CHAPTER 2

Preparing to Install the Router

This chapter describes site requirements and equipment needed for router installation. It includes the following sections:

- Safety Recommendations
- General Site Requirements
- Installation Checklist
- Creating a Site Log
- Inspecting the Router
- Required Tools and Equipment
- Console and Auxiliary Port Considerations
- Preparing to Connect to a Network

Safety Recommendations

Follow these guidelines to ensure general safety:

- Keep the chassis area clear and dust-free during and after installation.
- If you remove the chassis cover, put it in a safe place.
- Keep tools and chassis components away from walk areas.
- Do not wear loose clothing that could get caught in the chassis. Fasten your tie or scarf and roll up your sleeves.

- Wear safety glasses when working under conditions that might be hazardous to your eyes.
- Do not perform any action that creates a hazard to people or makes the equipment unsafe.

Warning Ultimate disposal of this product should be handled according to all national laws and regulations. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Safety with Electricity

Follow these guidelines when working on equipment powered by electricity:

Warning Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

- Locate the emergency power-OFF switch in the room in which you are working. Then, if an electrical accident occurs, you can quickly turn OFF the power.
- Disconnect all power before doing the following:
  - Installing or removing a chassis
  - Working near power supplies

Warning Before working on a chassis or working near power supplies, unplug the power cord on AC units; disconnect the power at the circuit breaker on DC units. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is OFF and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning This equipment is intended to be grounded. Ensure that the host is connected to earth ground during normal use. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning When installing the unit, the ground connection must always be made first and disconnected last. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

- Do not work alone if hazardous conditions exist.
- Never assume that power is disconnected from a circuit. Always check.

Warning Read the installation instructions before you connect the system to its power source. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, frayed power cords, and missing safety grounds.
- If an electrical accident occurs, proceed as follows:
  - Use caution; do not become a victim yourself.
  - Turn OFF power to the device.

— If possible, send another person to get medical aid. Otherwise, assess the victim's condition and then call for help.

— Determine if the person needs rescue breathing or external cardiac compressions; then take appropriate action.

In addition, use the following guidelines when working with any equipment that is disconnected from a power source, but still connected to telephone wiring or other network cabling:

- Never install telephone wiring during a lightning storm.

Warning Do not work on the system or connect or disconnect cables during periods of lightning activity. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

- Never install telephone jacks in wet locations unless the jack is specifically designed for it.
- Never touch uninsulated telephone wires or terminals unless the telephone line is disconnected at the network interface.
- Use caution when installing or modifying telephone lines.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) can damage equipment and impair electrical circuitry. It can occur if electronic printed circuit cards are improperly handled and can cause complete or intermittent failures. Always follow ESD prevention procedures when removing and replacing modules:

- Ensure that the router chassis is electrically connected to earth ground.
- Wear an ESD-preventive wrist strap, ensuring that it makes good skin contact. Connect the clip to an unpainted surface of the chassis frame to channel unwanted ESD voltages safely to ground. To guard against ESD damage and shocks, the wrist strap and cord must operate effectively.
- If no wrist strap is available, ground yourself by touching a metal part of the chassis.

Caution For the safety of your equipment, periodically check the resistance value of the antistatic strap. It should be from 1 to 10 megohms (Mohms).

General Site Requirements

This section describes the requirements your site must meet for safe installation and operation of your router. Ensure that the site is properly prepared before beginning installation. If you are experiencing shutdowns or unusually high errors with your existing equipment, this section can also help you isolate the cause of failures and prevent future problems.

Power Supply Considerations

Check the power at your site to ensure that you are receiving "clean" power (free of spikes and noise). Install a power conditioner if necessary.

Warning The device is designed to work with TN power systems. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning Do not work on the system or connect or disconnect cables during periods of lightning activity. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

The router AC power supply has the following characteristics:

- Autoranging, 140W, 100 to 240 VAC, 2.0A, 50 to 60 Hz
- 6-foot (1.8-meter) electrical power cord

The router DC power supply has the following characteristics:

- 140W, 38 to 72 VDC, 5.0A
- Use 14 American Wire Gauge (AWG) wire for DC-input power connections

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

Site Environment

The router can be placed on a desktop or mounted in a rack or on a wall. The location of your router and the layout of your equipment rack or wiring room are extremely important for proper operation. Equipment placed too close together, inadequate ventilation, and inaccessible panels can cause malfunctions and shutdowns, and can make maintenance difficult. Plan for access to both front and rear panels of the router.

When planning your site layout and equipment locations, remember the precautions described in the next section, “Preventive Site Configuration” to help avoid equipment failures and reduce the possibility of environmentally caused shutdowns. If you are currently experiencing shutdowns or unusually high errors with your existing equipment, these precautions may help you isolate the cause of the failures and prevent future problems.

Preventive Site Configuration

The following precautions will help you plan an acceptable operating environment for your router and will help you avoid environmentally caused equipment failures:

- Remember that electrical equipment generates heat. Ambient air temperature may not cool equipment to acceptable operating temperatures without adequate circulation. Ensure that the room where your router operates has adequate circulation.
- Always follow the ESD prevention procedures in the section “Preventing Electrostatic Discharge Damage” earlier in this chapter to avoid damage to equipment. Damage from static discharge can cause immediate or intermittent equipment failure.
- Ensure that the chassis cover and module rear panels are secure. All empty module slots and WAN interface card slots must have filler panels installed. The chassis is designed to allow cooling air to flow within it, through specially designed cooling slots. A chassis with uncovered openings will create air leaks, which may interrupt and reduce the flow of air across internal components.

Equipment Racks

You can mount the router in a 19-, 23-, or 24-inch equipment rack. The following information will help you plan your equipment rack configuration:

- Enclosed racks must have adequate ventilation. Ensure that the rack is not congested, because each unit generates heat. An enclosed rack should have louvered sides and a fan to provide cooling air. Heat generated by equipment near the bottom of the rack can be drawn upward into the intake ports of the equipment above.
- When mounting a chassis in an open rack, ensure that the rack frame does not block the intake or exhaust ports. If the chassis is installed on slides, check the position of the chassis when it is seated into the rack.
- Baffles can isolate exhaust air from intake air, which also helps to draw cooling air through the chassis. The best placement of the baffles depends on the airflow patterns in the rack, which can be found by experimenting with different configurations.
- When equipment installed in a rack (particularly in an enclosed rack) fails, try operating the equipment by itself, if possible. Power off other equipment in the rack (and in adjacent racks) to allow the unit under test a maximum of cooling air and clean power.

