Doc. No. 78-3172-01

Installing Fast Ethernet Network Processor Modules in the Cisco 4000 Series

Cisco Product Number: NP-1FE=

This document contains instructions for installing and configuring Fast Ethernet (100E) network processor modules in Cisco 4500, Cisco 4500-M, Cisco 4700, and Cisco 4700-M routers. The 100E network processor module enables Cisco 4000 series routers to connect to 100 Mbps Ethernet networks and create high-speed communication links between critical network devices.

This document is for the 100E network processor module installer, who should be familiar with electronic circuitry and wiring practices and have experience as an electronic or electromechanical technician.

If you have a Cisco 4500-M, or Cisco 4700-M router, use this document with the *Cisco 4000 Series Installation Guide* and the *Cisco 4000 Series Public Network Certification* document that shipped with your router. If you have a Cisco 4500 router, refer to the *Cisco 4000 Series Hardware Installation and Maintenance* publication. If you have a Cisco 4700 router, refer to the *Cisco 4000 Series Hardware Installation and Maintenance* publication.

Note Use of the 100E module is not supported in Cisco 4000 or Cisco 4000-M routers.

This document contains the following sections, including step-by-step procedures for installing or replacing and configuring your new 100E network processor modules:

- Overview of the 100E Network Processor Module
- Prerequisites for Installing 100E Network Processor Modules
- Safety Recommendations
- Safety with Electricity

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- Tools and Equipment Required
- Preparing to Make Connections
- Accessing the 100E Network Processor Modules
- Removing 100E Network Processor Modules
- Replacing or Adding 100E Network Processor Modules
- Replacing the Component Tray
- Making 100E Network Connections
- Replacing the Final Connections to the Router
- Configuring the 100E Network Processor Module Interface
- Checking the Router Configuration
- Problem Solving
- Cisco Connection Online

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.

Note Translations for all safety warnings included in this document are in the appendix "Translated Safety Warnings" in the *Cisco 4000 Series Installation Guide*.

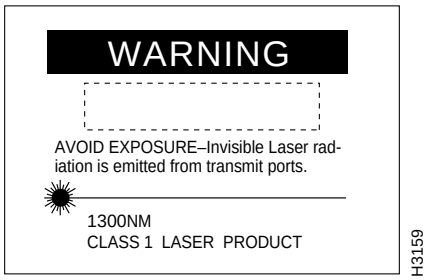
Caution To avoid damaging ESD-sensitive components, discharge all static electricity from your body before opening the chassis. Before performing procedures described in this document, review the sections "Safety Recommendations," "Safety with Electricity," and "Tools and Equipment Required."

Note The following warnings are only applicable if a single-mode FDDI, single-mode ATM OC-3, or BRI network processor modules are installed in the 4000 series router together with 100E network processor modules. If you do not have these modules installed in your router, proceed with the section "Overview of the 100E Network Processor Module."

Warning The ports labeled "Ethernet," "10BaseT," "Token Ring," "Console," and "AUX" are safety extra-low voltage (SELV) circuits. SELV circuits should only be connected to other SELV circuits. Because the BRI circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the telephone network voltage (TNV) circuits.

Warning The ISDN connection is 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.

Warning Invisible laser radiation may be emitted from the aperture ports of the single-mode FDDI card when no cable is connected. *Avoid exposure and do not stare into open apertures.* Following is an example of the warning label that appears on the product:



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.

Overview of the 100E Network Processor Module

By installing and operating the 100E network processor module in a Cisco 4000 series router, high-speed and inter-VLAN communication between critical network devices such as switches, servers, and other routers can be established.

The 100E network processor module provides a set of important benefits to the network, among them:

- Greater bandwidth for support of backbone/interconnect applications
- Improved performance during peak traffic periods and for remote office connections
- Network expansion through the addition of new nodes to 100 Mbps network segments

100BaseT: Fast Ethernet Technology

The term *Ethernet* is commonly used for all carrier sense multiple access collision detect (CSMA/CD) local area networks (LANs) that generally conform to Ethernet specifications, including IEEE 802.3u.

Note IEEE 802.3u is appropriate for applications where a local communication medium must carry sporadic, occasionally heavy traffic at high peak data rates.

Stations on a CSMA/CD LAN can access the network at any time. Before sending data, a station *listens* to the network to see if it is in use. If it is, the station waits until the network is available, then transmits in half-duplex mode.

Ethernet networks are broadcast networks, so all stations see all transmissions. Each station examines received frames to evaluate whether it is the intended destination. If it is, the station passes the frame to a higher protocol layer for processing.

A collision occurs when two stations listen for network traffic, hear none, and transmit almost simultaneously. When this happens, the data in both transmissions is corrupted. The stations detect the collision and use backoff algorithms to set a retransmit time.

Fast Ethernet Architecture

Fast Ethernet networks are 100 Mbps networks based on an architecture designed by the Fast Ethernet Alliance. Using Ethernet technology and protocols, Fast Ethernet enables data transfer rates 10 times faster than those possible in 10BaseT networks.

Fast Ethernet architecture requires changes only to the physical layer of the OSI network design standard. The crucial MAC layer is left untouched, and the same Ethernet rules for transmitting and receiving data still apply.

Because devices such as hubs, switches and routers are geared to MAC layer protocols, Fast Ethernet devices are compatible with existing standards while enabling rapid translation between network protocols. Additionally, Fast Ethernet devices can be connected to 10 Mbps networks if speed translation devices are present.

Though Fast Ethernet is used to denote 100BaseT, IEEE 802.3u specifies several physical layer protocols. Each has a name that summarizes its characteristics in the following format:

speed/signaling method/segment length

Each term is defined as follows:

Speed is the LAN speed in megabits per second (Mbps).

Signaling method is the signaling method used (either baseband or broadband).

Segment length is typically the maximum length between stations in hundreds of meters.

For example, 100BaseT specifies a 100-Mbps, baseband LAN, with maximum network segments of 100 meters (or 400 meters for 100BaseFX).

The Fast Ethernet physical layer protocols are as follows:

- 100BaseTX—100BaseT, half and full duplex over Category 5 unshielded twisted-pair (UTP), Electronics Industry Association/Telecommunications Industry Association [EIA/TIA]–568-compliant cable
- 100BaseFX—100BaseT, half and full duplex over optical fiber
- 100BaseT4—100BaseT, half and full duplex over Category 3, 4, or 5 UTP or Shielded Twisted Pair (STP) cabling with four pairs; also called *4T+* or *T2*, which is 2-pair UTP over Category 3 cable.

100E Network Processor Module Functionality

The 100E network processor module conforms to the IEEE 802.3u Fast Ethernet specification and provides connectivity via 100BaseTX and MII (media independent interface). The MII port enables connectivity to an external 100BaseFX or 100BaseT4 transceiver. The module also supports Interswitch Link (ISL) over Fast Ethernet to ensure VLAN compatibility.

The 100E Fast Ethernet module provides for a number of applications, each of which enhances network functionality. Important applications include:

- Routing between virtual LANs in Cisco switches
- Access to Fast Ethernet switches from LAN/WAN media and protocols

- High-bandwidth server connections for collapsed backbone and topologies, enabling rapid data flow between switches, hubs, servers, and the backbone

100E Network Processor Module Design Features

Software Design Features

The software architecture of the module is divided into two subsystems, one for the Peripheral Component Interconnect (PCI) bus and a second to perform 100 Mbps functions. The software code tests the module controller at startup, performing diagnostics, initializing the descriptors, buffers, and interrupt vectors for receiving and transmitting packets.

Packets received are checked for encapsulation and processed according to type. Packets are either bridgeable, fast switchable, or process switchable.

Packets are transmitted when the process-level switching code or fast switching code releases a packet. The driver either releases the packet for transmission or holds it in a buffer, or queue, until traffic clears.

Hardware Design Features

The hardware architecture of the 100E module is pipelined. The module is designed to run at a clock speed of 25 MHz (internal and external). It uses the DEC21140 chip as its LAN controller. This controller is initialized during each module start-up session.

The 100E network processor module contains 2 write and 2 read register arrays, and is PCI compliant. Its design enables external control of internal functions.

