Cisco XR 12000 Series Router Ethernet Line Card Installation

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This guide contains instructions for installing Ethernet line cards in supported Cisco XR 12000 Series Routers. Also included are basic troubleshooting techniques to help in line card installation.

Contents

This installation guide includes the following sections:

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

Important Information

This section contains information about the following topics:

Ethernet Line Card Product Numbers

Table 1 lists the Cisco product numbers to which this publication applies. This guide replaces the individual Ethernet line card installation documents for the Cisco 12000 Series Router.

Table 1 Ethernet Line Card Product Numbers

Ethernet Line Card	Cisco Product Number
4-Port Gigabit Ethernet Internet Services Engine (ISE) Line Card	4GE-SFP-LC=
10-Port 1-Gigabit Ethernet Line Card	10X1GE-SFP-LC= 10X1GE-SFP-LC-B=
1-Port 10-Gigabit Ethernet Line Card	1X10GE-LR-SC= 1X10GE-ER-SC=

Router Hardware Installation

For hardware installation information for Cisco XR 12000 Series Routers, refer to the installation guide for your router. The guide includes information on the router switch fabric and how it affects operation of the line card, as well as line card slot locations, slot width, and other requirements.

Also refer to the field-replacable unit (FRU) publications that describe how to install, maintain, and replace router subsystems, such as cooling fans, power supplies, chassis backplanes, and so on.

Supported Platforms

Table 2 lists the supported router platforms for Ethernet line cards:

Table 2 Ethernet Line Card Supported Router Platforms

Ethernet Line Card	Supported Platform
4-Port Gigabit Ethernet ISE	All Cisco 12000 Series Routers
10-Port 1-Gigabit Ethernet	All Cisco 12400 and 12800 Routers
1-Port 10-Gigabit Ethernet	All Cisco 12400 and 12800 Routers

Note The Cisco XR 12000 Series Routers must have a full set of switch fabric cards installed to support the requirements of the Ethernet line cards. See the appropriate Cisco 12000 Series Router installation guide for information about the switch fabric and other related requirements.

Note Because the 10-Port 1-Gigabit Ethernet, 1-Port 10-Gigabit Ethernet, and Modular Gigabit Ethernet line cards require a card cage slot that is 1.8 inches (4.5 centimeters) wide, you can use these line cards in only the Cisco 12416 Router, Cisco 12410 Router, Cisco 12406 Router, Cisco 12404 Router, Cisco 12816 Router, and Cisco 12810 Router.

Cisco IOS Software Release and Hardware Revision Requirements

The Ethernet line cards have certain Cisco IOS software requirements. Also, to ensure compatibility with the software, your Ethernet line card should have a specific hardware revision number. The number is printed on a label affixed to the component side of the card and is displayed by the **show diag** command.

Table 3 lists the hardware and software requirements for Ethernet line cards.

Table 3 Ethernet Line Card and Cisco IOS Release and Hardware Version Compatibility

Ethernet Line Card	Line Card Part Number	Minimum IOS Software Release	Required Hardware Version
4-Port Gigabit Ethernet ISE	4GE-SFP-LC=	Cisco IOS Release 12.0(25)S or later	73-8517-03, revision A0 or later
10-Port 1-Gigabit Ethernet	10X1GE-LC=	12.0(19)S or later release of 12.0S; or 12.0(19)ST or later release of 12.0ST	73-5479-06 or later
	10X1GE-LC-B=	12.0(21)S or later release of 12.0S; or 12.0(21)ST or later release of 12.0ST	73-7673-02 or later
1-Port 10-Gigabit Ethernet	1X10GE-LR-SC= (LR laser optical transceiver)	12.0(23)S, or later, release of 12.0S[1]	73-7182-01 or later
	1X10GE-ER-SC= (ER laser optical transceiver)	12.0(23)S, or later release of 12.0S	73-7182-01 or later

1. Cisco IOS Release 12.0(22)S does not support the 1X10GE-LR-SC Ethernet line cards.

The **show diag** *slot_number*, **show version**, and **show hardware** commands display the current hardware configuration of the router, including the system software version that is currently loaded and running, and the hardware revision number. For complete descriptions of **show** commands, refer to the *Cisco IOS Configuration Fundamentals Configuration Guide* and the *Cisco IOS Configuration Fundamentals Command Reference* for the installed Cisco IOS release.

If the command displays indicate that the Cisco IOS software is a version earlier than you need, check the contents of flash memory to determine if the required images are available on your system. The **dir** *devicename* command displays a list of all files stored in flash memory. If you do not have the correct software version, contact Cisco customer service.

For software configuration information, refer to the Cisco IOS software configuration and command reference publications for the installed Cisco IOS release. Also refer to the Cisco IOS software release notes for additional information.

Memory Options

Ethernet line card memory options vary by line card. See "Line Card Memory" section on page 65 for more information.

Related Documentation

This publication describes the basic installation of a Ethernet line card. For complete configuration information, refer to the following publications:

- *Cisco IOS XR Interface and Hardware Component Configuration Guide, Release 3.2*
- *Cisco IOS XR Interface and Hardware Component Command Reference, Release 3.2*
- *Cisco IOS XR Release 3.2 Release Notes for Cisco XR 12000 Series Routers*
- *Regulatory Compliance and Safety Information for Cisco XR 12000 Series Routers*

See the "Obtaining Documentation" section on page Boilerplate 1 for information on how to obtain these publications.

Product Overviews

The following sections provide information about the Ethernet line card products:

Ethernet Line Card Comparison

Table 4 provides comparative information about Ethernet line cards. The first Ethernet line card has a Fast Ethernet interface and the others have a Gigabit Ethernet interface.

Table 4 Ethernet Line Card Hardware Comparison

Ethernet Line Card	Line Card Part Number	Ports	GBIC Pluggable	SFP Pluggable	Insertable EPA Daughter Card	Cable and Connector
4-Port Gigabit Ethernet ISE	4GE-SFP-LC=	4		X		Single-mode or multimode fiber with LC connectors (depends on SFP)
10-Port 1-Gigabit Ethernet	10X1GE-SFP-LC=	10		X		Single-mode or multimode fiber with LC connectors (depends on SFP)
	10X1GE-SFP-LC-B=	10		X		Single-mode or multimode fiber with LC connectors (depends on SFP)

Table 4 Ethernet Line Card Hardware Comparison (continued)

Ethernet Line Card	Line Card Part Number	Ports	GBIC Pluggable	SFP Pluggable	Insertable EPA Daughter Card	Cable and Connector
1-Port 10-Gigabit Ethernet	1X10GE-LR-SC= (LR laser optical transceiver)	1				Single-mode fiber with SC connectors
	1X10GE-ER-SC= (ER laser optical transceiver)	1				Single-mode fiber with SC connectors

Caution To prevent system problems, do not use Gigabit Interface Converters (GBICs) from third-party vendors. Use only the GBIC that shipped with your Ethernet line card. The GBIC might contain an internal EPROM that identifies it to the Cisco IOS software.

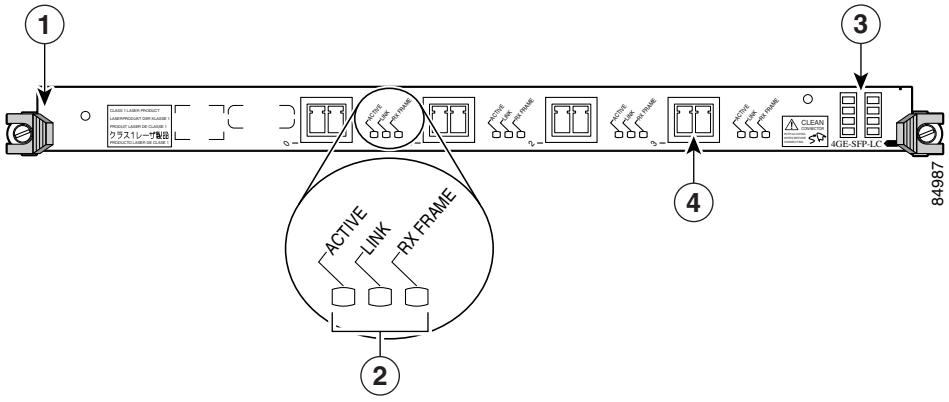
Caution Only use small form-factor pluggable modules (SFPs) supplied by Cisco in Cisco XR 12000 Series Routers. Each SFP module contains an internal serial number that is security programmed by the SFP module manufacturer with information that provides a way for Cisco (through the Cisco IOS software) to identify and validate the SFP module as a module type that is qualified by Cisco to operate with Gigabit Ethernet line cards. Unapproved SFP modules (those not purchased directly from Cisco) do not work.

4-Port Gigabit Ethernet ISE Line Card

The 4-Port Gigabit Ethernet ISE line card provides Cisco XR 12000 Series Routers with four optical Gigabit Ethernet interfaces on a single line card, using field replaceable SFP modules. The line card provides high-speed connections to other network devices, such as another Cisco XR 12000 Series Router, other routers, or layer-2 and layer-3 switches that support Gigabit Ethernet interfaces. The 4-Port Gigabit Ethernet line card throughput is limited to 4 million packets per second (4 Mpps) at 64 bytes, so all four ports cannot run at line rate.

Figure 1 shows the front view of the 4-Port Gigabit Ethernet ISE line card.

Figure 1 4-Port Gigabit Ethernet ISE Line Card



1	Ejector lever (one at each end)	**3**	Alphanumeric LEDs
2	Status LEDs (one set per port)	**4**	Port (provided by SFP module)

Table 5 summarizes the optics and connectors used by the 4-Port Gigabit Ethernet ISE line card.

Table 5 4-Port Gigabit Ethernet ISE Line Card Optics and Connector Types

Part Number	Optics/Transmission	Maximum Distance	Connector Type
4GE-SFP-LC	See Table 14 on page 49.	See Table 14 on page 49.	LC

For more information, refer to the "Gigabit Ethernet SFP Modules" section on page 48 and the "Cabling and Specifications" section on page 42.

The 4-Port Gigabit Ethernet ISE line card ships with 256 MB of route memory and 512 MB of packet memory. Route memory is field serviceable. For more information on memory, see the "Line Card Memory" section on page 65.

