vertical and slide the two guide tabs into the chassis slots. (See Figure 5-26a.)

Step 3 Check the top of the panel and make sure it is lined up with the top of the chassis opening. Failure to align the panel at this point can result in equipment damage when performing the next step.

Step 4 Push the panel upward to push the tabs into the slots (see Figure 5-26a) and pivot the bottom of the panel toward the chassis until the panel frame meets the chassis. (See Figure 5-26b.) Maintain a steady upward pressure to keep the guide tabs in the chassis slots.

Step 5 When the panel is flush against the front of the chassis, push the panel upward until the bottom of the panel is level with the bottom of the chassis opening. (See Figure 5-26c.)

Step 6 Place the palm of one hand against the top front center of the panel to brace it and hold it in place, and place the palm of your other hand against the lip on the bottom edge of the frame. (See Figure 5-26d.)

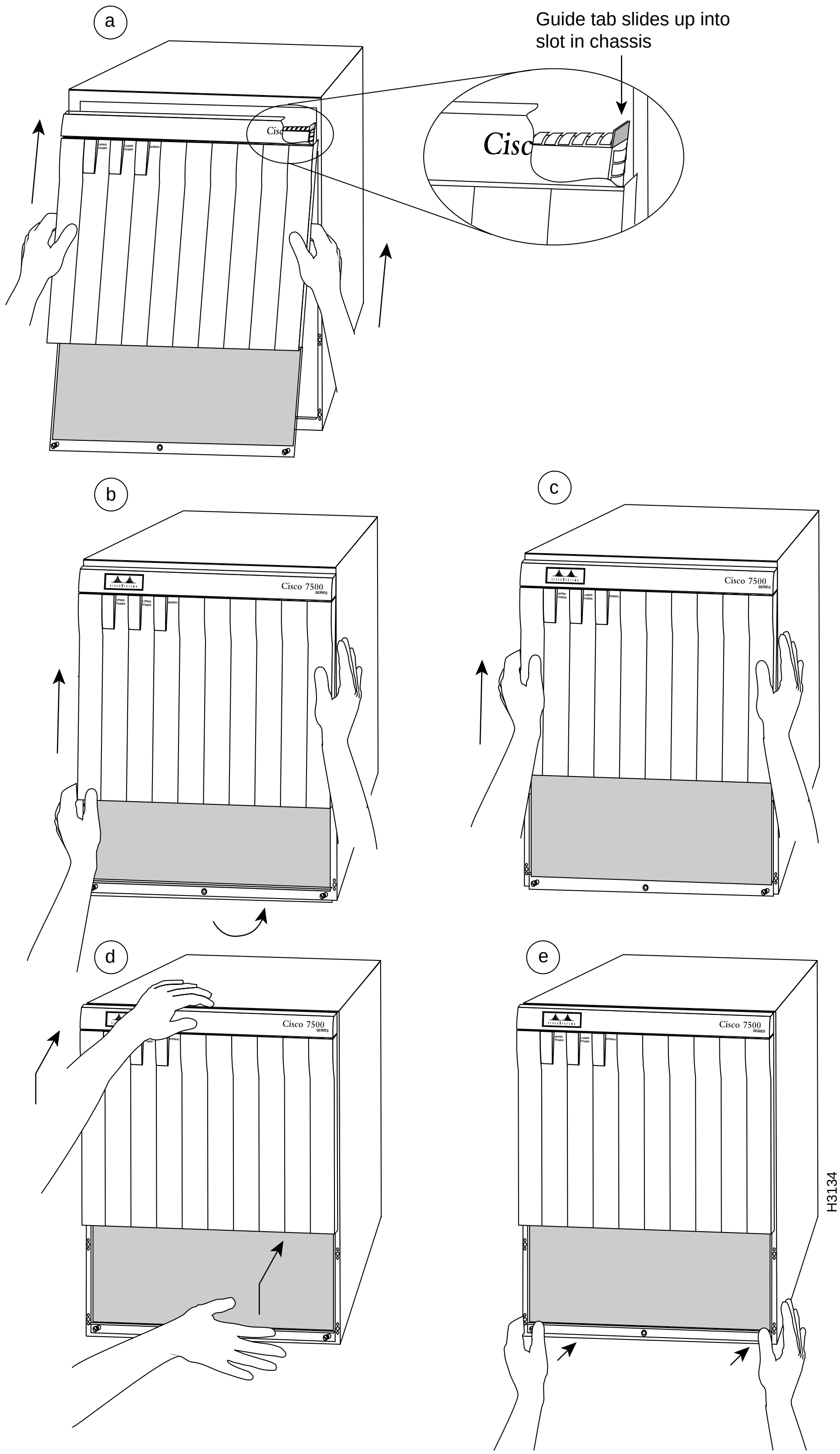
Step 7 Use your hand at the bottom of the frame to push the bottom of the panel upward and back into the chassis opening until the tabs on the front sides of the panel are flush against the front of the chassis. (See Figure 5-26d.) You will have to use significant force to compress the EMI shielding enough to fit into the opening. If the panel resists, pull it slightly downward and make sure that the panel is lined up with the top and sides of the opening in the chassis.