The hardware design includes MAC address filtering for more efficient network performance.

Module Interface Options

Module interface options are as follows:

- Each 100E module has two 100BaseX interfaces: one RJ-45 and one MII. The RJ-45 connects to Category 5 unshielded twisted pair (UTP) for 100BaseTX (in conformance with IEEE 802.3u), and the MII connector links through external transceivers to multimode fiber for 100BaseFX, or to Category 3, 4, and 5 UTP or shielded twisted pair (STP) for 100BaseT4 physical media. Only one connection can be used per module.
- Support for InterSwitch Link (ISL) over Fast Ethernet for compatibility with Catalyst switches and the Fast Ethernet Interface Processor (FEIP) which is used in Cisco 7000 family of routers.
- Support for IEEE 802.10 as an evolving VLAN interconnect standard.
- Multiprotocol support. The following protocols are supported:
  - IP
  - OSI
  - DECnet Phase IV
  - Novell IPX
  - Banyan Vines
  - AppleTalk Phase 2
  - APPN

— Native Mode LAN

— OLSw

The 100E network processor module does not support these options:

— Autosensing/autonegotiation

— Flow control

100E Network Processor Module LEDs

The 100E network processor module LEDs are located on the lower left corner of the face plate. (See Figure 1 and Figure 2.)

The four LEDs indicate the following:

- RJ-45 (GRN)/MII (YEL)—Green when the RJ-45 port is selected as the active port by the controller, yellow when the MII port is selected as the active port by the controller.
- Link—When the RJ-45 port is active, this LED is on and also when the 100E module is receiving a carrier signal from the network. When the MII port is active, this LED flickers on and off to correspond to network activity.
- RX (receive) (RJ-45 ONLY)—When on, this means that the system is receiving data on the 100BaseTX RJ-45 port.
- TX (transmit) (RJ-45 ONLY)—When on, this means that the system is sending Fast Ethernet transmissions to the 100BaseTX RJ-45 port.

Figure 1 Cisco 4000 Series—Rear View Showing Slot Numbering and Interface Ports

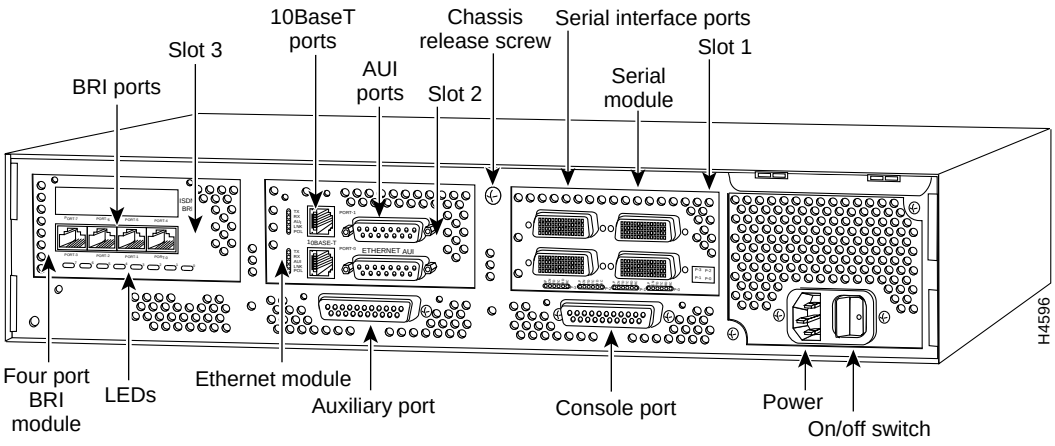
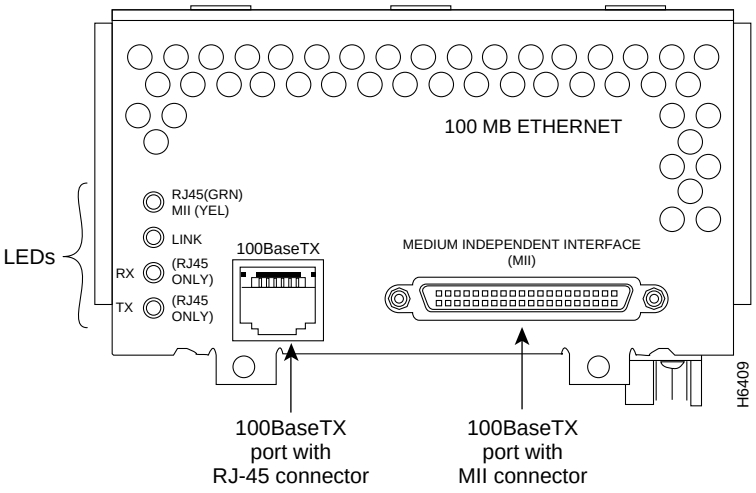


Figure 2 100E Network Processor Module



Reading the Front Panel LEDs

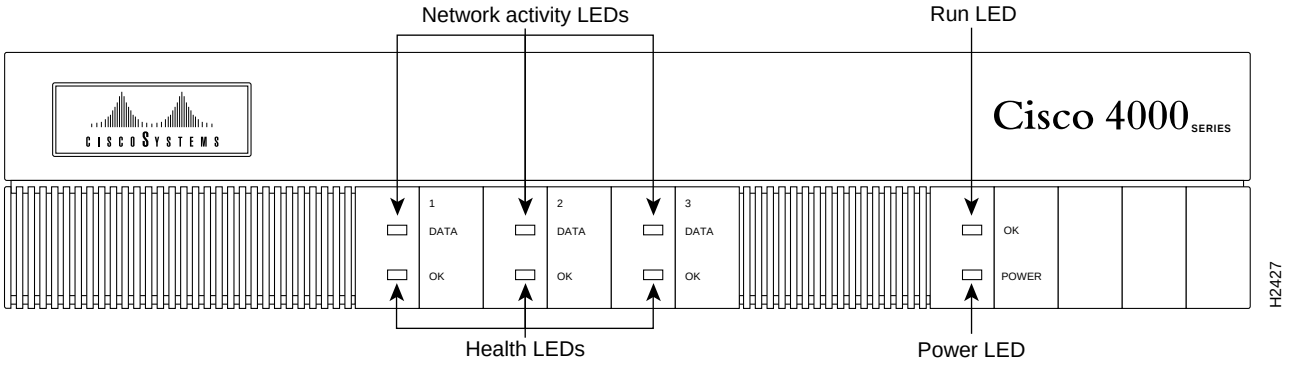
Figure 3 shows the Cisco 4000 series chassis front view with network activity, health, run, and power LEDs.

When you face the front of the chassis, the three LEDs (labeled OK) on the lower left correspond to three module slots. (See Figure 3.) When on, these LEDs indicate that the modules are operational. The upper LEDs (labeled DATA) blink to indicate network activity on the respective interfaces. If no module is installed in a slot, the LEDs corresponding to that slot will be off.

The LED labeled POWER becomes active to indicate that the system power is on. The LED labeled OK goes on to indicate that the system processor is functioning properly.

Note The module LEDs are visible through the cutouts in the rear of the chassis.

Figure 3 Cisco 4000 Series—Front View



Prerequisites for Installing 100E Network Processor Modules

System prerequisites are divided into software and hardware compatibility requirements.

Software Compatibility

Network processor modules must be supported by the appropriate level of system software. The minimum system software versions for the 100E module are Cisco IOS Release 11.1(5) and Cisco IOS Release 11.2(2). If you have an earlier version of Cisco IOS software, contact Cisco Customer Service (see the section “Cisco Connection Online”) or your local sales representative to order the appropriate version.

Hardware Compatibility

The 100E network processor module is supported by all models of the Cisco 4000 series router except for the Cisco 4000 and Cisco 4000-M. (See Table 1.)

Some restrictions apply to the use of the 100E module with other network processor modules. (See Table 1.) If two 100E modules are present in a router, you cannot install ATM or FDDI modules. However, a single 100E module will function alongside a single ATM or FDDI module. No additional restrictions apply.