10-Port 1-Gigabit Ethernet Line Card

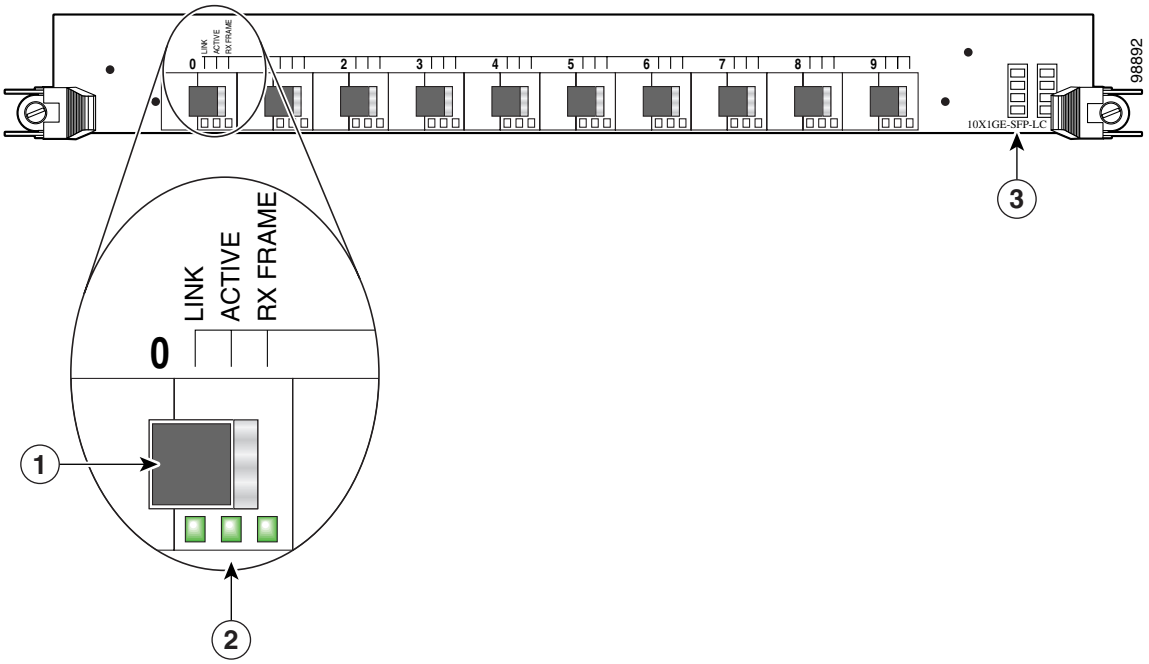
The 10-Port 1-Gigabit Ethernet line card, which is designed for high-density and server-aggregation applications, provides the Cisco 12400 and 12800 Routers with 10 optical 802.3 Gigabit Ethernet interfaces on a single line card. These interfaces provide high-speed connections to other network devices, such as another Cisco 12000 Series Router, other routers, or layer-2 or layer-3 switches that support Gigabit Ethernet interfaces. Figure 2 shows a front view of the line card.

The 10 ports on the front panel of the line card are numbered 0 through 9, from the top of the card to the bottom. Each port consists of a receptacle for a field-replaceable SFP laser optical transceiver module, which is inserted into the receptacle to provide the Gigabit Ethernet optical interface.

Next to each port on the line card are three green LEDs, aligned vertically and labeled from top to bottom as follows: LINK, ACTIVE, and RX FRAME.

Note The 10X1GE-SFP-LC-B version of this card is not shown. The 10X1GE-SFP-LC-B model of the 10-Port 1-Gigabit Ethernet line card is enhanced with minor hardware features that are not available with the original design.

Figure 2 10-Port 1-Gigabit Ethernet Line Card



1	SFP module receptacle	**2**	Port status LEDs	**3**	Alphanumeric LEDs

Table 6 summarizes the optics and connectors used by the 10-Port 1-Gigabit Ethernet line card.

Table 6 10-Port 1-Gigabit Ethernet Line Card Optics and Connector Types

Part Number	Optics/Transmission	Maximum Distance	Connector Type
10X1GE-SFP-LC, 10X1GE-SFP-LC-B	See Table 14 on page 49.	See Table 14 on page 49.	LC

For more information, refer to the "Gigabit Ethernet SFP Modules" section on page 48 and "Cabling and Specifications" section on page 42.

The 10-Port 1-Gigabit Ethernet line card ships with the following memory configurations installed:

- 256 MB of route processor memory (Product Number MEM-LC4-256)
- 512 MB of packet memory (Product Number MEM-LC4-PKT-512)—256 MB in both the receive and transmit directions

Line card memory on Engine 4 line cards (packet and route memory) is not field replaceable. For more information on memory, see the "Line Card Memory" section on page 65.

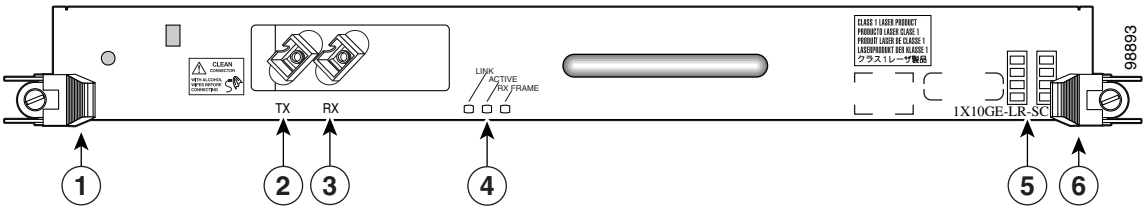
1-Port 10-Gigabit Ethernet Line Card

The 1-Port 10-Gigabit Ethernet line card provides the supported Cisco XR 12000 Series Routers with one optical 802.3ae 10-Gigabit Ethernet interface. This interface provides a high-speed connection to other network devices, such as Cisco XR 12000 Series Routers, or to other routers or layer-2 or layer-3 switches that support 10-Gigabit Ethernet interfaces. Figure 3 shows the front view of the line card.

The port on the front panel of the line card is port number 0. This port uses a hardwired laser optical transceiver to provide a 10-Gigabit Ethernet optical interface. The transceiver consists of two optical interfaces—laser transmit (TX) and laser receive (RX)—that use SC connectors.

Next to the port on the line card are three green LEDs, aligned vertically and labeled from top to bottom as follows: LINK, ACTIVE, and RX FRAME.

Figure 3 1-Port 10-Gigabit Ethernet Line Card



1	Ejector lever	**3**	RX port	**5**	Alphanumeric LEDs
2	TX port	**4**	Status LEDs	**6**	Ejector lever

Table 7 summarizes the optics and connectors used by the 1-Port 10-Gigabit Ethernet line card.

Table 7 1-Port 10-Gigabit Ethernet Line Card Optics and Connector Types

Part Number	Optics/Transmission	Maximum Distance	Connector Type
1X10GE-LR-SC	1550 nm (send), 1300 nm-1570 nm (receive)	20 km	SC
1X10GE-ER-SC	1550 nm (send), 1300 nm-1570 nm (receive)	75 km	SC

For more information, refer to the "10-Gigabit Ethernet" section on page 50 and the "Cabling and Specifications" section on page 42.

The 1-Port 10-Gigabit Ethernet line card ships with 256 MB of route processor memory and 512 MB of packet memory. The memory in the 1-Port 10-Gigabit Ethernet line card is not field replaceable. For more information on memory, see the "Line Card Memory" section on page 65.

Preparing for Installation

The following sections provide information about preparing to install line cards:

Safety Guidelines

Before you perform any procedure in this publication, review the safety guidelines in this section to avoid injuring yourself or damaging the equipment.

The following guidelines are for your safety and to protect equipment. The guidelines do not include all hazards. Be alert.

Note Review the safety warnings listed in the *Regulatory Compliance and Safety Information for Cisco 12000 Series Internet Router* publication (Document Number 78-4347-xx) that accompanied your router before installing, configuring, or maintaining a line card.

- Keep the work area clear and dust free during and after installation. Do not allow dirt or debris to enter into any laser-based components.
- Do not wear loose clothing, jewelry, or other items that could get caught in the router while working with line cards.
- Cisco equipment operates safely when it is used in accordance with its specifications and product usage instructions.

Before working with laser optics, read the "Laser Safety" section on page 82.

Preventing Electrostatic Discharge

Electrostatic discharge (ESD) damage, which can occur when electronic cards or components are improperly handled, results in complete or intermittent failures. Electromagnetic interference (EMI) shielding is an integral component of the line card. We recommend using an ESD-preventive strap whenever you are handling network equipment or one of its components.

The following are guidelines for preventing ESD damage:

- Always use an ESD-preventive wrist or ankle strap and ensure that it makes good skin contact. Connect the equipment end of the connection cord to an ESD connection socket on the router or to bare metal on the chassis.
- Handle Ethernet line cards by the captive installation screws, the provided handle, ejector levers, or the line card metal carrier only; avoid touching the board or connector pins.
- Place removed Ethernet line cards board-side-up on an antistatic surface or in a static shielding bag. If you plan to return the component to the factory, immediately place it in a static shielding bag.

- Avoid contact between the Ethernet line cards and clothing. The wrist strap protects the board from ESD voltages on the body only; ESD voltages on clothing can still cause damage.

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

Required Tools and Equipment

You need the following tools and parts to remove and install Ethernet line cards:

- Flat-blade or Phillips screwdriver
- ESD-preventive wrist or ankle strap and instructions
- Interface cables to connect the Ethernet line card with another router or switch
- Any EPAs, GBICs, SFP modules, or memory you need to install (and are not already installed)

Note If you need additional equipment, see Cisco.com or your service representative for ordering information.

Refer to the individual line card descriptions in the "Product Overviews" section on page 4 for more information. Table 4 on page 4 summarized the hardware requirements for each Ethernet line card.

Removing and Installing a Line Card

The following sections provide procedures for removing or installing a line card:

Note See the "Guidelines for Line Card Removal and Installation" section on page 11 before removing a line card while power to the router is on.

Note The procedures in the following sections use illustrations of a Cisco 12012 Internet Router to support the descriptions of removing and installing line cards. Although the card cages of the Cisco 12000 Series Routers differ in the number of card slots, the designated use of slots and the process of removing and installing a line card are basically the same. Therefore, separate procedures and illustrations for other Cisco routers are not included in this publication.

Guidelines for Line Card Removal and Installation

Guidelines for line card removal and installation include the following:

- Online insertion and removal (OIR) is supported, enabling you to remove and install line cards while the router is operating. OIR is seamless to users on the network, maintains all routing information, and ensures session preservation.

Note With OIR, notifying the software or resetting the power is not required. However, you have the option of using the **shutdown** command before removing a line card.

- After you reinstall a line card, the router automatically downloads the necessary software from the route processor (RP). Next, the router brings online only those interfaces that match the current configuration and were previously configured as administratively up. You must configure all others with the **configure** command.

Caution The router may indicate a hardware failure if you do not follow proper procedures. Remove or insert only one line card at a time. Allow at least 15 seconds for the router to complete the preceding tasks before removing or inserting another line card.

After removing and inserting a line card into the same slot, allow at least 60 seconds before removing or inserting another line card.

- Line cards have two ejector levers to release the card from its backplane connector. Use the levers when you are removing the line card and to seat the line card firmly in its backplane connector when you are installing the line card. The ejector levers align and seat the card connectors in the backplane.

Caution When you remove a line card, always use the ejector levers to ensure that the connector pins disconnect from the backplane in the sequence expected by the router. Any card that is only partially connected to the backplane can halt the router.

When you install a line card, always use the ejector levers to ensure that the card is correctly aligned with the backplane connector; the connector pins should make contact with the backplane in the correct order, indicating that the card is fully seated in the backplane. If a card is only partially seated in the backplane, the router hangs and subsequently crashes.