Installation Checklist

The sample Installation Checklist lists items and procedures for installing a new router. Make a copy of this checklist and mark the entries when completed. Include a copy of the checklist for each router in your Site Log (described in the next section, “Creating a Site Log”).

Installation checklist for site _____
Router name _____

Task	Verified by	Date
Installation checklist copied		
Background information placed in Site Log		
Site power voltages verified		
Installation site power check completed		
Required tools available		
Additional equipment available		
Router received		
This publication and the *Regulatory Compliance and Safety Information* document received		
Optional printed documentation or CD-ROM documentation received		
Information packet publication received		
Chassis components verified		
Initial electrical connections established		
ASCII terminal (for local configuration) or modem (for remote configuration)		
Signal distance limits verified		
Startup sequence steps completed		
Initial operation verified		
Software image verified		

Creating a Site Log

The Site Log provides a record of all actions related to the router. Keep it in an accessible place near the chassis where anyone who performs tasks has access to it. Use the Installation Checklist to verify steps in the installation and maintenance of the router. Site Log entries might include the following:

- Installation progress—Make a copy of the Installation Checklist and insert it into the Site Log. Make entries as each procedure is completed.
- Upgrade and maintenance procedures—Use the Site Log as a record of ongoing router maintenance and expansion history. A Site Log might include the following events:
  - Installation of modules
  - Removal or replacement of modules and other upgrades
  - Configuration changes
  - Maintenance schedules and requirements
  - Maintenance procedures performed
  - Intermittent problems
  - Comments and notes

  For information on maintaining the router, see the appendix “Maintaining the Router.”

Inspecting the Router

Do not unpack the router until you are ready to install it. If the final installation site will not be ready for some time, keep the chassis in its shipping container to prevent accidental damage. When you are ready to install the router, proceed with unpacking it.

The router, cables, publications, and any optional equipment you ordered may be shipped in more than one container. When you unpack the containers, check the packing list to ensure that you received all the following items:

- Router
- 6-foot (1.8-meter) power cord
- Rubber feet for desktop mounting

- Rack-mount brackets
- Console and auxiliary cabling kit (two RJ-45 rollover cables, one RJ-45-to-DB-9 terminal adapter, one RJ-45-to-DB-25 modem adapter, and one RJ-45-to-DB-25 terminal adapter)
- Optional equipment (such as network connection cables or additional rack-mount brackets)
- This publication, the *Regulatory Compliance and Safety Information* document, optional companion publications, or documentation CD-ROM, as specified in your order
- Information packet publication

Inspect all items for shipping damage. If anything appears to be damaged, or if you encounter problems installing or configuring your router, contact customer service. Warranty, service, and support information is in the information packet that shipped with your router.

Required Tools and Equipment

You need the following tools and equipment to install the router:

- ESD cord and wrist strap
- Number 1 Phillips or flat-blade screwdriver
  - To install or remove modules
  - To remove the cover, if you are upgrading or replacing memory
- Number 1 or 2 Phillips screwdriver and screws to fit your rack
  - For rack-mounting
- An adapter cable for each port to connect the port with a remote device or network
- A ROM extractor tool or small flat-blade screwdriver
  - For replacing the ROM

- Needlenose pliers
  - For straightening any pins bent when you install the ROM

In addition, depending on the type of modules you plan to use, you might need the following equipment to connect a port to an external network:

- Ethernet interfaces will require an Ethernet transceiver
- Token Ring interfaces will require a Token Ring media attachment unit (MAU)
- Serial interfaces may require a data service unit (DSU) or channel service unit/data service unit (CSU/DSU)
- CT1/PRI modules without the built-in CSU will require an external CSU
- ISDN BRI S/T interfaces will require an NT1 device if one is not supplied by your service provider

Console and Auxiliary Port Considerations

The router includes an asynchronous serial console port and an auxiliary port. The console and auxiliary ports provide access to the router either locally using a console terminal or remotely using a modem. This section discusses important cabling information to consider before connecting a console terminal, which can be either an ASCII terminal or a PC running terminal emulation software, to the console port or modem to the auxiliary port.

The main difference between the console and auxiliary ports is that the auxiliary port supports hardware flow control and the console port does not. Flow control paces the transmission of data between a sending device and a receiving device. Flow control ensures that the receiving device can absorb the data sent to it before the sending device sends more. When the buffers on the receiving device are full, a message is sent to the sending device to suspend transmission until the data in the buffers has been processed. Because the auxiliary port supports flow control, it is ideally suited for use with the high-speed transmissions of a modem. Console terminals transmit at slower speeds than modems; therefore, the console port is ideally suited for use with console terminals.

Console Port Connections

The router includes an EIA/TIA-232 asynchronous serial console port (RJ-45). Depending on the cable and the adapter used, this port will appear as a DTE or DCE device at the end of the cable. Your router comes with cables and adapters to connect a console terminal (an ASCII terminal or PC running terminal emulation software) to the console port. To connect an ASCII terminal to the console port, use the RJ-45 rollover cable with the female RJ-45-to-DB-25 adapter (labeled Terminal). To connect a PC running terminal emulation software to the console port, use the RJ-45 rollover cable with the female RJ-45-to-DB-9 adapter (labeled Terminal). The default parameters for the console port are 9600 baud, 8 data bits, no parity, and 2 stop bits. The console port does not support hardware flow control. For detailed information about installing a console terminal, see the section "Connecting the Console Terminal and Modem" in the chapter "Installing the Router." See the appendix "Cable Specifications" for cable and port pinouts.