Table 1 100E Network Processor Module Support in the Cisco 4000 Series

Cisco 4000 Series Router	Maximum Number of 100E Network Processor Modules	Other Module Restrictions
4000, 4000-M	Not supported	—
4500, 4500-M, 4700, 4700-M	One	One ATM or FDDI module–No restrictions on other modules
4500, 4500-M, 4700, 4700-M	Two	No ATM or FDDI modules–No restrictions on other modules

Memory Requirements

The standard 4 MB of shared memory found in most Cisco 4000 series routers is sufficient for installations with fewer than 24 physical or virtual interfaces. Routers with 24 or more interfaces require 8 or 16 MB of shared memory. See Table 1 for the shared memory required for specific network processor modules.

Table 2 Cisco 4500-M and Cisco 4700-M Shared Memory Requirements

Network Processor Module	Per-Module Shared Memory Requirements
Dual-port Ethernet and dual-port serial	0.4 MB
Dual-port Token Ring, four-port serial, and G.703/G.704 serial	0.6 MB
Six-port Ethernet, Eight-port BRI, CT1/PRI, and CE1/PRI	1.2 MB
Fast Ethernet	1.5 MB
ATM and one FDDI[1]	2.0 MB
Two FDDI[2]	3.0 MB

1. FDDI modules are an exception in that two FDDI modules do not require double the shared memory of one FDDI module.
2. FDDI modules are an exception in that two FDDI modules do not require double the shared memory of one FDDI module.

The amount of main memory required by a Cisco 4000 series router is affected by the size of the network and by the access list configurations. However, it is difficult to quantify the exact main memory requirements based only on network size. Use the following guidelines to determine approximate main memory requirements.

Note If your memory requirements fall near the upper end of one of the available main memory options, consider installing the next larger memory option to allow for network growth.

Main memory requirement guidelines for Cisco 4000 series routers are as follows:

- The 8 MB of main memory standard in the Cisco 4500-M and the 16 MB of main memory standard in the Cisco 4700-M is normally sufficent on routers running Cisco IOS Release 10.2.
- 16 MB of main memory, optional in the Cisco 4500-M and standard in the Cisco 4700-M, is normally sufficent on routers using Cisco IOS Release 10.3 or later.
- The 64 MB main memory option for the Cisco 4700-M is recommended for routers using Border Gateway Protocol (BGP).

Safety Recommendations

Follow these guidelines to ensure general safety:

- Keep the chassis area clear and dust-free during and after installation.
- Place 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 may get caught in the chassis. Fasten your tie or scarf and roll up your sleeves.

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

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. This can cause serious burns or even result in welding to the terminals.

Follow these guidelines when working on equipment powered by electricity:

- Locate the room's emergency power-off switch. Then, if an electrical accident occurs, you can quickly shut the power OFF.
- Before working on the system, turn OFF the power and unplug the power cord.
- Disconnect all power before doing the following:
  - Installing or removing a router chassis or network processor module
  - Working near power supplies
  - Performing a hardware upgrade
- Do not work alone if potentially hazardous conditions exist.
- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, and missing safety grounds.
- Never assume that power is disconnected from a circuit. Always check.
- If an electrical accident occurs, proceed as follows:
  - Use caution, and do not become a victim yourself.
  - Turn OFF power to the system.
  - 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 and operates effectively. Connect the clip to an unpainted surface of the chassis frame to safely channel unwanted ESD voltages to ground.

Caution If no wrist strap is available, ground yourself by touching the metal part of the chassis. For safety, periodically check the resistance value of the antistatic strap, which should be between 1 to 10 megohms (Mohms).

Tools and Equipment Required

The following tools and equipment are required to install and remove 100E modules in a Cisco 4000 series router:

- For 100BaseTX operation, Category 5 or UTP RJ-45 cable
- For MII, an external transceiver. The MII cable type required depends on the type of external transceiver used: TX, T4, or FX.
- ESD cord and wrist strap
- Screwdrivers, Number 1 and Number 2 Phillips

Preparing to Make Connections

The power cable and power switch are on the lower right of the rear panel of the router. The system console port, auxiliary port, and module ports appear to the left of the power cable and switch. (See Figure 1.)

Slot Numbering

The chassis contains slots for three network processor modules. These slots correspond to the three slot numbers printed on the front panel of the chassis. (See Figure 3.) Slot numbers represent the order in which the system scans the modules.

The location of modules is not slot dependent; you can move a module to any other available slot.

Unit Numbering

Unit numbering lets the system differentiate between two interfaces of the same type. The system assigns unit number addresses to modules by starting with zero for each module interface type. Numbering is from right to left and from bottom to top. The lowest unit number of that interface type is the module closest to the power supply. For example, the unit number addresses for the modules in Figure 4 are as listed in Table 3.

Table 3 Unit Number Addresses for Serial, Ethernet, and ISDN BRI Modules

Slot	Interface Type	Address
1	Serial port (labeled port 3)	3
	Serial port (labeled port 2)	2
	Serial port (labeled port 1)	1
	Serial port (labeled port 0)	0
2	Ethernet port (top)	1
	Ethernet port (bottom)	0
3	BRI port (labeled port 3)	3
	BRI port (labeled port 2)	2
	BRI port (labeled port 1)	1
	BRI port (labeled port 0)	0

If the ISDN BRI module in Figure 1 was replaced by a second Ethernet module, the unit addresses would be as listed in Table 4.

Table 4 Unit Number Addresses for Serial and Two Ethernet Modules

Slot	Interface Type	Address
1	Serial port (labeled port 3)	3
	Serial port (labeled port 2)	2
	Serial port (labeled port 1)	1
	Serial port (labeled port 0)	0
2	Ethernet port (top)	1
	Ethernet port (bottom)	0
3	Ethernet port (top)	3
	Ethernet port (bottom)	2

Figure 4 shows a chassis configured with two Ethernet modules and a single 100E module (in the center slot). Table 4 shows the corresponding unit numbering.

Figure 4 Cisco 4000 Series Router—Rear View Showing Port Unit Numbering

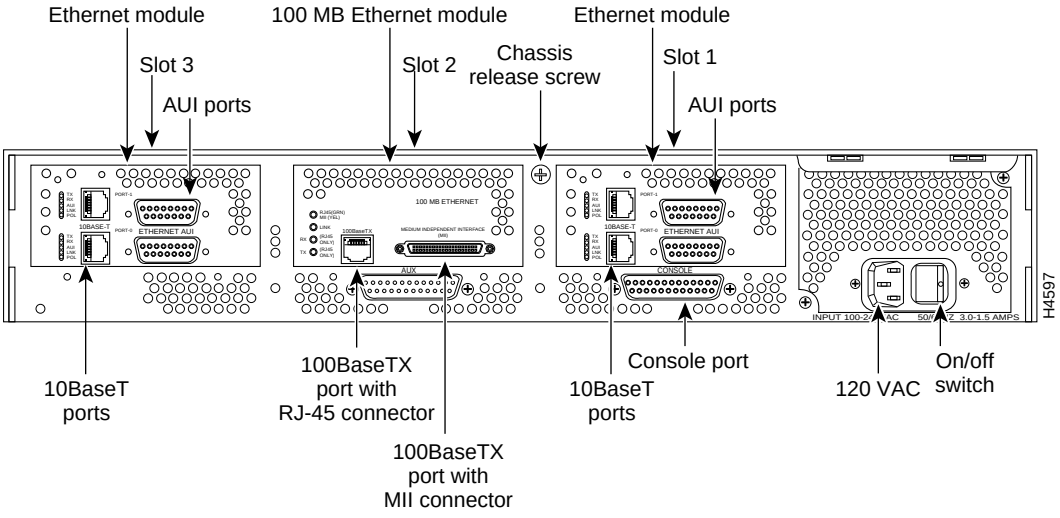


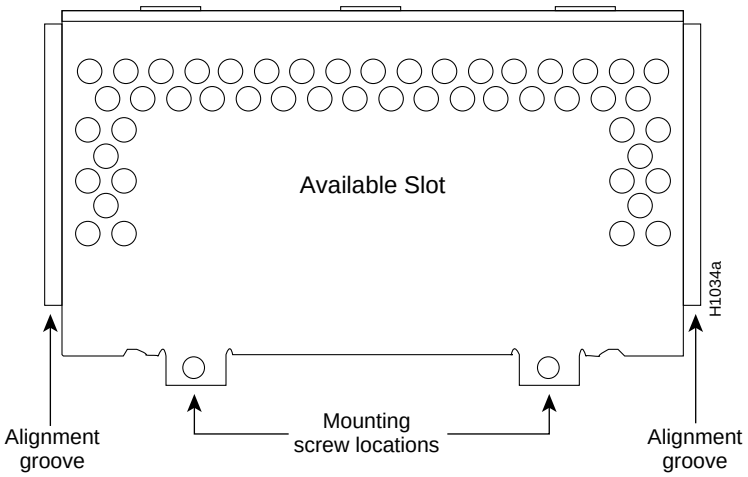
Table 5 Unit Number Addresses for 100E and Two Ethernet Modules

