



Doc. No. 78-3021-01

# 1-Port Serial WAN Interface Card Configuration Note

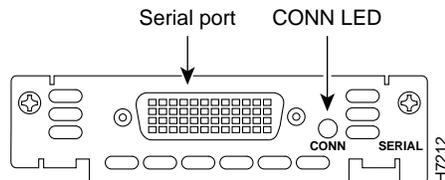
---

## Product Numbers: WIC-1T, CPAWIC-1T

This document provides information about the 1-port serial WAN interface card for the Cisco 3600 series and Cisco 1600 series of modular access routers. With the appropriate serial transition cable, this card can provide an EIA/TIA-232, EIA/TIA-449, V.35, X.21, DTE/DCE, EIA-530 DTE, or NRZ/NRZI serial interface.

Figure 1 shows the serial WAN interface card.

**Figure 1 1-Port Serial WAN Interface Card**



On Cisco 3600 series routers, the serial WAN interface card fits into a network module that has slots for WAN cards (called a 2-slot network module or base module). The network module installs in turn into the router chassis. You cannot install a WAN interface card directly into a Cisco 3600 series router chassis.

On Cisco 1600 series routers, the WAN interface card fits directly into the router chassis.

---

**Corporate Headquarters**  
Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA

Copyright © 1996  
Cisco Systems, Inc.  
All rights reserved.

Use this document in conjunction with your router installation and configuration guide and the *Regulatory Compliance and Safety Information* document for your router. If you have questions or need help, refer to the section “Obtaining Service and Support” later in this document for further information.

This document contains the following sections:

- Safety Recommendations, page 2
- Installing a Serial WAN Interface Card in a Cisco 3600 Series Router, page 4
- Installing a Serial WAN Interface Card in a Cisco 1600 Series Router, page 6
- Connecting the Serial WAN Interface Card to the Network, page 8
- Serial Cable Pinouts, page 10
- Serial WAN Interface Card LED, page 19
- Configuring the Serial WAN Interface, page 19
- Obtaining Service and Support, page 26
- Cisco Connection Online, page 27



**Warning** Only trained and qualified personnel should be allowed to install or replace this equipment. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)



**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** 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.)



**Caution** To avoid damaging electrostatic discharge (ESD)-sensitive components, ensure that you have discharged all static electricity from your body before opening the chassis. Before performing procedures described in this document, review the next section, “Safety Recommendations.”

## Safety Recommendations

Follow these guidelines to ensure general safety:

- Keep the chassis area clear and dust-free during and after installation.
- Put the removed chassis cover in a safe place.
- Keep tools away from walk areas where you or others could fall over them.
- 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 any conditions that might be hazardous to your eyes.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.



**Warning** The Ethernet 10BaseT, Token Ring, serial, console, and auxiliary ports contain safety extra-low voltage (SELV) circuits. BRI 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.)

## Safety with 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.)

Follow these guidelines when working on equipment powered by electricity:

- Locate the emergency power-OFF switch in the room in which you are working. Then, if an electrical accident occurs, you can quickly shut the power OFF.
- Before working on the router, turn OFF the power and unplug the power cord.
- Disconnect all power before doing the following:
  - Installing or removing a router chassis
  - Working near power supplies
- Do not work alone if potentially hazardous conditions exist.



**Warning** Before opening the chassis, disconnect the telephone-network cables to avoid contact with telephone-network voltages. (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.)

- Never assume that power is disconnected from a circuit. Always check.



**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.)

- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, 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 router.
  - If possible, send another person to get medical aid. Otherwise, determine the condition of the victim and then call for help.
  - Determine if the person needs rescue breathing or external cardiac compressions; then take appropriate action.

### Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) can damage equipment and impair electrical circuitry. It occurs when electronic printed circuit cards are improperly handled and can result in complete or intermittent failures. Always follow ESD prevention procedures when removing and replacing cards. 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 safely channel unwanted ESD voltages to ground. To properly guard against ESD damage and shocks, the wrist strap and cord must operate effectively. If no wrist strap is available, ground yourself by touching the metal part of the chassis.



**Caution** For safety, periodically check the resistance value of the antistatic strap, which should be between 1 and 10 megohms (Mohm).

## Installing a Serial WAN Interface Card in a Cisco 3600 Series Router

This section explains how to install a serial WAN interface card in a Cisco 3600 series router. To install the card in a Cisco 1600 series router, see the section “Installing a Serial WAN Interface Card in a Cisco 1600 Series Router” later in this document.

### Required Tools and Equipment

You need the following tools and equipment to install a WAN interface card in a Cisco 3600 series router:

- WAN interface card
- 2-slot network module
- Number 1 Phillips screwdriver or small flat-blade screwdriver
- ESD-preventive wrist strap

## WAN Interface Card Slot Assignments

A 2-slot module for Cisco 3600 series routers has two slots for installing WAN interface cards. These slots are numbered W0, on the right, and W1, on the left. Some WAN interface cards are keyed to be installed in slot W1 only. Cards that do not have a key fit into either slot. The serial WAN interface card does not have a key and fits into either slot.

## Inserting the Card in the Router



**Caution** WAN interface cards do not support online insertion and removal (hot swap). Before inserting a WAN interface card into a 2-slot network module that is already installed in the router chassis, you must turn OFF electrical power and disconnect network cables.

The following instructions apply only to installing a WAN interface card in a 2-slot network module. If you need to install the 2-slot module in a chassis slot, see your router installation and configuration guide.

You can install WAN interface cards either before or after mounting the router, whichever is more convenient. You can install the card in the base module either before or after installing the base module in the router chassis.

Follow this procedure to install the WAN interface card in the 2-slot network module:

**Step 1** If the 2-slot network module has already been installed in the router chassis, turn OFF power to the router. However, to channel ESD voltages to ground, do not unplug the power cable. Remove all network interface cables, including telephone cables, from the rear panel.

The following warning applies to routers that use a DC power supply:



**Warning** Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

**Step 2** Using either a number 1 Phillips screwdriver or a small flat-blade screwdriver, remove the blank filler panel from the slot in the 2-slot network module where you plan to install the card. Save the blank panel for future use.

**Step 3** Align the card with the guides in the 2-slot network module and slide it gently into the WAN interface card slot. (See Figure 2.)

**Step 4** Push the card into place until you feel its edge connector mate securely with the connector in the 2-slot network module.

**Step 5** Fasten the card's captive mounting screws into the holes in the 2-slot network module faceplate, using the Phillips or flat-blade screwdriver.

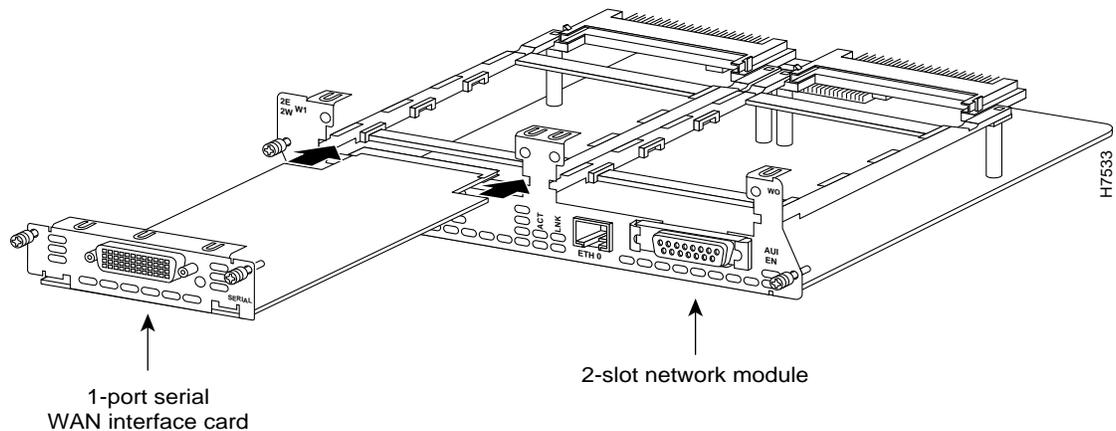
**Step 6** If the router was previously running, reinstall the network interface cables and turn ON power to the router.