Auxiliary Port Connections

The router includes an EIA/TIA-232 asynchronous serial auxiliary port (RJ-45) that supports flow control. Depending on the cable and the adapter used, this port will appear as a DTE or DCE device at the end of the cable. Your router includes a cable and an adapter to connect a modem to the auxiliary port. To connect a modem to the auxiliary port, use the RJ-45 rollover cable with the male RJ-45-to-DB-25 adapter (labeled Modem). For detailed information about connecting devices to the auxiliary port, see the section "Connecting the Console Terminal and Modem" in the chapter "Installing the Router." See the appendix "Cable Specifications" for cable and port pinouts.

Preparing to Connect to a Network

When setting up your router, consider distance limitations and potential electromagnetic interference (EMI) as defined by the applicable local and international regulations.

Network connection considerations are provided for several types of network interfaces and are discussed in the following sections:

- Ethernet Connections
- Token Ring Connections

- Serial Connections
- ISDN BRI Connections
- CT1/PRI Connections
- CE1/PRI Connections

Warning The Ethernet 10BaseT, Token Ring, serial, console, and auxiliary ports contain safety extra-low voltage (SELV) circuits. BRI and PRI circuits are treated like telephone-network voltage (TNV) circuits. Avoid connecting SELV circuits to TNV circuits. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Ethernet Connections

The IEEE has established Ethernet as standard IEEE 802.3. The most common Ethernet implementations are as follows:

- 10Base2—Ethernet on thin coaxial cable, also known as thin Ethernet. The maximum segment distance is 607 feet (186 meters).
- 10Base5—Ethernet on thick coaxial cable, also known as thick Ethernet. The maximum segment distance is 1,640 feet (500 meters).
- 10BaseT—Ethernet on unshielded twisted-pair (UTP) cable. The maximum segment distance is 328 feet (100 meters). UTP cables look like the wiring used for ordinary telephones; however, UTP cables meet certain electrical standards that telephone cables do not meet.

The Ethernet interfaces available for the router operate at speeds up to 10 Mbps. The 1E, 2E, and 1E1R 2-slot modules provide both an attachment unit interface (AUI) port and a 10BaseT port. (See Figure 2-1, Figure 2-2, and Figure 2-3, respectively.) Only one Ethernet port per module can be used at a time. The module will automatically detect which port, AUI or 10BaseT, is in use.

Figure 2-1 1E 2-Slot Module

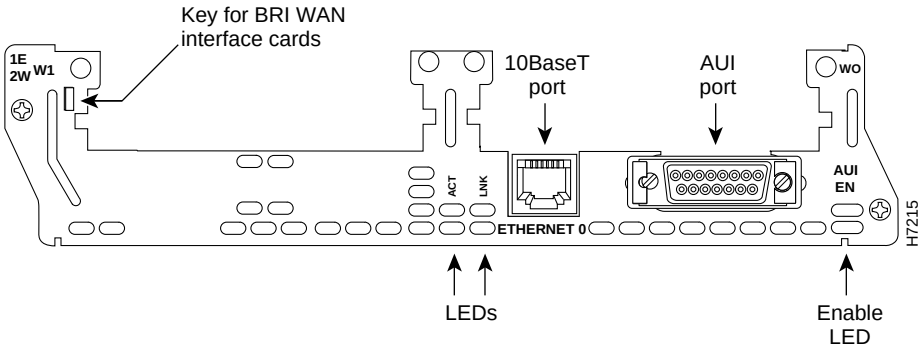


Figure 2-2 2E 2-Slot Module

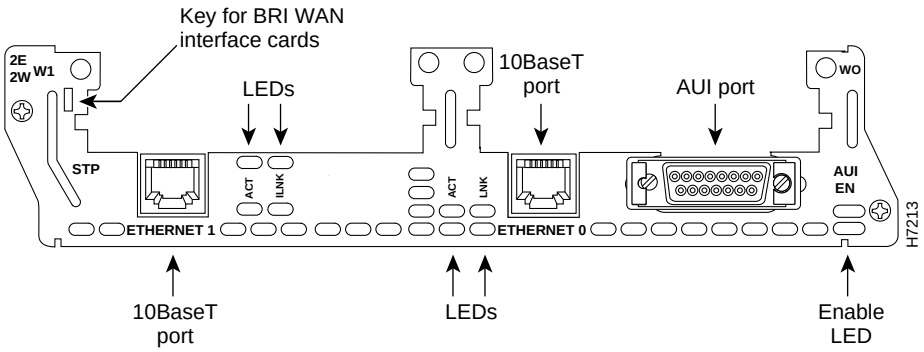
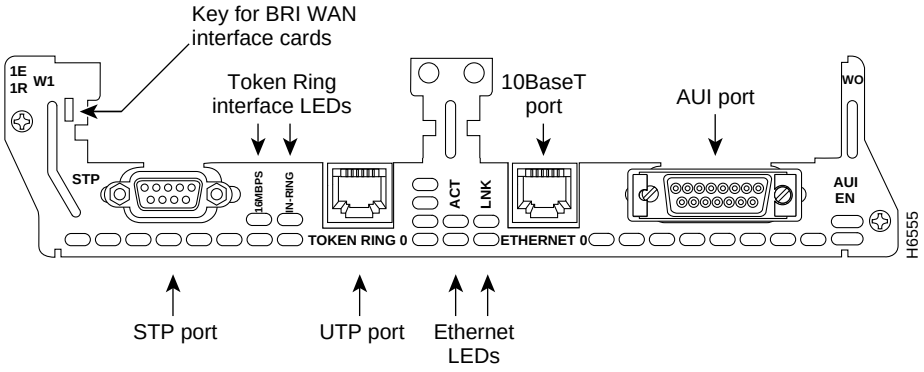


Figure 2-3 1E1R 2-Slot Module



Token Ring Connections

The 1E1R 2-slot module provides both an UTP interface and a shielded twisted-pair (STP) interface. (See Figure 2-3.)

The IEEE has established Token Ring as standard IEEE 802.5. The distance limitations for the IEEE 802.5 specification indicate a maximum segment distance of 328 feet (100 meters) for UTP cabling. The distance limitation is 1,640 feet (500 meters) for STP cabling.

