CISCO SYSTEMS

®

PA-4T+ Synchronous Serial Port Adapter Installation and Configuration

Product Number: PA-4T+(=)

Platforms Supported: Cisco 7200 Series, Cisco 7000 Series and Cisco 7500 Series with VIP2, Cisco uBR7200 Series, Cisco 7100 Series

Note   If you ordered this port adapter as a spare, for your convenience Cisco has included a port adapter installation and configuration note for the Catalyst 5000 series Route Switch Module/Versatile Interface Processor 2 (RSM/VIP2). Your port adapter is fully compatible with the RSM/VIP2.

PA-4T+ Synchronous Serial Port Adapter Installation and Configuration

Overview

This chapter describes the PA-4T+ port adapter and describes its LEDs, cables, and receptacles. This chapter contains the following sections:

- Port Adapter Overview, page 1-1
- Synchronous Serial Overview, page 1-3
- Serial Interface Specifications, page 1-4
- Cables and Pinouts, page 1-5
- LEDs, page 1-15

Port Adapter Overview

The PA-4T+ provides the following electrical interfaces: EIA/TIA-232, EIA/TIA-449, EIA-530. X.21, and V.35. Each interface complies with its specific interface specifications. The cable attached to each PA-4T+ port adapter's interface ports determines its type (EIA/TIA-232, and so forth) and its mode (data communications equipment [DCE] or data terminal equipment [DTE]).

Note The PA-4T+ provides enhanced performance over the PA-4T. To determine if a PA-4T+ or PA-4T is installed in your router, view the port adapters' faceplate labels (refer to Figure 1-1 and Figure 1-2, respectively) or use the **show diag** command to view installed interface types.

Figure 1-1   PA-4T+ —Faceplate View
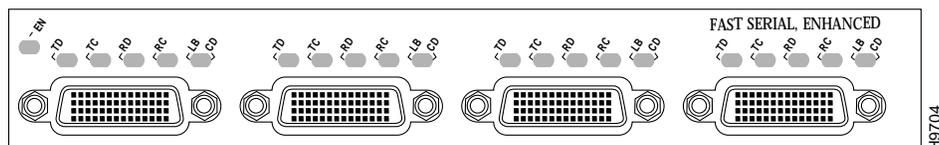
Figure 1-2   PA-4T Port Adapter—Faceplate View
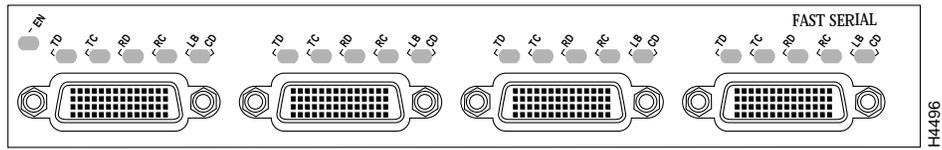
The following example of the **show diag** *slot* command shows a PA-4T+ in port adapter slot 0 (PA Bay 0) and a PA-4T in port adapter slot 1 (PA Bay 1) on a VIP2 that is in interface processor slot 3 in a Cisco 7500 series router.

Note   In the following examples, the PA-4T+ is displayed as *Mx serial*.

```
Router# show diag 3
Slot 3:
        Physical slot 3, ~physical slot 0x6, logical slot 3, CBus 0
        Microcode Status 0xC
        Master Enable, LED, WCS Loaded
        Board is analyzed
        Pending I/O Status: Console I/O
        EEPROM format version 1
        VIP2 controller, HW rev 2.2, board revision UNKNOWN
        Serial number: 03517093 Part number: 73-1684-03
        Test history: 0x00        RMA number: 00-00-00
        Flags: cisco 7000 board; 7500 compatible

        EEPROM contents (hex):
          0x20: 01 15 02 03 00 35 AA A5 49 06 94 03 00 00 00 00
          0x30: 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

        Slot database information:
        Flags: 0x4       Insertion time: 0x5314 (01:20:55 ago)

        Controller Memory Size: 8 MBytes DRAM, 1024 KBytes SRAM

        PA Bay 0 Information:
                Mx serial PA, 4 ports
                EEPROM format version 1
                HW rev 1.0, Board revision 154
                Serial number: 03699540  Part number: 73-1577-03

        PA Bay 1 Information:
                Fast-Serial PA, 4 ports
                EEPROM format version 1
                HW rev 1.0, Board revision 4
                Serial number: 02827523  Part number: 73-3417-04
```

The following example of the **show diag** *slot* command shows a PA-4T+ in port adapter slot 1 in a Cisco 7200 series or a cisco uBR7200 series router:

```
Router# show diag 1
Slot 1:
        Mx serial port adapter, 4 ports
        Port adapter is analyzed
        Port adapter insertion time 02:19:52 ago
        Hardware revision 1.0          Board revision UNKNOWN
        Serial number      3701161     Part number    73-1577-03
        Test history       0x0         RMA number     00-00-00
        EEPROM format version 1
        EEPROM contents (hex):
          0x20: 01 0C 01 00 00 38 79 A9 49 06 29 03 00 00 00 00
          0x30: 05 00 00 00 FF FF FF 00 FF FF FF FF FF FF FF FF
```

The following example of the **show diag** *slot* command shows a PA-4T in port adapter slot 1 in a Cisco 7100 series router:

```
Router# show diag 1
Slot 3:
        Serial port adapter, 4 ports
        Port adapter is analyzed
        Port adapter insertion time 02:19:52 ago
        EEPROM contents at hardware discovery:
        Hardware revision 1.0          Board revision A0
        Serial number      37296561     Part number    73-1556-04
        Test history       0x0         RMA number     00-00-00
        EEPROM format version 1
        EEPROM contents (hex):
          0x20: 01 11 01 00 00 A4 19 EC 49 06 98 04 00 00 00 00
          0x30: 50 00 00 00 98 10 21 00 FF FF FF FF FF FF FF FF
```

Synchronous Serial Overview

The PA-4T+ provides four channel-independent, synchronous serial ports that support full-duplex operation at T1 (1.544-Mbps) and E1 (2.048-Mbps) speeds. Each port supports any of the available interface types: Electronics Industries Association/Telecommunications Industries Association (EIA/TIA)-232, EIA/TIA-449, V.35, X.21, and EIA-530.

EIA/TIA-232, which is by far the most common interface standard in the U.S., supports unbalanced circuits at signal speeds up to 64 kbps. EIA/TIA-449, which supports balanced (EIA/TIA-422) and unbalanced (EIA/TIA-423) transmissions, is a faster (up to 2 Mbps) version of EIA/TIA-232 that provides more functions and supports transmissions over greater distances. The EIA/TIA-449 standard was intended to replace EIA/TIA-232, but it was not widely adopted.

Note The EIA/TIA standards were referred to as recommended standards called RS-232 and RS-449 prior to their acceptance by the ANSI committee.

The resistance to convert to EIA/TIA-449 was due primarily to the large installed base of DB-25 hardware and to the larger size of the 37-pin EIA/TIA-449 connectors, which limited the number of connections possible (fewer than is possible with the smaller, 25-pin EIA/TIA-232 connector).

EIA-530, which supports balanced transmission, provides the increased functionality, speed, and distance of EIA/TIA-449 on the smaller, DB-25 connector used for EIA/TIA-232. The EIA-530 standard was created to support the more sophisticated circuitry of EIA/TIA-449 on the large number of existing EIA/TIA-232 (DB-25) hardware instead of the larger, 37-pin connectors used for

EIA/TIA-449. Like EIA/TIA-449, EIA-530 refers to the electrical specifications of EIA/TIA-422 and EIA/TIA-423. The specification recommends a maximum speed of 2 Mbps. EIA-530 is used primarily in the United States.

The V.35 interface is most commonly used in the United States and throughout Europe, and is recommended for speeds up to 48 kbps. The X.21 interface uses a 15-pin connection for balanced circuits and is commonly used in the United Kingdom to connect public data networks. X.21 relocates some of the logic functions to the data terminal equipment (DTE) and data communications equipment (DCE) interfaces and, as a result, requires fewer circuits and a smaller connector than EIA/TIA-232.

All interface types except EIA-530 can be individually configured for operation with either external (DTE mode) or internal (DCE mode) timing signals; EIA-530 operates with external timing only. In addition, all VIP2 serial interface types support nonreturn to zero (NRZ) and nonreturn to zero inverted (NRZI) format, and both 16-bit and 32-bit cyclic redundancy checks (CRCs). The default configuration is for NRZ format and 16-bit CRC. You can change the default settings with software commands. (For more information, see the Chapter 8, "Configuring the PA-4T+ Interfaces.")

There is no default mode or clock rate set on the VIP2 serial ports, although an internal clock signal is present on all ports for DCE support. The internal clock also allows you to perform local loopback tests without having to terminate the port or connect a cable. (All interface types except X.21 DTE support loopback.) To use the port as a DCE interface, you must set the clock rate and connect a DCE adapter cable. To use the port as a DTE interface, you need only connect a DTE adapter cable to the port. Because the serial adapter cables determine the mode and interface type, the PA-4T+ interface becomes a DTE when a DTE cable is connected to it.

If a DTE cable is connected to a port with a clock rate set, the DTE ignores the clock rate and uses the external clock signal that is sent from the remote DCE. For a brief description of the **clockrate** command, see Chapter 8, "Configuring the PA-4T+ Interfaces." For complete command descriptions and instructions, see the publications listed in the section "Related Documentation" section on page vi.

Serial Interface Specifications

The PA-4T+ provides up to four synchronous serial interfaces. Each interface allows a maximum bandwidth of 2.048 Mbps; the speed depends on the type of electrical interface used. Use EIA/TIA-232 for speeds of 64 kilobits per second (kbps) and below, and use X.21, EIA/TIA-449, V.35, or EIA-530 for higher speeds.

Serial signals can travel a limited distance at any given bit rate; generally, the slower the baud rate, the greater the distance. All serial signals are subject to distance limits beyond which a signal degrades significantly or is completely lost.

Table 1-1 lists the recommended (standard) maximum speeds and distances for each PA-4T+ serial interface type. The recommended maximum rate for V.35 is 2.048 Mbps.

Table 1-1   Standards for Transmission Speed Versus Distance

Rate (bps)	EIA/TIA-232 Distances		EIA/TIA-449, X.21, V.35, EIA-530 Distances	
	Feet	Meters	Feet	Meters
2400	200	60	4,100	1,250
4800	100	30	2,050	625
9600	50	15	1,025	312
19200	25	7.6	513	156
38400	12	3.7	256	78
56000	8.6	2.6	102	31
1544000 (T1)	–	–	50	15

Balanced drivers allow EIA/TIA-449 signals to travel greater distances than EIA/TIA-232. The recommended distance limits for EIA/TIA-449 shown in Table 1-1 are also valid for V.35, X.21, and EIA-530. EIA/TIA-449 and EIA-530 support 2.048-Mbps rates, and V.35 supports 2.048-Mbps rates without any problems; we do not recommend exceeding published specifications for transmission speed versus distance. Do so at your own risk.

Cables and Pinouts

The following sections describe the serial receptacles on the PA-4T+, and the cables and pinouts for the various serial interface cables.

PA-4T+ Receptacles and Cables

The PA-4T+ and adapter cables allow a high density of interface ports, regardless of the size of the connectors typically used with each electrical interface type. All ports use an identical 60-pin D-shell receptacle that supports all interface types: EIA/TIA-232, V.35, EIA/TIA-449, X.21, and EIA-530. Each port requires a serial adapter cable, which provides the interface between the high-density serial port and the standard connectors that are commonly used for each electrical interface type.

Note The adapter cable determines the electrical interface type and mode of the port (DTE or DCE) to which it is connected.

The network end of the cable is an industry-standard connector for the type of electrical interface that the cable supports. For most interface types, the adapter cable for DTE mode uses a plug at the network end, and the cable for DCE mode uses a receptacle at the network end. Exceptions are V.35 adapter cables, which are available with either a V.35 plug or a receptacle for either mode, and the EIA-530 adapter cable, which is available only in DTE mode with a DB-25 plug at the network end. The mode is labeled on the molded plastic connector shell at the ends of all cables except V.35 (which uses the standard Winchester block-type connector instead of a molded plastic D shell).

Following are the available interface cable options (and product numbers) for the mode and network-end connectors for each cable:

- EIA/TIA-232: DTE mode with a DB-25 plug (CAB-232MT=); DCE mode with a DB-25 receptacle (CAB-232FC=).

- EIA/TIA-449: DTE mode with a 37-pin D-shell plug (CAB-449MT=); DCE mode with a 37-pin D-shell receptacle (CAB-449C=).

- V.35: DTE mode or DCE mode with a 34-pin Winchester-type V.35 plug (CAB-V35MT= or CAB-V35MC=); DTE mode or DCE mode with a 34-pin Winchester-type V.35 receptacle (CAB-V35FT= or CAB-V35FC=). Also available is a cable with a male DB-60 plug on the router end and a male DB-34 shielded plug on the network end (CAB-V35MTS=).

- X.21: DTE mode with a DB-15 plug (CAB-X21MT=); DCE mode with a DB-25 receptacle (CAB-X21FC=).

- EIA-530: DTE mode with a DB-25 plug (CAB-530MT=).

Note For cable pinouts, see the "PA-4T+ Port Adapter Cable Pinouts" section on page 1-9.

Figure 1-3 shows the serial port adapter cables for connection from the PA-4T+ port adapters to your network.

Figure 1-3   Serial Port Adapter Cables
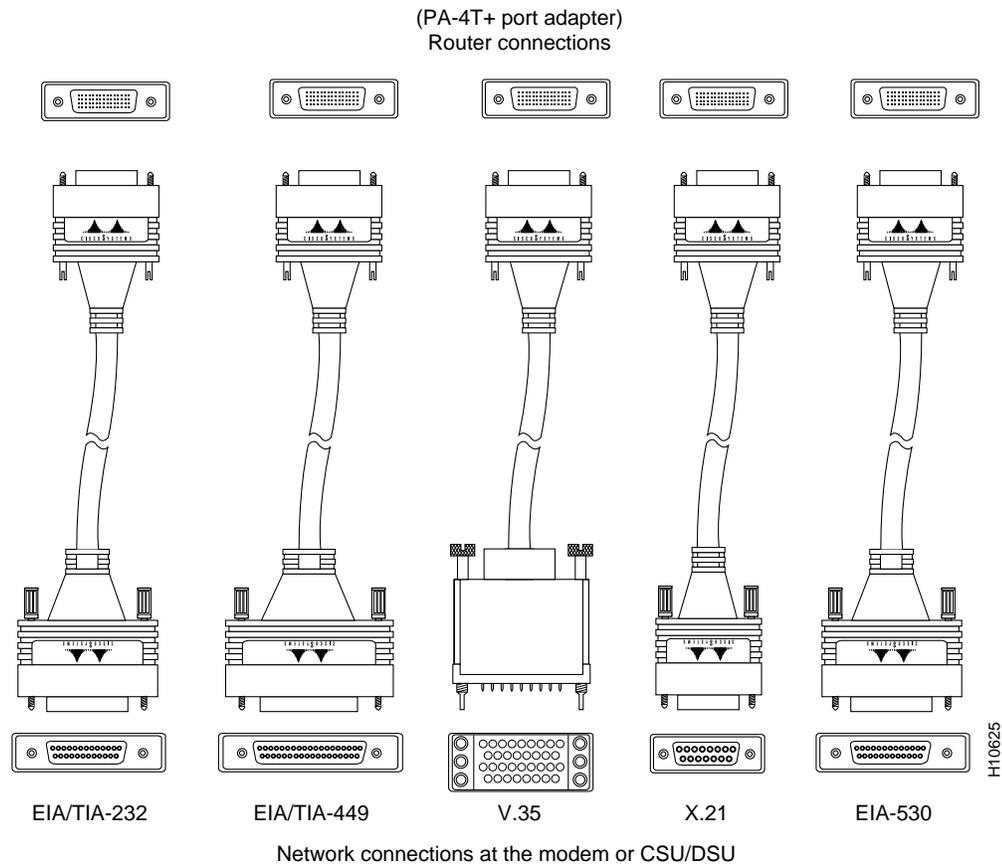
Metric (M3) thumbscrews are included with each port adapter cable to allow connections to devices that use metric hardware. Because the PA-4T+ uses a special, high-density port that requires special adapter cables for each electrical interface type, we recommend that you obtain serial interface cables from the factory.

EIA/TIA-232 Connections

The router end of all EIA/TIA-232 adapter cables is a high-density 60-pin plug. The network end of the adapter cable is a standard 25-pin D-shell connector (known as a DB-25) that is commonly used for EIA/TIA-232 connections. Figure 1-4 shows the connectors at the network end of the adapter cable.


Note The system console and auxiliary ports on the Route Switch Processor (RSP) in the Cisco 7500 series also use EIA/TIA-232 connections; however, the PA-4T+ interfaces support synchronous serial connections, and the console and auxiliary ports only support asynchronous connections. Use caution when connecting EIA/TIA-232 cables to the PA-4T+ receptacles.

Note Do not use the Cisco Systems-provided EIA/TIA-232 adapter cable CAB-232MT= to connect a PA-4T+ interface that is configured for DTE mode *directly* to an NEC - NEXTSTAR 1E model C4969 MD/SAC unit interface that is configured for DCE mode. Doing so will keep transmit and receive data signals from being properly exchanged between the two interfaces.

Instead, you must connect an additional, intermediate adapter cable—with standard EIA/TIA-232 DB-25 connectors at both ends—from the network end of CAB-232MT= to the standard EIA/TIA-232 DB-25 connector (the DCE interface) on the NEC - NEXTSTAR 1E model C4969 MD/SAC unit. Cisco Systems does not provide this additional cable; however, its signals and pin assignments are listed in Table 1-3.

Note You can use the Cisco Systems-provided EIA/TIA-232 adapter cable CAB-232FC= to connect a PA-4T+ interface that is configured for DCE mode *directly* to an NEC - NEXTSTAR 1E model C4969 MD/SAC unit interface that is configured for DTE mode.

Figure 1-4   EIA/TIA-232 Adapter Cable Connectors

DTE

DCE

H1343a
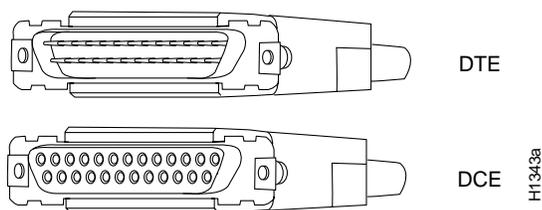
EIA/TIA-449 Connections

The router end of all EIA/TIA-449 adapter cables is a high-density 60-pin plug. The network end of the adapter cable provides a standard 37-pin D-shell connector, which is commonly used for EIA/TIA-449 connections. Figure 1-5 shows the connectors at the network end of the adapter cable. EIA/TIA-449 cables are available as either DTE (DB-37 plug) or DCE (DB-37 receptacle).

Figure 1-5   EIA/TIA-449 Adapter Cable Connectors

DTE

DCE

H1344a
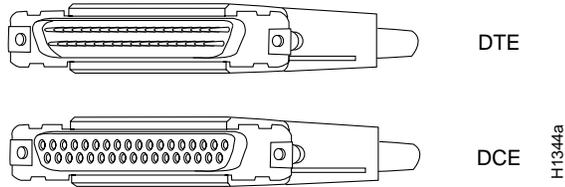
V.35 Connections

The router end of all V.35 adapter cables is a high-density 60-pin plug. The network end of the adapter cable provides a standard 34-pin Winchester-type connector commonly used for V.35 connections. Figure 1-6 shows the connectors at the network end of the V.35 adapter cable. V.35 cables are available with a standard V.35 plug for DTE mode (CAB-V35MT=) or a V.35 receptacle for DCE mode (CAB-V35FC=).