The following warning applies to routers that use a DC power supply:



**Warning** After wiring the DC power supply, remove the tape from the circuit breaker switch handle and reinstate power by moving the handle of the circuit breaker to the ON position. (To see translated versions of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied the router.)

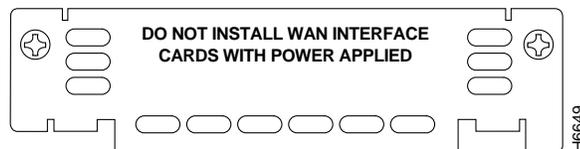
**Figure 2** Installing a Serial WAN Interface Card in a 2-Slot Network Module



### Blank WAN Interface Card Panels

If the 2-slot network module is configured with fewer than two WAN interface cards, make sure that blank panels fill the open slots to provide proper airflow. (See Figure 3.)

**Figure 3** Blank WAN Interface Card Panel



### Installing a Serial WAN Interface Card in a Cisco 1600 Series Router

This section explains how to install a serial WAN interface card in a Cisco 1600 series router. To install the card in a Cisco 3600 series router, see the section “Installing a Serial WAN Interface Card in a Cisco 3600 Series Router” earlier in this document.

### Required Tools and Equipment

You need the following tools and equipment to install a WAN interface card in a Cisco 1600 series router:

- WAN interface card
- Number 1 Phillips screwdriver or small flat-blade screwdriver
- ESD-preventive wrist strap

## Inserting the Card in the Router



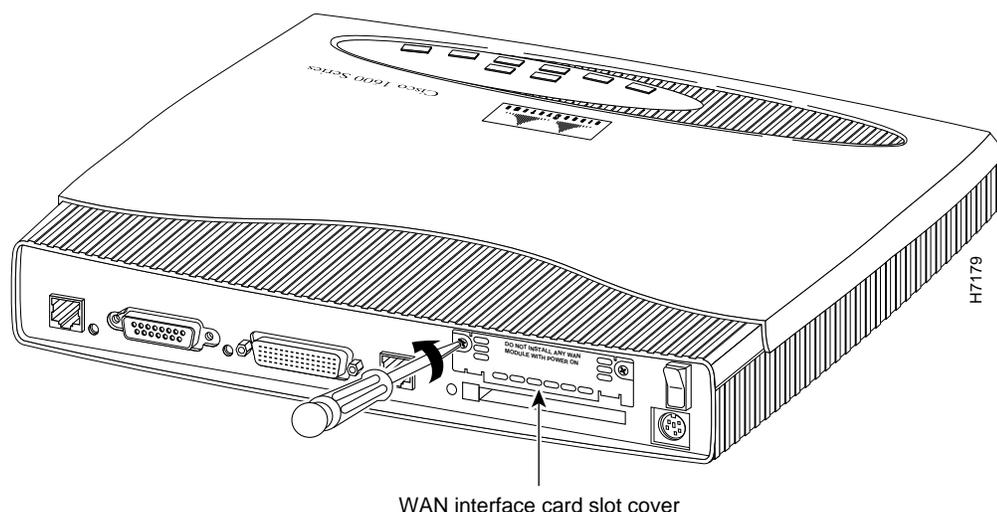
**Caution** WAN interface cards do not support online insertion and removal (hot swap). Before inserting a WAN interface card into the router chassis, you must turn OFF electrical power and disconnect network cables.

You can install WAN interface cards either before or after mounting the router, whichever is more convenient.

Follow this procedure to install the WAN interface card in the router:

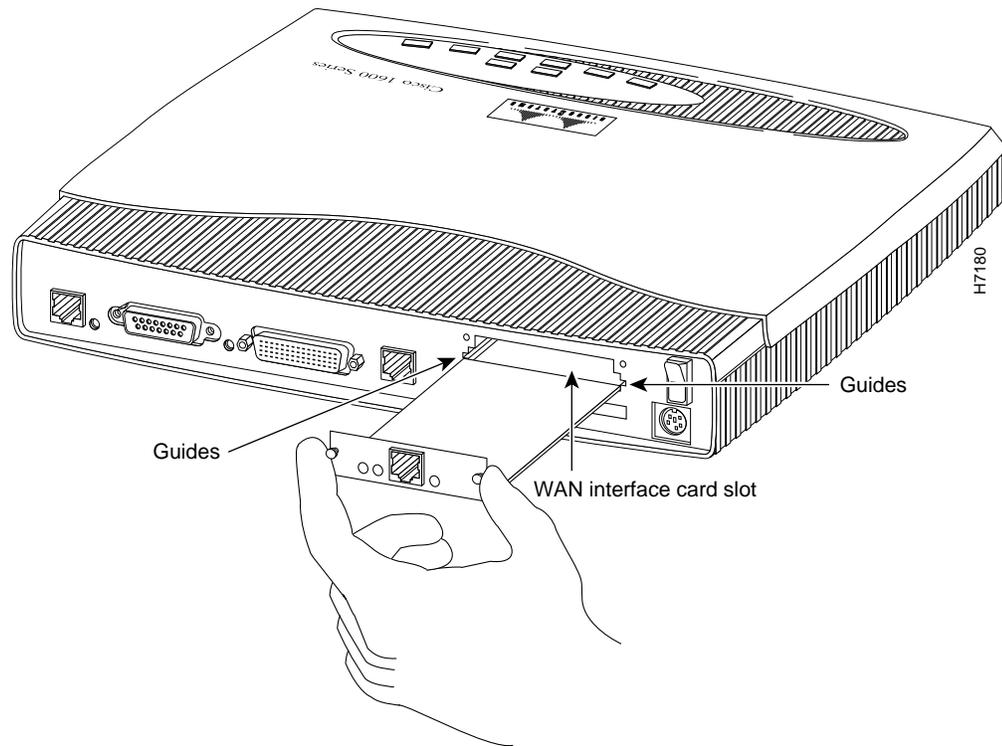
- Step 1** Turn OFF power to the router. However, to channel ESD voltages to ground, do not unplug the power cable. Remove all network interface cables, including telephone cables, from the rear panel.
- Step 2** Using either a number 1 Phillips screwdriver or a small flat-blade screwdriver, remove the blank filler panel from the WAN interface card slot. (See Figure 4.) Save the blank panel for future use.

**Figure 4** Removing the Slot Cover



- Step 3** Align the card with the guides and slide it gently into the WAN interface card slot. (See Figure 5.)

**Figure 5** Inserting the Card in the Router



- Step 4** Push the card into place until you feel its edge connector mate securely with the connector in the router chassis.
- Step 5** Fasten the card's captive mounting screws into the chassis, using the Phillips or flat-blade screwdriver.
- Step 6** If the router was previously running, reinstall the network interface cables and turn ON power to the router.

## Connecting the Serial WAN Interface Card to the Network

The 1-port serial WAN interface card uses a universal high-density 60-pin receptacle. The serial cable attached to this receptacle determines the port's electrical interface type and mode, DTE or DCE.