Removing a Line Card

If you are replacing a failed line card, remove the existing line card first, then install the new line card in the same slot. To remove a line card, use Figure 4 as a reference and follow these steps:

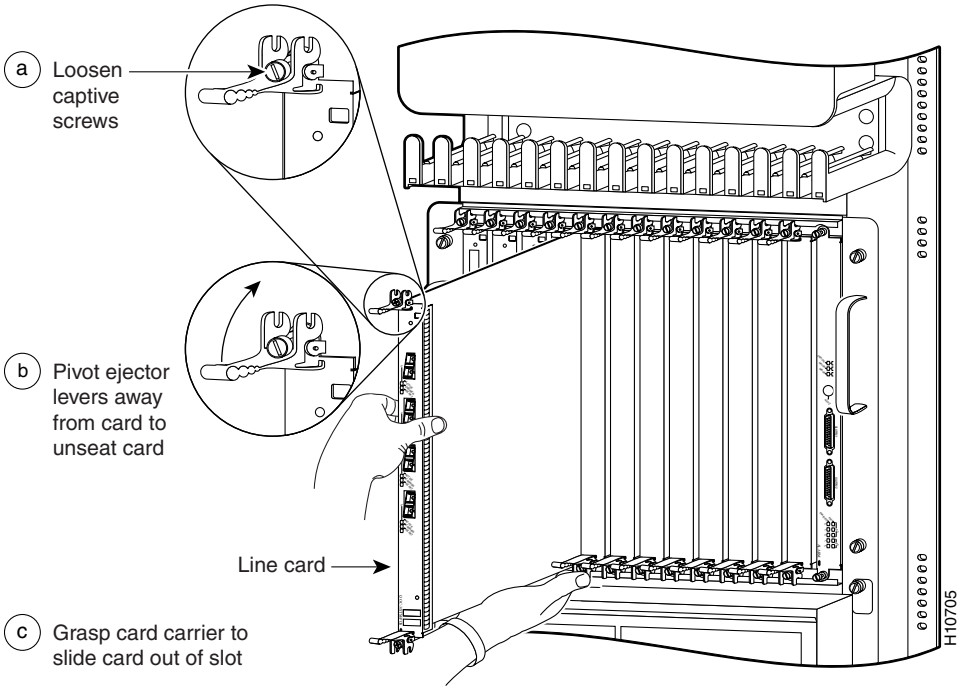
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Disconnect and remove all interface cables from the ports; note the current connections of the cables to the ports on the line card.

Step 3 Detach the line card cable-management bracket from the line card.

Step 4 Use a screwdriver to loosen the captive screw at each end of the line card faceplate. (See Figure 4a.)

Figure 4 Line Card Removal and Installation



Caution When you remove a line card, always use the ejector levers to ensure that the line card connector pins disconnect from the backplane in the logical sequence expected by the router. Any line card that is only partially connected to the backplane can halt the router.

Step 5 Simultaneously pivot the ejector levers away from each other to release the line card from the backplane connector. (See Figure 4b.)

Step 6 Grasp the ejector levers and pull the line card halfway out of the slot.

Step 7 Grasp the line card and gently pull it straight out of the slot, keeping your other hand under the line card to guide it. (See Figure 4c.) Avoid touching the line card printed circuit board, components, or any connector pins.

Step 8 Place the removed line card on an antistatic mat, or immediately place it in an antistatic bag if you plan to return it to the factory.

Step 9 If the line card slot is to remain empty, install a line card blank (Product Number MAS-GSR-BLANK) to keep dust out of the chassis and to maintain proper airflow through the line card compartment. Secure the line card blank to the chassis by tightening its captive screws.

Caution Be careful not to damage or disturb the EMI spring fingers located on the front edge of the card face plate.

Note Always insert a dust plug in an optical port opening for each port that is not in use.

For information on disconnecting interface cables, see the "Removing and Installing Fiber-Optic Interface Cables" section on page 52.

For information on removing the cable-management bracket, see the "Removing a Line Card Cable-Management Bracket" section on page 39.

Installing a Line Card

A line card slides into almost any available line card slot and connects directly to the backplane. If you install a new line card, you must first remove the line card blank from the available slot.

Note Refer to the installation and configuration guide for your router for information on line card slot types, slot width, and slot location.

Caution The router may indicate a hardware failure if you do not follow proper procedures. Remove or insert only one line card at a time. Allow at least 15 seconds for the router to complete the preceding tasks before removing or inserting another line card.

To install a line card, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

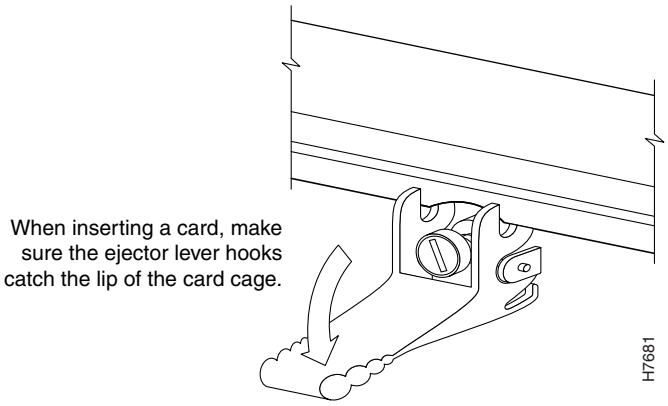
Step 2 Choose an available line card slot for the line card, and verify that the line card interface cable is long enough for you to connect the line card with any external equipment.

Caution To prevent ESD damage, handle line cards by the captive installation screws, the provided handle, ejector levers, or the card carrier edges only. Do not touch any of the electrical components or circuitry.

Step 3 Grasp the faceplate (or handle) of the line card with one hand and place your other hand under the card carrier to support the weight of the card; position the card for insertion into the card cage slot. Avoid touching the line card printed circuit board, components, or any connector pins.

Step 4 Carefully slide the line card into the slot until the ejector levers make contact with the edges of the card cage, then *stop* when the ejector lever hooks catch the lip of the card cage. If they do not catch, try reinserting the line card until the ejector lever hooks are fully latched. (See Figure 5.)

Figure 5 Ejector Levers



Caution When you install a line card, always use the ejector levers to ensure that the card is correctly aligned with the backplane connector, the card connector pins make contact with the backplane in the correct order, and the card is fully seated in the backplane. A card that is only partially seated in the backplane can cause the router to hang and subsequently crash.

Step 5 Simultaneously pivot both ejector levers toward each other until they are perpendicular to the line card faceplate. This action firmly seats the card in the backplane.

Step 6 Use a 3/16-inch flat-blade screwdriver to tighten the captive screw on each end of the line card faceplate to ensure proper EMI shielding and to prevent the line card from becoming partially dislodged from the backplane.

Caution To ensure adequate space for additional line cards, always tighten the captive installation screws on each newly installed line card *before* you insert any additional line cards. These screws also prevent accidental removal and provide proper grounding and EMI shielding for the router.

Step 7 Install the cable-management bracket.

Step 8 Install GBIC or SFP modules, and EPA daughter cards, in the line cards that use them.

Step 9 Install the interface cables.

For information on installing cable-management brackets, see the "Installing a Line Card Cable-Management Bracket" section on page 41.

For information on installing EPAs, see the "Removing and Installing EPAs" section on page 15.

For information on installing GBICs, see the "Removing and Installing GBICs" section on page 23.

For information on installing SFP modules, see the "Removing and Installing SFP Modules" section on page 26.

For information on installing interface cables, see the "Removing and Installing Fiber-Optic Interface Cables" section on page 52.

For information on verifying and troubleshooting the hardware installation, see the "Verifying and Troubleshooting the Installation" section on page 58.

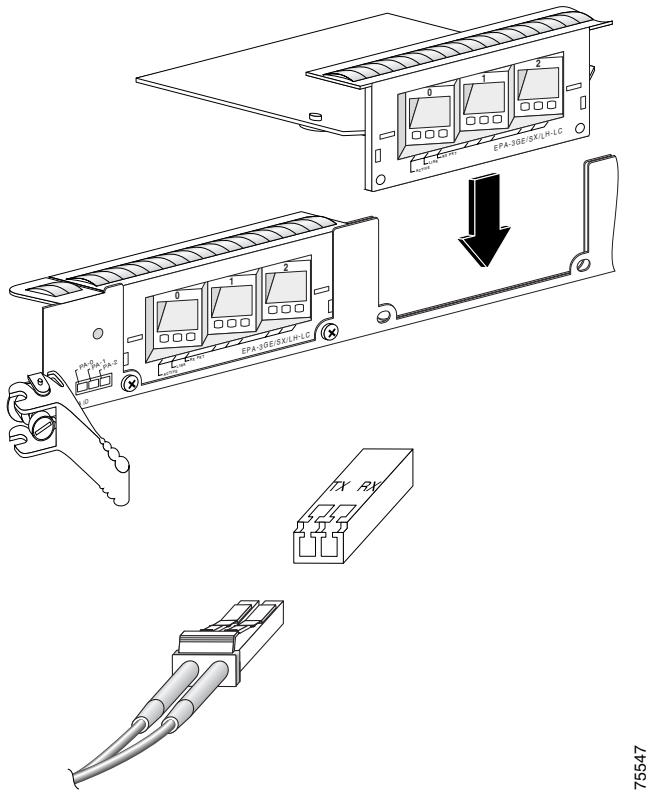
Removing and Installing EPAs

The Modular Gigabit Ethernet line card ships with 0, 1, 2, or 3 EPAs installed. If you need to add or change an EPA, follow the procedures in these sections:

- Removing an EPA from the Modular Gigabit Ethernet Line Card, page 15
- Inserting an EPA into a Modular Gigabit Ethernet Line Card, page 17

Figure 6 shows an exploded mechanical view of a Gigabit Ethernet EPA with three line card SFP receptacles, an SFP module, and a duplex LC-type cable.

Figure 6 Removing and Replacing EPAs



Removing an EPA from the Modular Gigabit Ethernet Line Card

You can remove an EPA from the Modular Gigabit Ethernet line card with or without the SFP modules installed.

To remove an EPA from your Modular Gigabit Ethernet line card, use Figure 7 on page 17 as a reference and follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its directions for use.

Step 2 Disconnect the LC-type fiber-optic cable connector from the SFP module.

Note which cable connector plug is TX and which is RX for reattachment.

Step 3 Insert a dust plug into the optical ports of the SFP module to keep the optical interfaces clean.

Step 4 Remove the Modular Gigabit Ethernet line card from the chassis, as described in the "Removing a Line Card" section on page 11, and place the line card on a clean, flat surface.

Step 5 Use a Phillips screwdriver to loosen and unscrew the two screws that connect the EPA to the line card, located on the faceplate of the line card, as shown in Figure 7A.

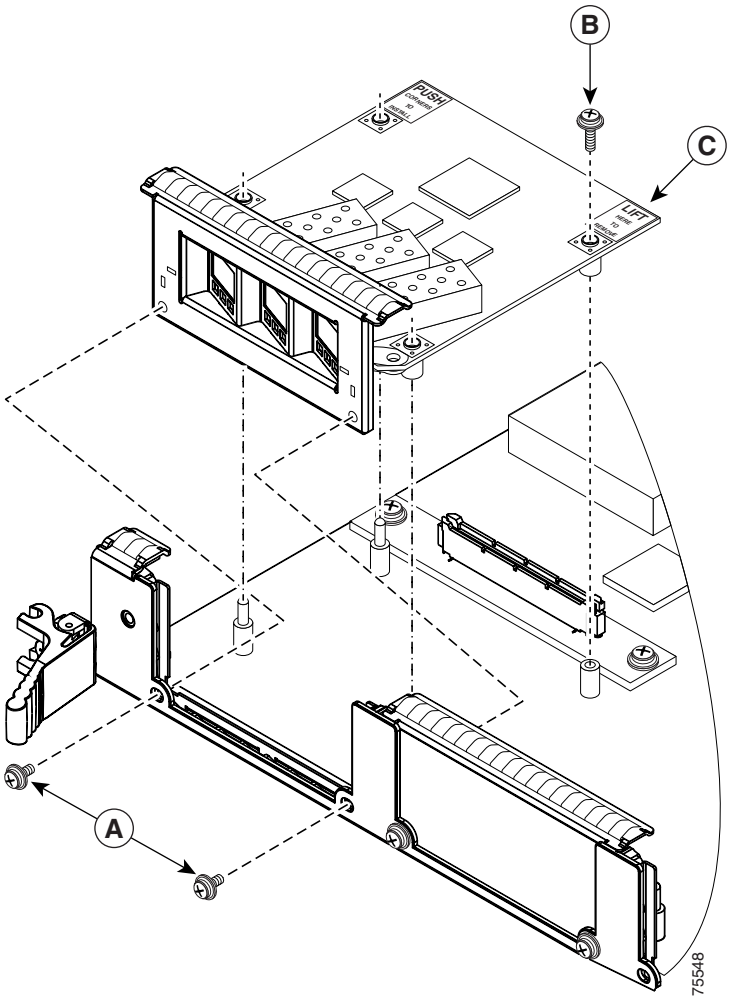
Step 6 Use a Phillips screwdriver to loosen and unscrew the one screw that connects the EPA to the inside of the line card, as shown in Figure 7B.