Figure 1-6   V.35 Adapter Cable Connectors

DTE

DCE

H1616a

Note   Also available, but not shown in Figure 1-6, are CAB-V35MC=, a V.35 cable with a plug on the network end for DCE mode, and CAB-V35FT=, a V.35 cable with a receptacle on the network end for DTE mode. These cables are used for connecting V.35-equipped systems back to back.

X.21 Connections

The router end of all X.21 adapter cables is a high-density 60-pin plug. The network end of the adapter cable is a standard DB-15 connector. Figure 1-7 shows the connectors at the network end of the X.21 adapter cable. X.21 cables are available as either DTE (DB-15 plug) or DCE (DB-15 receptacle).
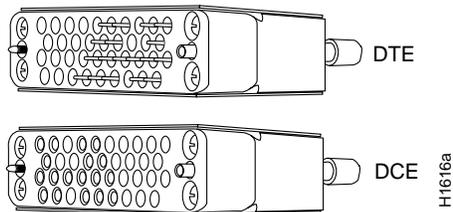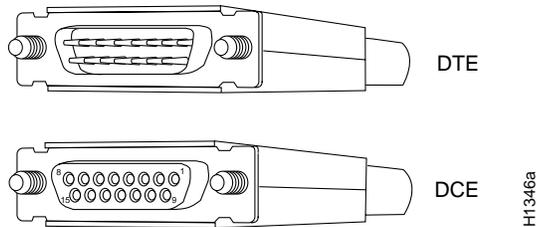
Figure 1-7   X.21 Adapter Cable Connectors

EIA-530 Connections

The EIA-530 adapter cable is available in DTE mode only. The router end of the EIA-530 adapter cable is a high-density 60-pin plug. The network end of the adapter cable is a standard DB-25 plug commonly used for EIA/TIA-232 connections. Figure 1-8 shows the DB-25 connector at the network end of the adapter cable.

Figure 1-8   EIA-530 Adapter Cable Connector
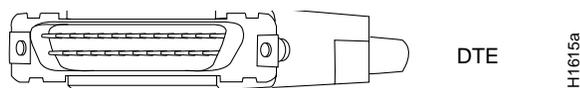
PA-4T+ Port Adapter Cable Pinouts

The PA-4T+ supports EIA/TIA-232, EIA/TIA-449, X.21, V.35, and EIA-530 serial interfaces. All PA-4T+ ports use a a 60-pin receptacle that supports all available interface types. A special serial adapter cable determines the electrical interface type and mode of the interface. The router end of all of the adapter cables has a 60-pin plug; the connectors at the network end are the standard connectors used for the respective interfaces. All interface types except EIA-530 are available in DTE or DCE format: DTE with a plug at the network end and DCE with a receptacle at the network end. V.35 is available in either mode with either gender at the network end. EIA-530 is available in DTE only. The tables that follow list the signal pinouts for both the DTE and DCE mode serial port adapter cables, for each of the following PA-4T+ interface types:

- EIA/TIA-232 pinouts, Table 1-2

- EIA/TIA-449 pinouts, Table 1-4

- EIA-530 pinouts, Table 1-5

- V.35 pinouts, Table 1-6

- X.21 pinouts, Table 1-7

Table 1-2   EIA/TIA-232 Adapter Cable Signals

DTE Cable (CAB-232MT=)				DCE Cable (CAB-232FC=)			
Router End, HD[1] 60-Position Plug			**Network End, DB-25 Plug**	**Router End, HD 60-Position Plug**			**Network End, DB-25 Receptacle**
Signal	**Pin**	**Pin**	**Signal**	**Signal**	**Pin**	**Pin**	**Signal**
Shield ground	46		1	Shield ground	Shield ground	46		1	Shield ground
TxD/RxD	41	—> 2	TxD	RxD/TxD	36	<— 2	TxD
RxD/TxD	36	<— 3	RxD	TxD/RxD	41	—> 3	RxD
RTS/CTS	42	—> 4	RTS	CTS/RTS	35	<— 4	RTS
CTS/RTS	35	<— 5	CTS	RTS/CTS	42	—> 5	CTS
DSR/DTR	34	<— 6	DSR	DTR/DSR	43	—> 6	DSR
Circuit ground	45		7	Circuit ground	Circuit ground	45		7	Circuit ground
DCD/LL	33	<— 8	DCD	LL/DCD	44	—> 8	DCD
TxC/NIL	37	<— 15	TxC	TxCE/TxC	39	—> 15	TxC
RxC/TxCE	38	<— 17	RxC	NIL/RxC	40	—> 17	RxC
LL/DCD	44	—> 18	LTST	DCD/LL	33	<— 18	LTST
DTR/DSR	43	—> 20	DTR	DSR/DTR	34	<— 20	DTR
TxCE/TxC	39	—> 24	TxCE	RxC/TxCE	38	<— 24	TxCE
Mode 0 Ground Mode_DCE	50 51 52		Shorting group	Mode 0 Ground	50 51		Shorting group

1   HD = high density.

**Table 1-3   Intermediate Adapter Cable Signals (for Connecting a PA-4T+ to a
NEC - NEXTSTAR 1E Model C4969 MD/SAC Unit)**

Router (DTE) End, DB-25 Receptacle			Network (DCE) End, DB-25 Plug	
Signal	**Pin**		**Pin**	**Signal**
Shield ground	1		1	Shield ground
TxD	2	—>	2	TxD
RxD	3	<—	3	RxD
RTS	4	—>	4	RTS
CTS	5	<—	5	CTS
DSR	6	<—	6	DSR
Circuit ground	7		7	Circuit ground
DCD	8	<—	8	DCD
TxC, RxC	15, 17	<—	15	TxC
–	–	<—	17	RxC
LTST	18	—>	18	LTST
DTR	20	—>	20	DTR
TxCE	24	—>	24	TxCE
Shorting group				Shorting group

Table 1-4   EIA/TIA-449 Adapter Cable Signals

DTE Cable (CAB-449MT=)					DCE Cable (CAB-449C=)				
Router End, HD[1] 60-Position Plug			**Network End, DB-37 Plug**		**Router End, HD 60-Position Plug**			**Network End, DB-37 Receptacle**	
Signal	**Pin**		**Pin**	**Signal**	**Signal**	**Pin**		**Pin**	**Signal**
Shield ground	46		1	Shield ground	Shield ground	46		1	Shield ground
TxD/RxD+	11	—>	4	SD+	RxD/TxD+	28	<—	4	SD+
TxD/RxD–	12	—>	22	SD–	RxD/TxD–	27	<—	22	SD–
TxC/RxC+	24	<—	5	ST+	TxCE/TxC+	13	—>	5	ST+
TxC/RxC–	23	<—	23	ST–	TxCE/TxC–	14	—>	23	ST–
RxD/TxD+	28	<—	6	RD+	TxD/RxD+	11	—>	6	RD+
RxD/TxD–	27	<—	24	RD–	TxD/RxD–	12	—>	24	RD–
RTS/CTS+	9	—>	7	RS+	CTS/RTS+	1	<—	7	RS+
RTS/CTS–	10	—>	25	RS–	CTS/RTS–	2	<—	25	RS–
RxC/TxCE+	26	<—	8	RT+	TxC/RxC+	24	—>	8	RT+
RxC/TxCE–	25	<—	26	RT–	TxC/RxC–	23	—>	26	RT–
CTS/RTS+	1	<—	9	CS+	RTS/CTS+	9	—>	9	CS+
CTS/RTS–	2	<—	27	CS–	RTS/CTS–	10	—>	27	CS–
LL/DCD	44	—>	10	LL	NIL/LL	29	—>	10	LL
Circuit ground	45		37	SC	Circuit ground	30		37	SC
DSR/DTR+	3	<—	11	ON+	DTR/DSR+	7	—>	11	ON+
DSR/DTR–	4	<—	29	ON–	DTR/DSR–	8	—>	29	ON–
DTR/DSR+	7	—>	12	TR+	DSR/DTR+	3	<—	12	TR+
DTR/DSR–	8	—>	30	TR–	DSR/DTR–	4	<—	30	TR–
DCD/DCD+	5	<—	13	RR+	DCD/DCD+	5	—>	13	RR+
DCD/DCD–	6	<—	31	RR–	DCD/DCD–	6	—>	31	RR–
TxCE/TxC+	13	—>	17	TT+	RxC/TxCE+	26	<—	17	TT+
TxCE/TxC–	14	—>	35	TT–	RxC/TxCE–	25	<—	35	TT–
Circuit ground	15		19	SG	Circuit ground	15		19	SG
Circuit ground	16		20	RC	Circuit ground	16		20	RC
Mode 1 Ground	49 48			Shorting group	Mode 1 Ground	49 48			Shorting group
Ground Mode_DCE	51 52			Shorting group					

1   HD = high density.

Table 1-5   EIA-530 DTE Adapter Cable Signals (CAB-530MT=)

Router End, HD[1] 60-Position Plug				Network End, DB-25 Plug
Signal	Pin		Pin	Signal
Shield ground	46		1	Shield ground
TxD/RxD+	11	—>	2	TxD+
TxD/RxD–	12	—>	14	TxD–
RxD/TxD+	28	<—	3	RxD+
RxD/TxD–	27	<—	16	RxC–
RTS/CTS+	9	—>	4	RTS+
RTS/CTS–	10	—>	19	RTS–
CTS/RTS+	1	<—	5	CTS+
CTS/RTS–	2	<—	13	CTS–
DSR/DTR+	3	<—	6	DSR+
DSR/DTR–	4	<—	22	DSR–
DCD/DCD+	5	<—	8	DCD+
DCD/DCD–	6	<—	10	DCD–
TxC/RxC+	24	<—	15	TxC+
TxC/RxC–	23	<—	12	TxC–
RxC/TxCE+	26	<—	17	RxC+
RxC/TxCE–	25	<—	9	RxC–
LL/DCD	44	—>	18	LL
Circuit ground	45		7	Circuit ground
DTR/DSR+	7	—>	20	DTR+
DTR/DSR–	8	—>	23	DTR–
TxCE/TxC+	13	—>	24	TxCE+
TxCE/TxC–	14	—>	11	TxCE–
Mode_1	49			
Ground	48			Shorting group
Mode_2	47			
Ground	51			Shorting group
Mode_DCE	52			

1   HD = high density.

Table 1-6   V.35 Adapter Cable Signals

DTE Cable (CAB-V35FT= or CAB-V35MT=)				DCE Cable (CAB-V35FC= or CAB-V35MC=)			
Router End, HD[1] 60-Position Plug			**Network End, 34-Position Plug**	**Router End, HD 60-Position Plug**			**Network End, 34-Position Receptacle**
Signal	**Pin**		**Pin**	**Signal**	**Signal**	**Pin**		**Pin**	**Signal**
Shield ground	46		A	Frame ground	Shield ground	46		A	Frame ground
Circuit ground	45		B	Circuit ground	Circuit ground	45		B	Circuit ground
RTS/CTS	42	—>	C	RTS	CTS/RTS	35	<—	C	RTS
CTS/RTS	35	<—	D	CTS	RTS/CTS	42	—>	D	CTS
DSR/DTR	34	<—	E	DSR	DTR/DSR	43	—>	E	DSR
DCD/LL	33	<—	F	RLSD	LL/DCD	44	—>	F	RLSD
DTR/DSR	43	—>	H	DTR	DSR/DTR	34	<—	H	DTR
LL/DCD	44	—>	K	LT	DCD/LL	33	<—	K	LT
TxD/RxD+	18	—>	P	SD+	RxD/TxD+	28	<—	P	SD+
TxD/RxD–	17	—>	S	SD–	RxD/TxD–	27	<—	S	SD–
RxD/TxD+	28	<—	R	RD+	TxD/RxD+	18	—>	R	RD+
RxD/TxD–	27	<—	T	RD–	TxD/RxD–	17	—>	T	RD–
TxCE/TxC+	20	—>	U	SCTE+	RxC/TxCE+	26	<—	U	SCTE+
TxCE/TxC–	19	—>	W	SCTE–	RxC/TxCE–	25	<—	W	SCTE–
RxC/TxCE+	26	<—	V	SCR+	NIL/RxC+	22	—>	V	SCR+
RxC/TxCE–	25	<—	X	SCR–	NIL/RxC–	21	—>	x	SCR–
TxC/RxC+	24	<—	Y	SCT+	TxCE/TxC+	20	—>	Y	SCT+
TxC/RxC–	23	<—	AA	SCT–	TxCE/TxC–	19	—>	AA	SCT–
Mode 1 Ground	49 48			Shorting group	Mode 1 Ground	49 48			Shorting group
Mode 0 Ground Mode_DCE	50 51 52			Shorting group	Mode 0 Ground	50 51			Shorting group
TxC/NIL RxC/TxCE RxC/TxD Ground	53 54 55 56			Shorting group	TxC/NIL RxC/TxCE RxC/TxD Ground	53 54 55 56			Shorting group

1   HD = high density.

Table 1-7   X.21 Adapter Cable Signals

DTE Cable (CAB-X21MT=)				DCE Cable (CAB-X21FC=)			
Router End, HD[1] 60-Position Plug			Network End, DB-15 Plug	Router End, HD 60-Position Plug			Network End, DB-15 Receptacle
Signal	Pin		Pin Signal	Signal	Pin		Pin Signal
Shield ground	46		1 Shield ground	Shield ground	46		1 Shield ground
TxD/RxD+	11	—>	2 Transmit+	RxD/TxD+	11	—>	2 Transmit+
TxD/RxD–	12	—>	9 Transmit–	RxD/TxD–	12	—>	9 Transmit–
RTS/CTS+	9	—>	3 Control+	CTS/RTS+	9	—>	3 Control+
RTS/CTS –	10	—>	10 Control–	CTS/RTS –	10	—>	10 Control–
RxD/TxD+	28	<—	4 Receive+	TxD/RxD+	28	<—	4 Receive+
RxD/TxD–	27	<—	11 Receive–	TxD/RxD–	27	<—	11 Receive–
CTS/RTS+	1	<—	5 Indication+	RTS/CTS+	1	<—	5 Indication+
CTS/RTS –	2	<—	12 Indication–	RTS/CTS–	2	<—	12 Indication–
RxC/TxCE+	26	<—	6 Timing+	TxC/RxC+	26	<—	6 Timing+
RxC/TxCE–	25	<—	13 Timing–	TxC/RxC –	25	<—	13 Timing–
Circuit ground	15		8 Circuit ground	Circuit ground	15		8 Circuit ground
Ground Mode_2	48 47		Shorting group	Ground Mode_2	48 47		Shorting group
Ground Mode_DCE	51 52		Shorting group	Ground Mode_DCE	51 52		

1   HD = high density.

LEDs

The PA-4T+ contains the enabled LED, standard on all port adapters, and one status LED for each port. After system initialization, the enabled LED goes on to indicate that the PA-4T+ has been enabled for operation. (The LEDs are shown in Figure 1-9.)

Figure 1-9   LEDs on the PA-4T+—Horizontal Orientation
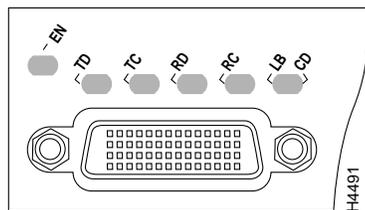
The following conditions must be met before the PA-4T+ is enabled:

* The port adapter is correctly connected to the backplane midplane and receiving power.

* A valid system software image for the port adapter has been downloaded successfully.

* The system software recognizes the port adapter or VIP2 with an installed PA-4T+.

If any of the above conditions are not met, or if the initialization fails for other reasons, the enabled LED will not go on. Table 1-8 lists port LED status indications.

Table 1-8   PA-4T+ Port LEDs

LED Label	Color	State	Function
EN	Green	On	Indicates ports are ready.
TD	Green	On	DTE—Transmit data out.
			DCE—Transmit data in.
TC	Green	On	DTE—Transmit clock in.
			DCE—Transmit clock in (TXCE).
RD	Green	On	DTE—Receive data in.
			DCE—Receive data out.
RC	Green	On	DTE—Receive clock in.
			DCE—Receive clock out.
LB/CD	Green	On	Indicates DTR, DSR, RTS, CTS, or DCD is active.
	Green	Flashing	Indicates RTS, CTS, or DCD is sending and receiving data in half-duplex mode.
	Yellow	On	Indicates local loop or internal loop active.

Preface

This preface describes the objectives and organization of this document and explains how to find additional information on the PA-4T+ port adapter and other Cisco products and services. This preface contains the following sections:

- Objectives, page v
- Document Organization, page vi
- Related Documentation, page vi
- Cisco Connection Online, page vii
- Documentation CD-ROM, page viii

Objectives

This document describes how to install and configure the PA-4T+ synchronous serial port adapter (PA-4T+[=]), which is used in the following platforms:

- Second-generation Versatile Interface Processor (VIP2) in Cisco 7500 series routers and Cisco 7000 series routers with the Cisco 7000 Series Route Switch Processor (RSP7000) and Cisco 7000 Series Chassis Interface (RSP7000CI)

- Cisco 7200 series routers—which consist of the two-slot Cisco 7202, the four-slot Cisco 7204 and Cisco 7204VXR, and the six-slot Cisco 7206 and Cisco 7206VXR

- Cisco uBR7200 series universal broadband routers—which consist of the six-slot Cisco uBR7246 and the three-slot Cisco uBR7223

- Cisco 7100 series routers—which consist of the Cisco 7120 series and Cisco 7140 series

Document Organization

This document is organized into the following chapters:

Section	Title	Description
Chapter 1	Overview	Describes the PA-4T+ port adapter, illustrates their location in the supported hardware platforms, and describes its LED displays, cables, and receptacles.
Chapter 2	Preparing for Installation	Describes safety considerations, tools required, and procedures you should perform before the actual installation.
Chapter 3	VIP2 and the PA-4T+ Port Adapter	Provides instructions for installing the PA-4T+ port adapter on a VIP2 interface processor installed in a Cisco 7500 or Cisco 7000 series router.
Chapter 4	Cisco 7200 Series and the PA-4T+ Port Adapter	Provides instructions for installing the PA-4T+ port adapter in a Cisco 7200 series router.
Chapter 5	Cisco uBR7200 Series and the PA-4T+ Port Adapter	Provides instructions for installing the PA-4T+ port adapter in a Cisco uBR7200 series universal broadband router.
Chapter 6	Cisco 7100 Series and the PA-4T+ Port Adapter	Provides instructions for installing the PA-4T+ port adapter in Cisco 7100 series routers.
Chapter 7	Installing the PA-4T+ Interface Cables	Provides instructions for installing port adapter cables on the supported platforms.
Chapter 8	Configuring the PA-4T+ Interfaces	Provides instructions for configuring your port adapter on the supported platforms. The instructions given in this chapter apply to all supported platforms described in this document.

Related Documentation

Your router and the Cisco IOS software running on it contain extensive features and functionality, which are documented in the following resources:

- For Cisco IOS software configuration information and support, refer to the modular configuration and modular command reference publications in the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware.

  Note   You can access Cisco IOS software configuration and hardware installation and maintenance documentation on the World Wide Web at http://www.cisco.com, http://www-china.cisco.com, or http://www-europe.cisco.com.

- For hardware installation and maintenance information on the Cisco 7000 series and Cisco 7500 series routers, and the VIP2, refer to the following publications:
  — The installation and configuration guide that shipped with your Cisco 7000 series or Cisco 7500 series router
  — *Second-Generation Versatile Interface Processor (VIP2) Installation and Configuration* (for VIP2 users only)

- For hardware installation and maintenance information on the Cisco 7100 series routers, refer to the *Cisco 7100 Series VPN Router Configuration Guide* publication that shipped with your Cisco 7100 series router

- For information on setting up a Virtual Private Network, see the *Cisco 7100 Series VPN Configuration Guide*.

- For hardware installation and maintenance information on the Cisco 7200 series routers, refer to the *Cisco 7200 Series Installation and Configuration Guide* that shipped with your Cisco 7200 series router.