### Types of Serial Cables

Five types of serial cables (also called serial adapter cables or serial transition cables) are available from Cisco Systems:

- EIA/TIA-232 Serial Cable Assembly
- EIA/TIA-449 Serial Cable Assembly
- V.35 Serial Cable Assembly
- X.21 Serial Cable Assembly
- EIA-530 Serial Cable Assembly

All serial cables provide a universal plug at the interface card end. The network end of each cable provides the physical connectors most commonly used for the interface. For example, the network end of the EIA/TIA-232 serial cable is a DB-25 connector, the most widely used EIA/TIA-232 connector.

All serial interface types except EIA-530 are available in DTE or DCE format: DTE with a plug connector at the network end and DCE with a receptacle at the network end. V.35 is available in either mode with either gender at the network end. EIA-530 is available in DTE only.

Serial cables are not provided with the card. For ordering information, refer to the section “Obtaining Service and Support” later in this document.

## Connecting the Card to the Network

After you install the serial WAN interface card, use the appropriate serial cable to connect the interface card’s DB-60 serial port to one of the following types of equipment (see Figure 6):

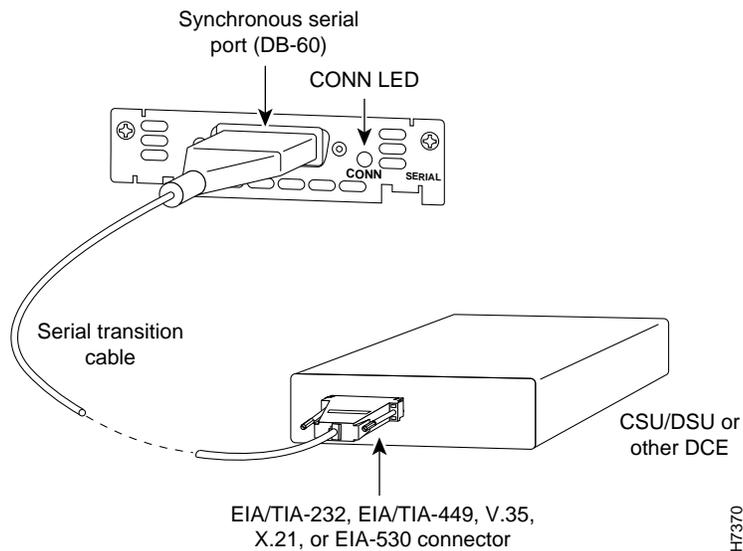
- An asynchronous modem, if connecting to an analog telephone line
- A synchronous modem, channel service unit/data service unit (CSU/DSU), or other data circuit-terminating equipment (DCE), if connecting to a digital WAN line

---

**Note** Cisco 3600 series routers support only synchronous modems. Cisco 1600 series routers support both synchronous and asynchronous modems.

---

**Figure 6 Attaching the Serial WAN Port to a Modem or CSU/DSU**



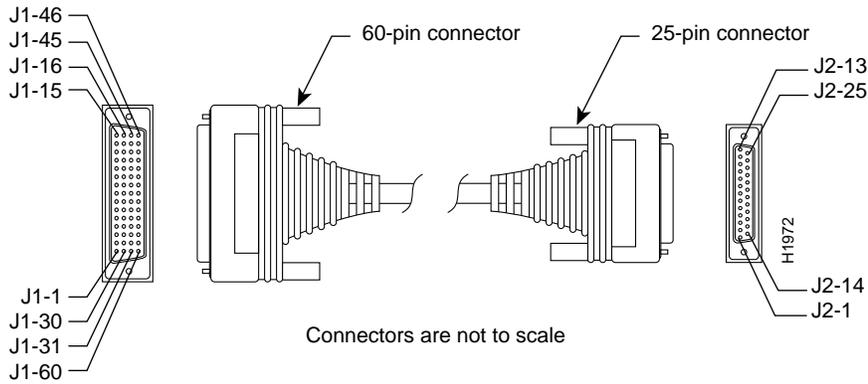
## Serial Cable Pinouts

The following sections illustrate serial cables of each interface type and list their signal pinouts.

### EIA/TIA-232 Serial Cable Assembly

Figure 7 shows the EIA/TIA-232 serial cable assembly. Table 1 lists the DTE pinout and Table 2 lists the DCE pinout. Arrows indicate signal direction: —> means DTE to DCE and <— means DCE to DTE.

**Figure 7 EIA/TIA-232 Cable Assembly**



**Table 1 EIA/TIA-232 DTE Cable Pinout (DB-60 to DB-25)**

60-Pin	Signal	Note	Direction	25-Pin	Signal
J1-50	MODE_0	Shorting group	—	—	—
J1-51	GND				
J1-52	MODE_DC E				
J1-46	Shield GND	Single	—	J2-1	Shield GND
J1-46	Shield GND	Single	—	J2-1	Shield GND
J1-41	TXD/RXD	Twisted pair no. 5	—>	J2-2	TXD
Shield	—		—	Shield	—
J1-36	RXD/TXD	Twisted pair no. 9	<—	J2-3	RXD
Shield	—		—	Shield	—
J1-42	RTS/CTS	Twisted pair no. 4	—>	J2-4	RTS
Shield	—		—	Shield	—
J1-35	CTS/RTS	Twisted pair no. 10	<—	J2-5	CTS
Shield	—		—	Shield	—
J1-34	DSR/DTR	Twisted pair no. 11	<—	J2-6	DSR
Shield	—		—	Shield	—
J1-45	Circuit GND	Twisted pair no. 1	—	J2-7	Circuit GND
Shield	—		—	Shield	—

**Table 1 EIA/TIA-232 DTE Cable Pinout (DB-60 to DB-25) (Continued)**

60-Pin	Signal	Note	Direction	25-Pin	Signal
J1-33 Shield	DCD/LL -	Twisted pair no. 12	<— -	J2-8 Shield	DCD -
J1-37 Shield	TXC/NIL -	Twisted pair no. 8	<— -	J2-15 Shield	TXC -
J1-38 Shield	RXC/TXCE -	Twisted pair no. 7	<— -	J2-17 Shield	RXC -
J1-44 Shield	LL/DCD -	Twisted pair no. 2	—> -	J2-18 Shield	LTST -
J1-43 Shield	DTR/DSR -	Twisted pair no. 3	—> -	J2-20 Shield	DTR -
J1-39 Shield	TXCE/TXC -	Twisted pair no. 6	—> -	J2-24 Shield	TXCE -

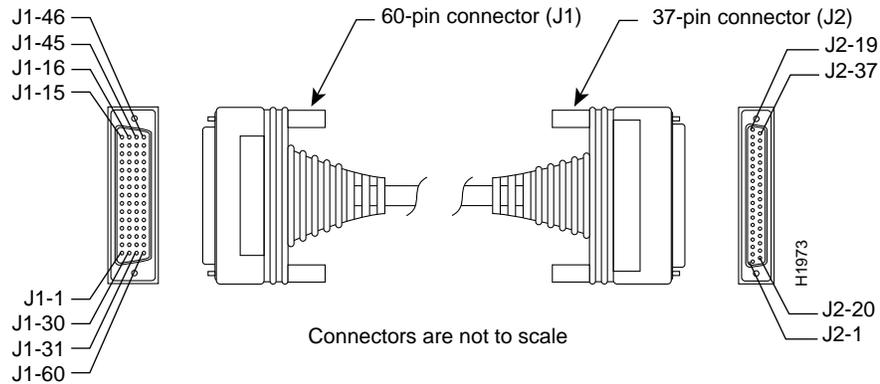
**Table 2 EIA/TIA-232 DCE Cable Pinout (DB-60 to DB-25)**