Slot	Interface Type	Address
1	Ethernet port (top)	1
	Ethernet port (bottom)	0
2	100 MB Ethernet port (top)	1
	100 MB Ethernet port (bottom)	0
3	Ethernet port (top)	3
	Ethernet port (bottom)	2

Use of the Slot Filler Panel

If the router is configured with fewer than three network processor modules, you must place a slot filler panel in the open slot to ensure proper airflow. (See Figure 5.)

Figure 5 Slot Filler Panel



Accessing the 100E Network Processor Modules

To access the modules, you must remove the component tray. Procedures for removing the component tray follow.

Removing the Component Tray Procedure

Some Cisco 4000 series routers have a safety latch tab on the chassis that affects removing the component tray. (See Figure 6 and Figure 7.)

If your chassis has a safety latch tab, refer to the next section, “Removing the Component Tray from a Chassis with a Safety Latch.”

If your chassis does not have a safety latch tab, go to the section “Removing the Component Tray from a Chassis without a Safety Latch.”

Removing the Component Tray from a Chassis with a Safety Latch

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.

Take the following steps to remove the component tray from a chassis with a safety latch:

Step 1 Turn OFF the system power.

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.

Step 2 Attach your ESD-preventive wrist strap.

Step 3 Remove all network cables. Continue with Step 4 if you have an AC-powered router or Step 5 if you have a DC-powered router.

Step 4 If you have an AC-power router, remove the power cable.

Step 5 If you have a DC-powered router, take these steps to remove the power cables:

- Use a screwdriver to loosen the captive installation screws on the terminal block cover.
- Lift and remove the terminal block cover.
- Use a screwdriver to remove the three power leads from the terminal block in the following order: negative, positive, then ground.

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

Warning Do not work on the system or connect or disconnect cables during periods of lightning activity.

Step 6 Loosen the nonremovable chassis release screw on the rear panel of the chassis. (See Figure 6.)

Step 7 Pull on the handle located on the upper right corner of the chassis to slide the component tray out of the chassis shell until the safety latch catches. (See Figure 6.)

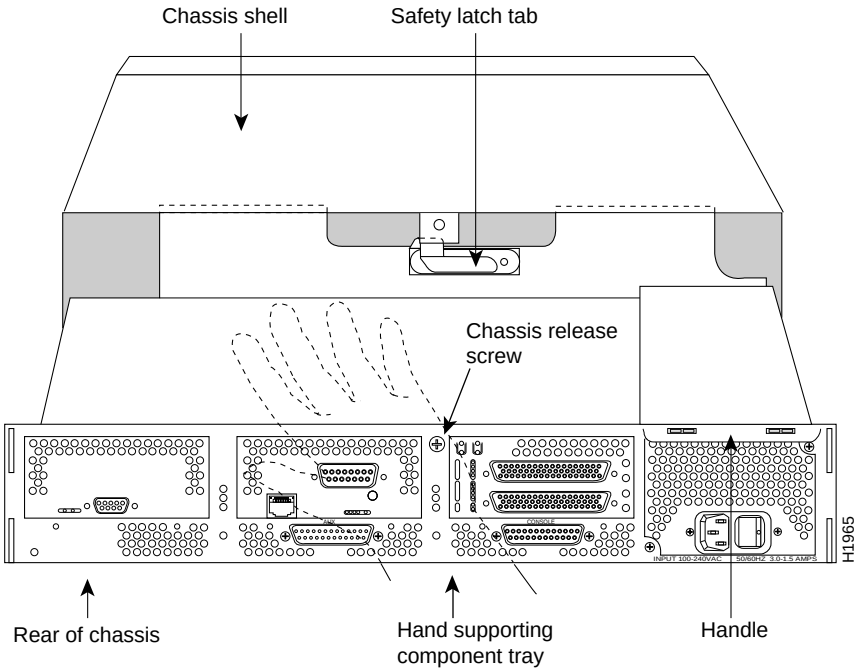
Warning Before releasing the safety latch, support the component tray from underneath, either on your work surface or with your hands, to prevent injury.

Step 8 Support the component tray with one hand, push down on the safety latch tab, and pull the component tray out completely.

Step 9 Set the component tray on your work surface. Then proceed with the section “Removing Network Processor Modules.”

Proceed to the next section “Removing 100E Network Processor Modules.”

Figure 6 Component Tray Removal for Chassis with a Safety Latch



Removing the Component Tray from a Chassis without a Safety Latch

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.

Take the following steps to remove the component tray from a chassis without a safety latch:

Step 1 Turn OFF the system power.

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.

Step 2 Attach your ESD-preventive wrist strap.

Step 3 Remove all network cables. Continue with Step 4 if you have an AC-powered router or Step 5 if you have a DC-powered router.

Step 4 If you have an AC-power router, remove the power cable.

Step 5 If you have a DC-powered router, take these steps to remove the power cables:

- Use a screwdriver to loosen the captive installation screws on the terminal block cover.
- Lift and remove the terminal block cover.
- Use a screwdriver to remove the three power leads from the terminal block in the following order: negative, positive, then ground.

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

Warning Do not work on the system or connect or disconnect cables during periods of lightning activity.

Step 6 Loosen the nonremovable chassis release screw on the rear panel of the chassis. (See Figure 7.)

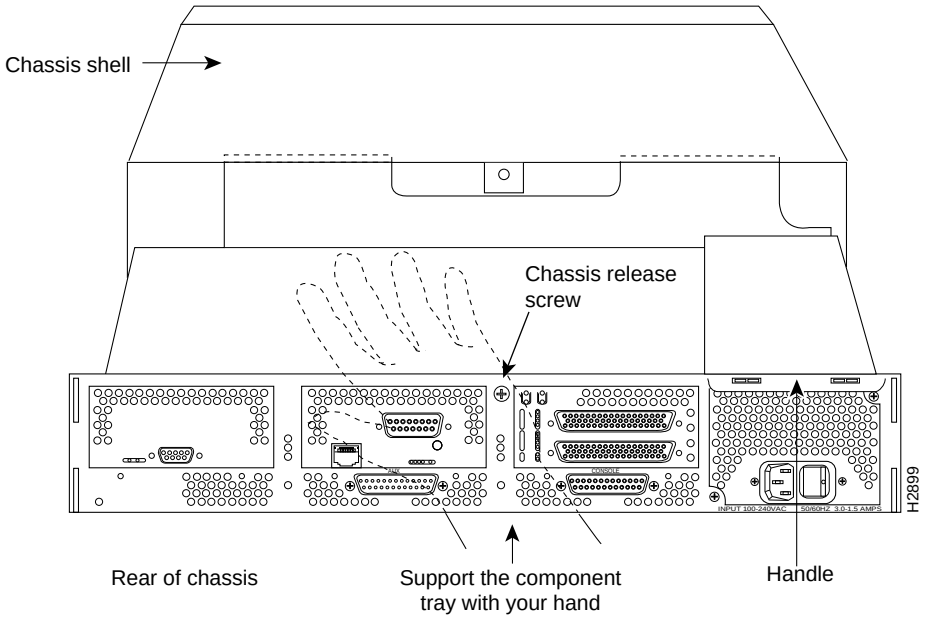
Warning To prevent the component tray from falling, support it from underneath, either on your work surface or with your hands.