- For hardware installation and maintenance information on the Cisco 7200 VXR routers, refer to the *Cisco 7200 VXR Installation and Configuration Guide* publication that shipped with your Cisco 7200 VXR router.

- For hardware installation and maintenance information on the Cisco uBR7200 series, refer to the *Cisco uBR72xx Series Universal Broadband Router Installation and Configuration Guide* that shipped with your Cisco uBR7200 series universal broadband router.

- For international agency compliance, safety, and statutory information for WAN interfaces for the Cisco 7500 series, Cisco 7000 series, Cisco 7200 series, Cisco uBR7200 series universal broadband routers, and the Cisco 7100 series routers, refer to the following publications:

  — *Regulatory Compliance and Safety Information for the Cisco 7500 Series Routers.*

  — *Regulatory Compliance and Safety Information for the Cisco 7000 Series Routers.*

  — *Regulatory Compliance and Safety Information for the Cisco 7200 Series Routers.*

  — *Regulatory Compliance and Safety Information for the Cisco uBR72xx Series Universal Broadband Router*

  — *Regulatory Compliance and Safety Information for the Cisco 7100 Series VPN Routers*

- To view Cisco documentation or obtain general information about the documentation, see the "Documentation CD-ROM" section on page vi, the next section "Cisco Connection Online", or call customer service at 800 553-6387 or 408 526-7208. Customer service hours are 5:00 a.m. to 6:00 p.m. Pacific time, Monday through Friday (excluding Cisco-observed holidays). You can also send e-mail to cs-rep@cisco.com.

Cisco Connection Online

Cisco Connection Online (CCO) is Cisco Systems' primary, real-time support channel. Maintenance customers and partners can self-register on CCO to obtain additional information and services.

Available 24 hours a day, 7 days a week, CCO provides a wealth of standard and value-added services to Cisco's customers and business partners. CCO services include product information, product documentation, software updates, release notes, technical tips, the Bug Navigator, configuration notes, brochures, descriptions of service offerings, and download access to public and authorized files.

CCO serves a wide variety of users through two interfaces that are updated and enhanced simultaneously: a character-based version and a multimedia version that resides on the World Wide Web (WWW). The character-based CCO supports Zmodem, Kermit, Xmodem, FTP, and Internet e-mail, and it is excellent for quick access to information over lower bandwidths. The WWW version of CCO provides richly formatted documents with photographs, figures, graphics, and video, as well as hyperlinks to related information.

You can access CCO in the following ways:

WWW: http://www.cisco.com

WWW: http://www-europe.cisco.com

WWW: http://www-china.cisco.com

Telnet: cco.cisco.com

Modem: From North America, 408 526-8070; from Europe, 33 1 64 46 40 82. Use the following terminal settings: VT100 emulation; databits: 8; parity: none; stop bits: 1; and connection rates up to 28.8 kbps.

For a copy of CCO's Frequently Asked Questions (FAQ), contact cco-help@cisco.com. For additional information, contact cco-team@cisco.com.

If you are a network administrator and need personal technical assistance with a Cisco product that is under warranty or covered by a maintenance contract, contact Cisco's Technical Assistance Center (TAC) at 800 553-2447, 408 526-7209, or tac@cisco.com. To obtain general information about Cisco Systems, Cisco products, or upgrades, contact 800 553-6387, 408 526-7208, or cs-rep@cisco.com.

Documentation CD-ROM

Cisco documentation and additional literature are available in a CD-ROM package, which ships with your product. The Documentation CD-ROM, a member of the Cisco Connection Family, is updated monthly. Therefore, it might be more current than printed documentation. To order additional copies of the Documentation CD-ROM, contact your local sales representative or call customer service. The CD-ROM package is available as a single package or as an annual subscription. You can also access Cisco documentation on the World Wide Web at http://www.cisco.com, http://www-china.cisco.com, or http://www-europe.cisco.com.

If you are reading Cisco product documentation on the World Wide Web, you can submit comments electronically. Click **Feedback** in the toolbar and select **Documentation**. After you complete the form, click **Submit** to send it to Cisco. We appreciate your comments.

Preparing for Installation

This chapter describes the general equipment, safety, and site preparation requirements for installing the PA-4T+ port adapter.

- Tools and Parts Required, page 2-1

- Software and Hardware Requirements, page 2-2

- Safety Guidelines, page 2-3

- FCC Class B Compliance, page 2-5

Tools and Parts Required

You need the following tools and parts to install a port adapter. If you need additional equipment, contact a service representative for ordering information.

- PA-4T+(=) port adapter and one of the following:

  — VIP2-15(=) if you are installing only one PA-4T+; otherwise, we recommend a VIP2-40(=) or VIP2-50(=)

  — Cisco 7200 series router with at least one available port adapter slot

  — Cisco uBR7200 series router with at least one available port adapter slot

  — Cisco 7100 series router with at least one available port adapter slot

- Serial cables appropriate for the desired port adapter interface types and the desired modes. (See the "LEDs" section on page 1-15.)

- Number 1 Phillips and a 3/16-inch, flat-blade screwdriver.

- Your own electrostatic discharge (ESD)-prevention equipment or the disposable grounding wrist strap included with all upgrade kits, field-replaceable units (FRUs), and spares.

Software and Hardware Requirements

 lists the minimum Cisco IOS software release required to use the PA-4T+ port adapter in supported router platforms.

Table 2-1   PA-4T+ Software Requirements

Router Platform	Recommended Minimum Cisco IOS Release
Cisco 7000 series and Cisco 7500 series	
• With VIP2-15(=) or VIP2-40(=)	Cisco IOS Release 11.1(8)CA or a later release of Cisco IOS Release 11.1 CA
• With VIP2-50(=)	Cisco IOS Release 11.1(14)CA or a later release of Cisco IOS Release 11.1 CA
Cisco 7200 series	
• Cisco 7204VXR and Cisco 7206VXR	Cisco IOS Release 12.0(3)T or a later release of Cisco IOS Release 12.0 T Cisco IOS Release 12.0(2)XE2 or a later release of Cisco IOS Release 12.0 XE
• Cisco 7204 and Cisco 7206	Cisco IOS Release 11.1(6)CA or a later release of Cisco IOS Release 11.1 CA[1]
• Cisco 7202	Cisco IOS Release 11.1(19)CC1 or a later release of Cisco IOS Release 11.1 CC Cisco IOS Release 11.3(4)AA or a later release of Cisco IOS Release 11.3 AA
Cisco uBR7200 series router	Cisco IOS Release 11.3(6)NA or a later release of Cisco IOS Release 11.3 NA
Cisco 7100 series	
• Cisco 7120 series and Cisco 7140 series	Cisco IOS Release 12.0(4)XE or a later release of Cisco IOS Release 12.0 XE Cisco IOS Release 12.0(5)T or a later release of Cisco IOS Release 12.0 T

[1] For PA-4T+ port adapters installed in Cisco 7200 series routers, Cisco IOS Release 11.1(6)CA, or later, is required; however, we recommend Cisco IOS Release 11.1(8)CA or later.

Note   Cisco IOS Release 11.2(7a)P or later supports half-duplex and binary synchronous communications (Bisync) operation on PA-4T+ port adapters in Cisco 7200 series routers.

Also refer to the Cisco IOS software release notes for the Cisco IOS software version you are running.

In Cisco 7000 series or Cisco 7500 series routers, the PA-4T+ requires the following VIP2 models:

- VIP2-15(=) (1 MB of SRAM, 8 MB of DRAM)

- VIP2-20(=) (1 MB of SRAM and 16 MB of DRAM)

- VIP2-40(=) (2 MB of SRAM, 32 MB of DRAM)

- VIP2-50(=) (4 to 8 MB of SRAM, 32 to 128 MB of DRAM)

Note   The PA-4T+ can be installed in port adapter slot 0 or slot 1 on the VIP2 motherboard, or in any available port adapter slot in a Cisco 7200 series chassis.

Caution   To prevent system problems, the VIP2 requires that Cisco 7000 series routers have the RSP7000 and RSP7000CI installed. The VIP2 will *not* operate properly with the Route Processor (RP), Switch Processor (SP), or Silicon Switch Processor (SSP) installed in a Cisco 7000 series router.

Note The minimum recommended VIP2 model is a VIP2-15.

Safety Guidelines

This section provides safety guidelines that you should follow when working with any equipment that connects to electrical power or telephone wiring.

Safety Warnings

Safety warnings appear throughout this publication in procedures that, if performed incorrectly, might harm you. A warning symbol precedes each warning statement.

Warning   This warning symbol means *danger.* You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.

Waarschuwing   Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen. Voor vertalingen van de waarschuwingen die in deze publicatie verschijnen, kunt u het document *Regulatory Compliance and Safety Information* (Informatie over naleving van veiligheids- en andere voorschriften) raadplegen dat bij dit toestel is ingesloten.

Varoitus   Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista. Tässä julkaisussa esiintyvien varoitusten käännökset löydät laitteen mukana olevasta *Regulatory Compliance and Safety Information* -kirjasesta (määräysten noudattaminen ja tietoa turvallisuudesta).

Attention   Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions d'avertissements figurant dans cette publication, consultez le document *Regulatory Compliance and Safety Information* (Conformité aux règlements et consignes de sécurité) qui accompagne cet appareil.

Warnung   Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt. Übersetzungen der in dieser Veröffentlichung enthaltenen Warnhinweise finden Sie im Dokument *Regulatory Compliance and Safety Information* (Informationen zu behördlichen Vorschriften und Sicherheit), das zusammen mit diesem Gerät geliefert wurde.

Avvertenza   Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti. La traduzione delle avvertenze riportate in questa pubblicazione si trova nel documento *Regulatory Compliance and Safety Information* (Conformità alle norme e informazioni sulla sicurezza) che accompagna questo dispositivo.

Advarsel Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker. Hvis du vil se oversettelser av de advarslene som finnes i denne publikasjonen, kan du se i dokumentet *Regulatory Compliance and Safety Information* (Overholdelse av forskrifter og sikkerhetsinformasjon) som ble levert med denne enheten.

Aviso Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes. Para ver as traduções dos avisos que constam desta publicação, consulte o documento *Regulatory Compliance and Safety Information* (Informação de Segurança e Disposições Reguladoras) que acompanha este dispositivo.

¡Advertencia! Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes. Para ver una traducción de las advertencias que aparecen en esta publicación, consultar el documento titulado *Regulatory Compliance and Safety Information* (Información sobre seguridad y conformidad con las disposiciones reglamentarias) que se acompaña con este dispositivo.

Varning! Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador. Se förklaringar av de varningar som förkommer i denna publikation i dokumentet *Regulatory Compliance and Safety Information* (Efterrättelse av föreskrifter och säkerhetsinformation), vilket medföljer denna anordning.

Electrical Equipment Guidelines

Follow these basic guidelines when working with any electrical equipment:

- Before beginning any procedures requiring access to the chassis interior, locate the emergency power-off switch for the room in which you are working.

- Disconnect all power and external cables before moving a chassis; Do not work alone when potentially hazardous conditions exist.

- Never assume that power has been disconnected from a circuit; always check.

- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe; carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.

Telephone Wiring Guidelines

Use the following guidelines when working with any equipment that is connected to telephone wiring or to other network cabling:

- Never install telephone wiring during a lightning storm.

- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.

- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.

- Use caution when installing or modifying telephone lines.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage, which can occur when electronic cards or components are improperly handled, results in complete or intermittent failures. Port adapters and processor modules comprise printed circuit boards that are fixed in metal carriers. Electromagnetic interference (EMI) shielding and connectors are integral components of the carrier. Although the metal carrier helps to protect the board from ESD, use a preventive antistatic strap during handling.

Following are guidelines for preventing ESD damage:

- Always use an ESD wrist or ankle strap and ensure that it makes good skin contact.

- Connect the equipment end of the strap to an unfinished chassis surface.

- When installing a component, use any available ejector levers or captive installation screws to properly seat the bus connectors in the backplane or midplane. These devices prevent accidental removal, provide proper grounding for the system, and help to ensure that bus connectors are properly seated.

- When removing a component, use any available ejector levers or captive installation screws to release the bus connectors from the backplane or midplane.

- Handle carriers by available handles or edges only; avoid touching the printed circuit boards or connectors.

- Place a removed component board-side-up on an antistatic surface or in a static shielding container. If you plan to return the component to the factory, immediately place it in a static shielding container.

- Avoid contact between the printed circuit boards and clothing. The wrist strap only protects components from ESD voltages on the body; ESD voltages on clothing can still cause damage.

- Never attempt to remove the printed circuit board from the metal carrier.

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

FCC Class B Compliance

The equipment described in this manual generates and may radiate radio-frequency energy. If it is not installed in accordance with Cisco's installation instructions, it may cause interference with radio and television reception. This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in part 15 of the FCC rules. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

You can determine whether your equipment is causing interference by turning it off. If the interference stops, it was probably caused by the Cisco equipment or one of its peripheral devices. If the equipment causes interference to radio or television reception, try to correct the interference by using one or more of the following measures:

- Turn the television or radio antenna until the interference stops.

- Move the equipment to one side or the other of the television or radio.

- Move the equipment farther away from the television or radio.

- Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

Modifications to this product not authorized by Cisco Systems, Inc. could void the FCC approval and negate your authority to operate the product.

VIP2 and the PA-4T+ Port Adapter

This chapter provides information on the PA-4T+ port adapter and its use in the VIP2 in Cisco 7000 series and Cisco 7500 series routers. This chapter contains the following sections:

- Installation Overview, page 3-1
- Removing a Port Adapter, page 3-3
- Installing a Port Adapter, page 3-4

In the Cisco 7000 series or Cisco 7500 series routers, the PA-4T+ requires the following VIP2 models:

- VIP2-15(=) (1 MB of SRAM, 8 MB of DRAM)
- VIP2-20= (1 MB of DRAM, 16 MB of SRAM)
- VIP2-40(=) (2 MB of SRAM, 32 MB of DRAM)
- VIP2-50(=) (4 to 8 MB of SRAM, 32 to 128 MB of DRAM)

Note   The PA-4T+ can be installed in port adapter slot 0 or slot 1 on the VIP2 motherboard, or in any available port adapter slot in a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series chassis.

![Caution triangle icon] **Caution**   To prevent system problems, the VIP2 requires that Cisco 7000 series routers have the RSP7000 and RSP7000CI installed. The VIP2 will *not* operate properly with the Route Processor (RP), Switch Processor (SP), or Silicon Switch Processor (SSP) installed in a Cisco 7000 series router.

Note   The minimum recommended VIP2 model is a VIP2-15.

Installation Overview

The PA-4T+ used on the VIP2 can be installed in either port adapter slot 0 or port adapter slot 1. Figure 3-1 shows the PA-4T+ installed in port adapter slot 1, on a VIP2-15 or VIP2-40.

Figure 3-1   VIP2-15 or VIP2-40 with a PA-4T+ in Port Adapter Slot 1
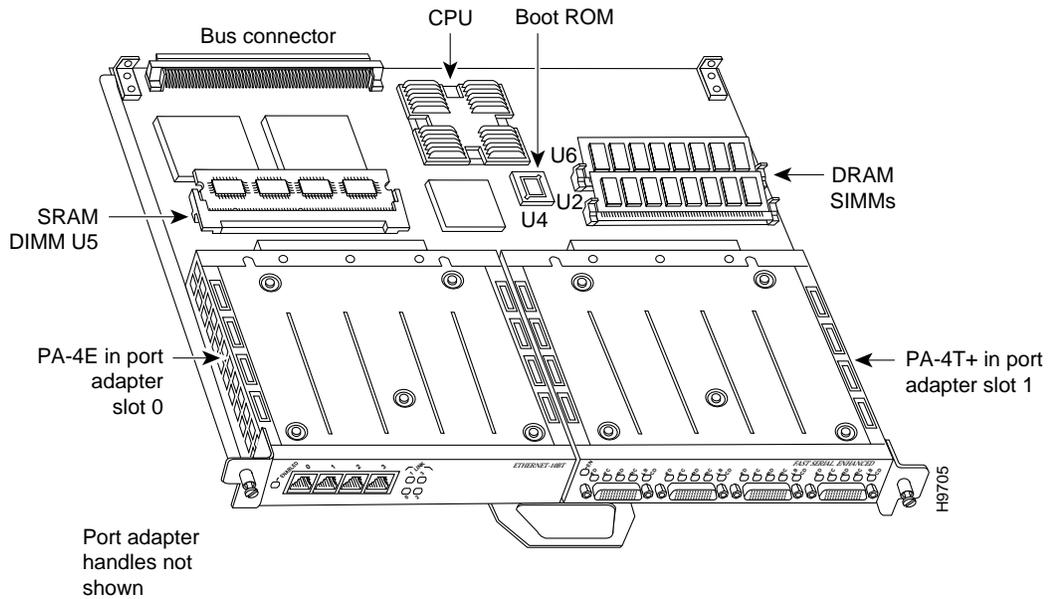
Note   Port adapters have a handle attached, but this handle is not shown to allow a full view of detail on each port adapter's faceplate.

Figure 3-2 shows two PA-4T+ port adapters installed in port adapter slots 0 and 1, on a VIP2-50.

Figure 3-2   VIP2-50 with Two PA-4T+ Port Adapters in Port Adapter Slots 0 and 1
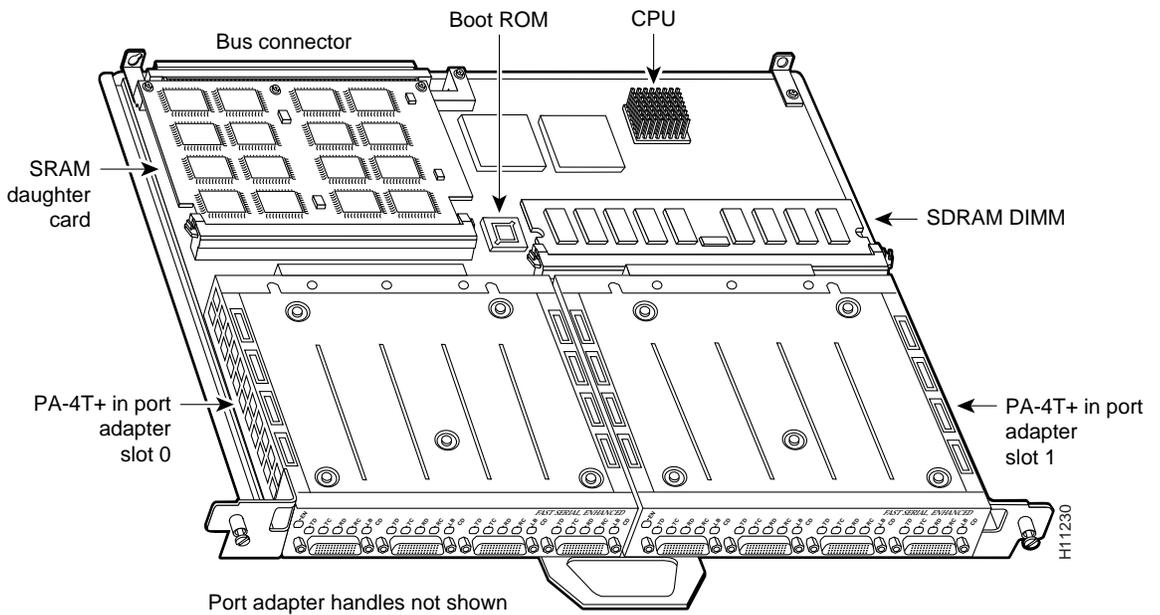
Removing a Port Adapter

This section provides the standard procedures for removing a port adapter on the VIP2.

Depending on the circumstances, you might need to install a new port adapter on a VIP2 motherboard or replace a failed port adapter in the field. In either case, you need a number 1 Phillips screwdriver, an antistatic mat onto which you can place the removed interface processor, and an antistatic container into which you can place a failed port adapter for shipment back to the factory.