60-Pin	Signal	Note	Direction	25-Pin	Signal
J1-50 J1-51	MODE_0 GND	Shorting group	-	-	-
J1-36 Shield	RXD/TXD -	Twisted pair no. 9	<— -	J2-2 Shield	TXD -
J1-41 Shield	TXD/RXD -	Twisted pair no. 5	—> -	J2-3 Shield	RXD -
J1-35 Shield	CTS/RTS -	Twisted pair no. 10	<— -	J2-4 Shield	RTS -
J1-42 Shield	RTS/CTS -	Twisted pair no. 4	—> -	J2-5 Shield	CTS -
J1-43 Shield	DTR/DSR -	Twisted pair no. 3	—> -	J2-6 Shield	DSR -
J1-45 Shield	Circuit GND -	Twisted pair no. 1	- -	J2-7 Shield	Circuit GND -
J1-44 Shield	LL/DCD -	Twisted pair no. 2	—> -	J2-8 Shield	DCD -
J1-39 Shield	TXCE/TXC -	Twisted pair no. 7	—> -	J2-15 Shield	TXC -
J1-40 Shield	NIL/RXC -	Twisted pair no. 6	—> -	J2-17 Shield	RXC -
J1-33 Shield	DCD/LL -	Twisted pair no. 12	<— -	J2-18 Shield	LTST -
J1-34 Shield	DSR/DTR -	Twisted pair no. 11	<— -	J2-20 Shield	DTR -
J1-38 Shield	RXC/TXCE -	Twisted pair no. 8	<— -	J2-24 Shield	TXCE -

### EIA/TIA-449 Serial Cable Assembly

Figure 8 shows the EIA/TIA-449 serial cable assembly. Table 3 lists the DTE pinout and Table 4 lists the DCE pinout. Arrows indicate signal direction: —> means DTE to DCE and <— means DCE to DTE.

**Figure 8 EIA/TIA-449 Serial Cable Assembly**



**Table 3 EIA/TIA-449 DTE Cable Pinout (DB-60 to DB-37)**

60-Pin	Signal Name	Note	Direction	37-Pin	Signal Name
J1-49 J1-48	MODE_1 GND	Shorting group	—	—	—
J1-51 J1-52	GND MODE_DCE	Shorting group	—	—	—
J1-46	Shield_GND	Single	—	J2-1	Shield GND
J1-11 J1-12	TXD/RXD+ TXD/RXD-	Twisted pair no. 6	—> —>	J2-4 J2-22	SD+ SD-
J1-24 J1-23	TXC/RXC+ TXC/RXC-	Twisted pair no. 9	<— <—	J2-5 J2-23	ST+ ST-
J1-28 J1-27	RXD/TXD+ RXD/TXD-	Twisted pair no. 11	<— <—	J2-6 J2-24	RD+ RD-
J1-9 J1-10	RTS/CTS+ RTS/CTS-	Twisted pair no. 5	—> —>	J2-7 J2-25	RS+ RS-
J1-26 J1-25	RXC/TXCE+ RXC/TXCE-	Twisted pair no. 10	<— <—	J2-8 J2-26	RT+ RT-
J1-1 J1-2	CTS/RTS+ CTS/RTS-	Twisted pair no. 1	<— <—	J2-9 J2-27	CS+ CS-
J1-44 J1-45	LL/DCD Circuit_GND	Twisted pair no. 12	—> —	J2-10 J2-37	LL SC
J1-3 J1-4	DSR/DTR+ DSR/DTR-	Twisted pair no. 2	<— <—	J2-11 J2-29	DM+ DM-
J1-7 J1-8	DTR/DSR+ DTR/DSR-	Twisted pair no. 4	—> —>	J2-12 J2-30	TR+ TR-

**Table 3 EIA/TIA-449 DTE Cable Pinout (DB-60 to DB-37) (Continued)**

60-Pin	Signal Name	Note	Direction	37-Pin	Signal Name
J1-5	DCD/DCD+	Twisted pair no. 3	<—	J2-13	RR+
J1-6	DCD/DCD-		<—	J2-31	RR-
J1-13	TXCE/TXC+	Twisted pair no. 7	—>	J2-17	TT+
J1-14	TXCE/TXC-		—>	J2-35	TT-
J1-15	Circuit_GND	Twisted pair no. 9	—	J2-19	SG
J1-16	Circuit_GND		—	J2-20	RC

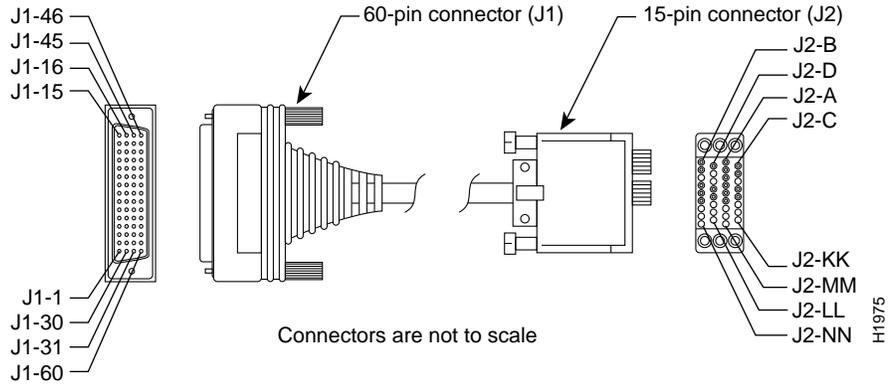
**Table 4 EIA/TIA-449 DCE Cable Pinout (DB-60 to DB-37)**

60-Pin	Signal Name	Note	Direction	37-Pin	Signal Name
J1-49	MODE_1	Shorting group	—	—	—
J1-48	GND				
J1-46	Shield_GND	Single	—	J2-1	Shield GND
J1-28	RXD/TXD+	Twisted pair no. 11	<—	J2-4	SD+
J1-27	RXD/TXD-		<—	J2-22	SD-
J1-13	TXCE/TXC+	Twisted pair no. 7	—>	J2-5	ST+
J1-14	TXCE/TXC-		—>	J2-23	ST-
J1-11	TXD/RXD+	Twisted pair no. 6	—>	J2-6	RD+
J1-12	TXD/RXD-		—>	J2-24	RD-
J1-1	CTS/RTS+	Twisted pair no. 1	<—	J2-7	RS+
J1-2	CTS/RTS-		<—	J2-25	RS-
J1-24	TXC/RXC+	Twisted pair no. 9	—>	J2-8	RT+
J1-23	TXC/RXC-		—>	J2-26	RT-
J1-9	RTS/CTS+	Twisted pair no. 5	—>	J2-9	CS+
J1-10	RTS/CTS-		—>	J2-27	CS-
J1-29	NIL/LL	Twisted pair no. 12	—>	J2-10	LL
J1-30	Circuit_GND		—	J2-37	SC
J1-7	DTR/DSR+	Twisted pair no. 4	—>	J2-11	DM+
J1-8	DTR/DSR-		—>	J2-29	DM-
J1-3	DSR/DTR+	Twisted pair no. 2	<—	J2-12	TR+
J1-4	DSR/DTR-		<—	J2-30	TR-
J1-5	DCD/DCD+	Twisted pair no. 3	—>	J2-13	RR+
J1-6	DCD/DCD-		—>	J2-31	RR-
J1-26	RXC/TXCE+	Twisted pair no. 10	<—	J2-17	TT+
J1-25	RXC/TXCE-		<—	J2-35	TT-
J1-15	Circuit_GND	Twisted pair no. 8	—	J2-19	SG
J1-16	Circuit_GND		—	J2-20	RC

## V.35 Serial Cable Assembly

Figure 9 shows the V.35 serial cable assembly. Table 5 lists the DTE pinout and Table 6 lists the DCE pinout. Arrows indicate signal direction: —> means DTE to DCE and <— means DCE to DTE.