Step 7 Gently lift up on one corner of the EPA to disconnect the EPA from the line card, as shown in Figure 7C.

Caution To prevent ESD damage, handle EPAs by the card carrier edges only.

Caution Avoid touching the EPA printed circuit board, components, or any connector pins.

Figure 7 Removing an EPA



If the EPA bay is to remain empty, install an EPA blank (Product Number MAS-EPA-BLANK=) to keep dust out of the line card and to maintain proper airflow and EMI through the line card and chassis.

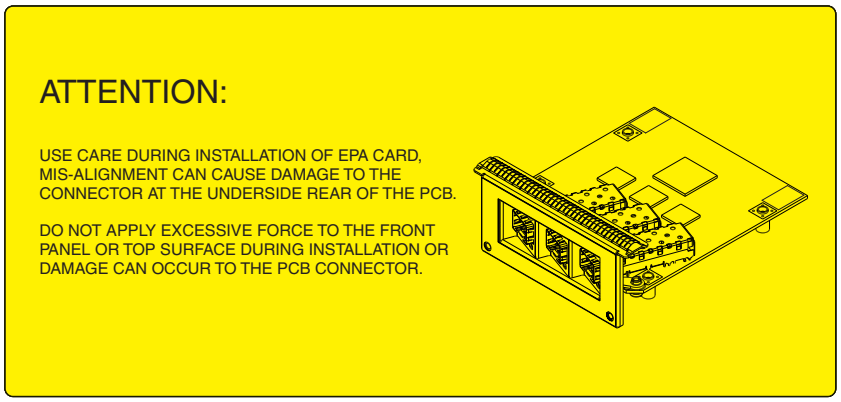
Inserting an EPA into a Modular Gigabit Ethernet Line Card

To insert an EPA into the Modular Gigabit Ethernet line card, follow these steps:

Warning **You must use an ESD-preventive wrist or ankle strap to do this procedure. Attach an ESD-preventive wrist or ankle strap and follow its directions for use, before you do this procedure.**

Step 1 First, read the yellow caution label on the EPA. Figure 8 shows a sample of this caution label.

Figure 8 Locations of Labels and Reference Points on the EPA



Caution The connectors must be engaged without any angular misalignment. Engaging the connectors at an angle will cause damage to the connectors.

Step 2 Ensure that the connector guide pins are aligned, and mate the connector of the EPA to the connector on the line card, as shown in Figure 9 and Figure 10. Figure 10 shows two side views of the EPA and line card.

Figure 9 Mating the Connector of the EPA to the Line Card

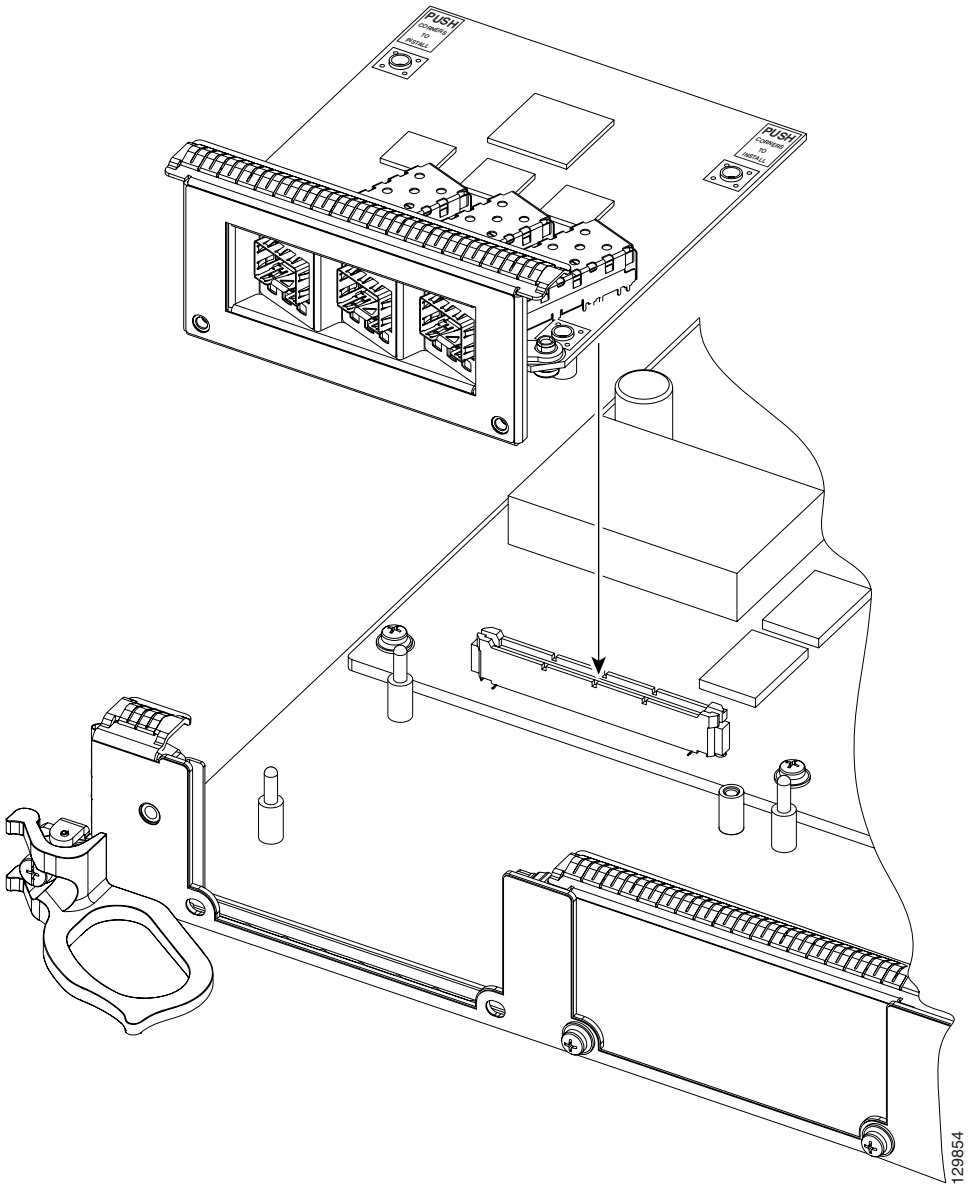
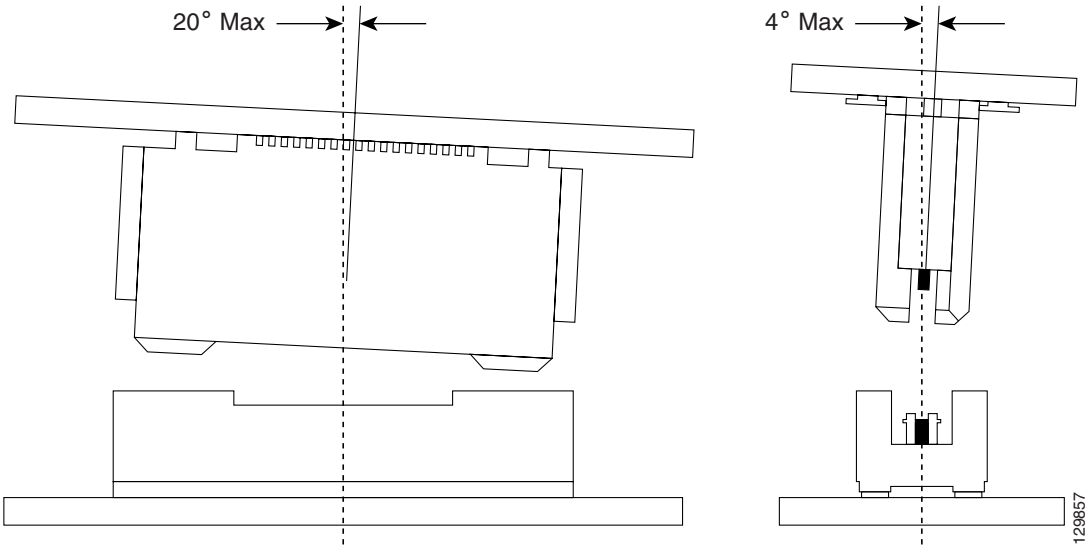


Figure 10 Side Views - Mating the Connector of the EPA to the Line Card



Step 3 Ensure that the connector guide pins are aligned. Once the connector is engaged, apply gentle pressure with your thumbs to the two rear outer corners of the EPA, as shown in Figure 11 and Figure 12.