> **Caution** To prevent system problems, do not remove port adapters from the VIP2 motherboard, or attempt to install other port adapters on the VIP2 motherboard, *while the system is operating*. To install or replace port adapters, first remove the VIP2 from its interface processor slot.

Note Each port adapter circuit board is mounted to a metal carrier and is sensitive to ESD damage. Each port adapter has one Phillips-head screw that secures it to its port adapter slot. We strongly recommend that the following procedures be performed by a Cisco-certified service provider; however, this is not a requirement.

While the VIP2 supports online insertion and removal (OIR), individual port adapters do not. To replace port adapters, you must first remove the VIP2 from the chassis, then install or replace port adapters as required. If a blank port adapter is installed on the VIP2 in which you want to install a new port adapter, you must first remove the VIP2 from the chassis, then remove the blank port adapter.

> **Caution** To prevent interface reconfiguration requirements, you *should* replace a port adapter with the same type of port adapter you removed, but this is not a requirement.

When only one port adapter is installed on a VIP2, a blank port adapter must fill the empty slot to allow the VIP2 and router chassis to conform to electromagnetic interference (EMI) emissions requirements, and so that air flows through the chassis properly. If you plan to install a new port adapter, you must first remove the blank port adapter.

Use the following standard procedure to remove and replace any type of port adapter on a VIP2:

Step 1 Attach an ESD-preventive wrist strap between you and an unfinished chassis surface.


Note If you want to install a new port adapter on a VIP2 with a single port adapter, you must first remove the blank port adapter from the port adapter slot in which you want to install the new port adapter.

Step 2 For a new port adapter installation or a port adapter replacement, disconnect any interface cables from the ports on the front of the port adapter, although, this is not required. You can remove VIP2s with cables attached; however, we do not recommend it.

Step 3 Remove the VIP2 from the system. (Follow the steps in the section "Removing a VIP2" in the configuration note *Second-Generation Versatile Interface Processor (VIP2) Installation and Configuration*, which shipped with your VIP2.) Place the removed VIP2 on an antistatic mat.

Step 4 Locate the screw at the rear of the port adapter (or blank port adapter) to be replaced. (See Figure 3-3.) This screw secures the port adapter (or blank port adapter) to its slot.

Figure 3-3   Location of Port Adapter Screw—Partial Port Adapter View
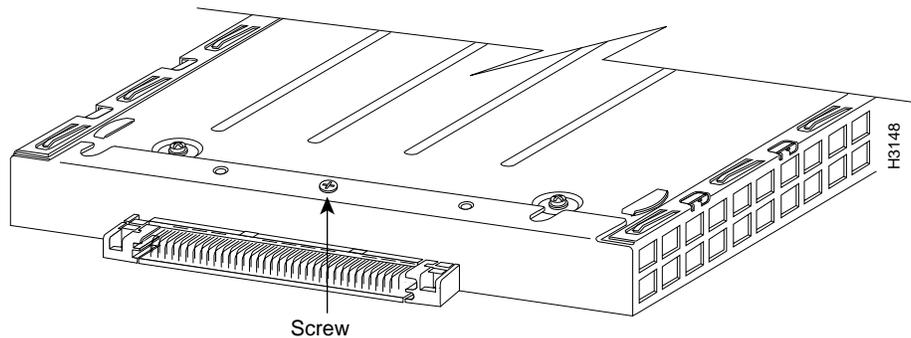
Screw

Step 5   Remove the screw that secures the port adapter (or blank port adapter).

Step 6   With the screw removed, grasp the handle on the front of the port adapter (or blank port adapter) and carefully pull it out of its slot, away from the edge connector at the rear of the slot. (See Figure 3-4.)

Figure 3-4   Pulling a Port Adapter Out of a Slot—Partial Port Adapter View
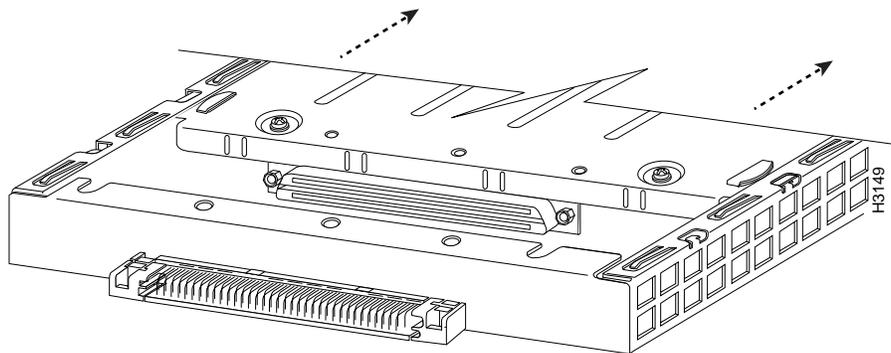
Step 7   If you removed a port adapter, place it in an antistatic container for safe storage or shipment back to the factory. If you removed a blank port adapter, no special handling is required; however, store the blank port adapter for potential future use.

This completes the procedure for removing a port adapter from a VIP2.

Installing a Port Adapter

Step 1   Remove the new port adapter from its antistatic container and position it at the opening of the slot. (See Figure 3-5.)

⚠ **Caution**   To prevent jamming the carrier between the upper and lower edges of the port adapter slot, and to assure that the edge connector at the rear of the port adapter mates with the connector at the rear of the port adapter slot, make certain that the leading edges of the carrier are between the upper and lower slot edges, as shown in the cutaway in Figure 3-5.

Figure 3-5   **Aligning a Port Adapter in a Port Adapter Slot**

Carrier

Upper edge

Lower edge
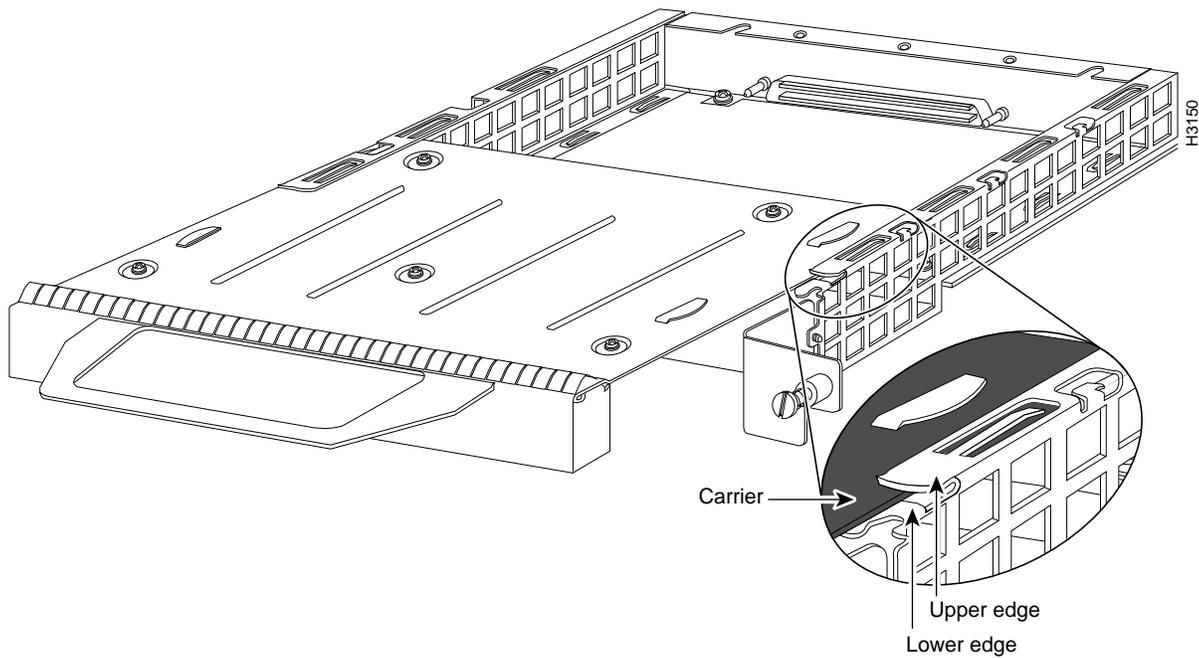
Step 2   Before you insert the new port adapter in its slot, verify that the port adapter carrier is between the upper and lower slot edges, as shown in Figure 3-5. Do not jam the carrier between the slot edges.

⚠ **Caution**   To ensure a positive ground attachment between the port adapter carrier and the VIP2 motherboard and port adapter slot, and to ensure that the connectors at the rear of the port adapter and slot mate properly, the carrier must be between the upper and lower slot edges. (See Figure 3-5.)

Step 3   Carefully slide the new port adapter into the port adapter slot until the connector on the port adapter is completely mated with the connector on the motherboard. (See Figure 3-6.)

Figure 3-6   Port Adapter Installed in a Port Adapter Slot—Partial Port Adapter View
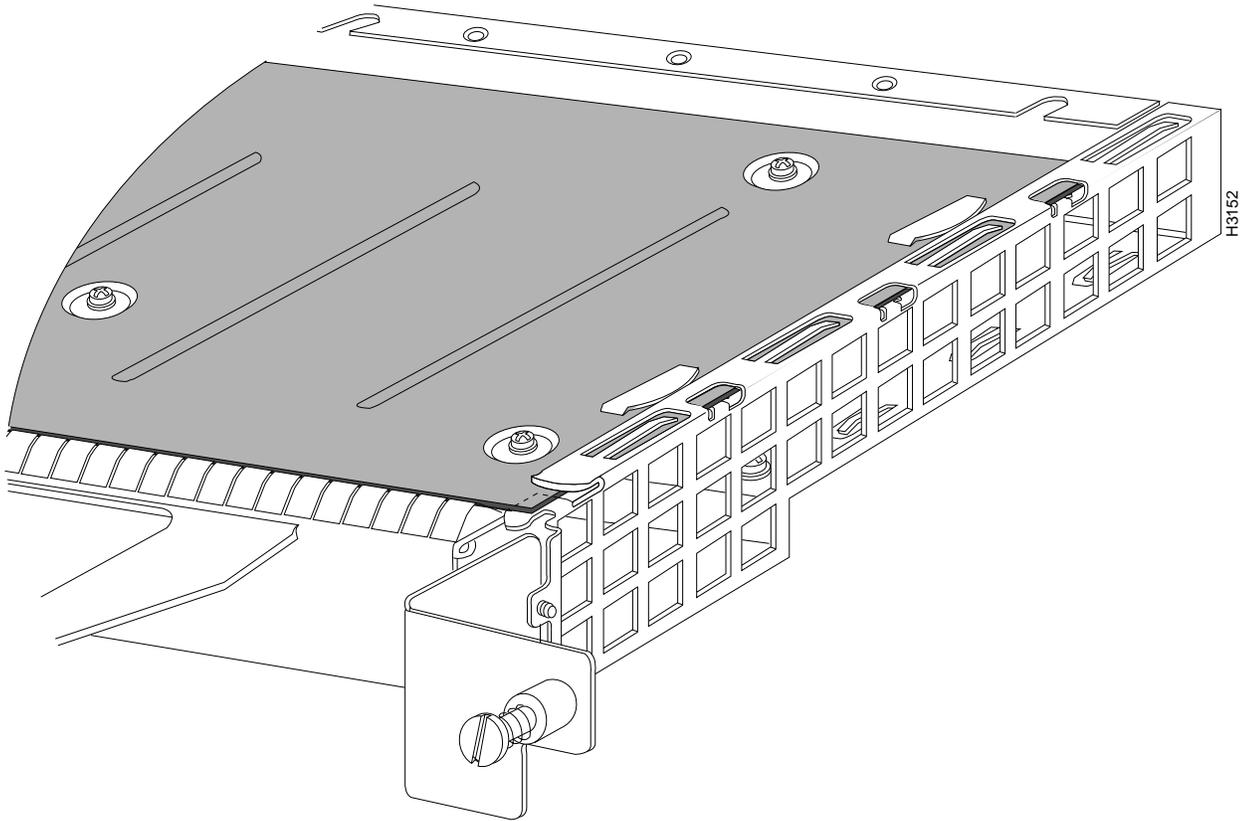
Step 4 Replace the screw in the rear of the port adapter slot. (See Figure 3-3 for its location.) Do not overtighten this screw.

Step 5 Reinstall the VIP2 in the system. (Follow the steps in the section "Installing a VIP2" in the configuration note *Second-Generation Versatile Interface Processor (VIP2) Installation and Configuration*, which shipped with your VIP2.)

Step 6 If disconnected, reconnect the interface cables to the port adapters.

This completes the procedure for installing a port adapter on a VIP2. Proceed to Chapter 7, "Installing the PA-4T+ Interface Cables," to connect the necessary cables to your port adapter.

Cisco 7200 Series and the PA-4T+ Port Adapter

This chapter provides information on the PA-4T+ and its use in the Cisco 7200 series routers. This chapter contains the following sections:

- Installation Overview, page 4-1
- Removing a Port Adapter, page 4-2
- Installing a Port Adapter, page 4-3

Installation Overview

Figure 4-1 shows a PA-4T+ installed in port adapter slot 1 of the Cisco 7206. The PA-4T+ is used in Cisco 7200 series routers and can be installed in any of the available port adapter slots.

Figure 4-1   Cisco 7206 with a PA-4T+ Installed
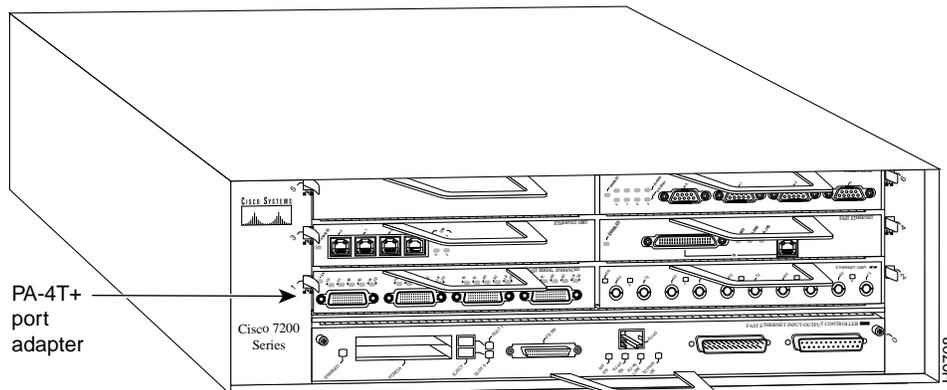
Depending on your circumstances, you might need to install a new port adapter in a Cisco 7200 series router or replace a failed port adapter in the field. In either case, no tools are necessary; all port adapters available for the Cisco 7200 series connect directly to the router midplane and are locked into position by a port adapter lever. When removing and replacing a port adapter, you will need an antistatic mat onto which you can place a removed port adapter and an antistatic container into which you can place a failed port adapter for shipment back to the factory.

Note   Cisco 7200 series routers support online insertion and removal (OIR); therefore, you do not have to power down Cisco 7200 series routers when removing and replacing a PA-4T+.


When a port adapter slot is not in use, a blank port adapter must fill the empty slot to allow the router to conform to EMI emissions requirements and to allow proper air flow across the port adapters. If you plan to install a new port adapter in a slot that is not in use, you must first remove a blank port adapter.

Removing a Port Adapter

Take the following steps to remove a port adapter from a Cisco 7200 series router:

Step 1   Attach an ESD-preventive wrist strap between you and an unfinished chassis surface.

Step 2   Place the port adapter lever for the desired port adapter slot in the unlocked position. The port adapter lever remains in the unlocked position. (See Figure 4-2.)

Figure 4-2   Placing the Port Adapter Lever in the Unlocked Position—Cisco 7206

Note: This adapter removal applies to any port or service adapter.

Port adapter handle

Port adapter lever (unlocked position)
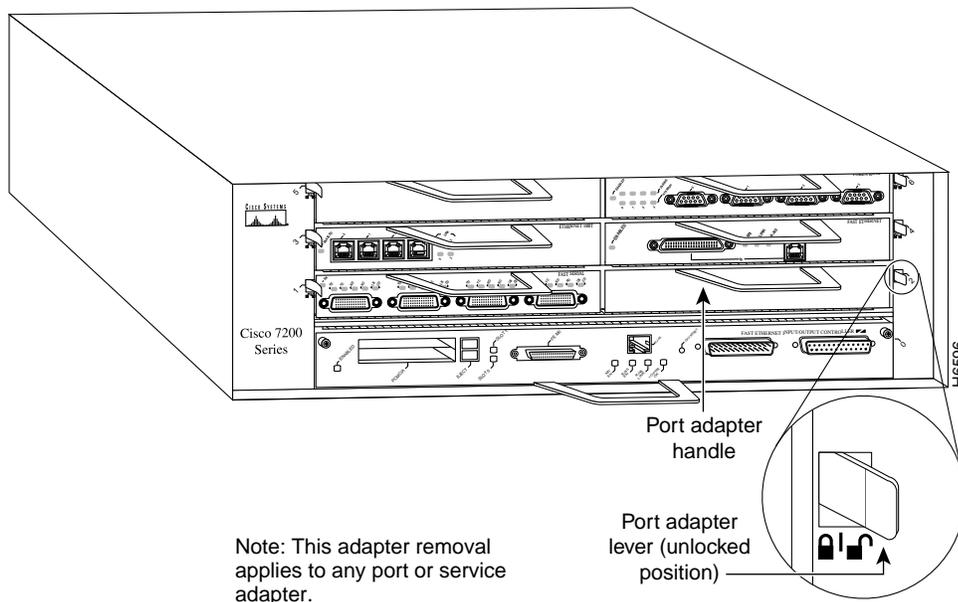
Step 3   Grasp the handle on the port adapter and pull the port adapter from the midplane, about halfway out of its slot. If you are removing a blank port adapter, pull the blank port adapter completely out of the chassis slot.

Note   As you disengage the port adapter from the router midplane, OIR administratively shuts down all active interfaces on the port adapter.

Step 4   With the port adapter halfway out of the slot, disconnect all cables from the port adapter.

Step 5   After disconnecting the cables, pull the port adapter from its chassis slot.

⚠ **Caution**   Always handle the port adapter by the carrier edges and handle; never touch the port adapter's components or connector pins. (See Figure 4-3.)

Figure 4-3   Handling a Port Adapter

**Step 6**   Place the port adapter on an antistatic surface with its components facing upward, or in a static shielding bag. If the port adapter will be returned to the factory, immediately place it in a static shielding bag.

This completes the procedure for removing a port adapter from a Cisco 7200 series router.

Installing a Port Adapter

Take the following steps to install a new port adapter in a Cisco 7200 series router:

Step 1   Attach an ESD-preventive wrist strap between you and an unfinished chassis surface.

Step 2   Use both hands to grasp the port adapter by its metal carrier edges and position the port adapter so that its components are downward. (See Figure 4-3.)

Step 3   Align the left and right edge of the port adapter metal carrier between the guides in the port adapter slot. (See Figure 4-4.)

Figure 4-4   Aligning the Port Adapter Metal Carrier Between the Slot Guides—Cisco 7206
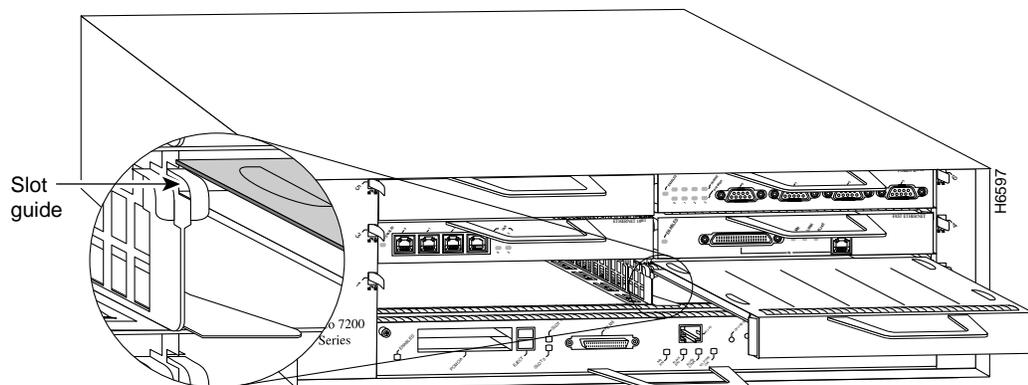
Note: This adapter alignment applies to any port or service adapter.