**Figure 9 V.35 Serial Cable Assembly**



**Table 5 V.35 DTE Cable Pinout (DB-60 to Winchester-Type 34-Pin)**

60-Pin	Signal Name	Type	Direction	34-Pin	Signal Name
J1-49 J1-48	MODE_1 GND	Shorting group	–	–	–
J1-50 J1-51 J1-52	MODE_0 GND MODE_DCE	Shorting group	–	–	–
J1-53 J1-54 J1-55 J1-56	TxC/NIL RxC_TxCE RxD/TxD GND	Shorting group	–	–	–
J1-46	Shield_GND	Single	–	J2-A	Frame GND
J1-45 Shield	Circuit_GND –	Twisted pair no. 12	–	J2-B Shield	Circuit GND –
J1-42 Shield	RTS/CTS –	Twisted pair no. 9	→	J2-C Shield	RTS –
J1-35 Shield	CTS/RTS –	Twisted pair no. 8	←	J2-D Shield	CTS –
J1-34 Shield	DSR/DTR –	Twisted pair no. 7	←	J2-E Shield	DSR –
J1-33 Shield	DCD/LL –	Twisted pair no. 6	←	J2-F Shield	RLSD –
J1-43 Shield	DTR/DSR –	Twisted pair no. 10	→	J2-H Shield	DTR –
J1-44 Shield	LL/DCD –	Twisted pair no. 11	→	J2-K Shield	LT –
J1-18 J1-17	TxD/RxD+ TxD/RxD–	Twisted pair no. 1	→	J2-P J2-S	SD+ SD–
J1-28 J1-27	RxD/TxD+ RxD/TxD–	Twisted pair no. 5	←	J2-R J2-T	RD+ RD–
J1-20 J1-19	TxCE/TxC+ TxCE/TxC–	Twisted pair no. 2	→	J2-U J2-W	SCTE+ SCTE–

**Table 5 V.35 DTE Cable Pinout (DB-60 to Winchester-Type 34-Pin) (Continued)**

60-Pin	Signal Name	Type	Direction	34-Pin	Signal Name
J1-26	RxC/TxCE+	Twisted pair no. 4	<—	J2-V	SCR+
J1-25	RxC/TxCE-		<—	J2-X	SCR-
J1-24	TxC/RxC+	Twisted pair no. 3	<—	J2-Y	SCT+
J1-23	TxC/RxC-		<—	J2-AA	SCT-

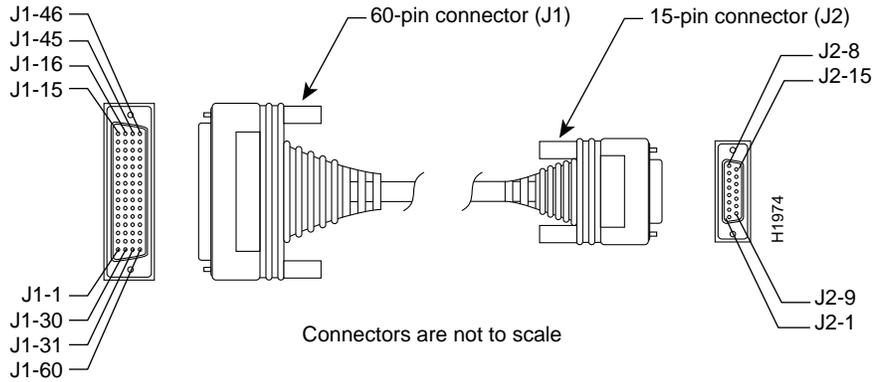
**Table 6 V.35 DCE Cable Pinout (DB-60 to Winchester-Type 34-Pin)**

60-Pin	Signal Name	Type	Direction	34-Pin	Signal Name
J1-49	MODE_1	Shorting group	—	—	—
J1-48	GND		—	—	—
J1-50	MODE_0	Shorting group	—	—	—
J1-51	GND		—	—	—
J1-53	TxC/NIL	Shorting group	—	—	—
J1-54	RxC_TxCE		—	—	—
J1-55	RxD/TxD		—	—	—
J1-56	GND		—	—	—
J1-46	Shield_GND	Single	—	J2-A	Frame GND
J1-45	Circuit_GND	Twisted pair no. 12	—	J2-B	Circuit GND
Shield	—		—	Shield	—
J1-35	CTS/RTS	Twisted pair no. 8	<—	J2-C	RTS
Shield	—		—	Shield	—
J1-42	RTS/CTS	Twisted pair no. 9	—>	J2-D	CTS
Shield	—		—	Shield	—
J1-43	DTR/DSR	Twisted pair no. 10	—>	J2-E	DSR
Shield	—		—	Shield	—
J1-44	LL/DCD	Twisted pair no. 11	—>	J2-F	RLSD
Shield	—		—	Shield	—
J1-34	DSR/DTR	Twisted pair no. 7	<—	J2-H	DTR
Shield	—		—	Shield	—
J1-33	DCD/LL	Twisted pair no. 6	<—	J2-K	LT
Shield	—		—	Shield	—
J1-28	RxD/TxD+	Twisted pair no. 5	<—	J2-P	SD+
J1-27	RxD/TxD-		<—	J2-S	SD-
J1-18	TxD/RxD+	Twisted pair no. 1	—>	J2-R	RD+
J1-17	TxD/RxD-		—>	J2-T	RD-
J1-26	RxC/TxCE+	Twisted pair no. 4	<—	J2-U	SCTE+
J1-25	RxC/TxCE-		<—	J2-W	SCTE-
J1-22	NIL/RxC+	Twisted pair no. 3	—>	J2-V	SCR+
J1-21	NIL/RxC-		—>	J2-X	SCR-
J1-20	TxCE/TxC+	Twisted pair no. 2	—>	J2-Y	SCT+
J1-19	TxCE/TxC-		—>	J2-AA	SCT-

### X.21 Serial Cable Assembly

Figure 10 shows the X.21 serial cable assembly. Table 7 lists the DTE pinout and Table 8 lists the DCE pinout. Arrows indicate signal direction: —> means DTE to DCE and <— means DCE to DTE.

**Figure 10 X.21 Serial Cable Assembly**



**Table 7 X.21 DTE Cable Pinout (DB-60 to DB-15)**

60-Pin	Signal Name	Type	Direction	15-Pin	Signal Name
J1-48	GND	Shorting group	-	-	-
J1-47	MODE_2				
J1-51	GND	Shorting group	-	-	-
J1-52	MODE_DCE				
J1-46	Shield_GND	Single	-	J2-1	Shield GND
J1-11	TXD/RXD+	Twisted pair no. 3	—>	J2-2	Transmit+
J1-12	TXD/RXD-		—>	J2-9	Transmit-
J1-9	RTS/CTS+	Twisted pair no. 2	—>	J2-3	Control+
J1-10	RTS/CTS-		—>	J2-10	Control-
J1-28	RXD/TXD+	Twisted pair no. 6	<—	J2-4	Receive+
J1-27	RXD/TXD-		<—	J2-11	Receive-
J1-1	CTS/RTS+	Twisted pair no. 1	<—	J2-5	Indication+
J1-2	CTS/RTS-		<—	J2-12	Indication-
J1-26	RXC/TXCE+	Twisted pair no. 5	<—	J2-6	Timing+
J1-25	RXC/TXCE-		<—	J2-13	Timing-
J1-15	Control_GND	Twisted pair no. 4	-	J2-8	Control GND
Shield	-		-	Shield	-