Step 8 When the tabs on the front sides of the panel are flush against the sides of the chassis, tighten the two captive screws in the bottom edge of the frame.

Step 9 To replace the bottom front panel, place the ball studs on the back of the panel over the holes in the front lip of the chassis and push the panel onto the chassis until the ball studs snap into place.

This completes the chassis front panel removal and replacement procedures.

Figure 5-26 Replacing the Top Front Panel



Cleaning and Replacing the Air Filter

The air filter removes dust from the air drawn in by the blower. The edges of the air filter fit into the lower frame of the top front chassis panel. Remove and vacuum the air filter at least once every two weeks, or more often in unusually dusty environments. If vacuuming is not possible, you can remove the filter and wash it, but ensure that it is completely dry before replacing it in the chassis. Have spares on hand in case the filter tears or becomes worn. A dirty filter can prohibit the flow of cooling air into the chassis and may cause an overtemperature condition.

You do not need to shut down the system *if* you can remove, clean, and replace the filter within five minutes. Remove the bottom front chassis panel to access and remove the filter, then move the filter away from the chassis for vacuuming. Vacuuming can dislodge substantial amounts of dust, and cleaning the filter near the opened chassis can allow loose particles to enter the chassis through the unfiltered blower. Instead, briefly remove the panel to clean it, then immediately replace it in the chassis.

Caution Do not operate the system for more than five minutes without a filter installed. Never place a wet filter in the chassis; the moisture drawn into the chassis can damage the equipment.

Tools Required

You will need a small hand vacuum to clean the air filter. Have a spare filter on hand so that you can replace it if necessary without leaving the system operating without a filter or bottom front panel.

Accessing and Cleaning or Replacing the Filter

Perform the following steps to check the filter and clean or replace it if necessary:

Step 1 Remove the bottom front panel. (Refer to the section "Removing the Panels" earlier n this chapter.) The edges of the air filter fit into the lower frame of the top front panel.

Step 2 Remove the filter by grasping it in the center and pulling the edges out of the frame.

Step 3 Check the condition of the filter. If the filter is extremely dusty, or if it appears worn or torn, discard it after you ensure that you have a replacement available. Proceed to Step 7 to install the new filter.

Step 4 Move the filter away from the chassis and vacuum it thoroughly. Do not vacuum the filter when it is installed or near the chassis opening; doing so can dislodge substantial amounts of dust and allow loose particles to enter the chassis.

Step 5 If the filter needs washing, refer to Step 7 to install a temporary replacement filter. If a replacement is not available, shut down the system until the filter dries and you can safely replace it. Do not operate the system for more than five minutes without a filter installed.

Step 6 Wash the filter in running water, or discard it and replace it with a new filter. The filter must be thoroughly dry before you replace it in the chassis.

Step 7 Place the new or clean, *dry* filter over the frame and push the edges into it with your fingers. Ensure that all edges are tucked into the frame.

Step 8 To replace the bottom front panel, align the bottom of the panel with the holes on the front of the chassis, then push the edges in until the ball studs snap into place.