Step 4   With the metal carrier aligned in the slot guides, gently slide the port adapter halfway into the slot.
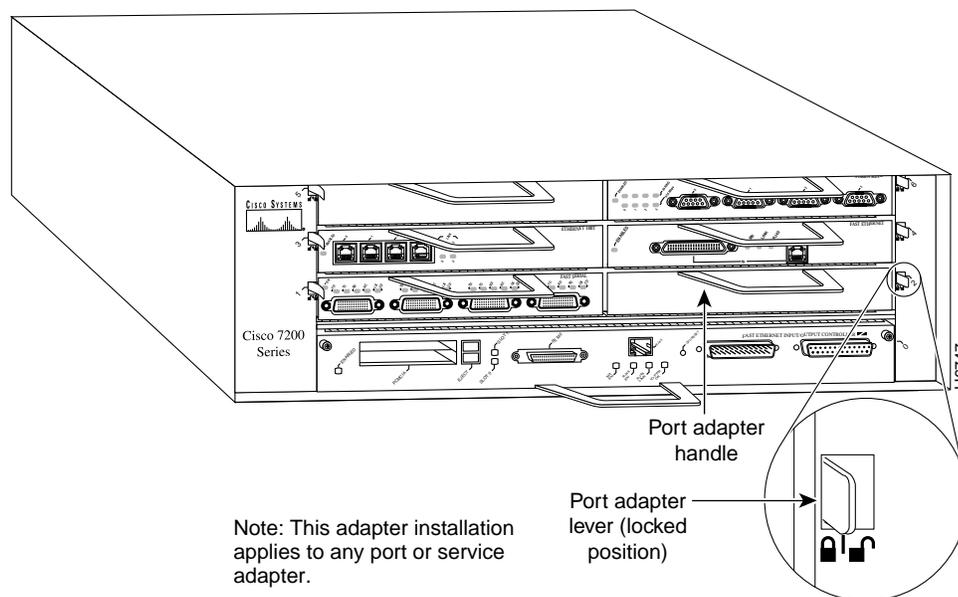
⚠ **Caution**   Do not slide the port adapter all the way into the slot until you have connected all required cables. Trying to do so will disrupt normal operation of the router.

Step 5   With the port adapter halfway in the slot, connect all required cables to the port adapter.

Step 6   After connecting all required cables, carefully slide the port adapter all the way into the slot until the port adapter is seated in the router midplane.

Step 7   After seating the port adapter in the router midplane, move the port adapter lever to the locked position. Figure 4-5 shows the port adapter lever in the locked position.

Note   If the port adapter lever does not move to the locked position, the port adapter is not completely seated in the midplane. Carefully pull the port adapter halfway out of the slot, reinsert it, and move the port adapter lever to the locked position.

Figure 4-5   Placing the Port Adapter Lever in the Locked Position—Cisco 7206

Port adapter handle

Note: This adapter installation applies to any port or service adapter.

Port adapter lever (locked position)

This completes the procedure for installing a new port adapter in a Cisco 7200 series router. Proceed to Chapter 7, "Installing the PA-4T+ Interface Cables," to connect the necessary cables to your port adapter.
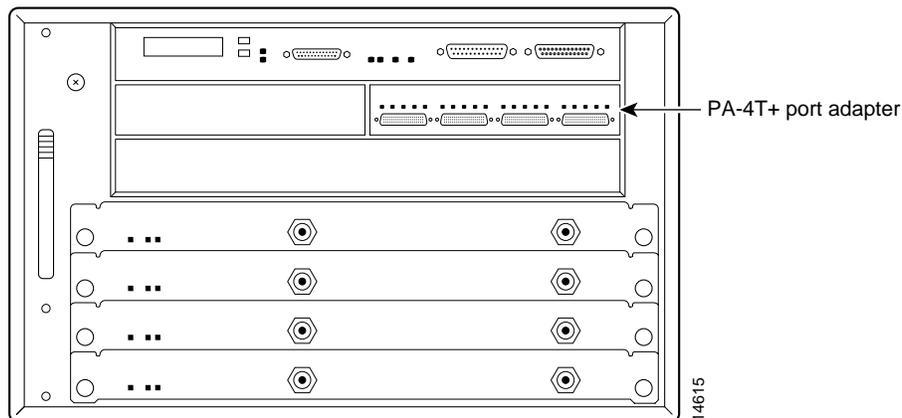
Cisco uBR7200 Series and the PA-4T+ Port Adapter

This chapter provides information on the PA-4T+ port adapter and its use on Cisco uBR7200 series universal broadband routers. This chapter includes the following sections:

- Installation Overview, page 5-1
- Removing a Port Adapter, page 5-2
- Installing a Port Adapter, page 5-4

Installation Overview

The PA-4T+ can be installed in any of the available port adapter slots in the Cisco uBR7200 series. Figure 5-1 shows a PA-4T+ installed in port adapter slot 2 of the Cisco uBR7246.

Figure 5-1   PA-4T+ in Port Adapter Slot 2—Cisco uBR7246

Depending on the circumstances, you might need to install a new port adapter or replace a failed port adapter in the Cisco uBR7200 series. In either case, no tools are necessary; all port adapters available for the Cisco uBR7200 series connect directly to the router midplane and are locked into position by a port adapter lever (Cisco uBR7223) or retention clip (Cisco uBR7246). When removing and replacing a port adapter, you will need an antistatic mat onto which you can place a removed port adapter and an antistatic container into which you can place a failed port adapter for shipment back to the factory.

> **Note** The Cisco uBR7200 series supports online insertion and removal (OIR); therefore, you do not have to power down the router when removing and replacing a PA-4T+.

When a port adapter slot is not in use, blank port adapters must fill empty slots to allow the router to conform to EMI emissions requirements and to allow proper air flow across the port adapters. If you plan to install a new port adapter in a slot that is not in use, you must first remove the blank port adapter.

Removing a Port Adapter

Take the following steps to remove a port adapter from a Cisco uBR7200 series:

Step 1 Attach an ESD-preventive wrist strap between you and an unfinished chassis surface.

Step 2 Place the port adapter in the unlocked position.

- For the Cisco uBR7246, place the port adapter retention clip for the desired port adapter slot in the unlocked position. The port adapter retention clip remains in the unlocked position. (See Figure 5-2.)

Figure 5-2   Placing the Port Adapter Retention Clip in the Unlocked Position—Cisco uBR7246
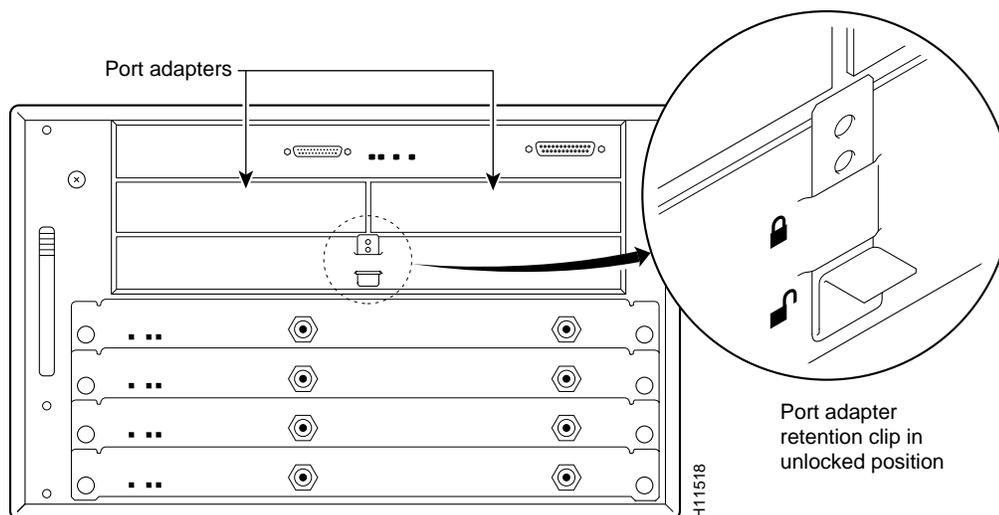
- For the Cisco uBR7223, place the port adapter lever in the unlocked position. (See Figure 5-3.)

Figure 5-3   Placing the Port Adapter Lever in the Unlocked Position—Cisco uBR7223
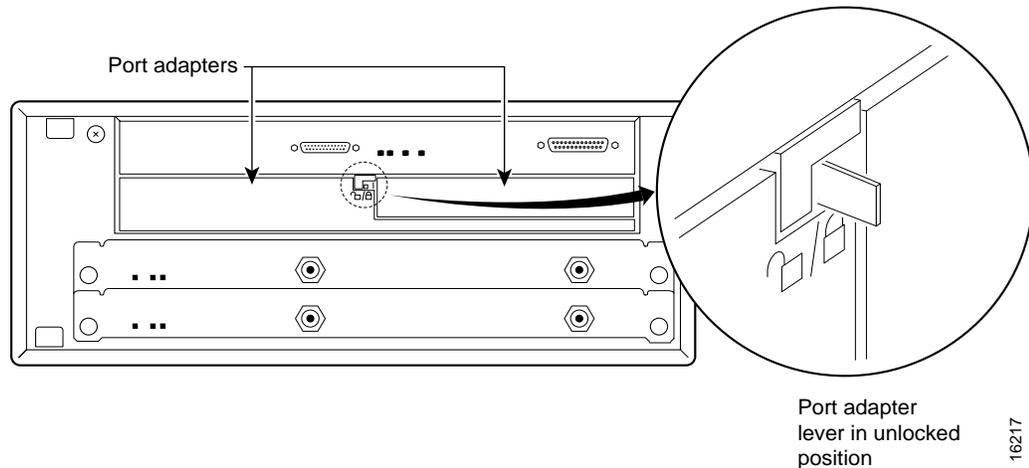
Step 3   Grasp the handle on the port adapter and pull the port adapter from the router midplane, about halfway out of its slot. If you are removing a blank port adapter, pull the blank port adapter completely out of the chassis slot.

Note   As you disengage the port adapter from the midplane, OIR administratively shuts down all active interfaces on the port adapter.
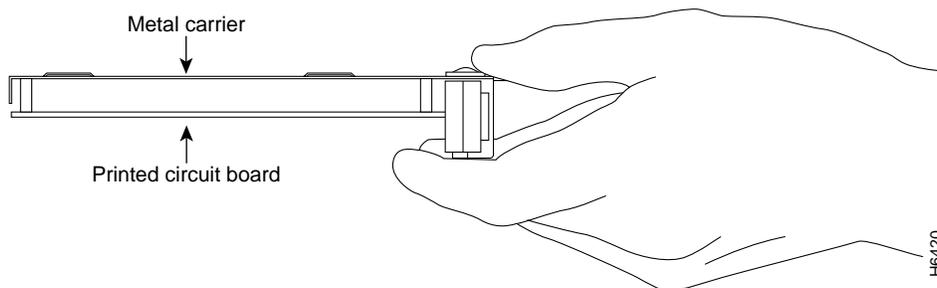
Step 4   With the port adapter halfway out of the slot, disconnect all cables from the port adapter.

Step 5   After disconnecting the cables, pull the port adapter from its chassis slot.

Caution   Always handle the port adapter by the carrier edges and handle; never touch the port adapter's components or connector pins. (See Figure 5-4.)

Figure 5-4   Handling a Port Adapter

Step 6 Place the port adapter on an antistatic surface with its components facing upward, or in a static shielding bag. If the port adapter will be returned to the factory, immediately place it in a static shielding bag.

This completes the procedure for removing a port adapter from a Cisco uBR7200 series router.

Installing a Port Adapter

Take the following steps to install a single-width port adapter in a Cisco uBR7200 series router:

Step 1 Attach an ESD-preventive wrist strap between you and an unfinished chassis surface.

Step 2 Use both hands to grasp the port adapter by its metal carrier edges and position the port adapter so that its components are downward. (See Figure 5-4.)

Step 3 Align the left and right edge of the port adapter metal carrier between the guides in the port adapter slot. (See Figure 5-5.)

Figure 5-5 Aligning the Port Adapter Metal Carrier Between the Slot Guides
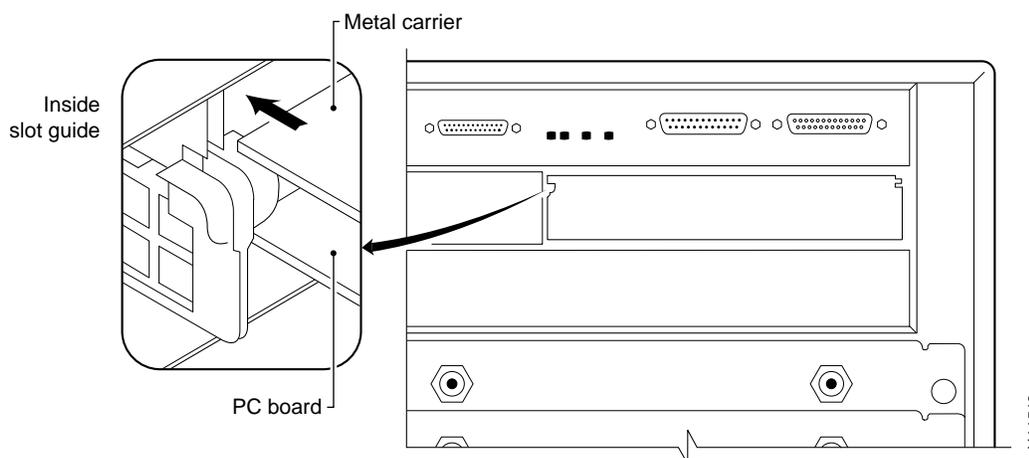
Step 4 With the metal carrier aligned in the slot guides, gently slide the port adapter halfway into the slot.

⚠ **Caution** Do not slide the port adapter all the way into the slot until you have connected all required cables. Trying to do so will disrupt normal operation of the router.

Step 5 With the port adapter halfway in the slot, connect all required cables to the port adapter.

Step 6 After connecting the cables, carefully slide the port adapter all the way into the slot until the port adapter is seated in the router midplane.

Step 7 Place the port adapter in the locked position.

- For the Cisco uBR7246, slide the port adapter retention clip up to the locked position. (See Figure 5-6.)
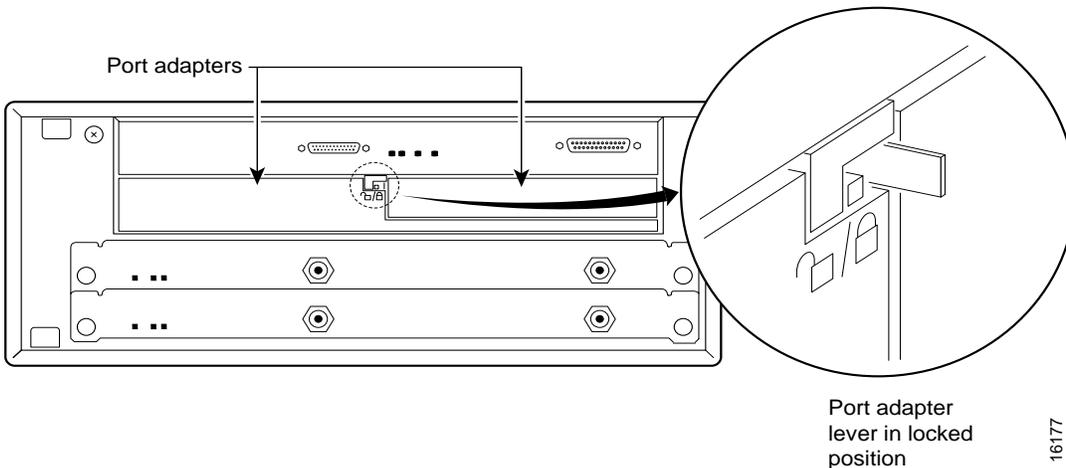
Note If the retention clip does not slide up to the locked position, the port adapter is not completely seated in the midplane. Carefully pull the port adapter halfway out of the slot, reinsert it, and slide the port adapter lever up to the locked position.

Figure 5-6   Placing the Port Adapter Lever in the Locked Position
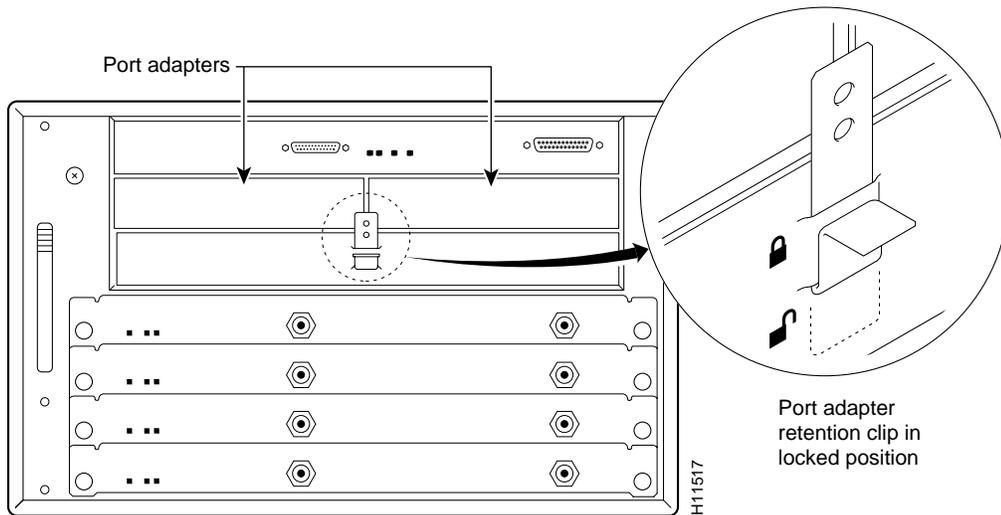
- For the Cisco uBR7223, place the port adapter lever in the locked position. (See Figure 5-7.)

Figure 5-7   Placing the Port Adapter Lever in the Locked Position—Cisco uBR7223

Note If the port adapter lever does not move to the locked position, the port adapter is not completely seated in the midplane. Carefully pull the port adapter halfway out of the slot, reinsert it, and move the port adapter lever to the locked position.

This completes the procedure for installing a port adapter in a Cisco uBR7200 series router. Proceed to Chapter 7, "Installing the PA-4T+ Interface Cables," to connect the necessary cables to your port adapter.

Cisco 7100 Series and the PA-4T+ Port Adapter

This chapter provides information on the PA-4T+ port adapter and its use in the Cisco 7100 series routers. This chapter contains the following sections:

- Installation Overview, page 6-1
- Removing a Port Adapter, page 6-2
- Installing a Port Adapter, page 6-3

Installation Overview

The PA-4T+ can be installed in port adapter slot 3 in the Cisco 7120 series, and in port adapter slot 4 in the Cisco 7140 series. Figure 6-1 shows port adapter slot 3 of a Cisco 7120 series router. Figure 6-2 shows port adapter slot 4 of a Cisco 7140 series router.