**Table 8 X.21 Serial DCE Cable Pinout (DB-60 to DB-15)**

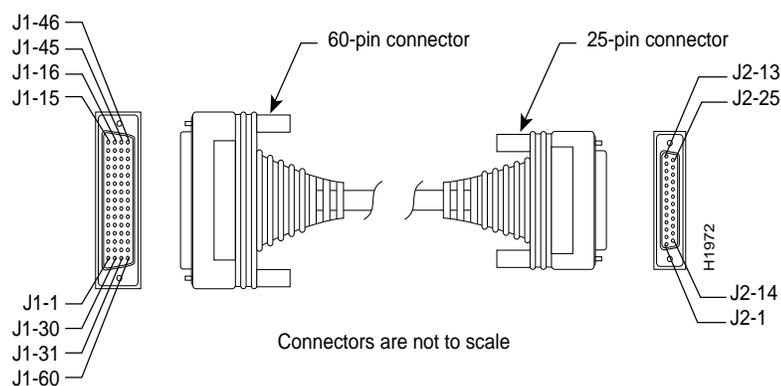
60 Pin	Signal Name	Type	Direction	15 Pin	Signal Name
J1-48	GND	Shorting group	-	-	-
J1-47	MODE_2				
J1-46	Shield_GND	Single	-	J2-1	Shield GND
J1-28	RXD/TXD+	Twisted pair no. 6	<—	J2-2	Transmit+
J1-27	RXD/TXD-		<—	J2-9	Transmit-
J1-1	CTS/RTS+	Twisted pair no. 1	<—	J2-3	Control+
J1-2	CTS/RTS-		<—	J2-10	Control-
J1-11	TXD/RXD+	Twisted pair no. 3	—>	J2-4	Receive+
J1-12	TXD/RXD-		—>	J2-11	Receive-
J1-9	RTS/CTS+	Twisted pair no. 2	—>	J2-5	Indication+
J1-10	RTS/CTS-		—>	J2-12	Indication-
J1-24	TXC/RXC+	Twisted pair no. 4	—>	J2-6	Timing+
J1-23	TXC/RXC-		—>	J2-13	Timing-
J1-15	Control_GND	Twisted pair no. 5	-	J2-8	Control GND
Shield	-		-	Shield	-

### EIA-530 Serial Cable Assembly

Figure 11 shows the EIA-530 serial cable assembly, and Table 9 lists the pinout. Arrows indicate signal direction: —> means DTE to DCE and <— means DCE to DTE.

The EIA-530 interface cannot be operated in DCE mode, and no DCE cable is available for it.

**Figure 11 EIA-530 Serial Cable Assembly**



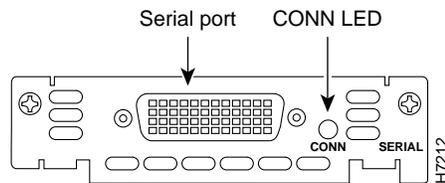
**Table 9 EIA-530 DTE Cable Pinout (DB-60 to DB-25)**

60-Pin	Signal Name	25-Pin	Signal Name	Direction
J1-11	TXD/RXD+	J2-2	BA(A), TXD+	—>
J1-12	TXD/RXD-	J2-14	BA(B), TXD-	—>
J1-28	RXD/TXD+	J2-3	BB(A), RXD+	<—
J1-27	RXD/TXD-	J2-16	BB(B), RXD-	<—
J1-9	RTS/CTS+	J2-4	CA(A), RTS+	—>
J1-10	RTS/CTS-	J2-19	CA(B), RTS-	—>
J1-1	CTS/RTS+	J2-5	CB(A), CTS+	<—
J1-2	CTS/RTS-	J2-13	CB(B), CTS-	<—
J1-3	DSR/DTR+	J2-6	CC(A), DSR+	<—
J1-4	DSR/DTR-	J2-22	CC(B), DSR-	<—
J1-46	Shield_GND	J2-1	Shield	Shorted
J1-47	MODE_2	-	-	
J1-48	GND	-	-	Shorted
J1-49	MODE_1	-	-	
J1-5	DCD/DCD+	J2-8	CF(A), DCD+	<—
J1-6	DCD/DCD-	J2-10	CF(B), DCD-	<—
J1-24	TXC/RXC+	J2-15	DB(A), TXC+	<—
J1-23	TXC/RXC-	J2-12	DB(B), TXC-	<—
J1-26	RXC/TXCE+	J2-17	DD(A), RXC+	<—
J1-25	RXC/TXCE-	J2-9	DD(B), RXC-	<—
J1-44	LL/DCD	J2-18	LL	—>
J1-45	Circuit_GND	J2-7	Circuit_GND	-
J1-7	DTR/DSR+	J2-20	CD(A), DTR+	—>
J1-8	DTR/DSR-	J2-23	CD(B), DTR-	—>
J1-13	TXCE/TXC+	J2-24	DA(A),	—>
J1-14	TXCE/TXC-	J2-11	TXCE+	—>
			DA(B),	
			TXCE-	
J1-51	GND	-	-	Shorted
J1-52	MODE_DCE	-	-	

## Serial WAN Interface Card LED

The 1-port serial WAN interface card has one LED, labeled CONN, which lights when the serial port is connected. (See Figure 12.) When the port is in DTE mode, the CONN LED indicates that DSR, DCD, and CTS have been detected. When the port is in DCE mode, it indicates that DTR and RTS have been detected.

**Figure 12 1-Port Serial WAN Interface Card LED**



## Configuring the Serial WAN Interface

Whenever you install a new WAN interface card, or if you want to change the configuration of an existing interface, you must configure the interface. If you replace a card that was already configured, the router recognizes it and brings up the interface in the existing configuration.

Before you configure an interface, have the following information available:

- Protocols you plan to route on the new interface
- IP addresses, subnet masks, network numbers, zones, or other information related to the routing protocol



**Timesaver** Obtain this information from your system administrator or network plan before you begin router configuration.

You can configure the new interface and other router parameters by using any of the following methods:

- Configuration Mode (manual configuration)—Recommended if you are familiar with Cisco Internetwork Operating System (Cisco IOS) commands. Enter the commands at the prompt.
- AutoInstall—Recommended for automatic installation if another router running Cisco IOS software is installed on the network. This configuration method must be set up by someone with experience using Cisco IOS software.
- System Configuration Dialog (setup facility)—Recommended if you are not familiar with Cisco IOS commands. You are prompted for each response.

These procedures are explained in the following sections. If you have questions or need help, refer to the section “Obtaining Service and Support” later in this document for further information.

---

**Note** If you install two 1-port serial WAN interface cards in the same base module of a Cisco 3600 series router and configure them with different IP addresses, removing the card in slot W0 causes the card in slot W1 to inherit the configuration of W0.

---

### Configuration Mode

You can configure the serial interface on your WAN interface card manually, by entering Cisco IOS commands on the command line. This method, called configuration mode, provides the greatest power and flexibility.

Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it ON if there is a WAN connection on both ends and the router does not have a valid configuration file stored in nonvolatile random-access memory NVRAM (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

To enter configuration mode, follow this procedure:

**Step 1** Connect a console to the router. If you need instructions for connecting a console, refer to the installation chapter of your router installation and configuration guide. Power up the router.

**Step 2** If the current configuration is no longer valid, after about a minute you see the following prompt:

```
Would you like to enter the initial dialog? [yes]:
```

Answer **no**. You now enter the normal operating mode of the router.