Figure 11 Press on the Rear Outer Corners of the EPA

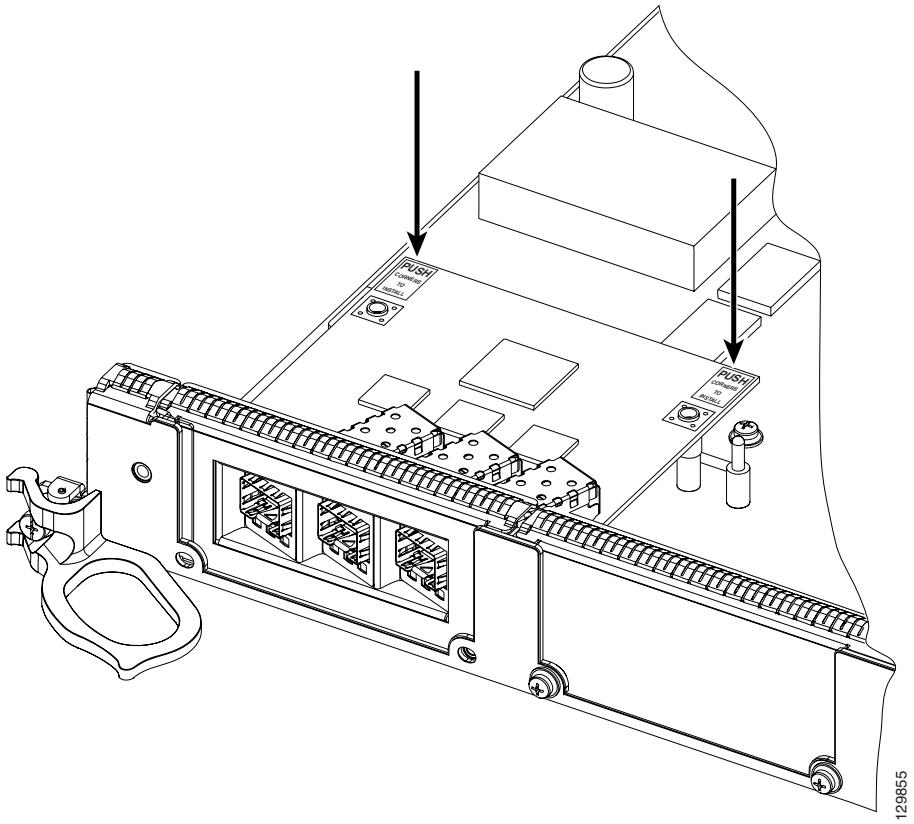
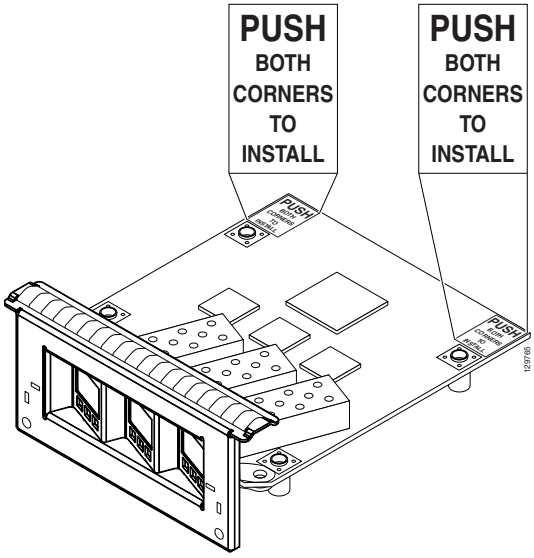
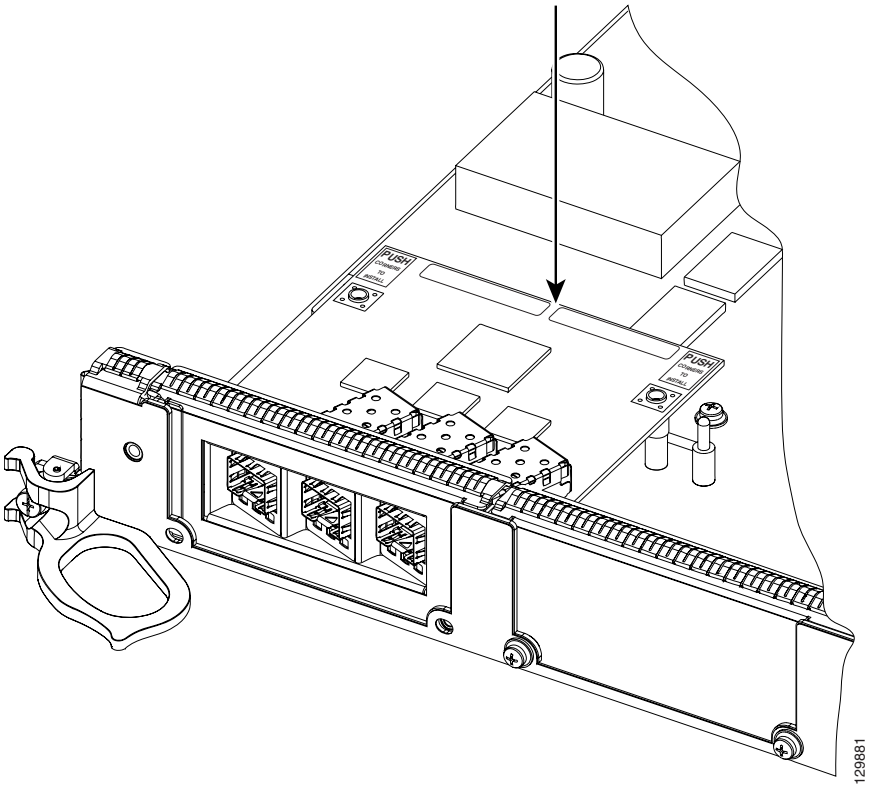


Figure 12 Rear Outer Corners of the EPA (Close-up)



Step 4 Press gently on the white labels in middle of the outer edge of the EPA as shown in Figure 13 to ensure that the connector is fully seated.

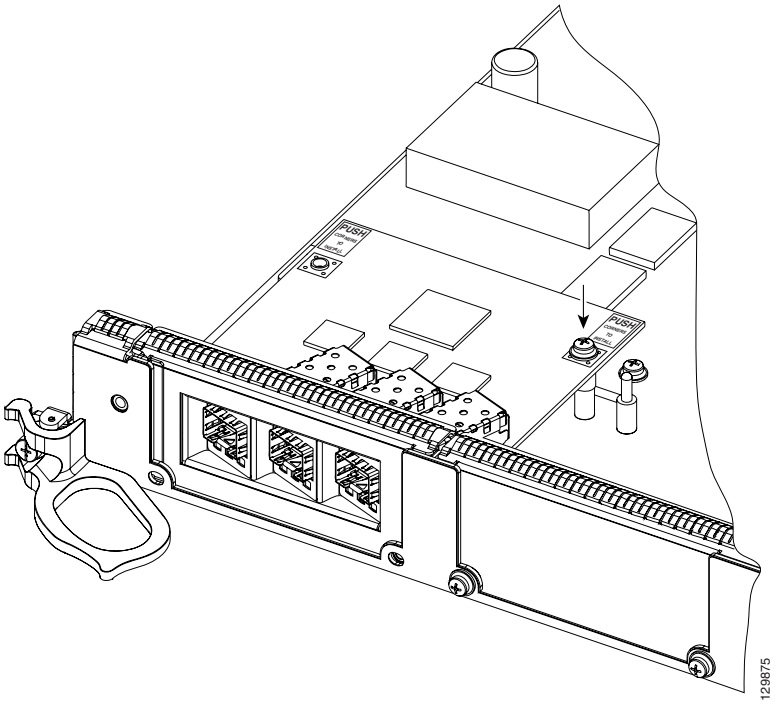
Figure 13 Press on the White Labels on the EPA



Step 5 Use a Phillips screwdriver to insert and tighten the screw on the EPA, 3 to 5 in-lbs, as shown in Figure 14.

Caution Apply no more than 5 in-lbs of torque when tightening the screw.

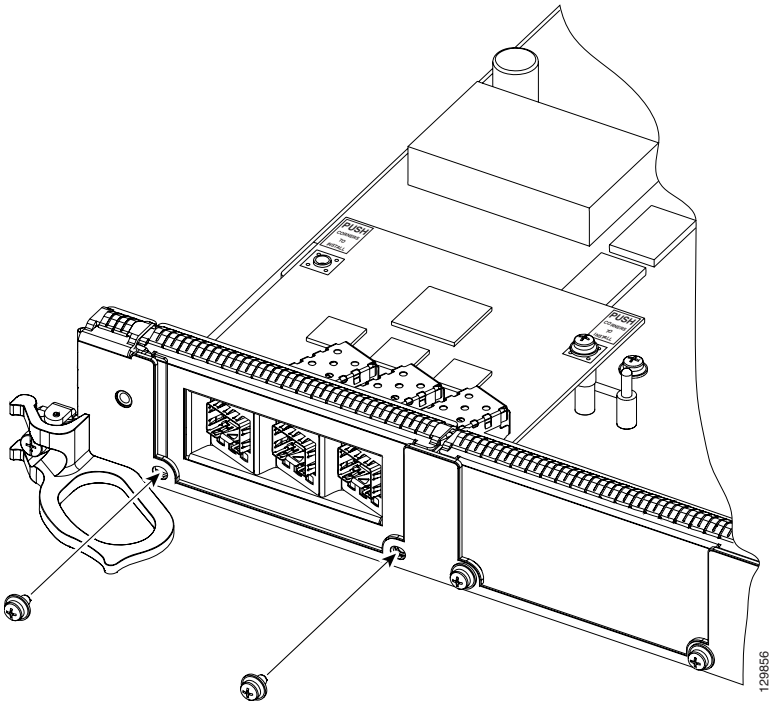
Figure 14 Inserting and Tightening the Screw on the EPA



Step 6 Use a Phillips screwdriver to insert and tighten the two screws on the faceplate of the line card, 3 to 5 in-lbs, as shown in Figure 15.

Caution Apply no more than 5 in-lbs of torque when tightening the screw.

Figure 15 Inserting the 2 screws on the Faceplate of the Line Card



Removing and Installing GBICs

Your Ethernet line card may have shipped with a GBIC installed. If your line card arrived without the GBIC installed and you need to install it now, or if you need to change your GBIC for another reason, use the procedures in these sections:

- General GBIC Handling and Maintenance Guidelines, page 24
- Removing the GBIC from an Ethernet Line Card, page 24
- Inserting a GBIC into the Gigabit Ethernet Interface, page 25

Before you remove or install a GBIC, read the installation information in this section and the "Laser Safety" section on page 82.

Note Cisco strongly recommends that you disconnect all fiber-optic cables before removing or installing a GBIC.

Caution To prevent system problems, do not use GBICs from third-party vendors. Use only the GBIC that shipped with your Gigabit Ethernet line card. These GBICs might contain an internal EPROM that identifies them to the Cisco IOS software.

Caution To prevent problems associated with data transmission, you must attach this device only to IEEE 802.3x-compliant devices.

Note The Ethernet line card supports online insertion and removal (OIR) of GBICs. This means that you can remove and replace GBICs while the system remains powered up. When you remove a GBIC, the interface becomes inactive because a GBIC is not detected in the GBIC receptacle.

General GBIC Handling and Maintenance Guidelines

Follow these GBIC handling and maintenance guidelines:

- GBICs are static sensitive. To prevent ESD damage, follow the guidelines described in the "Preventing Electrostatic Discharge" section on page 9.
- GBICs are dust sensitive. When the GBIC is stored or when a fiber-optic cable is not plugged into one of the optical ports on the GBIC, always insert an optical port dust plug.
- Keep the optical port clean. The most common source of contamination in the optical ports is debris that collects on the ferrules of the optical cable connectors. Use an alcohol swab or Kim-Wipe to clean the ferrules of the cable connector before inserting it into the GBIC.

Removing the GBIC from an Ethernet Line Card

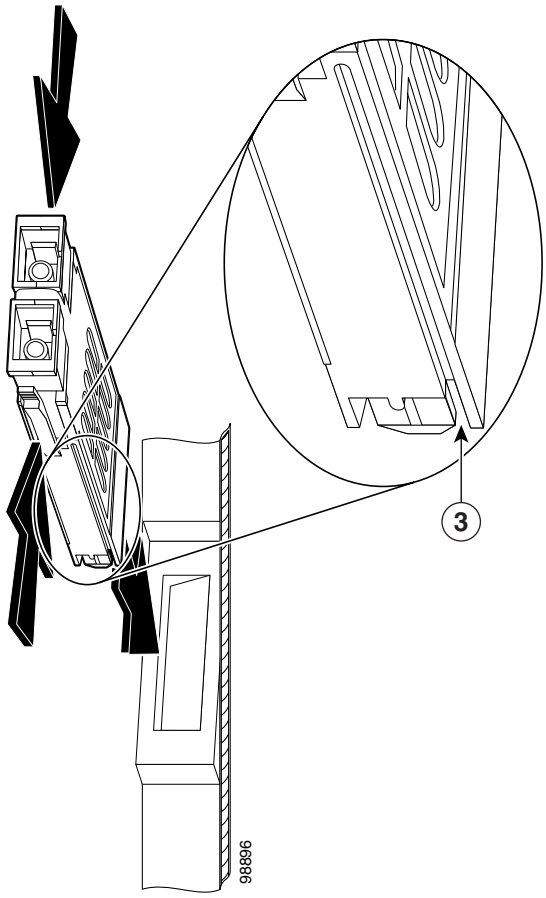
To remove the GBIC from an Ethernet line card, follow these steps:

Step 1 Disconnect the SC-type fiber-optic cables from the GBIC. Note which plug is TX and which plug is RX for reattachment.

Step 2 Attach an ESD wrist or ankle strap and follow its directions for use.