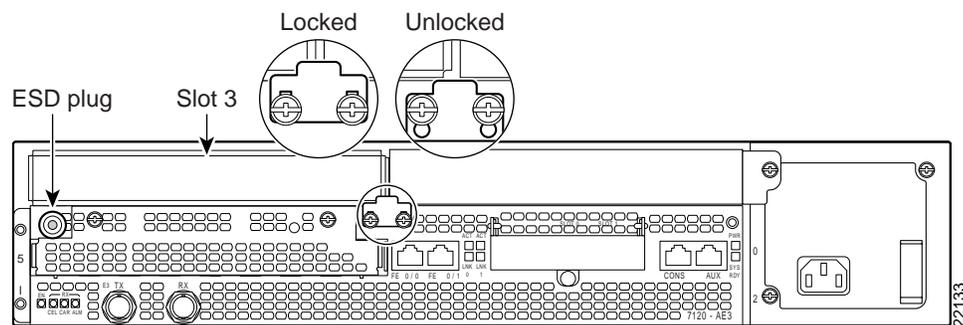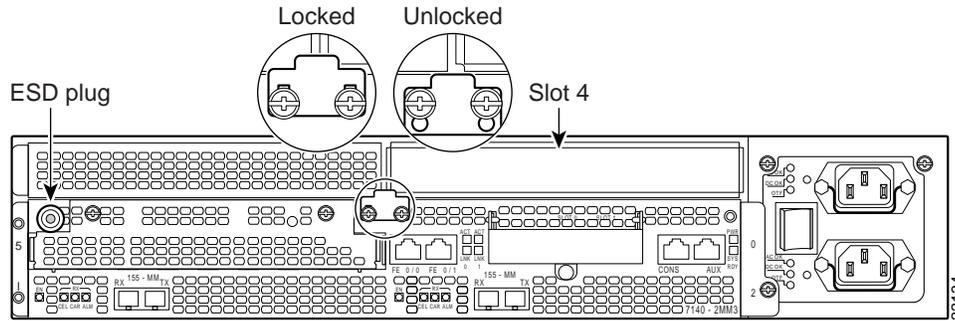**Figure 6-1   Cisco 7120 Series Router—Port Adapter Slot 3 Location**

Figure 6-2   Cisco 7140 Series Router—Port Adapter Slot 4 Location

Depending on your circumstances, you might need to install a new port adapter in a Cisco 7100 series router or replace a failed port adapter in the field. All port adapters available for the Cisco 7100 series connect directly to the router and are locked into position by a locking tab with two screws (seeFigure 6-1 orFigure 6-2.) You need a number 2 Phillips screwdriver to loosen the screws.

Note   Cisco 7100 series routers support online insertion and removal (OIR); therefore, you do not have to power down the router when removing and replacing a port adapter.

When a port adapter slot is not in use, a blank port adapter must fill the empty slot to allow the router to conform to EMI emissions requirements and to allow proper airflow across the port adapters. If you plan to install a new port adapter in a slot that is not in use, you must first remove a blank port adapter.

Removing a Port Adapter

Take the following steps to remove a port adapter from a Cisco 7100 series router:

Step 1   Attach an ESD-preventive wrist strap between you and the chassis. (See Figure 6-1 or Figure 6-2 for the location of the ESD plug.)

Step 2   Use a number 2 Phillips screwdriver to loosen the screws on the locking tab; then slide the tab down to the unlocked position. (See Figure 6-1 or Figure 6-2.)

Step 3   Grasp the handle on the port adapter and pull the port adapter from the router, about halfway out of its slot. If you are removing a blank port adapter, pull the blank port adapter completely out of the chassis slot.

Note   As you disengage the port adapter from the router, OIR administratively shuts down all active interfaces on the port adapter.

Step 4   With the port adapter halfway out of the slot, disconnect all cables from the port adapter.

Step 5   After disconnecting the cables, pull the port adapter from its chassis slot.

Caution   Always handle the port adapter by the carrier edges and handle; never touch the port adapter's components or connector pins. (See Figure 6-3.)

Figure 6-3   Handling a Port Adapter
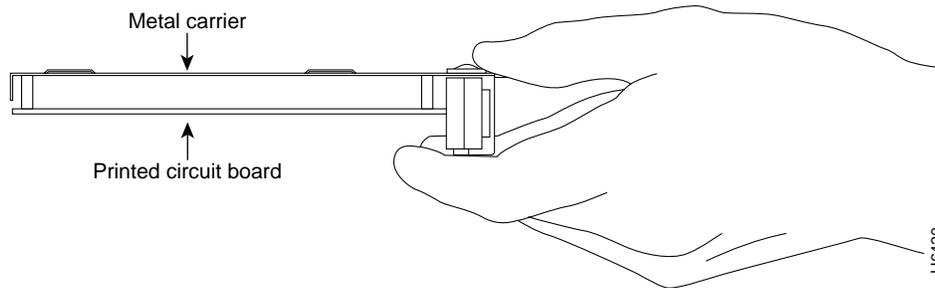
Metal carrier

Printed circuit board

H6420

Step 6 Place the port adapter on an antistatic surface with its components facing upward, or in a static shielding bag. If the port adapter will be returned to the factory, immediately place it in a static shielding bag.

Step 7 Install a blank port adapter or replacement port adapter to maintain proper flow of cooling air across the internal components and move the port adapter lever to the locked position and secure. For procedures on how to install a port adapter, see the next section, "Installing a Port Adapter."

Note The blank port adapter is available from Cisco Systems as a spare. The blank port adapter product number is MAS-7100-PABLANK.

This completes the procedure for removing a port adapter from a Cisco 7100 series router.

# Installing a Port Adapter

Follow these steps to install a new port adapter in a Cisco 7100 series router:

Step 1 Attach an ESD-preventive wrist strap between you and the chassis. (See Figure 6-1 or Figure 6-2 for the location of the ESD plug.)

Step 2 Ensure that the locking tab is down in the unlocked position. If it is locked, use a number 2 Phillips screwdriver to loosen the screws; then slide the tab down to the unlocked position. (See Figure 6-1 or Figure 6-2.)

Step 3 Remove the new port adapter from its antistatic container and position it at the opening of the slot.

Step 4 Use both hands to grasp the port adapter by its metal carrier edges, and position the port adapter so that its components face downward. (See Figure 6-3.)

Step 5 Align the left and right edge of the port adapter metal carrier between the guides in the port adapter slot. (See Figure 6-4.)

Step 6 With the metal carrier aligned in the slot guides, gently slide the port adapter halfway into the slot.

⚠️ **Caution** Do not slide the port adapter all the way into the slot until you have connected all required cables. Trying to do so disrupts normal operation of the router.

Figure 6-4   **Aligning the Single-Width Port Adapter Between the Slot Guides**
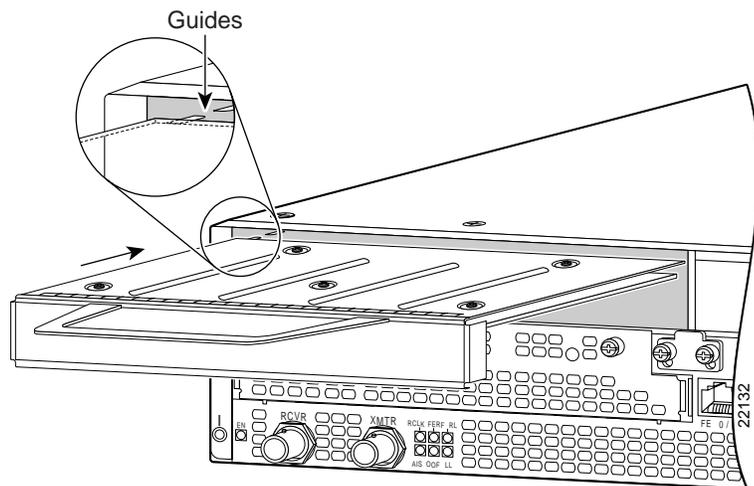
Step 7   With the port adapter halfway in the slot, connect all required cables to the port adapter.

Step 8   After connecting all required cables, carefully slide the port adapter all the way into the slot until the port adapter is seated in the router.

Step 9   After seating the port adapter in the router, slide the locking tab to the locked position and tighten the screws. (Figure 6-1 and Figure 6-2 show the locking tab in the locked position.)

This completes the procedure for installing a new port adapter in a Cisco 7100 series router. Proceed to Chapter 8, "Configuring the PA-4T+ Interfaces," to connect the necessary cables to your port adapter.

Installing the PA-4T+ Interface Cables

To continue your PA-4T+ port adapter installation, you must install the port adapter cables and configure the PA-4T+ interfaces. The instructions that follow apply to all supported platforms. Minor differences between the platforms are noted. This chapter contains the following sections:

- Attaching PA-4T+ Port Adapter Interface Cables, page 7-1
- Replacing PA-4T+ Port Adapter Cables, page 7-2

Attaching PA-4T+ Port Adapter Interface Cables

On a single PA-4T+, you can use up to four synchronous serial connections. Use the following procedure to connect a serial cable to the PA-4T+:

Step 1   Attach the appropriate serial cable directly to the receptacle on the PA-4T+ and tighten the strain-relief screws. (See Figure 7-1.)

Note   Port adapters have a handle attached, but this handle is not shown to allow a detailed view of each port adapter's faceplate.

Figure 7-1   Connecting PA-4T+ Serial Cables—Horizontal Orientation (Shown Without Handles)
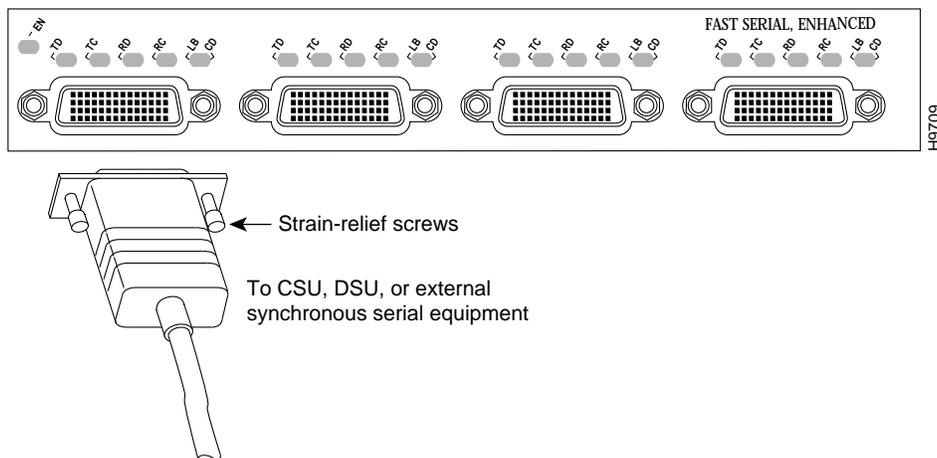
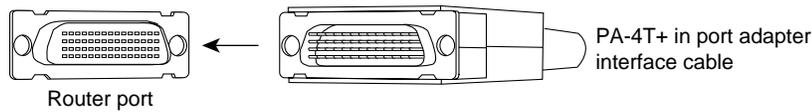⚠️ **Caution** Serial interface cables must be attached correctly or damage to the cable plug will result. Attempting to force a cable plug on the 60-pin receptacle can damage the plug. (See Figure 7-2.)

Figure 7-2   Connecting Serial Port Adapter Cables

Correct

Router port — PA-4T+ in port adapter interface cable

Incorrect, cable upside down

Router port — PA-4T+ in port adapter interface cable

H9706
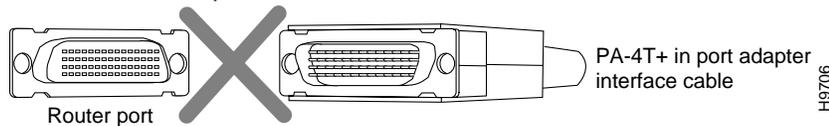
Step 2   Attach the network end of the serial cable to your DSU, CSU, DTE, or other external synchronous serial equipment and tighten the strain-relief screws.

This completes the procedure for attaching serial interface cables to the PA-4T+.

Replacing PA-4T+ 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 controllers** command for Cisco 7100 series, Cisco 7200 series or Cisco uBR7200 series routers that shows an interface port (1/0) that has an EIA/TIA-232 DCE cable attached:

```
Router# show controllers serial 1/0

M4T: show controller:
PAS unit 8, subunit 0, f/w version 1-25, rev ID 0x2800001, version 2
idb = 0x60B83B40, ds = 0x60B858B8, ssb=0x60B85FFC
Clock mux=0x0, ucmd_ctrl=0x1C, port_status=0x3E
Serial config=0x0, line config=0x200
maxdgram=1524, bufpool=48Kb, 96 particles
     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
line state: up
cable type : V.24 (RS-232) DCE cable, received clockrate 9600
[display text omitted]
```

Note In the above output from the **show controllers** command, the PA-4T+ is displayed as M4T.

Following is an example of the **show controllers cbus** command for a VIP2 that shows an interface port (3/1/0) that has an EIA/TIA-232 DTE cable attached:

```
Router# show controllers cbus 3/1/0

slot3: VIP2, hw 2.3, sw 21.40, ccb 5800FF30, cmdq 48000088, vps 8192
    software loaded from system
    IOS (tm) VIP Software (SVIP-DW-M), Version 11.1(8)CA, RELEASED SOFTWARE
    ROM Monitor version 17.0
  Mx Serial(4), HW Revision 0x2, FW Revision 1.25
    Serial3/1/0, applique is RS-232 DTE
      gfreeq 48000140, lfreeq 480001D0 (1536 bytes), throttled 0
      rxlo 4, rxhi 81, rxcurr 1, maxrxcurr 2
      txq 48001A00, txacc 48001A02 (value 6), txlimit 6
```

To change the mode of a port online, use software commands to shut down the interface, replace the compact serial cable, restart the interface and, if necessary, reconfigure the port for the new interface. At system startup or restart, the system polls the interfaces and determines the electrical interface type of each port (according to the type of compact serial cable attached). However, the system 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.

If you are replacing a cable with a cable that has the same mode, these steps are not necessary (simply replace the cable without interrupting operation).

Step 1   Enter configuration mode and at the privileged level of the EXEC (also called enable mode), specify the port address, shut down the interface, and write the configuration to nonvolatile random-access memory (NVRAM). (See the "Using the EXEC Command Interpreter" section on page 8-1 for an explanation of the privileged level of the EXEC.) Add additional configuration commands, as needed, before you exit from configuration mode (before you press **Ctrl-Z** or enter **end**).

For a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series router, use the following commands:

```
Router> enable
Password:
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 1/0
Router(config-if)# shutdown
Ctrl-Z
Router#
```

For a VIP2, use the following commands:

```
Router> enable
Password:
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/1/0
Router(config-if)# shutdown
Ctrl-Z
Router#
```

Step 2   Locate and remove the adapter cable to be replaced.

Step 3   Connect the new cable between the PA-4T+ and the network connection. Tighten the thumbscrews at both ends of the cable to secure it in the ports.

Step 4   Enter configuration mode again, bring the port back up, and save the running configuration to NVRAM.

For a Cisco 7100 series, Cisco 7200 series, or Cisco uBR7200 series router, use the following commands:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 1/0
Router(config-if)# no shutdown
Ctrl-Z
Router#

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

For a VIP2, use the following commands:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/1/0
Router(config-if)# no shutdown
Ctrl-Z
Router#

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

These steps will prompt the system to poll the interface and recognize new interface immediately.

When you configure a port for a DCE interface for the first time, or when you set up a loopback test, you must set the clock rate for the port. When you connect a DCE cable to a port, the interface will remain down, the clock LEDs will remain off, and the interface will not function until you set a clock rate (regardless of the DCE mode default).

If you are changing the mode of the interface from DCE to DTE, you do not need to change the clock rate for the port. After you replace the DCE cable with a DTE cable and the system recognizes the interface as a DTE, it will use the external clock signal from the remote DCE device and ignore the internal clock signal that the DCE interface normally uses. Therefore, after 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.

This completes the procedure for replacing a port adapter cable on the PA-4T+. Proceed to Chapter 8, "Configuring the PA-4T+ Interfaces," to configure the interfaces on your PA-4T+.

Configuring the PA-4T+ Interfaces

To continue your PA-4T+ port adapter installation, you must install the port adapter cables and configure the PA-4T+ interfaces. The instructions that follow apply to all supported platforms. Minor differences between the platforms are noted. This chapter contains the following sections:

- Using the EXEC Command Interpreter, page 8-1

- Identifying Port Adapter Slot and PA-4T+ Interface Port Numbers, page 8-2

- Shutting Down an Interface, page 8-5

- Performing a Basic Configuration, page 8-8

- Configuring Timing (Clock) Signals, page 8-9

- Configuring Half-Duplex and Binary Synchronous Communications, page 8-12

- Checking the Configuration, page 8-14

If you installed a new PA-4T+ or if you want to change the configuration of an existing interface, you must enter configuration mode using the **configure** command. If you replaced a PA-4T+ that was previously configured, the system will recognize the new PA-4T+ interfaces and bring each of them up in their existing configuration.

After you verify that the new PA-4T+ is installed correctly (the enabled LED goes on), use the privileged-level **configure** command to configure the new interfaces. Be prepared with the information you will need, such as the following:

- Protocols you plan to route on each new interface

- IP addresses if you will configure the interfaces for IP routing

- Whether or not the new interfaces will use bridging

- Timing source for each new interface and clock speeds for external timing

For a summary of the configuration options available and instructions for configuring interfaces on the PA-4T+, refer to the appropriate configuration publications listed in the "Related Documentation" section on page vi.

Using the EXEC Command Interpreter

You modify the configuration of your router through the software command interpreter called the *EXEC* (also called enable mode). You must enter the privileged level of the EXEC command interpreter with the **enable** command before you can use the **configure** command to configure a new interface or to change the existing configuration of an interface. The system prompts you for a password if one is set.

The system prompt for the privileged level ends with a pound sign (#) instead of an angle bracket (>). At the console terminal, use the following procedure to enter the privileged level:

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.

When you enter the correct password, the system displays the privileged-level system prompt (#):

```
Router#
```

Identifying Port Adapter Slot and PA-4T+ Interface Port Numbers

This section describes how to identify port adapter slot and PA-4T+ interface port numbers for the Cisco 7100 series, Cisco 7200 series, the Cisco uBR7200 series routers, and the VIP2.

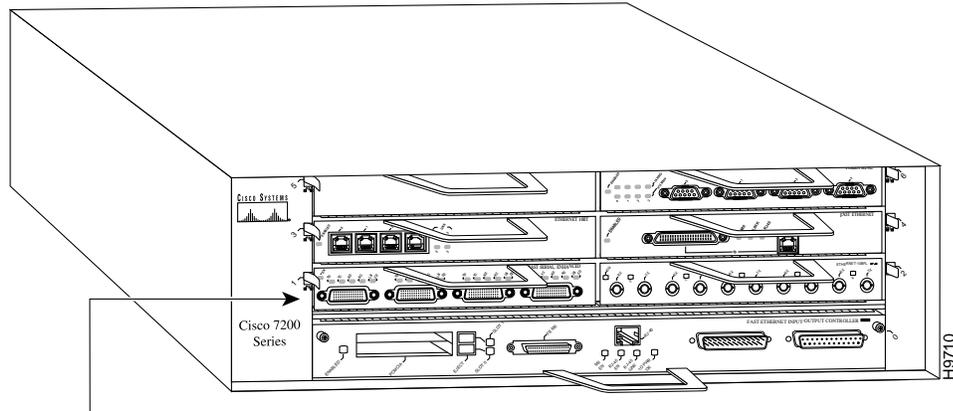## Cisco 7200 Series and Cisco uBR7200 Series Ports

Physical port addresses specify the actual physical location of each interface port on a Cisco 7200 series router (see Figure 8-1) or a Cisco uBR7200 series router (see Figure 8-2). This address is composed of a two-part number in the format *port adapter slot number/interface port number*, as follows:

- The first number identifies the chassis slot in which the PA-4T+ is installed.

- The second number identifies the interface ports on each PA-4T+, which are always numbered in sequence as interface 0 through 3.

Interface ports on the PA-4T+ maintain the same address regardless of whether other port adapters are installed or removed. However, when you move a port adapter to a different slot, the first number in the address changes to reflect the new slot number.