---

**Note** If the current configuration is valid, you enter the normal operating mode automatically.

---

**Step 3** After a few seconds you see the user EXEC prompt (Router>). Type **enable** and the password to enter enable mode:

```
Router> enable  
Password:
```

Configuration changes can be made only in enable mode. The prompt changes to the privileged EXEC (enable) prompt (Router#):

```
Router#
```

**Step 4** Enter the command **config terminal** to enter configuration mode:

```
Router# config terminal  
Router(config)#
```

The router enters global configuration mode, indicated by the Router(config)# prompt.

- Step 5** If you have not configured the router before, or want to change the configuration, configure global parameters, passwords, network management, and routing protocols. In this example, IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing are all enabled:

```
Router(config)# ip routing
Router(config)# appletalk routing
Router(config)# ipx routing
```

For complete information about global configuration commands, refer to the Cisco IOS configuration guides and command references.

- Step 6** Select the serial interface to configure:

```
Router(config)# interface serial 0/0
Router(config-if)#
```

The prompt changes again to show that you are in interface configuration mode.

---

**Note** This example shows interface numbering for a Cisco 3600 series router. On a Cisco 1600 series router, the serial interface is numbered 1 (Cisco 1601 and 1602) or 0 (Cisco 1603 and 1604).

---

- Step 7** Configure routing protocols on the interface. (You must have previously enabled these protocols as part of global configuration.) In this example, IP, AppleTalk, and IPX are being configured on the serial interface:

```
Router(config-if)# ip address 172.16.74.1 255.255.255.0
Router(config-if)# appletalk static cable-range 5-5
Router(config-if)# appletalk zone ZZSerial
Router(config-if)# ipx network B003
```

- Step 8** All serial ports are initially configured as synchronous. If you want to change the port to asynchronous operation, enter the **physical-layer** command:

```
Router(config-if)# physical-layer async
```

Configure other parameters according to your needs, for example:

```
Router(config-if)# async mode dedicated
Router(config-if)# async default routing
```

To return an asynchronous port to synchronous operation, enter the following command:

```
Router(config-if)# physical-layer sync
```

---

**Note** Cisco 3600 series routers support only synchronous operation. Cisco 1600 series routers support both synchronous and asynchronous operation.

---

**Step 9** Low-speed serial ports configured as DCE can be set to use either controlled carrier mode or constant carrier mode. Controlled carrier mode raises Data Carrier Detect (DCD) only when data is received. The interface waits for a specified period before transmitting; it then waits for another specified period before dropping DCD. Constant carrier mode (the default for low-speed serial interfaces) raises DCD at all times.

To reset the port from constant carrier mode to controlled carrier mode, enter the **half-duplex** command:

```
Router(config-if)# half-duplex controlled carrier
```

To return to constant carrier mode, enter the **no half-duplex** command:

```
Router(config-if)# no half-duplex controlled carrier
```

**Step 10** Enter **half-duplex timer** commands to specify the time that the interface waits in controlled carrier mode. These commands are listed in Table 10. Time is measured in milliseconds. For example, to configure the DCD drop delay to 100 ms, enter the following command:

```
Router(config-if)# half-duplex timer dcd-drop-delay 100
```

**Table 10 Half-Duplex Timer Commands**

Timer	Syntax	Default Setting (Milliseconds)
CTS <sup>1</sup> delay	<b>half-duplex timer cts-delay</b>	100
CTS drop timeout	<b>half-duplex timer cts-drop-timeout</b>	5000
DCD drop delay	<b>half-duplex timer dcd-drop-delay</b>	100
DCD transmission start delay	<b>half-duplex timer dcd-txstart-delay</b>	100
RTS <sup>2</sup> drop delay	<b>half-duplex timer rts-drop-delay</b>	100
RTS timeout	<b>half-duplex timer rts-timeout</b>	2000
Transmit delay	<b>half-duplex timer transmit-delay</b>	0

1. CTS = Clear To Send.  
 2. RTS = Ready To Send.

**Step 11** All serial interfaces support both DTE and DCE modes. To use a port as a DTE interface, connect a DTE serial cable to the port. When the router detects the cable, it automatically uses the external timing signal. To use a port in DCE mode, connect a DCE serial cable and set the internal transmit clock signal (TXC) speed in bits per second with the **clockrate** command, for example:

```
Router(config-if)# clockrate 72000
```

Acceptable clock rate settings are:

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

Speeds above 64 kbps (64000) are not supported for EIA/TIA-232.

Use the **no clockrate** command to remove the clock rate for DTE operation.

- Step 12** When a port is operating in DCE mode, the default operation is for the DCE to send serial clock transmit (SCT) and serial clock receive (SCR) clock signals to the DTE, and for the DTE to return a serial clock transmit external (SCTE) signal to the DCE. If the DTE does not return SCTE, you must use the **dce-terminal-timing-enable** command to configure the DCE port to use its own clock signal:

```
Router(config-if)# dce-terminal-timing-enable
```

To disable this command, use the **no dce-terminal-timing-enable** command.

- Step 13** Routers that use long cables may experience high error rates when operating at higher transmission speeds, because the clock and data signals can shift out of phase. If a DCE port is reporting a high number of error packets, inverting the clock using the **invert-txc** command can often correct this shift:

```
Router(config-if)# invert-txc
```

Use the **no invert-txc** command to change the clock signal back to its original phase.

- Step 14** All serial interfaces support both nonreturn to zero (NRZ) and nonreturn to zero inverted (NRZI) formats. NRZ is the default; NRZI is commonly used with EIA/TIA-232 connections in IBM environments. To enable NRZI encoding on an interface, enter the **nrzi-encoding** command:

```
Router(config-if)# nrzi-encoding
```

To disable NRZI encoding on a port, enter the **no nrzi-encoding** command.

- Step 15** If your router has more than one serial interface, enter the **exit** command to return to the Router(config)# prompt. Repeat Step 6 through Step 14 of this procedure to configure the next serial interface.

- Step 16** When you are finished configuring interfaces, exit configuration mode and return to the enable prompt by pressing **Ctrl-Z**. To see the current operating configuration, including any changes you just made, enter the **show running-config** command:

```
Router# show running-config
```

To see the configuration currently stored in NVRAM, enter the command **show startup-config** at the enable prompt.

```
Router# show startup-config
```

- Step 17** The results of the **show running-config** and **show startup-config** commands differ from each other if you have made changes to the configuration, but have not yet written them to NVRAM. To write your changes to NVRAM, making them permanent, enter the command **copy running-config startup-config** at the enable prompt:

```
Router# copy running-config startup-config
Building configuration. . .
[OK]
Router#
```

The router is now configured to boot in the new configuration.

## AutoInstall

The AutoInstall process is designed to configure the router automatically after it connects to your WAN. For AutoInstall to work properly, a TCP/IP host on your network must be configured to provide the configuration files. The TCP/IP host can reside anywhere on the network if the following two conditions are met:

- The host must be on the remote side of the router's synchronous serial connection to the WAN.
- User Datagram Protocol (UDP) broadcasts to and from the router and the TCP/IP host must be enabled.

This functionality is coordinated by your system administrator at the TCP/IP host site. You should not try to use AutoInstall unless the required files have been installed on the TCP/IP host.

Follow this procedure to prepare your router for the AutoInstall process:

- Step 1** Connect the router to the WAN, following the instructions in the section "Connecting the Serial WAN Interface Card to the Network" earlier in this document.

- Step 2** Turn ON power to the router.

The router loads the operating system image from Flash memory. If the remote end of the WAN connection is connected and properly configured, the AutoInstall process begins.

- Step 3** If AutoInstall succeeds, you should write the configuration data to the router's NVRAM. To do this, enter the **copy running-config startup-config** command at the Router# prompt:

```
Router# copy running-config startup-config
Building configuration. . .
[OK]
Router#
```

---

**Note** This step saves the configuration settings that the AutoInstall process created. If you do not do this, your new configuration will be lost the next time you boot the router.