Step 3 Locate the tabs on either side of the exposed portion of the GBIC and squeeze them with your thumb and forefinger, as you gently pull the GBIC out of the GBIC slot. (See arrows in Figure 16.)

Figure 16 Removing and Replacing a GBIC



1	Locking tab	**2**	Locking tab	**3**	Alignment groove

Inserting a GBIC into the Gigabit Ethernet Interface

To insert a GBIC into the Gigabit Ethernet interface, follow these steps:

Step 1 Attach an ESD wrist or ankle strap and follow its directions for use.

Step 2 Locate the alignment groove on the GBIC. (See the enlargement in Figure 16 on page 25.) Position the GBIC so that this groove is in the position shown in the enlargement to ensure that the 20-pin plug on the GBIC is in the correct position.

Caution To prevent damage to the GBIC plug and receptacle before you insert the GBIC into the GBIC slot on the Gigabit Ethernet interface, ensure that the plug and alignment groove are matched.

Step 3 Squeeze the tabs on each side of the GBIC using your thumb and forefinger, and insert the GBIC into the GBIC slot on the Gigabit Ethernet interface. (See Figure 16 on page 25.)

Step 4 Using moderate force, ensure that the GBIC is fully inserted into the 20-pin receptacle at the rear of the GBIC slot. The tabs on either side of the GBIC will snap into place when you have completely and properly inserted the GBIC.

Step 5 Reattach the SC-type fiber-optic cable to the GBIC.

Removing and Installing SFP Modules

Before you remove or install an SFP module, read the installation information in this section and the "Laser Safety" section on page 82.

Caution Protect the SFP modules by inserting clean dust covers into them after the cables are removed. Be sure to clean the optic surfaces of the fiber cables before you plug them back into the optical ports of another SFP module. Avoid getting dust and other contaminants into the optical ports of your SFP modules, because the optics will not work correctly when obstructed with dust.

Caution It is strongly recommended that you do not install or remove the SFP module with fiber-optic cables attached to it because of the potential of damaging the cable, the cable connector, or the optical interfaces in the SFP module. Disconnect all cables before removing or installing an SFP module.

Removing and inserting an SFP module can shorten its useful life, so you should not remove and insert SFP modules any more often than is absolutely necessary.

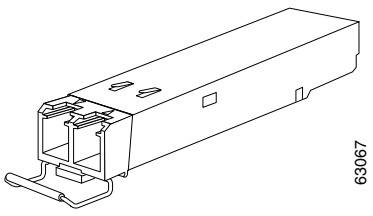
SFP modules use one of four different latching devices to install and remove the module from a port. The four types of SFP module latching devices are described in the following sections:

- Bale Clasp SFP Module, page 26
- Mylar Tab SFP Module, page 29
- Actuator Button SFP Module, page 32
- Slide Tab SFP Module, page 34

Bale Clasp SFP Module

The bale clasp SFP module has a clasp that you use to remove or install the SFP module. (See Figure 17.)

Figure 17 Bale Clasp SFP Module



Removing a Bale Clasp SFP Module

To remove this type of SFP module, follow these steps:

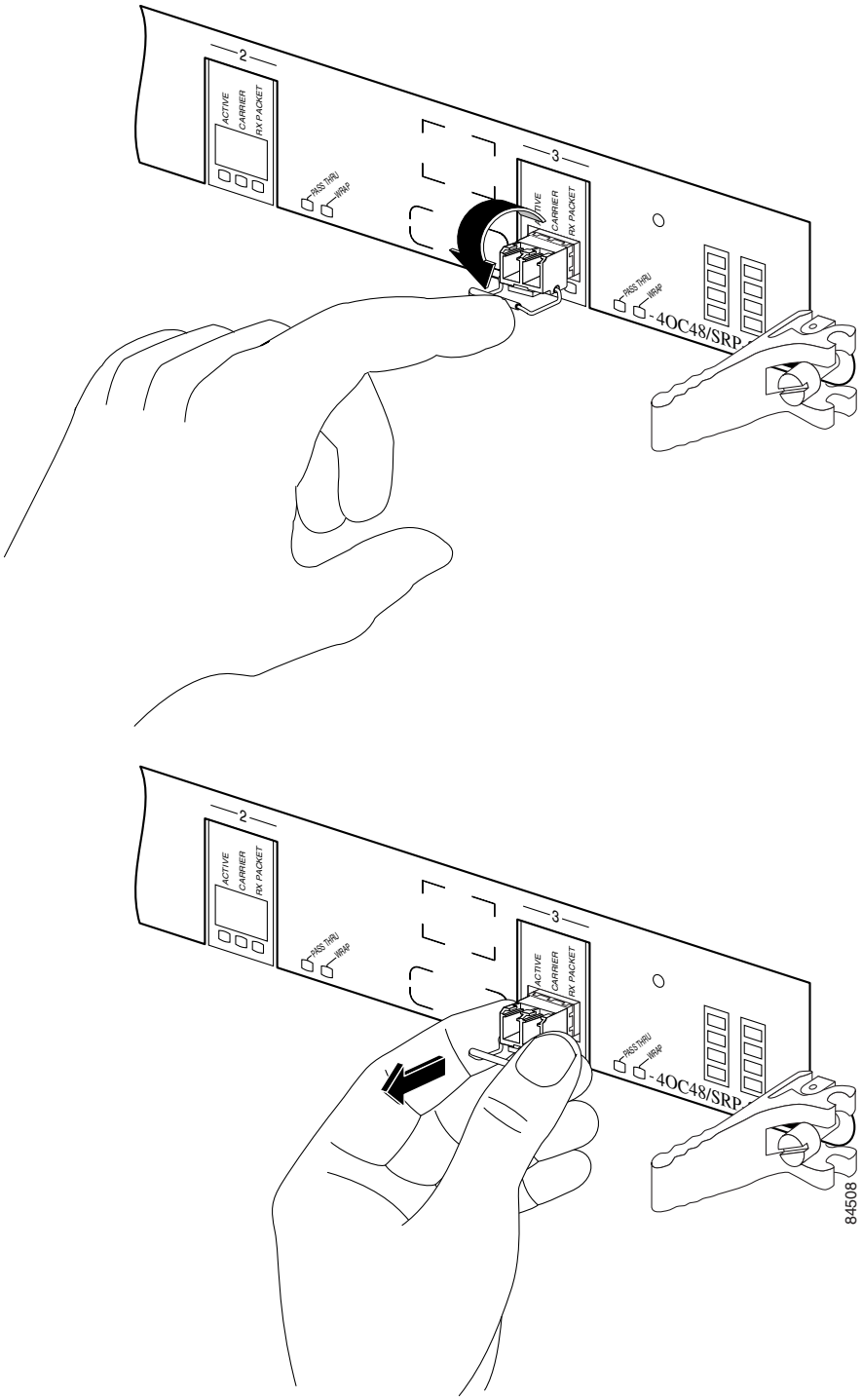
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Disconnect and remove all interface cables from the ports; note the current connections of the cables to the ports on the line card.

Step 3 Open the bale clasp on the SFP module with your index finger in a downward direction, as shown in Figure 18. If the bale clasp is obstructed and you cannot use your index finger to open it, use a small flat-blade screwdriver or other long, narrow instrument to open the bale clasp.

Step 4 Grasp the SFP module between your thumb and index finger and carefully remove it from the port, as shown in Figure 18.

Figure 18 Removing a Bale Clasp SFP Module



Step 5 Place the removed SFP module on an antistatic mat, or immediately place it in a static shielding bag if you plan to return it to the factory.

Step 6 Protect your line card by inserting clean SFP module cage covers into the optical module cage when there is no SFP module installed.

Installing a Bale Clasp SFP Module

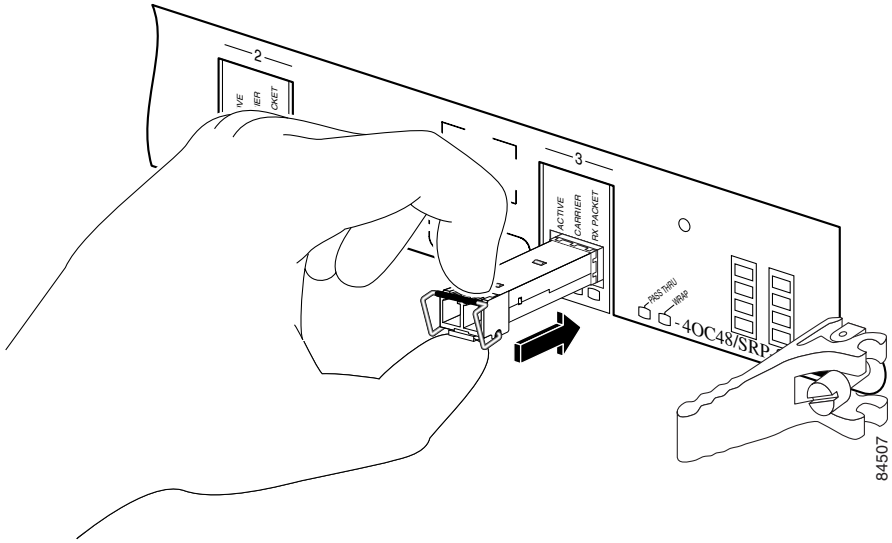
To install this type of SFP module, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Close the bale clasp before inserting the SFP module.

Step 3 Line up the SFP module with the port and slide it into the port. (See Figure 19.)

Figure 19 Installing a Bale Clasp SFP Module into a Port

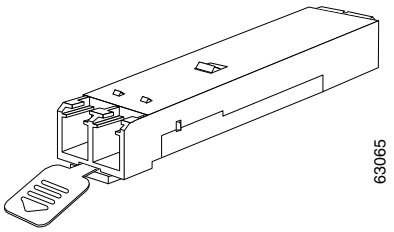


Note Verify that the SFP modules are completely seated and secured in their assigned receptacles on the line card by firmly pushing on each SFP module. If the SFP module was not completely seated and secured in the receptacle, you will hear a click as the triangular pin on the bottom of the SFP module snaps into the hole in the receptacle.

Mylar Tab SFP Module

The mylar tab SFP module has a tab that you pull to remove the module from a port. (See Figure 20.)

Figure 20 Mylar Tab SFP Module



Removing a Mylar Tab SFP Module

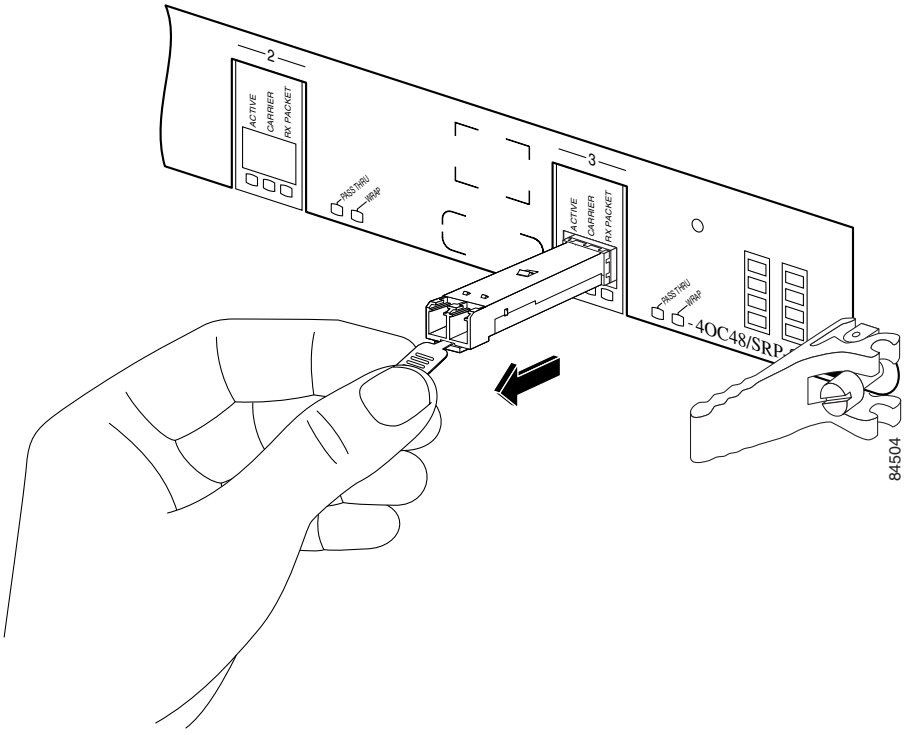
To remove this type of SFP module, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Disconnect and remove all interface cables from the ports; note the current connections of the cables to the ports on the line card.