Token Ring can operate at two different ring speeds: 4 and 16 Mbps. All devices on the ring must use the same operating speed.

Only one Token Ring port can be used at a time. The module will automatically detect which port, STP or UTP, is in use.

Use a Token Ring lobe cable to connect the router to a MAU. The lobe cable and MAU are not included with the router. Refer to the section “Token Ring Port Pinouts” in the appendix “Cable Specifications” for the Token Ring port pinouts.

Serial Connections

Serial connections are provided by the 4- and 8-port A/S serial modules and by the 1-port serial WAN interface card. (See Figure 2-4, Figure 2-5, and Figure 2-6, respectively.) The serial WAN interface card can be installed in either slot of a 2-slot module.

Before you connect a device to a serial port, you need to know the following:

- The type of device, DTE or DCE, you are connecting to the synchronous serial interface
- The type of connector, male or female, required to connect to the device
- The signaling standard required by the device

Figure 2-4 4-Port A/S Serial Module

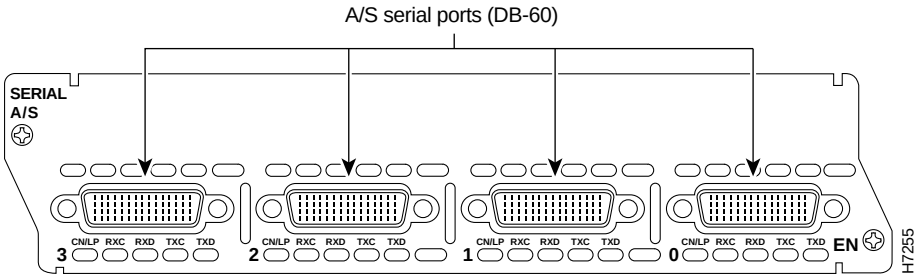


Figure 2-5 8-Port A/S Serial Module

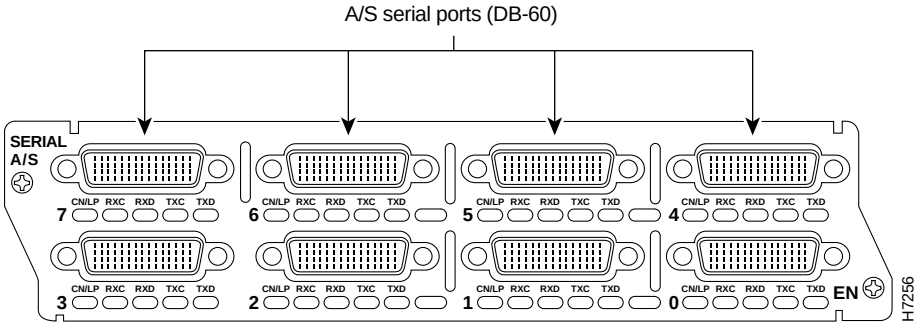
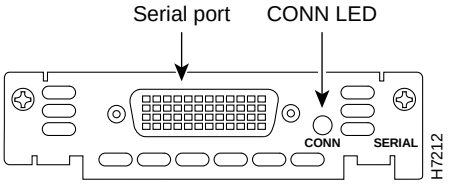


Figure 2-6 1-Port Serial WAN Interface Card



Configuring Serial Connections

The serial ports on the A/S serial modules and the serial WAN interface card use DB-60 connectors. (See Figure 2-4, Figure 2-5, and Figure 2-6, respectively.) Serial ports can be configured as DTE or DCE, depending on the serial cable used.

Serial DTE or DCE Devices

A device that communicates over a synchronous serial interface is either a DTE or DCE device. A DCE device provides a clock signal that paces the communications between the device and the router. A DTE device does not provide a clock signal. DTE devices usually connect to DCE devices. The documentation that accompanied the device should indicate whether it is a DTE or DCE device. (Some devices have a jumper to select either DTE or DCE mode.) If you cannot find the information in the documentation, refer to Table 2-1 to help you select the proper device type.

Table 2-1 Typical DTE and DCE Devices

Device type	Gender	Typical Devices
DTE	Male[1]	Terminal
		PC
DCE	Female[2]	Modem
		CSU/DSU
		Multiplexer

1. If pins protrude from the base of the connector, the connector is male.
2. If the connector has holes to accept pins, the connector is female.

Signaling Standards Supported

The synchronous serial ports available for the router support the following signaling standards: EIA/TIA-232, EIA/TIA-449, V.35, X.21, and EIA-530. You can order from us a DB-60 shielded serial transition cable that has the appropriate connector for the standard you specify. The router end of the shielded serial transition cable has a DB-60 connector, which connects to the DB-60 port on a serial WAN interface card. The other end of the serial transition cable is available with the connector appropriate for the standard you specify. The documentation for the device you want to connect should indicate the standard used for that device. The synchronous serial port can be configured as DTE or DCE (except EIA-530, which is DTE only), depending on the attached cable. To order a shielded cable, contact customer service. (See the information packet publication that came with your router.)

Note All serial ports configured as DTE require external clocking from a CSU/DSU or other DCE device.

Although attempting to manufacture your own serial cables is not recommended (because of the small size of the pins on the DB-60 serial connector), cable pinouts are provided in the appendix "Cable Specifications."

Distance Limitations

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

Note Only the serial WAN interface card supports bit rates above 128 kbps.

Table 2-2 lists the recommended maximum speeds and distances for each serial interface type; however, you may get good results at speeds and distances greater than those listed. For instance, the recommended maximum rate for V.35 is 2 Mbps, but 4 Mbps is commonly used. If you understand the electrical problems that might arise and can compensate for them, you can get good results with rates and distances greater than those shown. However, do so at your own risk.