Caution Never place a wet filter in the chassis; the moisture drawn into the chassis can damage the equipment.

Replacing Internal Components

The replaceable internal components are accessible by removing the top and bottom front chassis panels. Always turn off the system power before removing the chassis top front panel. With the top front panel removed, 100A of current is exposed on the front of the backplane and around the power supply wiring harnesses.

Note Each replaceable component ships with installation documentation. Refer to the accompanying documentation for updated procedures and information.

This section contains replacement procedures for the following equipment:

- The LED board (MAS-7KLED), the small circuit board that contains the system LEDs and which connects internally to the RSP2—replace this board if an LED or the board itself fails.
- Blower (MAS-7KFAN), the chassis fans (in a single unit) that draw in cooling air and distribute it across the RSP2 and interface processors.

Figure 5-27 shows the locations of each of these components inside the front cavity of the chassis (shown with both front chassis panels removed).

Caution Before performing any procedures in this chapter, review the following sections in the chapter "Preparing for Installation:" "Safety Recommendations," "Safety with Electricity," and "Preventing Electrostatic Discharge Damage."

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

Replacing the LED Board

The LED board contains the three status LEDs that provide system (normal) and power supply (upper power and lower power) status on the front panel. Replace the LED board if it fails or if one of the LEDs fails.

The LED board is mounted on a horizontal plane near the top of the chassis interior. (See Figure 5-27.) The board slides into two brackets mounted to the front of the backplane and attaches to a connector on the backplane. Two pins in the brackets and a metal spring keep the board in place. (See Figure 5-28.)

Tools Required

You need a number 1 Phillips or 3/16-inch flat-blade screwdriver to remove the top front chassis panel.

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

Removing the LED Board

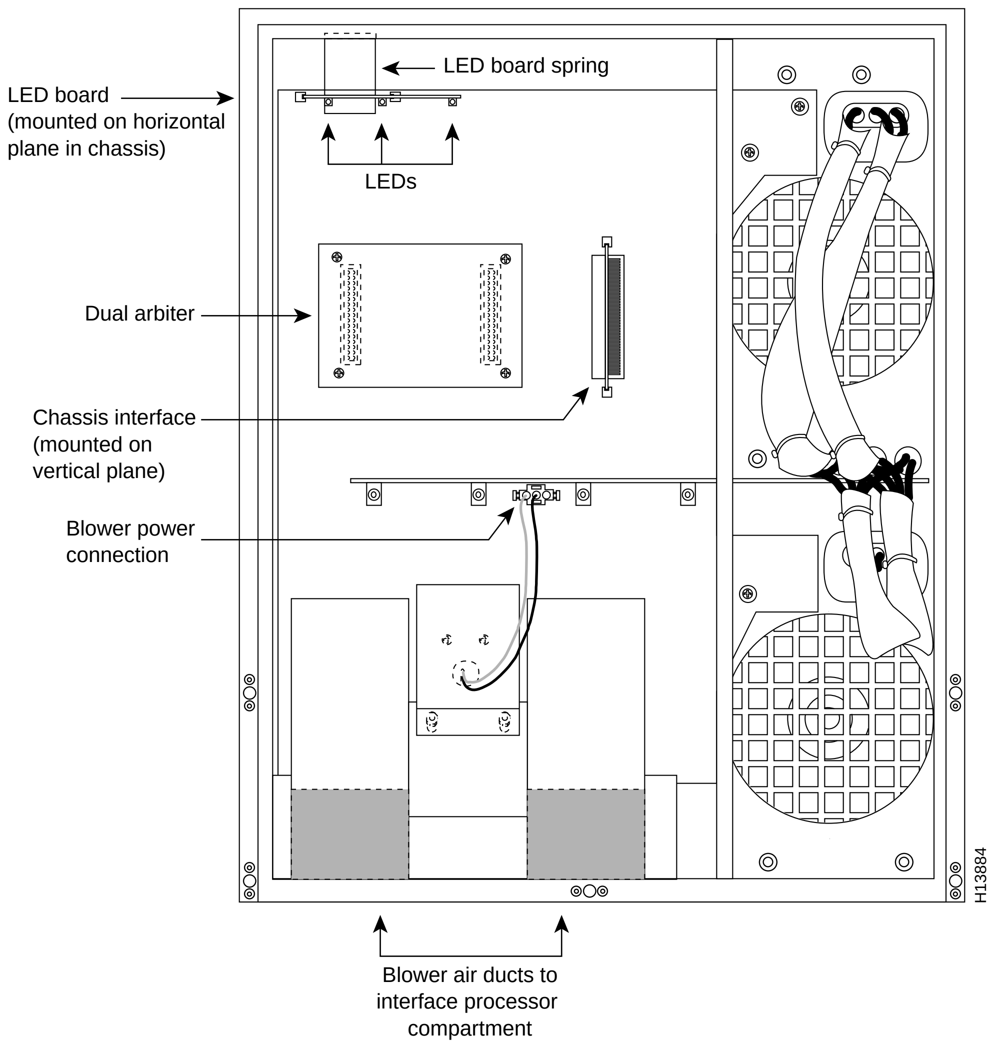
Remove the existing LED board as follows:

Step 1 On each installed power supply, turn OFF the power switch and disconnect the power cable from the power source.

Step 2 Remove the front panels according to the procedure in the section "Removing the Panels" earlier in this chapter.

Step 3 Locate the LED board (see Figure 5-27), which is mounted on a horizontal plane in two plastic brackets.

Figure 5-27 Internal Chassis Components



Step 4 Two steel pins near the front of the brackets hold the board in place. (See Figure 5-28.) On each pin, place your thumb on the top of the pin and your forefinger underneath the bracket to support it, and press the pins down and out of the guide holes in the board.

Caution Handle the LED board by the edges only to avoid damage from ESD.

Step 5 Grasp the edges of the board and place a finger on the top of the LED board spring to depress it.

Step 6 Keep the spring depressed as you pull the board straight out at a 90-degree orientation to the backplane.

Step 7 Place the board in an antistatic bag if returning it to the factory.

Installing a New LED Board

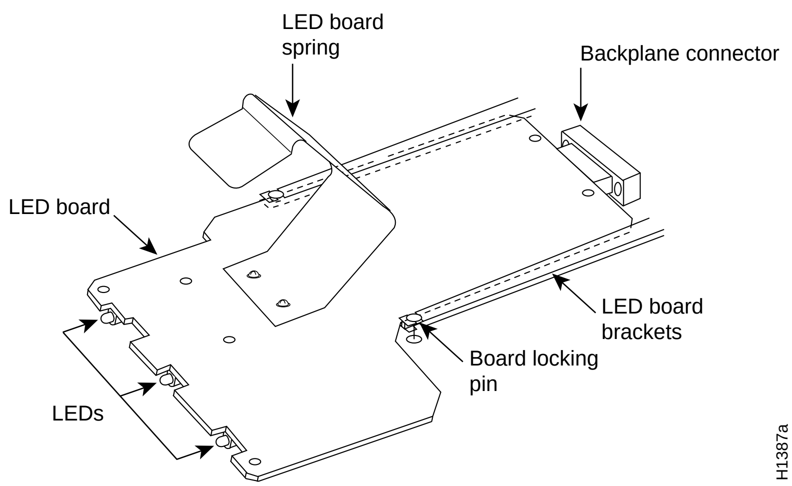
Install the new LED board as follows:

Step 1 Ensure that the power supplies are still turned OFF.

Step 2 Hold the board with the LEDs toward you, with the spring on the top, and with the LEDs and components on the underside of the board. Grasp the edges of the board and place a finger on the top of the LED board spring to depress it.

Step 3 Slide the back edge of the board (the end with the connector) into the guides in the plastic brackets. (See Figure 5-28.)

Figure 5-28 LED Board



Step 4 Keep the spring depressed as you push the board straight in at a 90-degree orientation to the backplane until the connector on the LED board is fully seated in the backplane connector.

Step 5 Release the spring; it will spring up against the chassis ceiling.