Step 3 Pull the tab gently in a slightly downward direction until it disengages from the port, then pull the SFP module out. (See Figure 21.)

Figure 21 Removing a Mylar Tab SFP Module



Step 4 Place the removed SFP module on an antistatic mat, or immediately place it in a static shielding bag if you plan to return it to the factory.

Step 5 Protect your line card by inserting clean SFP module cage covers into the optical module cage when there is no SFP module installed.

Caution When pulling the tab to remove the SFP module, be sure to pull in a straight outward motion so you remove the SFP module from the port in a parallel direction. Do not twist or pull the tab, because you might disconnect it from the SFP module.

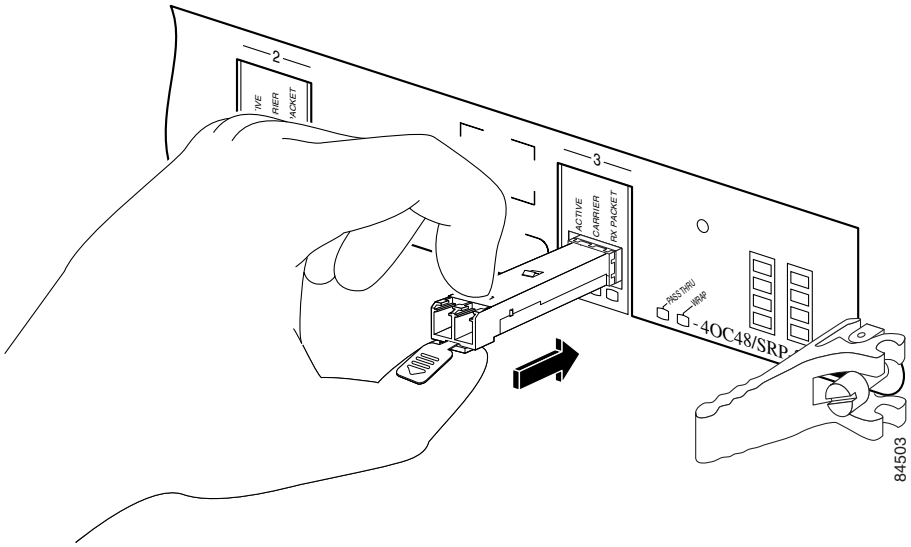
Installing a Mylar Tab SFP Module

To install this type of SFP module, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Line up the SFP module with the port, and slide it into place. (See Figure 22.)

Figure 22 Installing a Mylar Tab SFP Module

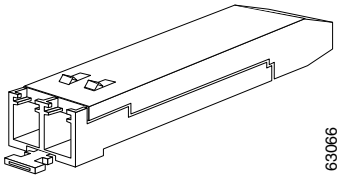


Note Verify that the SFP modules are completely seated and secured in their assigned receptacles on the line card by firmly pushing on each SFP module. If the SFP module was not completely seated and secured in the receptacle, you will hear a click as the triangular pin on the bottom of the SFP module snaps into the hole in the receptacle.

Actuator Button SFP Module

The actuator button SFP module includes a button that you push in order to remove the SFP module from a port. (See Figure 23.)

Figure 23 Actuator Button SFP Module



Removing an Actuator Button SFP Module

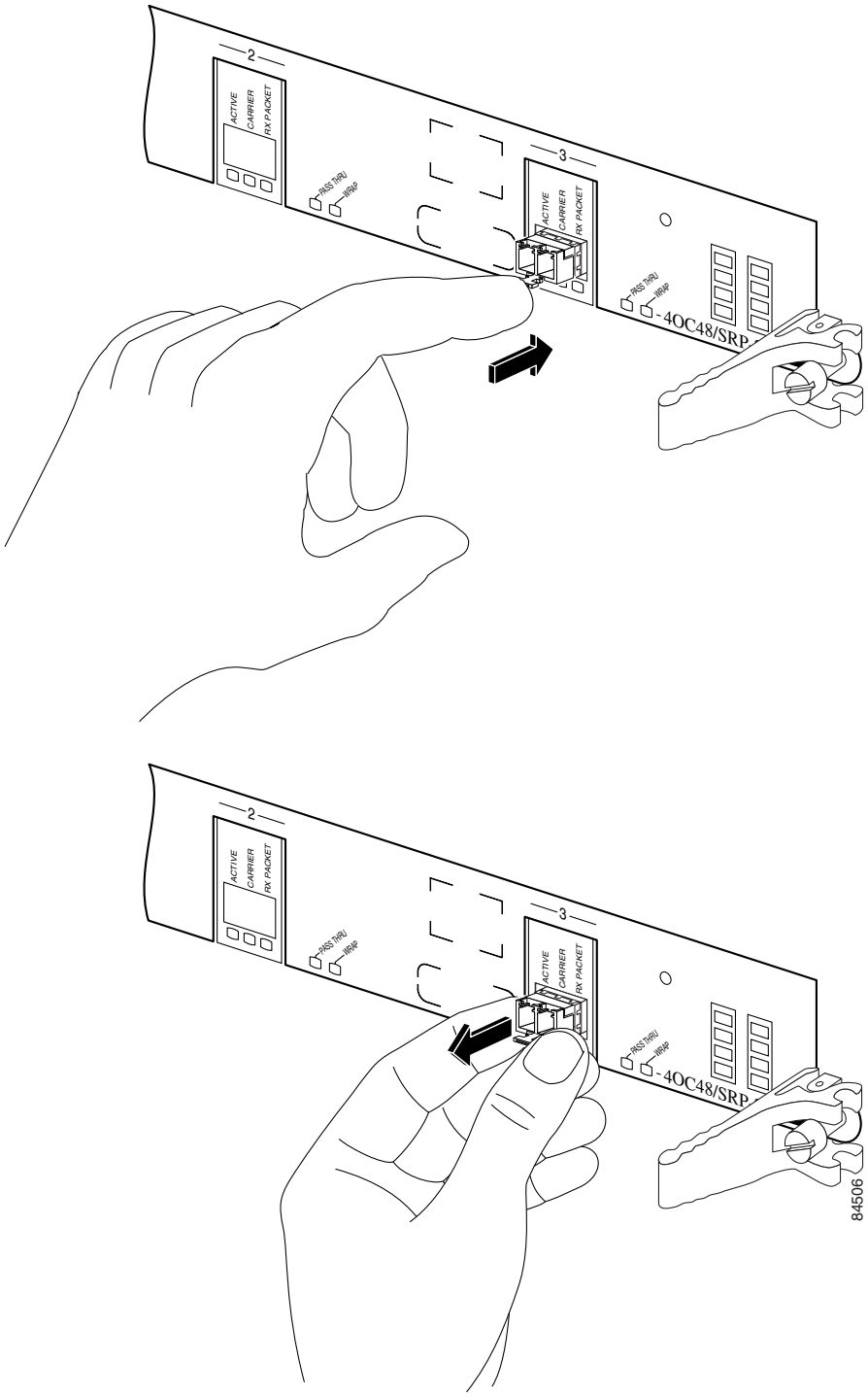
To remove this type of SFP module, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Disconnect and remove all interface cables from the ports; note the current connections of the cables to the ports on the line card.

Step 3 Gently press the actuator button on the front of the SFP module until it clicks and the latch mechanism activates, releasing the SFP module from the port. (See Figure 24.)

Figure 24 Removing an Actuator Button SFP Module from a Port



Step 4 Grasp the actuator button between your thumb and index finger and carefully pull the SFP module from the port.

Step 5 Place the removed SFP module on an antistatic mat, or immediately place it in a static shielding bag if you plan to return it to the factory.

Step 6 Protect your line card by inserting clean SFP module cage covers into the optical module cage when there is no SFP module installed.

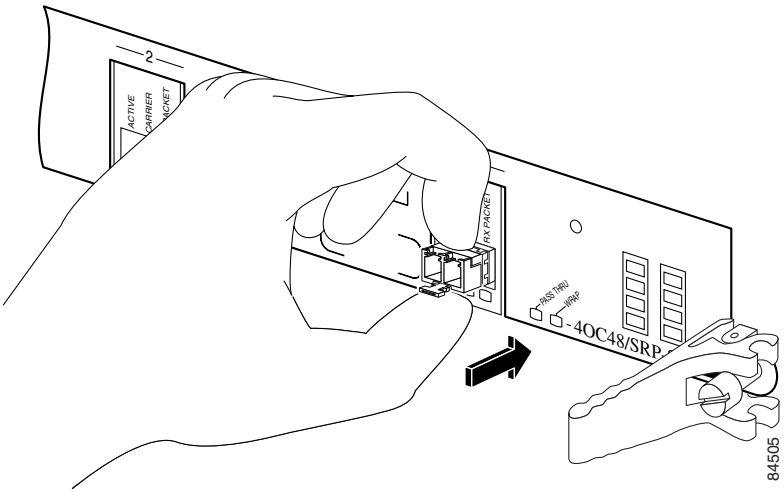
Installing an Actuator Button SFP Module

To install this type of SFP module, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Line up the SFP module with the port and slide it in until the actuator button clicks into place. (See Figure 25.) Be sure not to press the actuator button as you insert the SFP module because you might inadvertently disengage the SFP module from the port.

Figure 25 Installing an Actuator Button SFP Module

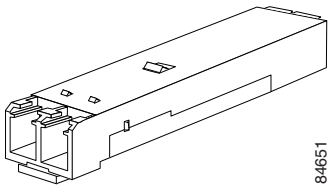


Note Verify that the SFP modules are completely seated and secured in their assigned receptacles on the line card by firmly pushing on each SFP module. If the SFP module was not completely seated and secured in the receptacle, you will hear a click as the triangular pin on the bottom of the SFP module snaps into the hole in the receptacle.

Slide Tab SFP Module

The slide tab SFP module has a tab underneath the front of the SFP module that you use to disengage the module from a port. (See Figure 26.)