Table 2-2 Serial Signal Transmission Speeds and Distances

	EIA/TIA-232 Distance		EIA/TIA-449, X.21, V.35, EIA-530 Distance	
Rate (bps)	**Feet**	**Meters**	**Feet**	**Meters**
2400	200	60	4100	1250
4800	100	30	2050	625
9600	50	15	1025	312

Table 2-2 Serial Signal Transmission Speeds and Distances (Continued)

	EIA/TIA-232 Distance		EIA/TIA-449, X.21, V.35, EIA-530 Distance	
Rate (bps)	**Feet**	**Meters**	**Feet**	**Meters**
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 signals. The recommended distance limits for EIA/TIA-449 shown in Table 2-2 are also valid for V.35, X.21, and EIA-530. However, you can get good results at distances and rates greater than those shown in Table 2-2. Typically, EIA/TIA-449 and EIA-530 support 2-Mbps rates, and V.35 can support 4-Mbps rates.

A/S Serial Module Baud Rates

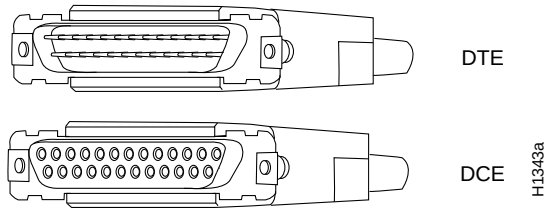
The following baud-rate limitations apply to the slow-speed serial interfaces found in the A/S serial modules:

- The maximum baud rate on the slow-speed asynchronous interface is 115.2 kbps. The traffic throughput rate allowed will be full 115.2 kbps with 10 percent of traffic in the opposite direction.
- The maximum baud rate for the slow-speed synchronous interface is 128 kbps full duplex.

EIA/TIA-232 Connections

EIA/TIA-232 supports unbalanced circuits at signal speeds up to 64 kbps. The network end of the adapter cable is a standard 25-pin D-shell connector known as a DB-25. (See Figure 2-7.) The router console and auxiliary ports also use EIA/TIA-232 connections; however, the serial module ports support synchronous connections, and the console and auxiliary ports support asynchronous connections.

Figure 2-7 EIA/TIA-232 Adapter Cable Connectors, Network End



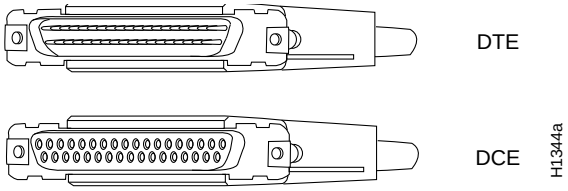
EIA/TIA-449 Connections

EIA/TIA-449, which supports balanced (EIA/TIA-422) and unbalanced (EIA/TIA-423) transmissions, is a faster (up to 2 Mbps) version of EIA/TIA-232 that provides more functions and supports transmissions over greater distances.

The EIA/TIA-449 standard was intended to replace the EIA/TIA-232 standard, but it was not widely adopted primarily because of the large installed base of DB-25 hardware and because of the larger size of the 37-pin EIA/TIA-449 connectors, which limited the number of connections possible (fewer than possible with the smaller, 25-pin EIA/TIA-232 connector).

The network end of the EIA/TIA-449 adapter cable provides a standard 37-pin D-shell connector. (See Figure 2-8.) EIA/TIA-449 cables are available as either DTE (DB-37 plug) or DCE (DB-37 receptacle).

Figure 2-8 EIA/TIA-449 Adapter Cable Connectors, Network End

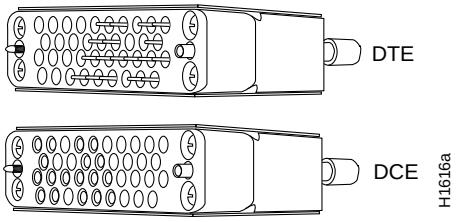


V.35 Connections

The V.35 interface is recommended for speeds up to 48 kbps, although in practice it is used successfully at 4 Mbps.

The network end of the V.35 adapter cable provides a standard 34-pin Winchester-type connector. (See Figure 2-9.) V.35 cables are available with a standard V.35 plug or receptacle in either DTE or DCE mode.

Figure 2-9 V.35 Adapter Cable Connectors, Network End

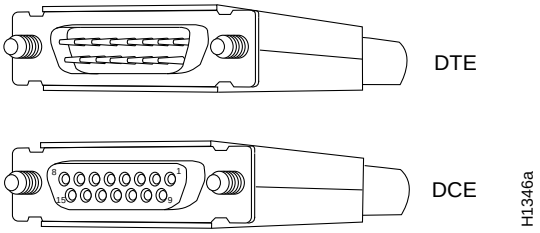


X.21 Connections

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

The network end of the X.21 adapter cable is a standard DB-15 connector. (See Figure 2-10.) X.21 cables are available as either DTE (DB-15 plug) or DCE (DB-15 receptacle).

Figure 2-10 X.21 Adapter Cable Connectors, Network End



EIA-530 Connections

EIA-530, which supports balanced transmission, provides the increased functionality, speed, and distance of EIA/TIA-449 on the smaller DB-25 connector used for EIA/TIA-232, instead of the 37-pin connectors used for EIA/TIA-449. Like EIA/TIA-449, EIA-530 refers to the electrical specifications of EIA/TIA-422 and EIA/TIA-423. Although the specification recommends a maximum speed of 2 Mbps, EIA-530 is used successfully at 4 Mbps or faster speeds over short distances.

The EIA-530 adapter cable is available in DTE mode only. The network end of the EIA-530 adapter cable is a standard DB-25 plug commonly used for EIA/TIA-232 connections. Figure 2-11 shows the DB-25 connector at the network end of the adapter cable.