Step 7 Pull on the handle located on the upper right corner of the chassis to slide the component tray out of the chassis shell while you support the component tray with one hand.

Step 8 Set the tray on your work surface.

Proceed to the next section "Removing 100E Network Processor Modules."

Figure 7 Component Tray Removal for Chassis without a Safety Latch



Removing 100E Network Processor Modules

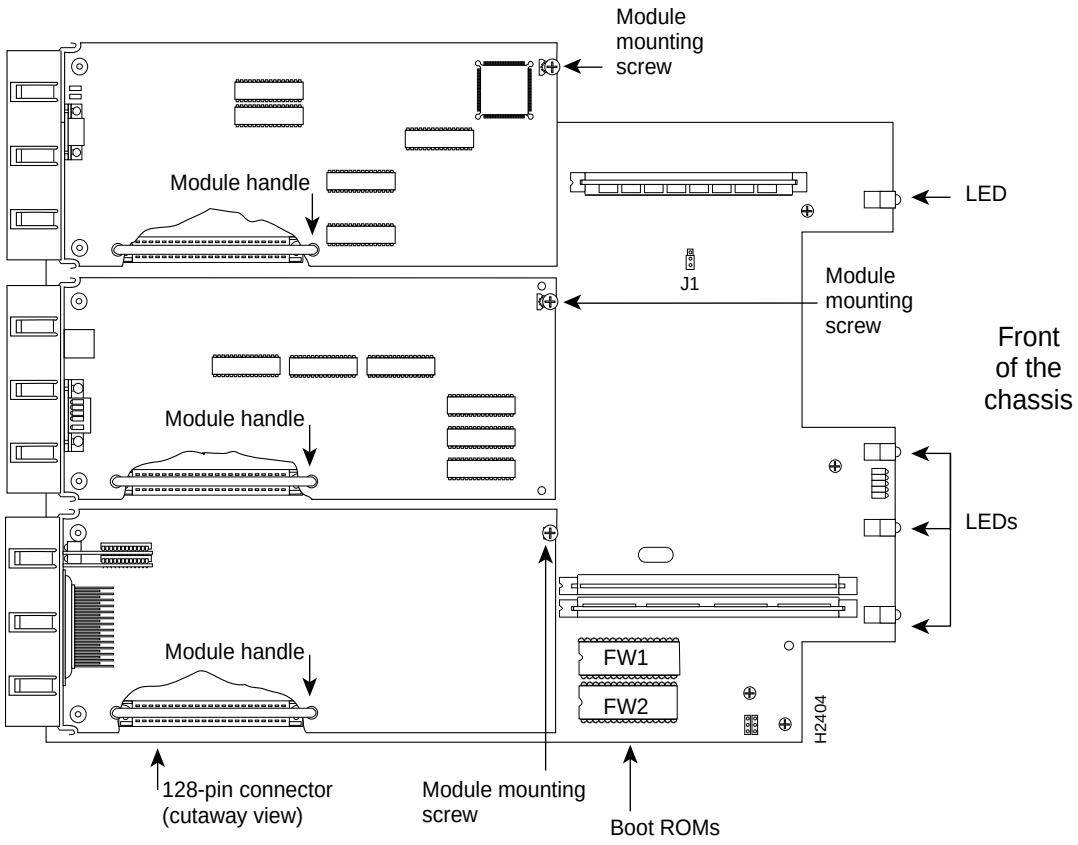
After you remove the component tray from the chassis, you can remove the modules from the chassis.

Caution Some network processor modules are secured to the rear of the chassis with two external screws. You must remove these screws before safely lifting the module out of the chassis.

Take the following steps to remove a module:

Step 1 Orient the component tray as shown in Figure 8, then remove the module mounting screw from the top of the module. Remove the two external rear mounting screws if present, and set them aside.

Figure 8 Cisco 4000-M Component Tray—Typical of Cisco 4000 Series



Step 2 Grasp the module handle and pull it straight up to lift the module out of its connector. (See Figure 9.)

Step 3 Place the removed module on an ESD mat.

Caution Do not wiggle the module's handle or exert any side-to-side pressure. The handle may work loose and damage the module.

Caution If any of the modules have daughter cards projecting at right angles to the module (see Figure 10), do not bend the modules during installation because the daughter cards could become disconnected. Carefully reseat any loosened cards, handling them by the edges without touching any components.

Note For network connection pinout information, refer to the *Cisco 4000 Series Installation Guide* on the Cisco Connection Documentation, Enterprise Series CD ROM, or the printed publication. You can also access the documentation on the world wide web. See the section "Cisco Connection Online" for more information.

Figure 9 Network Processor Module Components

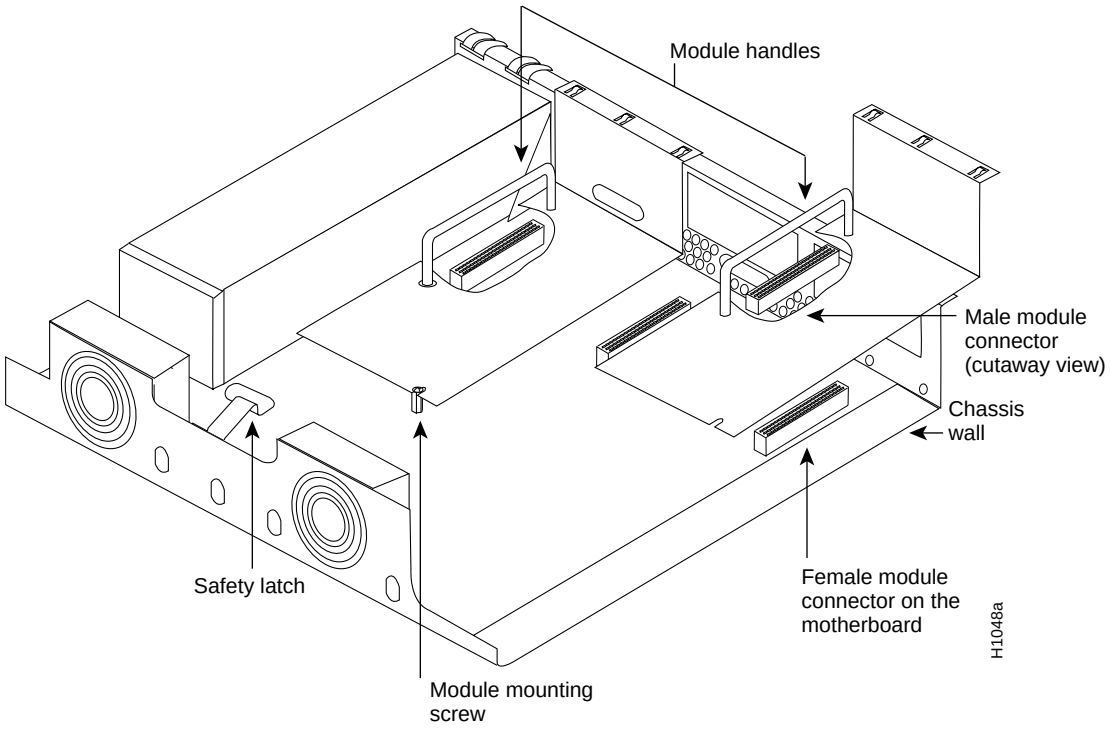
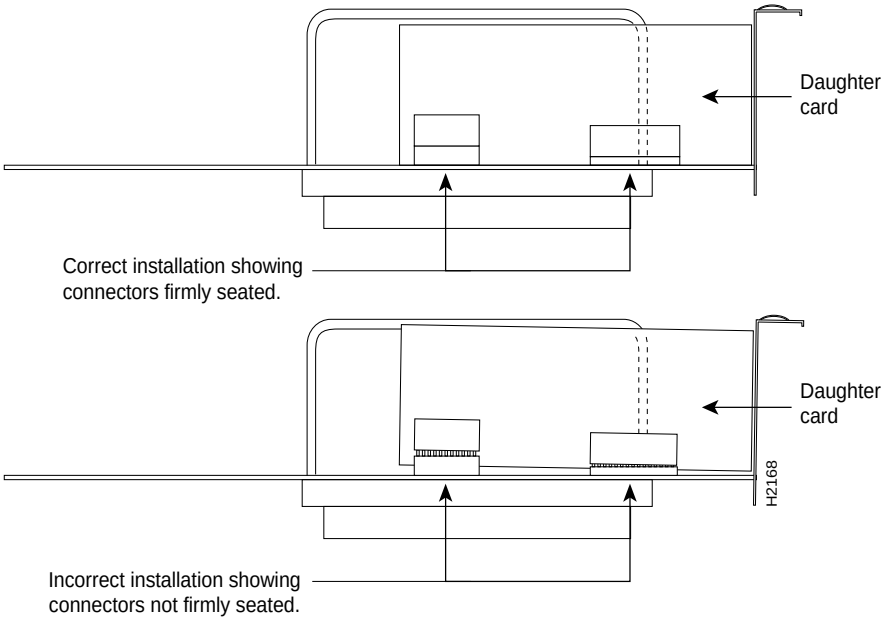