Step 6 A steel pin at the front of each bracket holds the board in place. On each side, place your thumb underneath the pin and your forefinger on top of the bracket to support it, and press the pin up through the guide hole in the board. If the pin does not extend fully upward, push the board firmly into the backplane connector until the pins align with the guide holes in the board.

Step 7 Replace the top and bottom front chassis panels (refer to the section "Replacing the Panels" earlier in this chapter) and proceed to the following section to verify the installation.

Installation Checkout for the New LED Board

Perform the following steps to verify that the new LED board is installed correctly.

Step 1 Turn on the power switches on all installed power supplies.

Step 2 After the system boots successfully, verify that the normal LED goes on. If it does not, do the following:

- Check the normal LED on the RSP2. If it is not on, the system has not reached normal operating state. Refer to the troubleshooting procedures in the chapter “Troubleshooting the Installation.”
- If the normal LED on the RSP2 is ON, the system software is functioning properly. On all installed power supplies, turn the switch OFF and reseat the LED board by following Steps 2 through 6 of the previous procedure “Installing a New LED Board.”

Step 3 Verify that the upper and lower power LEDs light for the installed power supplies. If they do not, check the LEDs on the AC-input (or DC-input) power supplies in the back of the chassis as follows:

- Check the AC power (or input power) LED on the power supply for the front panel LED that does not light. If the AC power (or input power) LED is ON, the power supply is functioning properly. Turn OFF the system power and reseat the LED board by following Steps 2 through 6 of the previous procedure “Installing a New LED Board.”
- If the power supply AC power (or input power) LED is not ON, or if the DC fail (or out fail) LED is ON, the power supply has failed. Refer to the troubleshooting procedures in the chapter “Troubleshooting the Installation.”

Step 4 If after several attempts the LEDs do not operate properly, or if you experience trouble with the installation (for instance, if the guide pins do not align with the holes in the board), contact a customer service representative for assistance.

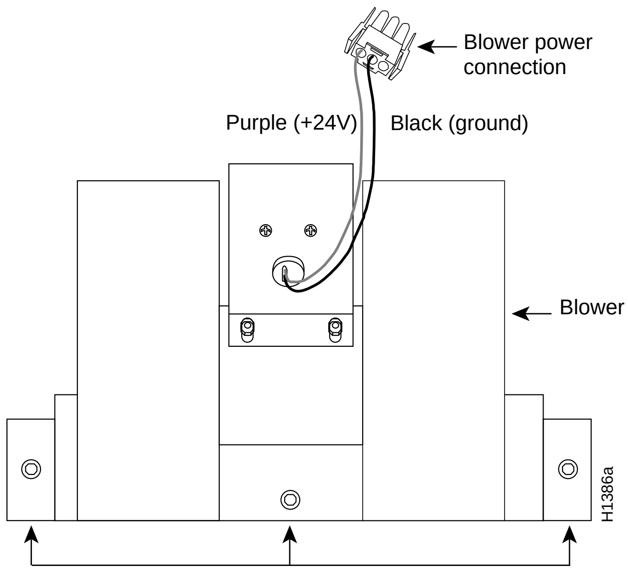
Replacing the Chassis Blower

The chassis blower draws cooling air in through the chassis bottom front panel and sends it up through the floor of the inner rear compartment to cool the RSP2 and interface processors. The absence of cooling air can cause the interior of the chassis to heat up and may cause an overtemperature condition. Never operate the system if the blower is not functioning properly.

Caution Never operate the system if the blower is not functioning properly or if one is not installed. An overtemperature condition can result in severe equipment damage.

The blower is located at the bottom of the chassis interior. (See Figure 5-27.) Two air ducts on the rear of the blower, shown shaded in the illustration, fit snugly into the two cutouts in the backplane. The blower is secured to the backplane with three large captive Allen-head screws, which are shown in Figure 5-29.

Figure 5-29 Chassis Blower



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

Tools Required

The following tools are required for this procedure:

- 3/16-inch flat-blade screwdriver to remove the chassis top front panel.
- Long (12 inches or longer) 3-mm center-hex Allen-head wrench or driver for the captive screws on the blower. (A T-handle driver is included with blower spares kits.)
- Flashlight (optional, as described following).