Figure 2-11 EIA-530 Adapter Cable Connector, Network End

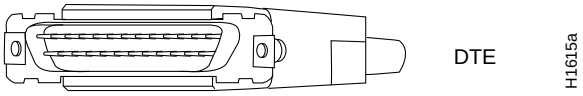
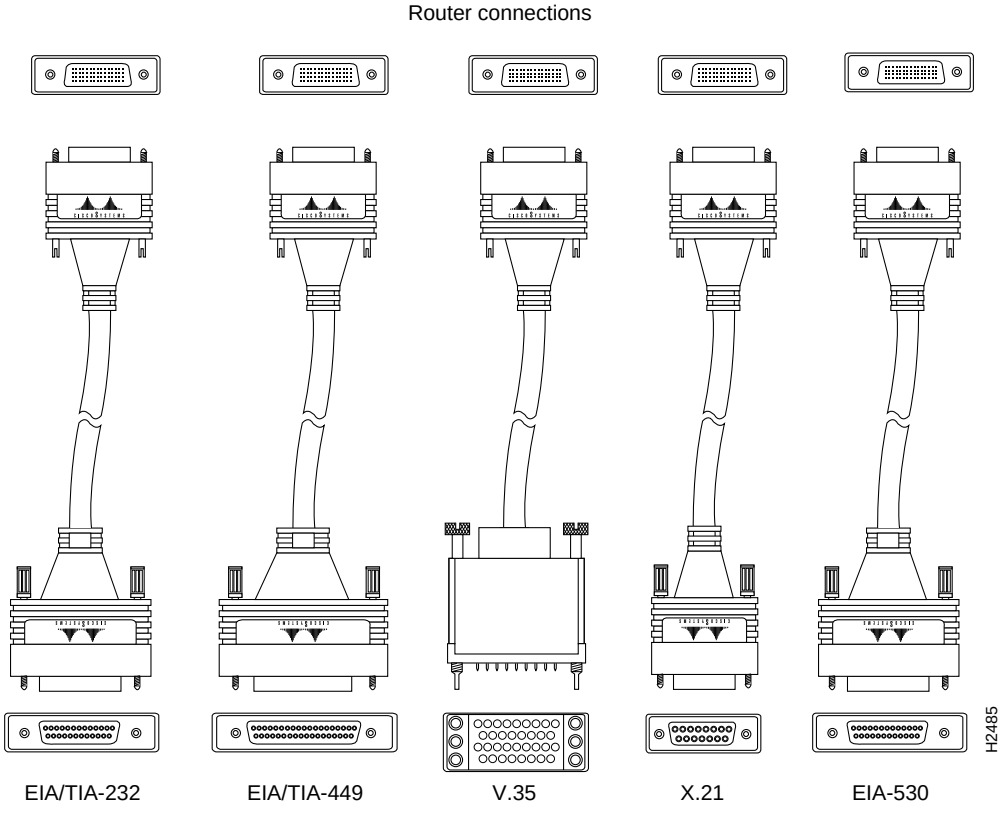


Figure 2-12 shows the serial transition cables you can connect to the DB-60 port on the A/S serial modules and serial WAN interface card.

Figure 2-12 Serial Interface Adapter Cables



ISDN BRI Connections

The BRI modules and BRI WAN interface cards provide ISDN BRI connections. The BRI modules and BRI WAN interface cards are available with either an S/T interface that requires an external NT1, or a U interface that has a built-in NT1.

The BRI WAN interface cards mount only in the W1 slot of a two-slot module and provide a single BRI interface. (See Figure 2-13 and Figure 2-14.)

Note The BRI S/T WAN interface card includes two termination jumpers, labeled J1 and J2. Before you install the WAN interface card, ensure that the termination jumpers are set appropriately for your installation. The termination jumpers are factory-configured in the B position (100 Ohms termination). See the section "Installing a WAN Interface Card in a Module Slot" in the chapter "Installing the Router" for more information.

Figure 2-13 BRI S/T WAN Interface Card

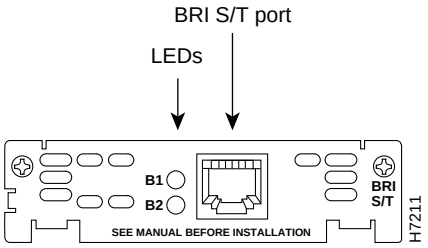
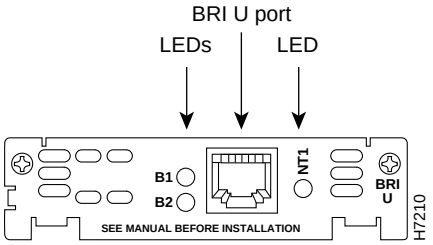


Figure 2-14 BRI U WAN Interface Card



You can install the BRI modules into any available slot in the chassis. (See Figure 2-16 and Figure 2-15.)

Figure 2-15 4-Port BRI U Module

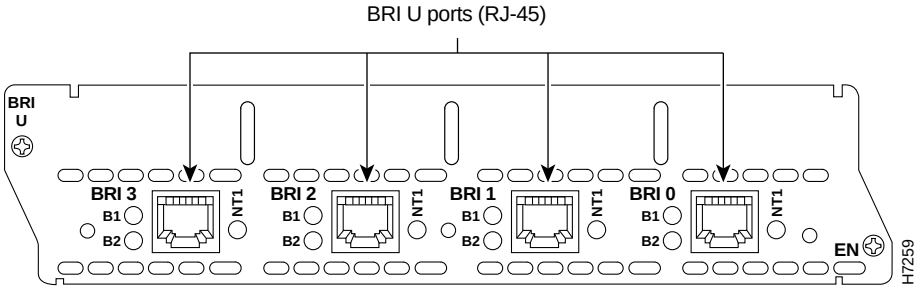
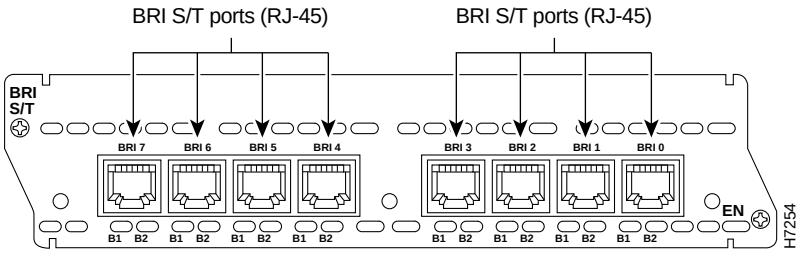


Figure 2-16 8-Port BRI S/T Module



Warning Network hazardous voltages are present in the BRI cable. If you detach the BRI cable, detach the end away from the router first to avoid possible electric shock. Network hazardous voltages also are present on the system card in the area of the BRI port (RJ-45 connector), regardless of when power is turned OFF. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Warning The ISDN connection is regarded as a source of voltage that should be inaccessible to user contact. Do not attempt to tamper with or open any public telephone operator (PTO)-provided equipment or connection hardware. Any hardwired connection (other than by nonremovable, connect-one-time-only lug) must be made only by PTO staff or suitably trained engineers. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

Use a BRI cable (not included) to connect the router directly to an ISDN. Table 2-3 lists the specifications for ISDN BRI cables. Refer to the section “BRI Pinouts” in the appendix “Cable Specifications” for pinouts.