Figure 10 Network Processor Module Daughter Card Installation



Replacing or Adding 100E Network Processor Modules

Take the following steps to replace or add a module:

Step 1 Hold the module by its handle, align it with the grooves in the chassis (not shown) and over its connector, and push the module lightly against the chassis wall. (See Figure 9.)

Step 2 Push the module gently into place without bending the connector pins, inserting the male connector into the female connector on the motherboard.

Step 3 Replace the module mounting screw in its place on the end of the module. (See Figure 8.)

Step 4 Replace the external rear mounting screws, if these are present.

Caution Do not overtorque the screws because this may damage the module or the underlying motherboard. The maximum screw torque is 7-inch-lb.

Replacing the Component Tray

Take the following steps to replace the component tray in the chassis shell:

Step 1 Reinsert the component tray into the shell, pushing on the back of the tray while pressing on the chassis release screw (as shown in Figure 6 and Figure 7) with the thumb of your right hand.

Step 2 Retighten the chassis release screw.

Making 100E Network Connections

The two interface receptacles on the 100E network processor module are a single MII, 40-pin, D-shell type, and a single RJ-45. Each connection supports IEEE 802.3u interfaces that are compliant with the 100BaseX and 100BaseT standards. Only one can be used at a time.

The RJ-45 connection does not require an external transceiver. The MII connection requires an external physical sublayer (PHY) and an external transceiver.

Figure 11 shows the RJ-45 connectors.

Figure 11 RJ-45 Connector and Plug

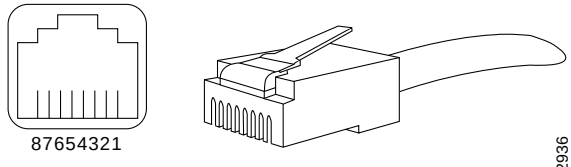


Table 6 lists the pinouts and signals for the RJ-45 connectors. Refer to the RJ-45 pinout in Table 5 when selecting proper common-mode line terminations for the unused Category 5, UTP cable pairs 4/5 and 7/8. Wire pairs 4/5 and 7/8 are actively terminated in the RJ-45, 100BaseTX port circuitry in the 100E module. Common-mode termination reduces electromagnetic interference (EMI) and susceptibility to common-mode sources.

Table 6 RJ-45 Connector Pinout

Pin	Description
1	Receive Data + (RxD+)
2	RxD–
3	Transmit Data + (TxD+)
6	TxD–

Depending on your RJ-45 interface cabling requirements, use the pinouts in Figure 12 and Figure 13.

Figure 12 Straight-Through Cable Pinout (Connecting 100E RJ-45 Interface to a Hub or Repeater)

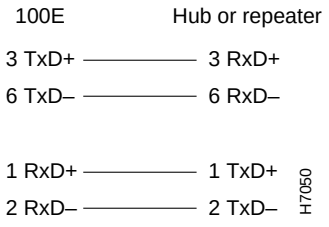
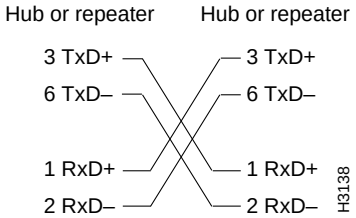


Figure 13 Crossover Cable Pinout (RJ-45 Connections Between Hubs and Repeaters)



The module transceiver must be equipped with the appropriate connector, depending on the media type used for the MII connection. Connectors can be ST-type for optical fiber, RJ-45 for 100BaseT4, and so on. Figure 14 shows the pin orientation of the female MII connector on the 100E module.

The MII receptacle uses 2-56 screw-type locks, called *jackscrews* (shown in Figure 14), to secure the cable or transceiver to the MII port and provide strain relief. MII cables and transceivers have knurled thumbscrews (tightened with the fingers) that fasten to the jackscrews on the module's MII connector (shown in Figure 14). In contrast, the RJ-45 modular plug has strain relief functionality incorporated into the design of its standard plastic connector.

Figure 14 MII Connection (Female)

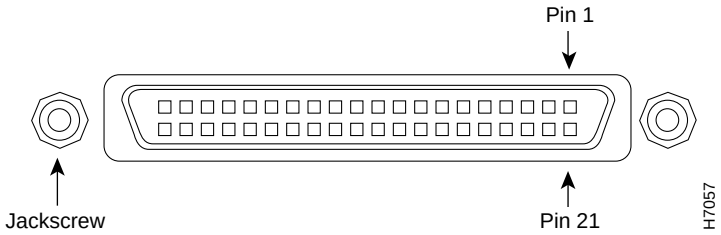


Table 6 lists the MII connector pinouts and signals. MII cables are available commercially.

Table 7 MII Connector Pinouts and Signals

Pin[1]	In	Out	In/Out	Description
14–17	–	Yes	–	Transmit Data (TxD)
12	Yes	–	–	Transmit Clock (Tx_CLK)[2]
11	–	Yes	–	Transmit Error (Tx_ER)
13	–	Yes	–	Transmit Enable (Tx_EN)
3	–	Yes	–	MII Data Clock (MDC)
4–7	Yes	–	–	Receive Data (RxD)
9	Yes	–	–	Receive Clock (Rx_CLK)
10	Yes	–	–	Receive Error (Rx_ER)
8	Yes	–	–	Receive Data Valid (Rx_DV)
18	Yes	–	–	Collision (COL)
19	Yes	–	–	Carrier Sense (CRS)
2	–	–	Yes	MII Data Input/Output (MDIO)

Table 7 MII Connector Pinouts and Signals

Pin[1]	In	Out	In/Out	Description
22–39	–	–	–	Common (ground)
1, 20, 21, 40	–	–	–	+5.0 volts (V)

1. Any pins not indicated are not used.
2. Tx_CLK and Rx_CLK are generated by the external transceiver.

Table 7 lists the cabling specifications for 100-Mbps 100BaseT transmission over UTP and STP cables.

Table 8 Specifications and Connection Limits for 100-Mbps 100BaseT Transmission

Parameter	RJ-45	MII
Cable specification	Category 5[1] UTP[2], 22 to 24 AWG[3]	Category 3, 4, or 5, 150-ohm UTP or STP, or multimode optical fiber
Maximum cable length	–	0.5 m (1.64') (MII-to-MII cable[4])
Maximum segment length	100 m (328') for 100BaseTX	1 m (3.28')[5] or 400 m (1.312') for 100BaseFX
Maximum network length	200 m (656')[5] (with 1 repeater)	–

1. EIA/TIA-568 or EIA-TIA-568 TSB-36 compliant.
2. Cisco Systems does not supply Category 5 UTP RJ-45 or 150-ohm STP MII cables. Both are available commercially.
3. AWG = American Wire Gauge. This gauge is specified by the EIA/TIA-568 standard.
4. This is the cable between the MII port on the 100E module and the appropriate transceiver.
5. Between any two stations on a segment.

Table 8 contains IEEE 802.3u 100BaseT physical characteristics.