In Cisco 7200 series routers, port adapter slots are numbered from the lower left to the upper right, beginning with port adapter slot 1 and continuing through port adapter slot 2 for the Cisco 7202, slot 4 for the Cisco 7204 and Cisco 7204VXR, and slot 6 for the Cisco 7206 and Cisco 7206VXR. Port adapter slot 0 is reserved for the optional Fast Ethernet port on the I/O controller—if present. Figure 8-1 shows the interface ports of a PA-4T+ in slot 1 of a Cisco uBR7246 router.

For example, the addresses of the interface ports on the PA-4T+ in chassis slot 1 are 1/0 through 1/3 (chassis slot 1 and interface ports 0 through 3). If the PA-4T+ was in port adapter slot 4, these same interface ports would be numbered 4/0 through 4/3.

Figure 8-1   PA-4T+ Interface Port Address Example—Cisco uBR7246

PA-4T+ port adapter
(interface port addresses 1/0, 1/1, 1/2,
1/3 from left to right)

Figure 8-2 shows the interface ports of a PA-4T+ in slot 2 of the Cisco uBR7200 series. The port adapter slot are numbered slot 1 and slot 2 (slot 0 is always reserved for the Fast Ethernet port on the I/O controller—if present). The individual interface port numbers always begin with 0. The number of additional ports depends on the number of ports on a port adapter. Port adapters can occupy any port adapter slot; there are no restrictions.
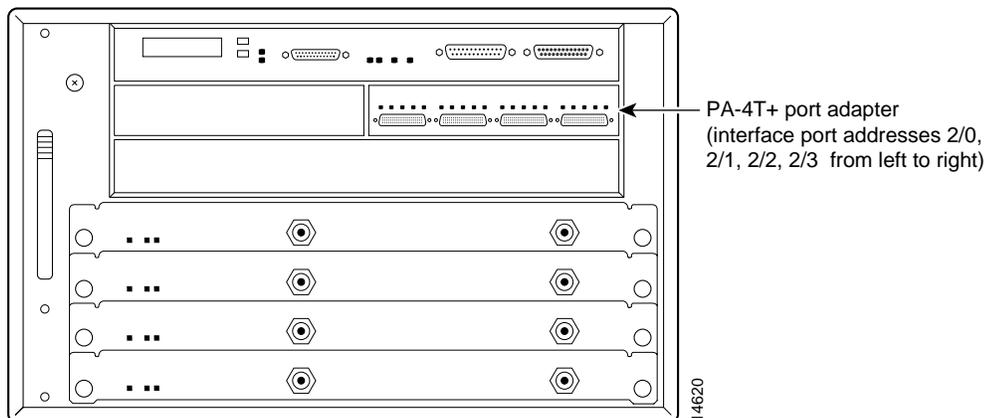
For example, the addresses of the interface ports on the PA-4T+ in chassis slot 2 are 2/0 through 2/3 (chassis slot 2 and interface ports 0 through 3). If the PA-4T+ was in port adapter slot 1, these same interface ports would be numbered 1/0 through 1/3.

Figure 8-2   PA-4T+ Interface Port Address Example—Cisco uBR7200 Series

PA-4T+ port adapter
(interface port addresses 2/0,
2/1, 2/2, 2/3 from left to right)

You can identify interface ports by physically checking the slot/port adapter/interface port location on the back of the router or by using software commands to display information about a specific interface or all interfaces in the router.

VIP2 Ports

In the router, physical port addresses specify the actual physical location of each interface port on the router interface processor end. (See Figure 8-3.) This address is composed of a three-part number in the format *interface processor slot number/port adapter number/interface port number.*

Note   Although the processor slots in the 7-slot Cisco 7000 and Cisco 7507 and 13-slot Cisco 7513 are vertically oriented and those in the 5-slot Cisco 7010 and Cisco 7505 are horizontally oriented, all models use the same method for slot and port numbering.


- The first number identifies the interface processor slot in which the VIP2 is installed.

- The second number identifies the port adapter slot on the VIP2, and is either 0 or 1.

- The third number identifies the interface ports on each PA-4T+, which are always numbered in sequence as interface 0 through 3.

Interface ports on a PA-4T+ that is installed in a VIP2 maintain the same address regardless of whether other interface processors are installed or removed. However, when you move a VIP2 to a different slot, the first number in the address changes to reflect the new slot number.

Figure 8-3 shows some of the port adapter slot and interface ports of a sample Cisco 7505 router. The interface port addresses for the installed PA-4T+ are 3/1/0 through 3/1/3 (interface processor slot 3, port adapter slot 1, and interface ports 0 through 3). If the PA-4T+ was in port adapter slot 0, these same interface ports would be numbered 3/0/0 through 3/0/3.

Note   If you remove the VIP2 (shown in Figure 8-3) from interface processor slot 3 and install it in interface processor slot 2, the addresses of those same PA-4T+ ports become 2/1/0 through 2/1/3.

Figure 8-3   PA-4T+ Interface Port Address Example—Cisco 7505
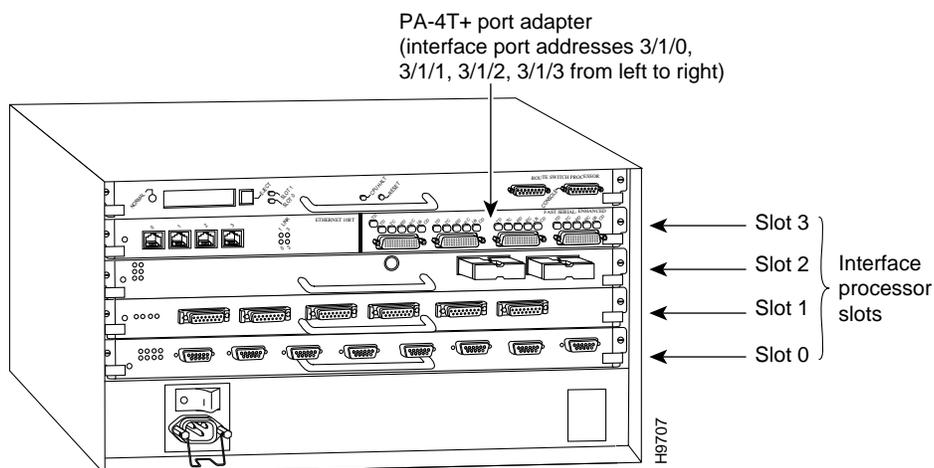

You can identify interface ports by physically checking the slot/port adapter/interface port location on the back of the router or by using **show** commands to display information about a specific interface or all interfaces in the router.

Cisco 7100 Series Ports

In Cisco 7100 series routers, the s*lot number* is the location in the chassis where the interface resides and the *port number* is the physical port. Interfaces in the Cisco IOS software are identified by a type, slot number, and port number. For example, serial 3/1 indicates port 1 on the serial port adapter in slot 3.

Slots in Cisco 7120 series routers are numbered as shown in Figure 8-4. The fixed LAN interface is slot 0, the fixed WAN interface is slot 1, and the modular port adapter interface is slot 3. On the Cisco 7120 series, slots 2 and 4 are not used. Slot 5 is the service adapter.

Figure 8-4   Port Adapter Slot Numbering—Cisco 7120 Series
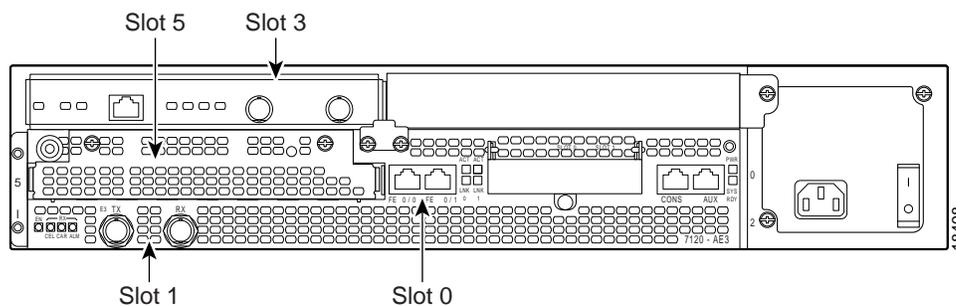
Slots in the Cisco 7140 series are numbered as shown Figure 8-5. The fixed LAN interface is slot 0, the fixed WAN interfaces are slots 1 and 2, and the modular port adapter interface is slot 4. Slot 3 is not used. Slot 5 is the service adapter.

Figure 8-5   Port Adapter Slot Numbering—Cisco 7140 Series
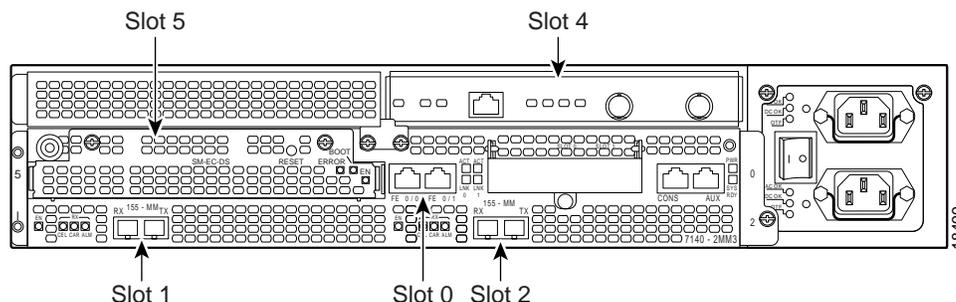
Shutting Down an Interface

Before you replace an interface cable, replace port adapters, or remove an interface that you will not replace, use the **shutdown** command to shut down (disable) the interfaces. Doing so prevents anomalies from occurring when you reinstall the new or reconfigured port adapter. When you shut down an interface, it is designated *administratively down* in the **show** command displays.

Follow these steps to shut down an interface:

Step 1   Enter the privileged level of the EXEC command interpreter. (See the "Using the EXEC Command Interpreter" section on page 8-1 for instructions.)

Step 2 At the privileged-level prompt, enter configuration mode and specify that the console terminal will be the source of the configuration subcommands as follows:

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

Step 3 For a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series router, specify the slot/port address of the first interface that you want shut down by entering the subcommand **interface**, followed by the *type* (**serial**) and *slot/port* (port adapter slot number/0). The example that follows is for a port adapter in slot 1:

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

For a VIP2, specify the slot/port address of the first interface that you want shut down by entering the subcommand **interface**, followed by the *type* (**serial**) and *slot/port* (interface processor slot number/0). The example that follows is for a VIP2 in interface processor slot 3:

```
Router(config)# interface serial 3/0
```

Step 4 Enter the **shutdown** command as follows:

```
Router(config-if)# shutdown
```

Step 5 To shut down additional interfaces, enter the slot/port address of each additional interface followed by the **shutdown** command. When you have entered all the interfaces to be shut down, press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter prompt.

For a Cisco 7100 series, Cisco 7200 series or Cisco uBR7200 series router, use the following example:

```
Router(config-if)# interface serial 1/0
Router(config-if)# shutdown
Router(config-if)# interface serial 1/1
Router(config-if)# shutdown
Ctrl-Z
Router#
```

For a VIP2, use the following example:

```
Router(config-if)# interface serial 3/0
Router(config-if)# shutdown
Router(config-if)# interface serial 3/0
Router(config-if)# shutdown
Ctrl-Z
Router#
```

Step 6 Write the new configuration to memory as follows:

```
Router# copy running-config startup-config
[OK]
Router#
```

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

Step 7 Verify that new interfaces are now in the correct state (shutdown). To do so, use the **show interfaces serial** *slot/port* command to display the specific interface, or use the **show interfaces** command, without variables, to display the status of all interfaces in the system.

For a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series router, use the following example:

```
Router# show interfaces serial 1/0

Serial 1/0 is administratively down, line protocol is down
  Hardware is M4T
  [display text omitted]
```

For a VIP2, use the following example:

```
Router# show interfaces serial 3/1/0

Serial 1/1/0 is administratively down, line protocol is down
  Hardware is cyBus Serial
  [display text omitted]
```

Step 8   Reenable the interfaces. To do so, repeat the previous steps, but use the **no shutdown** command in Step 4; then write the new configuration to memory.

For a Cisco 7200 series, Cisco uBR7200 series, or a Cisco 7100 series router, use the following example:

```
Router(config)# interface serial 1/0
Router(config-if)# no shutdown
Ctrl-Z
Router#

Router# copy running-config startup-config
[OK]
Router# show interfaces serial 1/0

Serial 1/0 is up, line protocol is up
  Hardware is M4T
  [display text omitted]
```

Note   In the above output from the **show interfaces** command, the PA-4T+ is displayed as M4T.

For a VIP2, use the following example:

```
Router(config)# interface serial 3/1/0
Router(config-if)# no shutdown
Ctrl-Z
Router#

Router# copy running-config startup-config
[OK]
Router# show interfaces serial 3/1/0

Serial 3/1/0 is up, line protocol is up
  Hardware is cxBus VIP2
  [display text omitted]
```

For complete descriptions of software configuration commands, refer to the publications listed in the "Related Documentation" section on page vi. Proceed to the following section to configure the new interfaces.

Performing a Basic Configuration

Following are instructions for a basic interface configuration: enabling an interface, specifying IP routing, and setting up external timing on a DCE interface. 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 serial interfaces, refer to the appropriate software documentation.

In the following procedure, press the **Return** key after each step unless otherwise noted. At any time you can exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable

Router>
```

Step 1   At the privileged-level prompt, enter configuration mode and specify that the console terminal will be the source of the configuration subcommands as follows:

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

Step 2   For a Cisco 7200 series, Cisco uBR7200 series or a Cisco 7100 series router, specify the first interface to configure by entering the subcommand **interface**, followed by the *type* (**serial**) and *slot/interface* (port adapter slot number and interface number). The example that follows is for the first interface of the port adapter on a Cisco 7200 series, Cisco 7100 series, or Cisco uBR7200 series router in slot 1:

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

For a VIP2, specify the first interface to configure by entering the subcommand **interface**, followed by the *type* (**serial**) and *slot/port* (interface processor slot number/0). The example that follows is for the first interface of the first port adapter on a VIP2 in interface processor slot 3:

```
Router(config)# interface serial 3/0
```

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-if)# ip address 10.10.10.10 255.255.255.255
```

Step 4   Add any additional configuration subcommands required to enable routing protocols and set the interface characteristics.

Step 5   If you are configuring a DTE interface, proceed to Step 7. If you are configuring a DCE interface, you need to configure the external clock signal, as described in the next step.

Step 6   Set the clock rate with the **clock rate** command. (See the next section, "Configuring Timing (Clock) Signals.")

```
Router(config-if)# clockrate 7200
```

Step 7   Change the shutdown state to up and enable the interface as follows:

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

Step 8   Configure additional interfaces as required.

Step 9 When you have included all of the configuration subcommands to complete the configuration, press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter prompt.

Step 10 Write the new configuration to nonvolatile memory as follows:

```
Router# copy running-config startup-config
[OK]
Router#
```

This completes the procedure for creating a basic configuration. Proceed to the following section "Configuring Timing (Clock) Signals."

The following sections describe the commands for configuring an external clock signal for a DCE interface and for configuring a port for NRZI encoding or 32-bit CRC. Configuration commands are executed from the privileged level of the EXEC command interpreter, which usually requires password access. Contact your system administrator, if necessary, to obtain access. (See the "Using the EXEC Command Interpreter" section on page 8-1 for an explanation of the privileged level of the EXEC.)

Configuring Timing (Clock) Signals

All PA-4T+ interfaces support both DTE and DCE mode, depending on the mode of the interface cable attached to the port. To use a port as a DTE interface, you need only connect a DTE cable to the port. When the system detects the DTE mode cable, it automatically uses the external timing signal. To use a port in DCE mode, you must connect a DCE interface cable and set the clock speed with the **clock rate** configuration command. You must also set the clock rate to perform a loopback test. This section describes how 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

The default operation on a PA-4T+ DCE interface is for the DCE device 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 (PA-4T+). The **clock rate** command specifies the rate as a bits-per-second value. In the following example for a Cisco 7100 series, Cisco 7200 series or Cisco uBR7200 series router, the clock rate for the serial interface on a PA-4T+ in slot 1 (1/0) is specified as 72 kbps:

```
Router(config)# interface serial 1/0
Router(config-if)# clock rate 72000
```

In the following example, the clock rate for the serial interface on a PA-4T+ on a VIP2 in interface processor slot 3 (3/1/0) is specified as 72 kbps:

```
Router(config)# interface serial 3/1/0
Router(config-if)# clock rate 72000
```

Use the **no clock rate** command to remove the clock rate.

Following are the standard clock rates:

1200, 2400, 4800, 9600, 19200 38400, 56000, 64000,
72000, 125000 148000, 250000, 500000, 800000, 1000000,
1300000, 2000000, 4000000, 8000000

Note Cisco IOS Release 11.2(7a)P or later, or 11.1(10)CA or later loaded on your Cisco 7200 series, Cisco 7000 series, or Cisco 7500 series router with a VIP2-40(=) support nonstandard clock rates (any value from 1200 to 8000000) on PA-4T+ interfaces.

Cisco IOS Release 12.0(3)T or later, or 12.0(1)XE or later support nonstandard clock rates on PA-4T+ interfaces installed in Cisco 7204VXR and Cisco 7206VXR routers.

Cisco IOS Release 11.3(6)NA or later loaded on your Cisco uBR7200 series router supports nonstandard clock rates (any value from 1200 to 8000000) on PA-4T+ interfaces.

Nonstandard clock rates are rounded (if necessary) to the nearest clock rate that the hardware can support

---

The following example shows how to configure a nonstandard clock rate on a PA-4T+ interface in port adapter slot 1 (1/0) on a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series router:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 1/0
Router(config-if)# clock rate 1234567
%Clockrate rounded to nearest value that your hardware can support.
%Use Exec Command 'show running-config' to see the value rounded to.
Router(config-if)# exit
Router(config)#
```

The following example shows how to configure a nonstandard clock rate on a PA-4T+ interface in interface processor slot 3 (3/1/0) on a VIP2:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/1/0
Router(config-if)# clock rate 1234567
%Clockrate rounded to nearest value that your hardware can support.
%Use Exec Command 'show running-config' to see the value rounded to.
Router(config-if)# exit
Router(config)#
```

The following example shows how to determine the exact clock rate that the interface was rounded to by using the **show running-config** command (only the relevant output from the **show running-config** command is included in the example; other information has been omitted).

```
Router# show running-config
Building configuration...
...
!
interface Serial 1/0
 no ip address
 clockrate 1151526
!
...
```

Inverting the Clock Signal

Systems that use long cables or cables that are not transmitting the TxC (clock) signal might experience high error rates when operating at higher transmission speeds. If a PA-4T+ DCE port is reporting a high number of error packets, a phase shift might be the problem. Inverting the clock might correct this shift.

When the PA-4T+ interface is a DTE, the **invert-txc** command inverts the TxC signal it receives from the remote DCE. When the PA-4T+ interface is a DCE, this command inverts the clock signal to the remote DTE port. Use the **no invert-txc** command to change the clock signal back to its original phase.

Inverting the Data Signal

If the interface on the PA-4T+ synchronous serial port adapter is used to drive a dedicated T1 line that does not have B8ZS encoding (a method to avoid 15 zeros), the data stream must be inverted (both TxD and RxD) either in the connecting CSU/DSU or the interface. To invert the data stream coming out of the PA-4T+, use the **invert data** command.

By inverting the HDLC data stream, the HDLC zero insertion algorithm becomes a ones insertion algorithm that satisfies the T1 requirements. Be careful not to invert data both on the interface and on the CSU/DSU because two data inversions will cancel each other out.

Configuring NRZI Format

All PA-4T+ interfaces support nonreturn-to-zero (NRZ) and nonreturn-to-zero inverted (NRZI) formats. Both formats use two different voltage levels for transmission. NRZ signals maintain constant voltage levels with no signal transitions (no return to a zero voltage level) during a bit interval and are decoded using absolute values (0 and 1). NRZI uses the same constant signal levels but interprets the absence of data (a space) at the beginning of a bit interval as a signal transition and the presence of data (a mark) as no transition. NRZI uses relational encoding to decode signals rather than determining absolute values.