Table 2-3 ISDN BRI Cable Specifications

Specification	High-Capacitance Cable	Low-Capacitance Cable
Resistance (at 96 kHz)	160 ohms/km	160 ohms/km
Capacitance (at 1 kHz)	120 nF[1]/km	30 nF/km
Impedance (96 kHz)	75 ohms	150 ohms
Wire diameter	0.024" (0.6 mm)	0.024" (0.6 mm)
Distance limitation	32.8' (10 m)	32.8' (10 m)

1. nF=nanoFarad.

CT1/PRI Connections

CT1/PRI modules are available with and without a built-in CSU and with one or two ports. The CT1/PRI modules connect to an external CSU. (See Figure 2-17 and Figure 2-18.) The CT1/PRI-CSU modules connect directly to the network. (See Figure 2-19 and Figure 2-20.) Each of the T1 modules provide up to 24 virtual channels per T1 port. Each of the virtual channels is presented to the system as a serial interface that can be configured individually. The T1 interface is the physical medium that supports ISDN PRI.

The CT1/PRI and CT1/PRI-CSU modules receive and transmit data bidirectionally at the T1 rate of 1.544 Mbps.

Figure 2-17 1-Port CT1/PRI Module

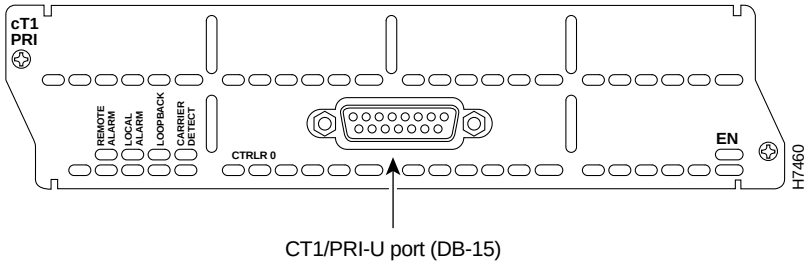


Figure 2-18 2-Port CT1/PRI Module

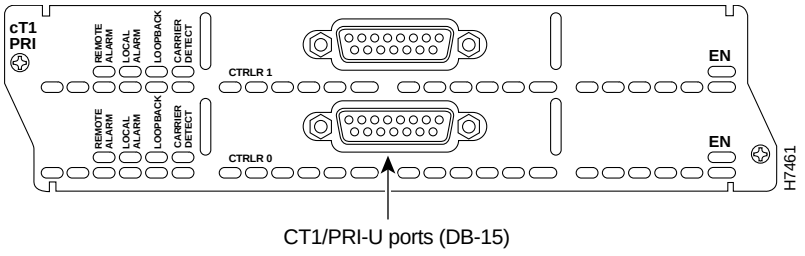


Figure 2-19 1-Port CT1/PRI-CSU Module

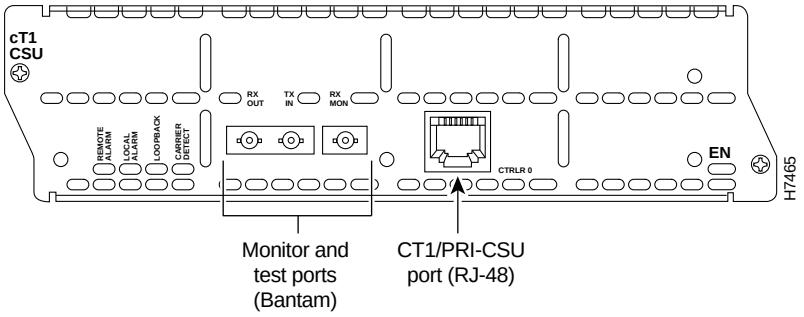
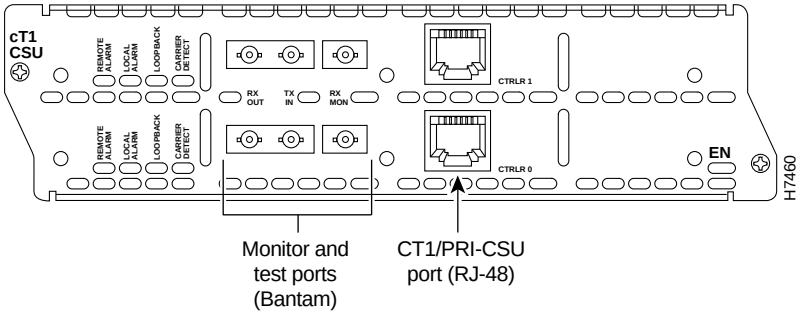


Figure 2-20 2-Port CT1/PRI-CSU Module



T1 Cabling

The CT1/PRI network processor module includes a female DB-15 connector. The cable for this module has male 15-pin DB connectors at each end. Two standard T1 serial cables are available from us: straight-through and null-modem. The straight-through cable connects your router to an external CSU. Null-modem cables are used for back-to-back operation and testing. Port pinouts are listed in the section “CT1/PRI Pinouts” in the appendix “Cable Specifications.”

The CT1/PRI-CSU module includes an RJ-48C port. Cables are not included with the module; however, port pinouts are listed in the section “CT1/PRI-CSU Pinouts” in the appendix “Cable Specifications.”

CE1/PRI Connections

The CE1/PRI modules are available with one or two E1 ports and with balanced or unbalanced interfaces. (See Figure 2-21 and Figure 2-22.) CE1/PRI modules receive and transmit data bidirectionally at the E1 rate of 2.048 Mbps and provide up to 30 virtual channels per E1 port. Each of the virtual channels is presented to the system as a serial interface that can be configured individually. The E1 interface is the physical media that supports ISDN PRI.