Table 9 IEEE 802.3u Physical Characteristics

Parameter	100BaseT
Data rate (Mbps)	100
Signaling method	Baseband
Maximum segment length (meters)	100 m between DTE[1] and repeaters
Media	RJ-45: Category 5 UTP MII: Category 3, 4, or 5, 150-ohm UTP or STP, with appropriate transceiver
Topology	Star/Hub

1. DTE = data terminal equipment.

Attaching 100E Interface Cables

For a single 100E module, you can use *either* the RJ-45 connection *or* the MII connection.

If there are two 100E modules in the router, you can use the RJ-45 connection for one and the MII connection for the other.

Note RJ-45 and MII cables are not available from Cisco Systems. RJ-45 cables are widely available, and must be Category 5 cables. MII cables connect to an external transceiver. Contact your transceiver vendor to obtain the partner MII cable.

Connect RJ-45 and MII cables as follows:

Step 1 If you have RJ-45 connections, attach the Category 5 UTP cable directly to the RJ-45 port on the module which is labled "100Base-TX.". (See Figure 15.)

If you have MII connections, attach an MII cable directly to the MII port on the 100E module, or attach a 100BaseT transceiver, with the media appropriate to your application, to the same port. (See Figure 16).

Figure 15 Connecting RJ-45 Cables

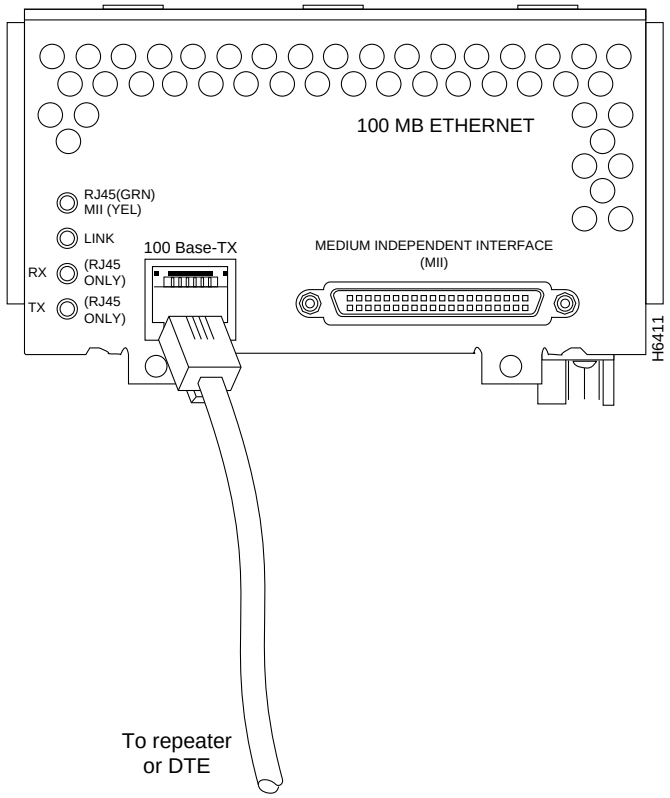
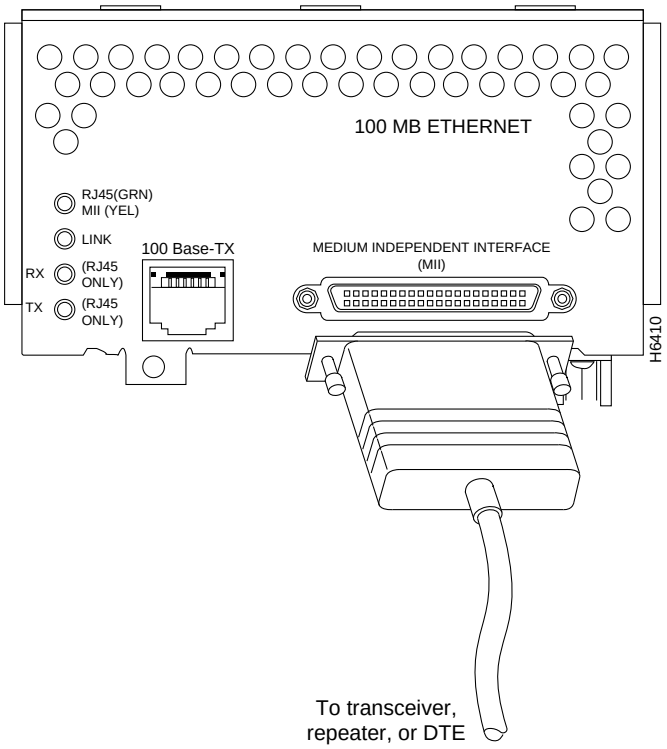


Figure 16 Connecting MII Cables



Note The 100E network processor module is an end station device and not a repeater. It *must* be connected to a repeater or hub.

Step 2 Attach the network end of your RJ-45 or MII cable to your 100BaseT transceiver, switch, hub, repeater, DTE, or other external 100BaseT equipment.

Note It is recommended that you plug in connectors when power to the system is off. If you unplug and then *reattach* the MII transceiver from the MII port when the system is up and running, you will need to reinitialize the module interface.

Caution On a single 100E module, only one network connection can be used at one time. Only connect cables that comply with EIA/TIA-568 standards. (Refer to Table 7 for cable recommendations and specifications.)

Replacing the Final Connections to the Router

Take the following steps to make the final connections to the router:

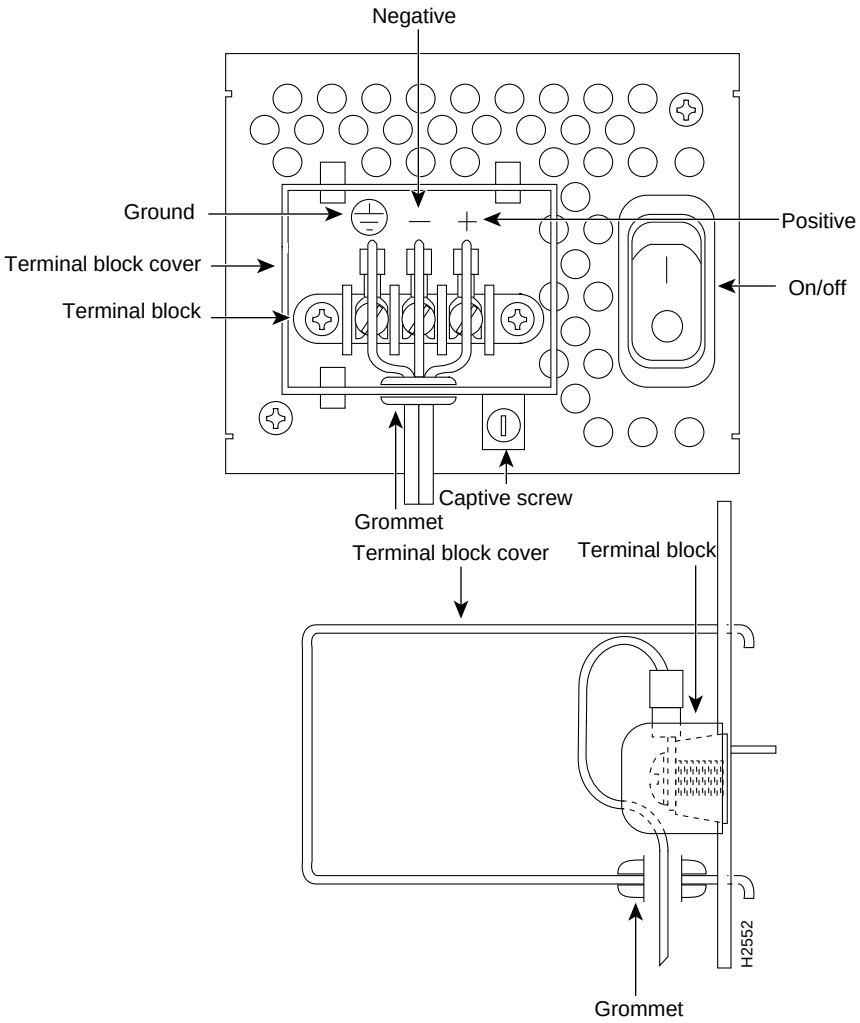
Step 1 Replace all remaining network connections. Continue with Step 2 if you have an AC-powered router or Step 3 if you have a DC-powered router.