NRZ format, the factory default on all interfaces, is most common. NRZI format, which is configured with a software command, is commonly used 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** [*mark*]. When you have finished with the configuration change, press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter prompt. In the example that follows, the first serial port on a PA-4T+ in port adapter slot 1 of a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series router is configured for NRZI encoding:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 1/0
Router(config-if)# nrzi-encoding
Ctrl-Z
Router#
```

In the example that follows, the first serial port on a PA-4T+ in interface processor slot 3 of a VIP2 is configured for NRZI encoding:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/1/0
Router(config-if)# nrzi-encoding
Ctrl-Z
Router#
```

To disable NRZI encoding on a port, specify the slot and port address and use the **no nrzi-encoding** command. For complete command descriptions and instructions, refer to the *Configuration Fundamentals Configuration Guide* publication. If you need more information, see the "Cisco Connection Online" section on page vii and the "Related Documentation" section on page vi.

Configuring CRCs

Cyclic redundancy check (CRC) is an error-checking technique that uses a calculated numeric value to detect errors in transmitted data. All interfaces use a 16-bit CRC (CRC-CITT) by default, but also support a 32-bit CRC. The sender of a data frame calculates the *frame check sequence* (FCS). Before it sends a frame, the sender appends the FCS value to the message. The receiver recalculates the FCS and compares its calculation to the FCS from the sender. If there is a difference between the two calculations, the receiver assumes that a transmission error occurred and sends a request to the sender to resend the frame.

To enable 32-bit CRC on an interface, specify the slot and port address of the interface followed by the command **crc 32**. In the example that follows, the first serial port on a PA-4T+ in port adapter slot 1 of a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series router is configured for 32-bit CRC:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 1/0
Router(config-if)# crc 32
Ctrl-Z
Router#
```

In the example that follows, the first serial port on a PA-4T+ on a VIP2 in interface processor slot 3 is configured for 32-bit CRC:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/1/0
Router(config-if)# crc 32
Ctrl-Z
Router#
```

To disable CRC-32 and return to the default CRC-16 (CRC-CITT) setting, specify the slot and port address and use the **no crc 32** command. For command descriptions, refer to the *Configuration Fundamentals Configuration Guide* publication. If you need more information, see the "Cisco Connection Online" section on page vii and the "Related Documentation" section on page vi.

If you are configuring a PA-4T+ installed on the Cisco 7200 series router, proceed to the following section "Configuring Half-Duplex and Binary Synchronous Communications," otherwise, proceed to the "Checking the Configuration" section on page 8-14.

Configuring Half-Duplex and Binary Synchronous Communications

This section explains how to configure PA-4T+ interfaces for half-duplex and Bisync operation in Cisco 7100 series and Cisco 7200 series routers.

Note   Cisco IOS Release 11.2(7a)P or later supports half-duplex and bisync operation on PA-4T+ port adapters in Cisco 7200 series router.

Cisco IOS Release 12.0(3)T or later, or 12.0(1)XE or later support nonstandard clock rates on PA-4T+ interfaces installed in Cisco 7204VXR and Cisco 7206VXR routers.

Configuring Half-Duplex

Use the **half-duplex** command to configure PA-4T+ interfaces for half-duplex mode; full-duplex mode is the default for low-speed serial interfaces. Serial DCE interfaces in half-duplex mode can be configured for controlled-carrier mode or constant-carrier mode; constant-carrier mode is the default. Use the **half-duplex controlled-carrier** command to configure a PA-4T+ interface for controlled-carrier mode. Use the **no half-duplex controlled-carrier** command to return the interface to constant-carrier mode.

Controlled-carrier mode sets the PA-4T+ interface to deactivate data carrier detect (DCD) until a transmission is sent to the interface. After a transmission is received, DCD is activated and the interface waits a user-configured amount of time, then transmits the data. After the transmission, the interface waits a user-configured amount of time and then deactivates DCD.

Constant-carrier mode activates DCD at all times.

Follow these steps to configure controlled-carrier mode on a PA-4T+ interface:

Step 1 At the privileged-level prompt, enter configuration mode and specify that the console terminal will be the source of the configuration subcommands, as follows:

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

Step 2 Specify the interface to configure for controlled-carrier mode (using the subcommand **interface**, followed by the *type* [**serial**] *and slot/port* [port adapter slot number and interface number] and then the subcommand **half-duplex controlled-carrier**). The following example is for the first interface of the port adapter in slot 1:

```
Router(config)# interface serial 1/0
Router(config-if)# half-duplex controlled-carrier
```

Step 3 Specify the time that the interface delays when configured for controlled-carrier mode by entering the **half-duplex timer** {**cts-delay** *value* | **cts-drop-timeout** *value* | **dcd-drop-delay** *value* | **dcd-txstart-delay** *value* | **rts-drop-delay** *value* | **rts-timeout** *value* | **transmit-delay** *value*} command. The following example configures the DCD drop delay on the first interface of the port adapter in slot 1 for 100 milliseconds:

```
Router(config)# interface serial 1/0
Router(config-if)# half-duplex timer dcd-drop-delay 100 ms
```

Note Table 8-1 lists the default settings for each half-duplex timer.

Step 4 After including all of the configuration subcommands, to complete the configuration, enter **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter prompt.

Step 5 Write the new configuration to nonvolatile memory as follows:

```
Router# copy running-config startup-config
[OK]
Router#
```

This completes the procedure for configuring controlled-carrier mode on a PA-4T+ interface. For additional information on configuring half-duplex operation on low-speed serial interfaces, refer to the chapter "Configuring Interfaces" of the *Configuration Fundamentals Configuration Guide* publication. If you need more information, see the "Cisco Connection Online" section on page vii and the "Related Documentation" section on page vi.

Table 8-1   Half-Duplex Timer Default Settings

Timer	Command Syntax	Default Settings (Milliseconds)
CTS delay	**half-duplex timer cts-delay**	0
CTS drop timeout	**half-duplex timer cts-drop-timeout**	250
DCD drop delay	**half-duplex timer dcd-drop-delay**	100
DCD transmission start delay	**half-duplex timer dcd-txstart-delay**	100
RTS drop delay	**half-duplex timer rts-drop-delay**	3
RTS timeout	**half-duplex timer rts-timeout**	3
Transmit delay	**half-duplex transmit-delay**	0

Configuring Bisync

To configure PA-4T+ interfaces for Bisync operation in Cisco 7200 series routers, refer to the "Block Serial Tunneling (BSTUN)" section of the "Configuring Serial Tunnel (STUN) and Block Serial Tunnel (BSTUN)" chapter of the *Bridging and IBM Networking Configuration Guide*.

Checking the Configuration

After configuring the new interface, use the **show** commands to display the status of the new interface or all interfaces and the **ping** and **loopback** commands to check connectivity.

Using show Commands to Verify the New Interface Status

Use the following steps tiuse verify that the new interfaces are configured and operating correctly:

Step 1   Use the **show version** command to display the system hardware configuration. Ensure that the list includes the new serial interfaces.

Step 2   Display all the current interface processors and their interfaces with the **show controllers** command. Verify that the new PA-4T+ appears in the correct slot.

Step 3   Specify one of the new interfaces:

- Cisco 7100 series, Cisco 7200 series or Cisco uBR7200 series routers—Use the **show interfaces** [*type slot/port*] command.

- VIP2—Use the **show interfaces** *type slot/port-adapter/port* command.

Verify that the first line of the display specifies the interface with the correct slot number. Also verify that the interface and line protocol are in the correct state: up or down.

Step 4   Display the protocols configured for the entire system and specific interfaces with the **show protocols** command. If necessary, return to configuration mode to add or remove protocol routing on the system or specific interfaces.

Step 5   Display the running configuration file with the **show running-config** command. Display the configuration stored in NVRAM using the **show startup-config** 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 service representative for assistance.

Using show Commands to Display Interface Information

To display information about a specific interface, use the **show interfaces** command with the interface type and port address in the format **show interfaces** [*type slot/port*] on a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series router, or **show interfaces** [*type slot/port-adapter/port*] on a VIP2.

Note   Output from the **show interfaces** command displays the PA-4T+ as M4T.

Cisco 7200 Series, Cisco uBR7200 Series, and Cisco 7100 Series show interfaces Command

Following are examples of how the **show interfaces** [*type slot/port*] command on a Cisco 7200 series, Cisco 7100 series or a Cisco uBR7200 series router displays status information (including the physical slot and port address) for the interface you specify. The four PA-4T+ interfaces (0–3) are in port adapter slot 1.

```
Router# show interfaces serial 1/0
Serial1/0 is up, line protocol is up
  Hardware is M4T
  Internet address is 10.10.10.1
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
(display text omitted]

Router# show interfaces serial 1/1
Serial1/1 is up, line protocol is up
  Hardware is M4T
  Internet address is 10.10.10.2
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
(display text omitted]

Router# show interfaces serial 1/2
Serial1/2 is up, line protocol is up
  Hardware is M4T
  Internet address is 10.10.10.3
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
(display text omitted]

Router# show interfaces serial 1/3
Serial1/3 is up, line protocol is up
  Hardware is M4T
  Internet address is 10.10.10.4
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
(display text omitted]
```

The following example of the **show interfaces serial** *slot/port* command on a Cisco 7200 series, Cisco uBR7200 series, or Cisco 7100 series router shows all of the information specific to the first PA-4T+ interface port (interface port 0) in port adapter slot 1:

```
Router# show interfaces serial 1/0
Serial1/0 is up, line protocol is up
  Hardware is M4T
  Internet address is 10.10.10.1
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
  LCP Open
  Open: ipcp
  Last input 00:00:09, output 00:00:09, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/64/0 (size/threshold/drops)
     Conversations  0/1 (active/max active)
     Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     1675 packets input, 26792 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     1676 packets output, 26806 bytes, 0 underruns
     0 output errors, 0 collisions, 3 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

The **show version** (or **show hardware**) command displays the configuration of the system hardware (the number of each port adapter type installed), the software version, the names and sources of configuration files, and the boot images. Following is an example of the **show version** command:

```
Router# show version

Cisco Internetwork Operating System Software
IOS (tm) 7200 Software (C7200-J-M), RELEASED VERSION 11.1(8)CA [sglee 108]
Synced to mainline version: 11.1
Copyright (c) 1986-1997 by cisco Systems, Inc.
Compiled Thu 27-Feb-97 23:54 by sglee
Image text-base: 0x600088F0, data-base: 0x6072C000

ROM: System Bootstrap, Version 11.1(5) RELEASED SOFTWARE
ROM: 7200 Software (software-image), Released Version 11.1(8)CA [sglee 101]

pulp uptime is 2 hours, 19 minutes
System restarted by reload
System image file is "image-name", booted via tftp from 10.10.10.1

cisco 7206 (NPE150) processor with 26624K/6144K bytes of memory.
R4700 processor, Implementation 33, Revision 1.0 (512KB Level 2 Cache)
Last reset from power-on
Bridging software.
SuperLAT software copyright 1990 by Meridian Technology Corp).
X.25 software, Version 2.0, NET2, BFE and GOSIP compliant.
TN3270 Emulation software (copyright 1994 by TGV Inc).
Chassis Interface.
3 Ethernet/IEEE 802.3 interfaces.
1 FastEthernet/IEEE 802.3 interface.
4 Serial interfaces.
125K bytes of non-volatile configuration memory.
1024K bytes of packet SRAM memory.

8192K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x0
```

Use the **show diag** command to view all the port adapter types installed in your system. Use the **show diag** *slot* command to view information about a port adapter installed in a specific port adapter slot. In the following example, a PA-4T+ in port adapter slot 1 is used:

```
Router# show diag 1

Slot 1:
        Mx serial port adapter, 4 ports
        Port adapter is analyzed
        Port adapter insertion time 02:19:52 ago
        Hardware revision 1.0          Board revision UNKNOWN
        Serial number     3701161      Part number    73-1577-03
        Test history      0x0          RMA number     00-00-00
        EEPROM format version 1
        EEPROM contents (hex):
          0x20: 01 0C 01 00 00 38 79 A9 49 06 29 03 00 00 00 00
          0x30: 05 00 00 00 FF FF FF 00 FF FF FF FF FF FF FF FF
```

For command descriptions and examples for Cisco 7200 series, Cisco 7100 series or Cisco uBR7200 routers, refer to the publications listed in the "Related Documentation" section on page vi. Proceed to the "Using ping and loopback Commands" section on page 8-21.

VIP2 show interfaces Command

Following are examples of how the **show interfaces** [*type slot/port-adapter/port*] command displays status information (including the physical slot and port address) for the interfaces you specify. The four PA-4T+ interfaces (0–3) are in interface processor slot 3, in port adapter slot 1.

```
Router# show interfaces serial 3/1/0
Serial3/1/0 is up, line protocol is up
  Hardware is cyBus Serial
  Internet address is 10.10.10.1
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
[display text omitted]

Router# show interfaces serial 3/1/1
Serial3/1/1 is up, line protocol is up
  Hardware is cyBus Serial
  Internet address is 10.10.10.2
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
[display text omitted]

Router# show interfaces serial 3/1/2
Serial3/1/2 is up, line protocol is up
  Hardware is cyBus Serial
  Internet address is 10.10.10.3
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
[display text omitted]

Router# show interfaces serial 3/1/3
Serial3/1/3 is up, line protocol is up
  Hardware is cyBus Serial
  Internet address is 10.10.10.3
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
[display text omitted]
```

The following example of the **show interfaces serial** *slot/port-adapter/port* command shows all of the information specific to the first PA-4T+ interface port (interface port 0) in port adapter slot 1:

```
Router# show interfaces serial 3/1/0
Serial3/1/0 is up, line protocol is up
  Hardware is cyBus Serial
  Internet address is 10.10.10.1
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
  LCP Open
  Open: ipcp
  Last input 00:00:08, output 00:00:08, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/64/0 (size/threshold/drops)
     Conversations  0/1 (active/max active)
     Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     14 packets input, 216 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     14 packets output, 216 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     1 carrier transitions
     RTS up, CTS up, DTR up, DCD up, DSR up
```

The **show version** (or **show hardware**) 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. Following is an example of the **show version** command used with a Cisco 7500 series router:

```
Router# show version

Cisco Internetwork Operating System Software
IOS (tm) GS Software (image-name), Version 11.1(8)CA, RELEASED SOFTWARE
Synced to mainline version: 11.1(8)
Copyright (c) 1986-1997 by cisco Systems, Inc.
Compiled Thu 23-Jan-97 18:14 by bellb
Image text-base: 0x60010900, data-base: 0x609EE000

ROM: System Bootstrap, Version 11.5 [kmac 3.2], RELEASED SOFTWARE
ROM: GS Software (image-name), Released version 11.1(5) [sglee 112]

GEN1 uptime is 2 minutes
System restarted by reload
System image file is "image-name", booted via tftp from 10.10.10.1

cisco RSP2 (R4600) processor with 32768K bytes of memory.
R4600 processor, Implementation 32, Revision 2.0
Last reset from power-on
G.703/E1 software, Version 1.0.
SuperLAT software copyright 1990 by Meridian Technology Corp).
Bridging software.
X.25 software, Version 2.0, NET2, BFE and GOSIP compliant.
TN3270 Emulation software (copyright 1994 by TGV Inc).
Chassis Interface.
1 VIP2 controller (4 Ethernet)(4 Serial).
4 Ethernet/IEEE 802.3 interfaces.
4 Network Serial interfaces.
125K bytes of non-volatile configuration memory.

16384K bytes of Flash PCMCIA card at slot 1 (Sector size 128K).
8192K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x0
```

Use the **show diag** command to view all the interface types installed in your system. Use the **show diag** *slot* command to view information about port adapters on a VIP2 that is installed in your system, as shown in the following example of a PA-4T+ on a VIP2 that is in interface processor slot 3:

```
Router# show diag 3
Slot 3:
        Physical slot 3, ~physical slot 0x6, logical slot 3, CBus 0
        Microcode Status 0xC
        Master Enable, LED, WCS Loaded
        Board is analyzed
        Pending I/O Status: Console I/O
        EEPROM format version 1
        VIP2 controller, HW rev 2.2, board revision UNKNOWN
        Serial number: 03517093 Part number: 73-1684-03
        Test history: 0x00        RMA number: 00-00-00
        Flags: cisco 7000 board; 7500 compatible

        EEPROM contents (hex):
          0x20: 01 15 02 03 00 35 AA A5 49 06 94 03 00 00 00 00
          0x30: 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

        Slot database information:
        Flags: 0x4        Insertion time: 0x5314 (01:20:55 ago)

        Controller Memory Size: 8 MBytes DRAM, 1024 KBytes SRAM

        PA Bay 0 Information:
                Mx Serial PA, 4 ports
                EEPROM format version 1
                HW rev 1.0, Board revision 154
                Serial number: 03699540  Part number: 73-1577-03

        PA Bay 1 Information:
                Ethernet PA, 4 ports
                EEPROM format version 1
                HW rev 1.0, Board revision 160
                Serial number: 02023164  Part number: 73-1556-03
```

For complete VIP2 command descriptions and examples, refer to the publications listed in the "Related Documentation" section on page vi. Proceed to the following section "Using ping and loopback Commands."

Using ping and loopback Commands

The *packet internet groper* (**ping**) and **loopback** commands allow you to verify that an interface port is functioning properly and to check the path between a specific port and connected devices at various locations on the network. This section provides brief descriptions of these commands. After you verify that the system has booted successfully and is operational, you can use these commands to verify the status of interface ports. Refer to the publications listed in the "Related Documentation" section on page vi for detailed command descriptions and examples.

The **ping** command sends an echo request out to a remote device at an IP address that you specify. After sending a series of signals, the command waits a specified time for the remote device to echo the signals. Each returned signal is displayed as an exclamation point (!) on the console terminal; each signal that is not returned before the specified time-out is displayed as a period (.). A series of exclamation points (!!!!!) indicates a good connection; a series of periods (.....) or the messages [timed out] or [failed] indicate that the connection failed.

Following is an example of a successful **ping** command to a remote server with the address 10.10.10.10:

```
Router# ping 10.10.10.10 <Return>
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 10.10.10.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/15/64 ms
Router#
```

If the connection fails, verify that you have the correct IP address for the server and that the server is active (powered on), and repeat the **ping** command.

The loopback test allows you to detect and isolate equipment malfunctions by testing the connection between the PA-4T+ interface and a remote device such as modems or CSU/DSUs. The **loopback** subcommand sends a series of packets out to and through the device (or cable), and back to the PA-4T+ interface. If the packets complete the loop, the connection is good. If not, you can isolate a fault to the remote device or interface cable in the path of the loopback test.

Note You must configure a clock rate on the port *before* performing a loopback test. However, if no cable is attached to the port, the port is administratively up, and the port is in loopback mode, you do not have to configure a clock rate on the port *before* performing a loopback test.

Depending on the mode of the port, issuing the **loopback** command checks the following path:

- When no interface cable is attached to the PA-4T+ interface, or if a DCE cable is attached to a port that is configured as line protocol up, the **loopback** command tests the path between the network processing engine and the interface port only (without leaving the network processing engine and port adapter).

- When a DTE cable is attached to the port, the **loopback** command tests the path between the network processing engine and the near (network processing engine) side of the DSU or modem to test the PA-4T+ interface and interface cable.

For complete descriptions of interface subcommands and the configuration options available for Cisco 7200 series routers, Cisco uBR7200 series, and Cisco 7100 series routers, and VIP2 interfaces, refer to the publications listed in the"Related Documentation" section on page vi.

Note The X.21 interface definition does not include a loopback definition. On the PA-4T+, the X.21 DTE interface does not support the loopback function. Because of the internal clock signal present on the PA-4T+ interfaces, loopback will function on an X.21 DCE interface.