Although the far-left Allen-head screw on the blower is slightly obscured from view by the left lip of the chassis and the left blower air duct, an access hole in the lip of the chassis is provided specifically for access to this screw. By inserting the Allen wrench straight into the access hole, you should be able to find the screw without any trouble. However, if you do have trouble finding the screw, and if the lighting around the chassis is poor, you may need a flashlight to locate the screw and position the Allen wrench correctly.

Removing the Blower

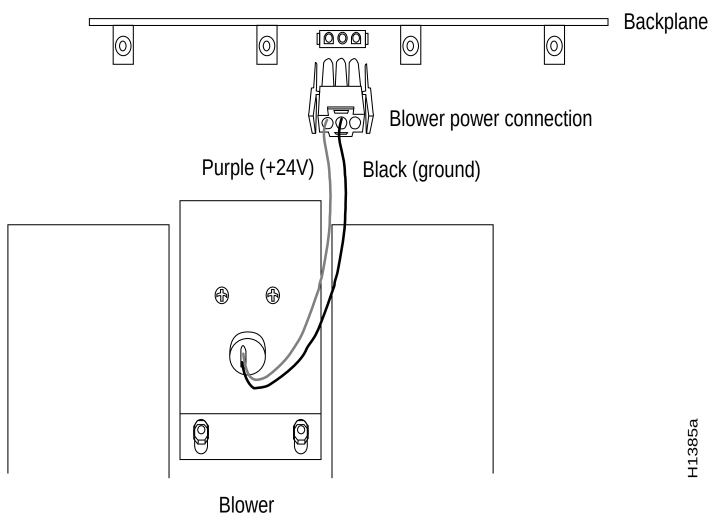
Remove the existing chassis blower as follows:

Step 1 On each installed power supply, turn OFF the power switch and unplug the power cable from the power source.

Step 2 Remove the front panels according to the procedure in the section "Removing the Panels" earlier in this chapter.

Step 3 Locate the blower (see Figure 5-27 in the section “Removing the LED Board”), which is mounted to the bottom of the backplane, and the blower power connector (see Figure 5-30), which is connected to a port in the backplane under the white power bar. Note the orientation of the power connector and its orientation in the backplane port.

Figure 5-30 Blower Power Connector



Step 4 Disconnect the blower 24V DC power connector from the backplane by pinching the sides of the connector inward and pulling the connector out and away from the backplane. Lay the connector and wiring on top of the blower to keep it out of the way while you remove the blower.

Step 5 Using a long Allen wrench, loosen each of the three captive screws by turning them counterclockwise two full turns. Use the access hole in the lower lip of the chassis to access this screw. Insert the wrench straight into the hole at a 90-degree angle to the backplane. If necessary, use a flashlight to locate and guide the wrench to the screw.

Step 6 When all three screws are loosened, unscrew them from the backplane. These captive screws are fixed to the blower; do not attempt to completely remove them.

Step 7 Two air ducts on the blower extend into the two cutouts in the backplane. (See Figure 5-27 in the section “Removing the LED Board.”) Grasp the blower with both hands and pull it outward (toward you and away from the backplane) while gently rocking it slightly up and down, and left to right, to free the blower ducts from the backplane.

Step 8 If the blower does not budge, check the three captive screws and ensure that they are free of the backplane. (They are fixed to the blower, but they should spin freely.)

Step 9 Pull the blower outward using steady pressure and jogging it until it frees the backplane.

Step 10 Lift the blower out of the chassis and place it aside out of traffic areas.

Step 11 Do not replace the front chassis panels until you install a new blower. If the system is inadvertently turned on without the blower installed, the internal chassis components may overheat, which can result in severe equipment damage.

Caution Never operate the system if the blower is removed or if it is not functioning properly. An overtemperature condition can result in severe equipment damage.

Installing a New Blower

Install the new chassis blower as follows:

Step 1 Ensure that the power supplies are still turned OFF.

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

Step 2 Note the orientation of the two air ducts on the back of the new blower and the two cutouts in the backplane. The two ducts fit snugly into the backplane cutouts.