Step 2 If you have an AC-powered system, plug the system power cord into a 3-terminal, single-phase power source that provides power within the acceptable range (100–240 VAC, 50–60 Hz, 3.0–1.5 A).

Step 3 If you have a DC-powered system, rewire the DC-input power supply (40 to 72 VDC) to the terminal block. The proper wiring sequence is ground to ground, positive to positive, and negative to negative. (See Figure 17.)

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

Figure 17 DC-Input Power Supply Connections



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

Step 4 Turn ON the system power switch. The power LED on the front should go ON. (See Figure 3.)

Step 5 Check the OK LED on the right side of the front panel (see Figure 3) to verify that it goes ON after a few seconds delay when booting. If the OK LED does not go on, refer the section "Problem Solving."

Configuring the 100E Network Processor Module Interface

When you install a new 100E module or wish to configure an existing interface, you must enter configuration mode. If the new module replaces a previously configured module, the system will bring the new module up in the existing configuration.

After you verify that the new 100E module is installed correctly (the enabled LED goes on), use the privileged-level **configure** command to configure the new interfaces. You will need the following information:

- Protocols to be routed on each new interface
- Internet protocol (IP) addresses if you will configure the interfaces for IP routing
- Whether the new interfaces will use bridging

Note The **configure** command requires privileged-level access to the EXEC command interpreter, which usually requires a password. Contact your system administrator if necessary to obtain EXEC-level access.

Note Refer to the Cisco IOS software configuration guides and command references for your router for more software configuration information.

Using the EXEC Command Interpreter

Before you use the **configure** command, you must enter the privileged level of the EXEC command interpreter with the **enable** command. The system will prompt you for a password if one is set.

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

Step 1 At the user-level EXEC prompt, enter the **enable** command. At the EXEC prompt, enter a privileged-level password, as follows:

```
Router> enable
Password:
```

Step 2 Enter the password (the password is case sensitive). For security purposes, the password is not displayed on your console.

Step 3 After you enter the correct password and press **Return**, the system displays the privileged-mode system prompt (#) as follows:

```
Router#
```

Step 4 Proceed to the following section, "Using the configure Command—Descriptions and Examples," to configure the new interfaces.

Using the configure Command—Descriptions and Examples

Following are descriptions and examples of the commands for configuring the 100E module port 0. Configuring other 100E modules is an identical process except that the port numbers reflect consecutive unit numbering. When two modules of the same type are installed in a Cisco 4000 series router, the system assigns the first port on the *second* module the next number in the sequence.

Descriptions are limited to fields that are relevant for establishing and verifying interface configuration. After configuring the new 100E interface, use **show** commands to display its status and those of all installed interfaces, or to verify changes that you made.

Depending on the requirements for your system configuration and the routing protocols that you intend for the interface, you may need to enter additional configuration subcommands.

The RJ-45 connection is the default. To change to an MII connection and then verify it, use the following series of commands:

```
Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# int fa 0
Router(config-if)# media-type mii
Router(config-if)# ^Z

Router# sh int fa 0

FastEthernet0 is administratively down, line protocol is down

  (display text omitted)
  Encapsulation ARPA, loopback not set, keepalive not set, hdx, MII
  (display text omitted)
```

Use the **media-type 100BaseTX** command to return the interface to its default state for RJ-45 connections.

Checking the Router Configuration

After you configure the interface, use the **show interface** command to check the network interface statistics. Options to the **show interface** command include the type of interface (for example, *serial*), and the unit number of the interface. The following example shows the use of the **show interface** command:

```
router# show interface fastethernet 0
```

The field underrun in the output of the **show interface** command may be nonzero in approximately 1 of 250,000 packets.

To display the current internal status of an interface module, use the **show controller** command with the interface type and unit number options:

```
router# show controller fastethernet 0
```

Note Refer to the Cisco IOS software configuration guides and command references for your router for more software configuration information.

Problem Solving

Use the information in this section to help isolate problems. This section helps you rule out the router as the problem source. You can always contact a service representative for information on how to proceed in resolving the problem. Before you call, have the following information ready:

- Chassis type and serial number
- 100E network pressor module and serial number
- Maintenance agreement or warranty information
- Type of software and version number
- Date you received the new chassis and the network processor module
- Brief description of your problem
- Brief explanation of steps you took to isolate the problem

The key to problem solving is to isolate the problem to a specific subsystem. By comparing how the system is operating to standard and smooth operation, it is easier to isolate a problem.

When problem solving, consider the following subsystems of the router:

- Power system—This subsystem includes the power supply and the wiring.
- Cooling system—The fan should go on when power is applied.
- Network processor modules—Problems with these modules can be the most difficult to troubleshoot. The LEDs on the modules can be used to help identify a failure. For complete information on LED indications, refer to Figure 1, Cisco 4000 Series—Rear View Showing Slot Numbering and Interface Ports, page 6.
- System cables—This subsystem includes all the external cables that connect the router to the network.

After you have the information listed above and have attempted to isolate the problem, contact customer assistance. Refer to the section “Cisco Connection Online.”

Troubleshooting the Power and Cooling Systems

Check the following items to help isolate the problem:

- With the power switch on, is the power LED on the front panel on?
  - If not, check the AC input, AC source, router circuit breaker, and the power supply cable.
  - If the power LED is still off, the problem might be a power supply failure.
- Does the system shut down after being on a short time?
  - Check the fan. If the fan is not working the system will overheat and shut itself down.
  - Check the environmental site requirements in the section “General Site Requirements” in the chapter “Preparing to Install the Cisco 4000 Series Router“ in the *Cisco 4000 Series Installation Guide*, and ensure that the chassis intake and exhaust vents are clear.

Troubleshooting the 100E Network Processor Modules and Cables

Check for the following symptoms to help isolate the problem:

- The network processor module is not recognized by the system when you use the Cisco IOS **show version** command.

  - Check the front panel OK LED for the module. The OK LED should be on.
  - Check the LEDs on the module.
  - Check to make sure the module motherboard and any daughter cards are fully seated.
  - Check that the correct software version is installed. Refer to "Software Compatibility" in the section labeled "Prerequisites for Installing 100E Network Processor Modules."
- The module is recognized when you use the **show interface** command, but interface port(s) will not initialize.
  - Check to ensure that the module is fully connected.
  - Check the external cables for connection.
  - Check the link light. If it is currently out, you may have a cable problem or the wrong media type.
  - Use the **show interface** command to ensure that the module is not shut down.
  - If you are using RJ-45, make sure that you do not have "media-type mii" in the **configure** command sequence.
  - If you are using MII, make sure that "media-type mii" *is* in the **configure** command sequence.
- System will not boot properly, or constantly or intermittently reboots.
  - Check to make sure the module's connection to the motherboard is fully seated.
  - Check that the correct software version is installed. Refer to "Software Compatibility" in the section labeled "Prerequisites for Installing 100E Network Processor Modules."
  - Remove each module one at a time. While each module is removed, reboot the system. If the system boots properly when one of the modules is removed, the module might be at fault.
- The system boots, but the console screen is frozen.
  - Check the external console connection.
  - Verify the console baud rate in the documentation for the terminal.

Cisco Connection Online

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

Available 24 hours a day, 7 days a week, CCO provides a wealth of standard and value-added services to Cisco's customers and business partners. CCO services include product information, 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, Internet e-mail, and fax download options, 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`.
- Telnet: `cco.cisco.com`.
- Modem: From North America, 408 526-8070; from Europe, 33 1 64 46 40 82. Use the following terminal settings: VT100 emulation; databits: 8; parity: none; stop bits: 1; and baud rates up to 14.4 kbps.

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

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

This document is to be used in conjunction with the *Cisco 4000 Series Installation Guide*, the *Cisco 4000 Series Hardware Installation and Maintenance*, and the *Cisco 4000 Hardware Installation and Maintenance* publications and the *Cisco 4000 Series Public Network Certification* document.

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