---

## System Configuration Dialog

You can configure the router manually using the System Configuration Dialog facility. Unlike configuration mode, the System Configuration Dialog prompts you for each response.

Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it ON if there is a WAN connection on both ends and the router does not have a configuration file stored in NVRAM. It can take several minutes for the router to determine that AutoInstall is not connected to a remote TCP/IP host.

This section shows a sample configuration using the System Configuration Dialog. You should enter values appropriate for your router and network.

Many prompts in the System Configuration Dialog include default answers, shown in square brackets following the question. Enter your response, or press **Return** to accept the default answer.

You can request help at any time by entering a question mark (?) at a System Configuration Dialog prompt.

Follow this procedure to configure the router using the System Configuration Dialog:

**Step 1** Connect a console to the router. If you need instructions for connecting a console, refer to your router installation and configuration guide. Power up the router.

**Step 2** If the current configuration is no longer valid, after about a minute you see the following prompt:

```
Would you like to enter the initial dialog? [yes]:
```

Press **Return** or enter **yes** to enter the System Configuration Dialog.

---

**Note** You can enter the System Configuration Dialog at any time from the enable prompt (Router#) by entering the **setup** command.

---

**Step 3** When the System Configuration Dialog asks whether you want to view the current interface summary, press **Return** or enter **yes**:

```
First, would you like to see the current interface summary? [yes]:
```

```
Any interface listed with OK? value "NO" does not have a valid configuration
```

Interface	IP-Address	OK?	Method	Status	Protocol
Serial0/0	unassigned	NO	unset	down	down

---

**Note** This example shows interface numbering for a Cisco 3600 series router. On a Cisco 1600 series router, the serial interface is numbered 1 (Cisco 1601 and 1602) or 0 (Cisco 1603 and 1604).

---

**Step 4** If you have not configured the router before, or want to change the configuration, you should now configure global parameters, passwords, network management, and routing protocols. Refer to the procedures in the Cisco IOS configuration guides and command references. Press **Return** if you want to accept the default values.

- Step 5** The System Configuration Dialog prompts you to configure network interfaces. When you reach the first serial interface, determine which protocols you want on the interface and enter the appropriate responses. (You must have previously enabled these protocols as part of global configuration.) In the following example, the interface is being configured for IP, AppleTalk, and IPX:

```
Configuring interface Serial0/0:
  Is this interface in use? [yes]:
Configure IP on this interface? [yes]:
  Configure IP unnumbered on this interface? [no]:
  IP address for this interface: 172.16.74.1
  Number of bits in subnet field [8]:
  Class B network is 172.16.0.0, 8 subnet bits; mask is
  255.255.255.0
Configure AppleTalk on this interface? [no]: yes
  Extended AppleTalk network? [yes]:
  AppleTalk starting cable range [2]: 5
  AppleTalk ending cable range [3]: 5
  AppleTalk zone name [myzone]: ZZSerial
  AppleTalk additional zone name:
Configure IPX on this interface? [no]: yes
  IPX network number [2]: B003
```

- Step 6** If your router has more than one serial interface, repeat this procedure to configure the next serial interface.
- Step 7** The configuration you entered is displayed as a command script and you are asked if you want to use it. If you enter **no**, the information you just entered is discarded and you can begin the configuration again. If you enter **yes**, the configuration is saved in the startup configuration:

```
Use this configuration? [yes/no]: yes
Building configuration...
Use the enabled mode 'configure' command to modify this configuration.
```

Press RETURN to get started!

The configuration is saved. If you added an interface, the router reboots in the new configuration when you press **Return**.

All serial ports are initially configured as synchronous. You can configure serial ports you plan to use as asynchronous or make other changes to the configuration in configuration mode, explained in the section “Configuration Mode” earlier in this document.

## Obtaining Service and Support

For service and support for a product purchased from a reseller, contact the reseller. Resellers offer a wide variety of Cisco service and support programs, which are described in the section “Service and Support” in the information packet that shipped with your chassis.

---

**Note** If you purchased your product from a reseller, you can access Cisco Connection Online (CCO) as a guest. CCO is Cisco Systems’ primary, real-time support channel. Your reseller offers programs that include direct access to CCO’s services.

---

For service and support for a product purchased directly from Cisco, use CCO.

## Cisco Connection Online

CCO is Cisco Systems' primary, real-time support channel. SMARTnet customers and partners can self-register on CCO to obtain additional content and services.

---

**Note** If you purchased your product from a reseller, you can access CCO as a guest. Your reseller offers programs that include direct access to CCO's 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, 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 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](http://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 baud rates up to 14.4 kbps.

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

---

**Note** If you need technical assistance with a Cisco product that is under warranty or covered by a Cisco maintenance contract, contact Cisco's Technical Assistance Center (TAC) at 800 553-2447, 408 526-7209, or [tac@cisco.com](mailto:tac@cisco.com).

---

Please use CCO to obtain general information about Cisco Systems, Cisco products, or upgrades. If CCO is not accessible, contact 800 553-6387, 408 526-7208, or [cs-rep@cisco.com](mailto:cs-rep@cisco.com).

This document is to be used in conjunction with your router installation and configuration guide and the *Regulatory Compliance and Safety Information* document for your router.

AtmDirector, AutoConnect, AutoRoute, AXIS, BPX, Catalyst, CD-PAC, CiscoAdvantage, CiscoFusion, Cisco IOS, the Cisco IOS logo, *CiscoLink*, CiscoPro, the CiscoPro logo, CiscoRemote, the CiscoRemote logo, CiscoSecure, Cisco Systems, CiscoView, CiscoWorks, ClickStart, ControlStream, EdgeConnect, EtherChannel, FairShare, FastCell, FastForward, FastManager, FastMate, FastPADImp, FastPADmicro, FastPADmp, FragmentFree, FrameClass, Fulcrum INS, IGX, Impact, Internet Junction, JumpStart, LAN<sup>2</sup>LAN Enterprise, LAN<sup>2</sup>LAN Remote Office, LightSwitch, NetBeyond, NetFlow, Newport Systems Solutions, *Packet*, PIX, Point and Click Internetworking, RouteStream, Secure/IP, SMARTnet, StrataSphere, StrataSphere BILLder, StrataSphere Connection Manager, StrataSphere Modeler, StrataSphere Optimizer, Stratm, StrataView Plus, StreamView, SwitchProbe, SwitchVision, SwitchWare, SynchroniCD, *The Cell*, The FastPacket Company, TokenSwitch, TrafficDirector, Virtual EtherSwitch, VirtualStream, VlanDirector, Web Clusters, WNIC, Workgroup Director, Workgroup Stack, and XCI are trademarks; Access by Cisco, Bringing the Power of Internetworking to Everyone, Enter the Net with MultiNet, and The Network Works. No Excuses. are service marks; and Cisco, the Cisco Systems logo, CollisionFree, Combinet, EtherSwitch, FastHub, FastLink, FastNIC, FastPacket, FastPAD, FastSwitch, ForeSight, Grand, Grand Junction, Grand Junction Networks, the Grand Junction Networks logo, HSSI, IGRP, IPX, Kalpana, the Kalpana logo, LightStream, MultiNet, MultiWare, OptiClass, Personal Ethernet, Phase/IP, RPS, StrataCom, TGV, the TGV logo, and UniverCD are registered trademarks of Cisco Systems, Inc. All other trademarks, service marks, registered trademarks, or registered service marks mentioned in this document are the property of their respective owners.

Copyright © 1996, Cisco Systems, Inc.  
All rights reserved. Printed in USA.  
969R