Step 3 Hold the blower with the two air ducts facing away from you, and the three captive screws along the bottom of the side facing you (shown in the orientation shown in Figure 5-29 in the section "Replacing the Chassis Blower.") Lay the connector and wiring on top of the blower to keep it out of the way while you install the blower.

Step 4 Place the blower into the front chassis cavity so it rests on the floor of the chassis, then lift the blower up slightly and align the air ducts with the backplane cutouts.

Step 5 Push the air ducts into the cutouts. If necessary, wiggle the blower slightly as you push it inward (the ducts fit snugly into the cutouts) until the edges of the blower meet the backplane.

Step 6 Use the Allen wrench to turn each of the captive installation screws clockwise about two full turns to ensure that they are aligned in the backplane holes; you should not feel much resistance. If a screw is hard to turn, do not force it. Wiggle the chassis around, ensure that the screw is straight, and try tightening the screw again. If after several attempts the screw does not tighten easily, refer to the following section "Installation Checkout for the New Blower," for further instructions.

Step 7 Tighten each of the three captive installation screws by turning them clockwise. The far left screw is slightly obscured by the left lip of the chassis and the left blower air duct, but is accessible by inserting a long Allen wrench into the access hole in the lower lip of the chassis. Insert the wrench straight into the hole at a 90-degree angle to the backplane. If necessary, use a flashlight to locate and guide the wrench to the screw.

Step 8 Locate the blower power connection port (see Figure 5-30), which is under the white power bus bar on the backplane. Both the port and the connector are keyed so the flat edge of the connector is at the bottom.

Step 9 Hold the blower 24V DC power connector with the flat edge down and the red or purple (+24V) wire to the left, and plug the connector into the backplane connector. When the connector is fully inserted, two plastic tabs snap outward to secure the connector in place.

Step 10 Replace the top and bottom front chassis panels (refer to the section "Replacing the Panels" in this chapter) and proceed to the next section to verify the installation.

Installation Checkout for the New Blower

Perform the following steps to verify that the new blower is installed correctly.

Step 1 Turn ON all AC-input (or DC-input) power supplies. The AC power LED on all AC-input power supplies (or the input power LED on the DC-input power supplies) should go on. If any do not, or if the DC fail LED, on the AC-input power supply (or the out fail LED on the DC-input power supply) is on, the power supply has failed. Refer to the troubleshooting procedures in the chapter "Troubleshooting the Installation."

Step 2 Listen for the blower; you should immediately hear it operating. If you do not hear it, turn off the system power and do the following:

- Remove the top and bottom front chassis panels. (Refer to the section "Removing the Panels" earlier in this chapter.)
- Check the blower power connector and ensure that it is fully seated in the backplane port by pinching the sides and pushing it firmly into the port.
- Check the two wires between the blower and the power connector: the red or purple +24V wire and the black ground wire. Ensure that they have not pulled out of the power connector by pinching each wire near the back connector and pushing it firmly into the connector.
- Replace the front chassis panels, turn the power supplies back on, and listen for the blower.

Step 3 If after several attempts the blower does not operate, or if you experience trouble with the installation (for instance, if the captive installation screws do not align with the backplane holes), contact a customer service representative for assistance.

This completes the blower replacement.

Installation Checkout for the New Arbiter Board

Perform the following steps to verify that the new arbiter board is installed correctly.

Step 1 Turn each power supply back ON. The AC power LED on all AC-input power supplies (or the input power LEDs on the DC-input power supplies) should go on. If any do not, or if the DC fail LED on the AC-input power supply (or the out fail LED on the DC-input power supply) is on, the power supply has failed. Refer to the troubleshooting procedures in the chapter "Troubleshooting the Installation."

Step 2 After the system boots successfully, verify that the normal LED on the RSP2 goes on. If it does not, refer to the troubleshooting procedures in the chapter "Troubleshooting the Installation."

Note All spare parts are shipped with detailed, up-to-date instructions (called *configuration notes*) for installing and, if applicable, configuring the spare.

If you must return the chassis to the factory, be sure to remove all power supplies and to repack the chassis in the original shipping container. If the shipping container and packing material are no longer available, contact a customer service representative for instructions.