The CE1/PRI-B module provides a 120-ohm E1 interface for network connections. (See Figure 2-21.)

Figure 2-21 1-Port CE1/PRI-B Module

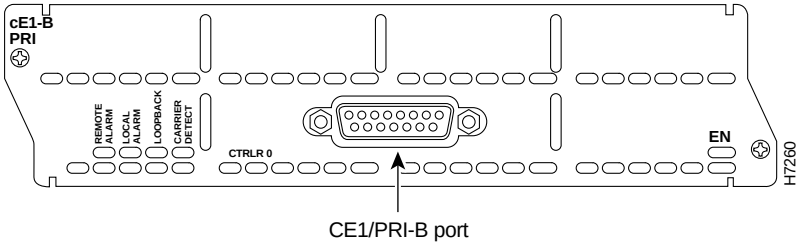
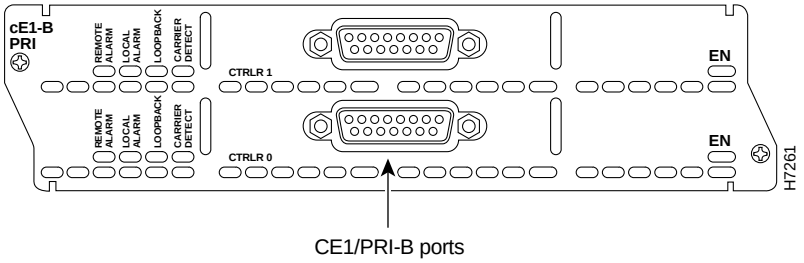


Figure 2-22 2-Port CE1/PRI-B Module



The CE1/PRI-U modules provide a 75-ohm E1 interface for network connections. (See Figure 2-23 and Figure 2-24.)

Figure 2-23 1-Port CE1/PRI-U Module

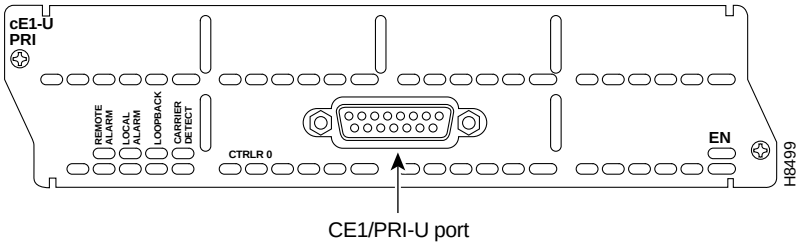
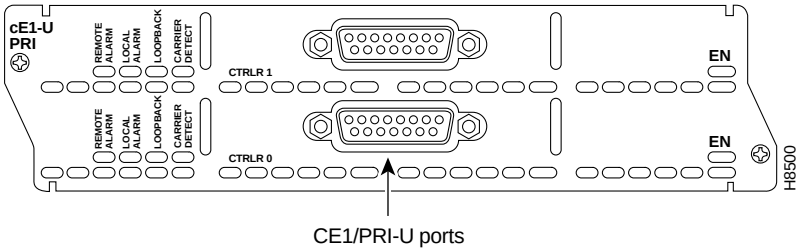


Figure 2-24 2-Port CE1/PRI-U Module



CE1/PRI Module Jumper Settings

Jumpers on the CE1/PRI modules can be used to connect or disconnect receive shield to ground. (See Table 2-4.) The default setting for balanced, 120-ohm CE1/PRI-B modules disconnects receive shield to ground. The default setting for unbalanced, 75-ohm CE1/PRI-U modules connects receive shield to ground. If you are experiencing ground loop problems with E1 cabling, you may want to try changing the jumper settings in the module.

Table 2-4 CE1/PRI-B and CE1/PRI-U Module Jumper Settings

CE1/PRI Module Type	Default Jumper Setting	Function
Balanced, 120 ohm	2 and 3	Disconnects receive shield from ground
Unbalanced, 75 ohm	1 and 2	Connects receive shield to ground

CE1/PRI Module Cables

Four serial cables are available from us for the CE1/PRI module. All four cables have DB-15 connectors on the router end and BNC, DB-15, Twinax, or RJ-45 connectors on the network end. Figure 2-25 to Figure 2-28 show the E1 interface cables. Port pinouts are listed in the section “CE1/PRI Pinouts” in the appendix “Cable Specifications.”

Figure 2-25 E1 Interface Cable for 75-Ohm, Unbalanced Connections (with BNC Connectors)

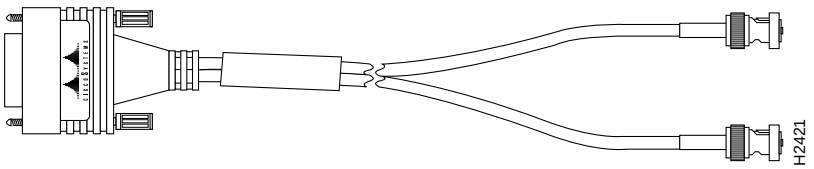


Figure 2-26 E1 Interface Cable for 120-Ohm, Balanced Connections (with DB-15 Connector)

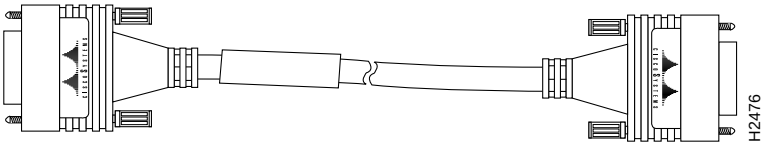


Figure 2-27 E1 Interface Cable for 120-Ohm, Balanced Connections (with Twinax Connectors)

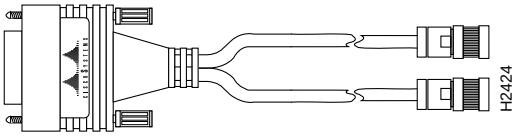


Figure 2-28 E1 Interface Cable for 120-Ohm, Balanced Connections (with RJ-45 Connector)