Figure 26 Slide Tab SFP Module



Removing a Slide Tab SFP Module

To remove this type of SFP module, follow these steps:

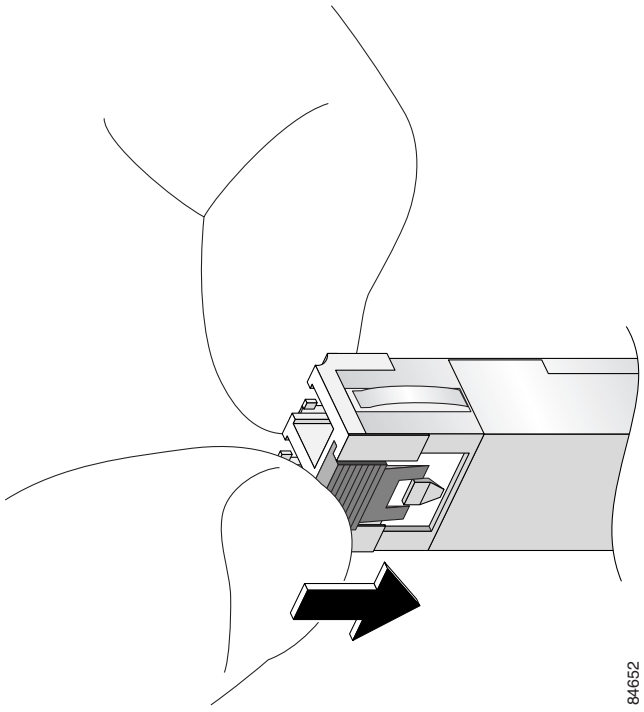
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Disconnect and remove all interface cables from the ports; note the current connections of the cables to the ports on the line card.

Step 3 Grasp the SFP module between your thumb and index finger.

Step 4 With your thumb, push the slide tab on the bottom front of the SFP module in the direction of the line card to disengage the module from the line card port. (See Figure 27.)

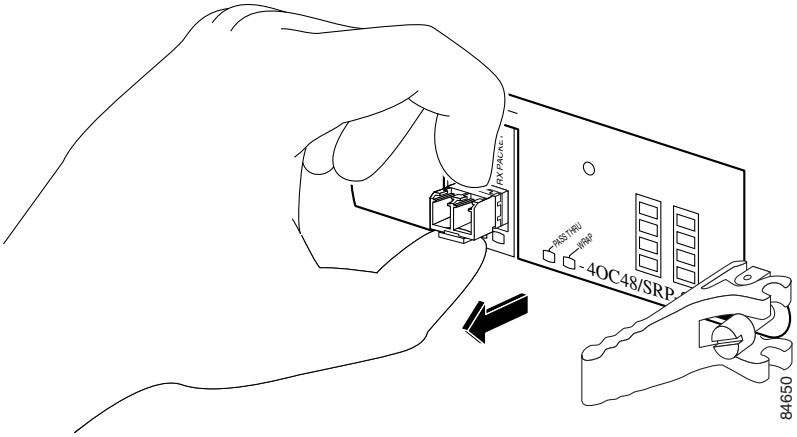
Figure 27 Disengaging the Slide Tab



Step 5 With the tab still pushed, carefully pull the SFP module from the port as shown in Figure 28.

Caution You must disengage the SFP module by pushing on the slide tab before you can pull out the SFP module. If you pull on the SFP module without disengaging the tab, you can damage the SFP module.

Figure 28 Removing a Slide Tab SFP Module



Step 6 Place the removed SFP module on an antistatic mat, or immediately place it in a static shielding bag if you plan to return it to the factory.

Step 7 Protect your line card by inserting clean SFP module cage covers into the optical module cage when there is no SFP module installed.

Installing a Slide Tab SFP Module

To install this type of SFP module into a line card, follow these steps:

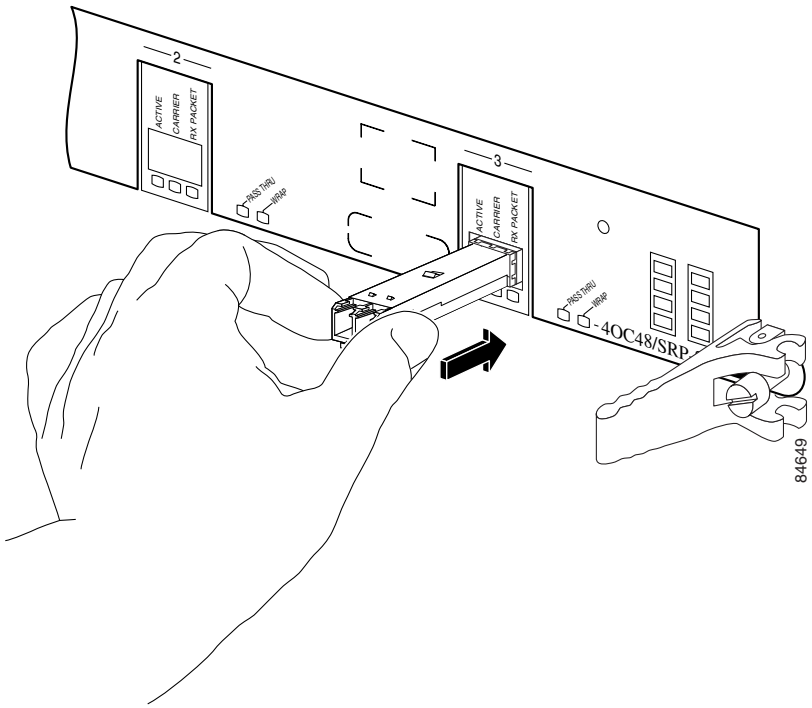
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Hold the SFP module with the hardware label facing up.

Caution The SFP module must be inserted with the hardware label facing up to avoiding damaging the module or the line card.

Step 3 Insert the SFP module into the appropriate slot and gently push on it until it snaps into the slot tightly. (See Figure 29.)

Figure 29 Installing a Slide Tab SFP Module



Note Verify that the SFP modules are completely seated and secured in their assigned receptacles on the line card by firmly pushing on each SFP module. If the SFP module was not completely seated and secured in the receptacle, you will hear a click as the triangular pin on the bottom of the SFP module snaps into the hole in the receptacle.

Line Card Cable-Management Bracket

Note The illustrations in this section show various line cards, but the line card cable-management bracket installation procedure is the same regardless of the specific line card.

Cisco XR 12000 Series Routers include a cable-management system that organizes the interface cables entering and exiting the router, keeping them out of the way and free of sharp bends.

Caution Excessive bending of interface cables can damage the cables.

The cable-management system consists of two separate components:

1. A cable-management tray that is mounted on the chassis. Refer to the appropriate Cisco XR 12000 Series Router installation and configuration guide for more information on the cable-management tray.
2. A cable-management bracket that attaches to a line card.

This section describes the line card cable-management bracket. Figure 30 shows the single-port line card cable-management bracket; Figure 31 shows the multiport line card cable-management bracket.

Figure 30 Single-Port Line Card Cable-Management Bracket

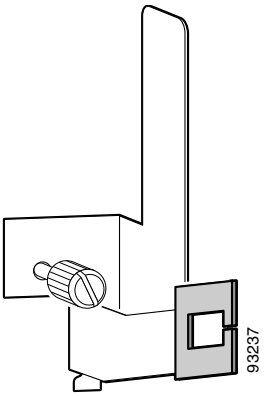
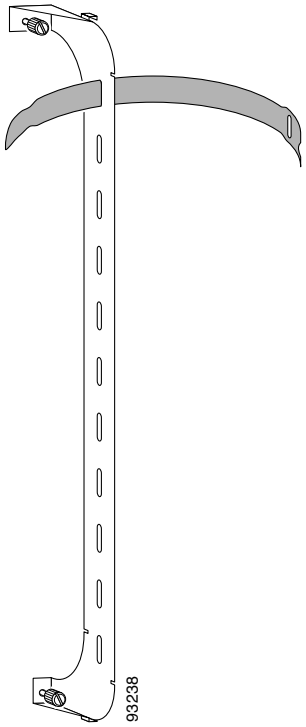


Figure 31 Multiport Line Card Cable-Management Bracket



Note When shipped with spare line card orders, the cable-management bracket is not attached to the line card. You must attach the cable-management bracket to the line card before you insert the line card into the router.

Caution Do not use the cable-management bracket as a handle to pull out or push in the line card. The cable-management bracket is designed to hold the interface cables and may break if you use the bracket to push, pull, or carry the line card after it is removed from the router.

Removing and installing the line card cable-management bracket is described in the following procedures:

- Removing a Line Card Cable-Management Bracket, page 39
- Installing a Line Card Cable-Management Bracket, page 41

Removing a Line Card Cable-Management Bracket

To remove a line card cable-management bracket, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Note the current interface cable connections to the ports on each line card.

Step 3 Starting with the interface cable for the bottom port on the line card, disconnect the cable from the line card interface.

Note It is not necessary to remove the interface cables from the line card cable-management bracket. The bracket (with attached cables) can be hooked to the cable-management tray or a bracket on the chassis until a new line card is installed.

Step 4 For multiport line card cable-management brackets, proceed upward and remove the interface from the Velcro strap on the end of the cable standoff. (See Figure 32.)

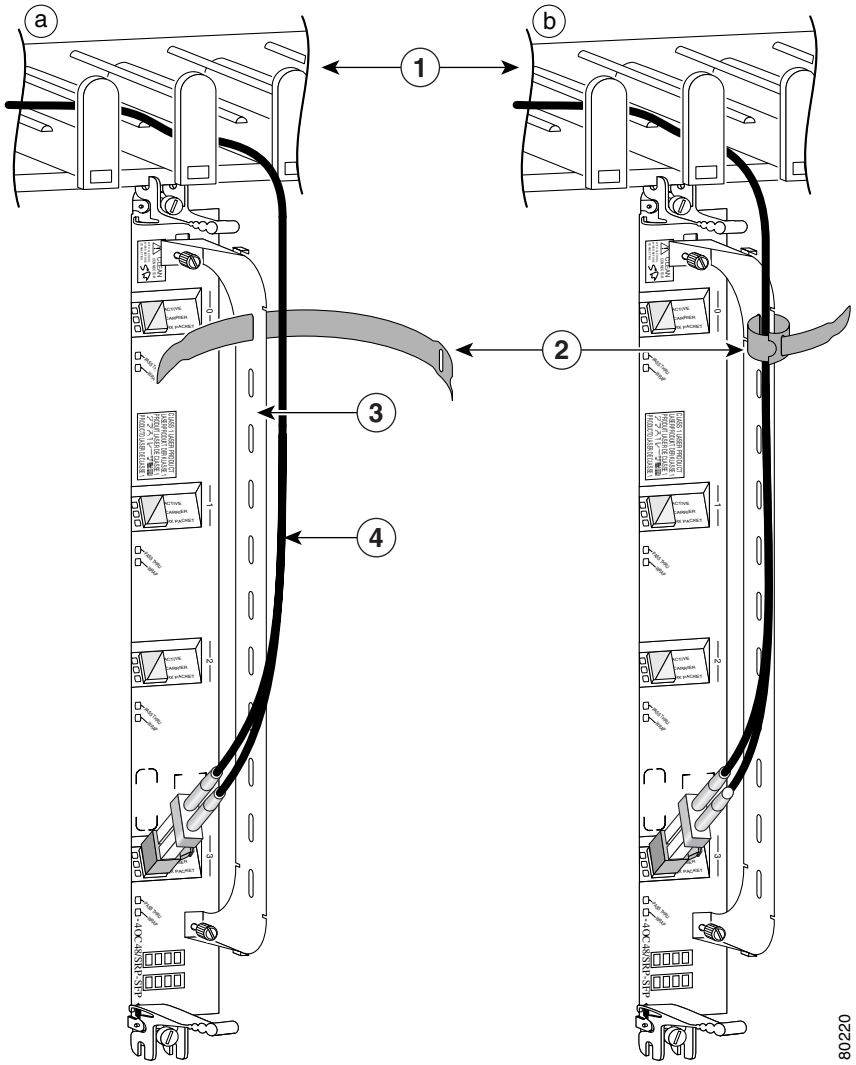
For single-port line card cable-management brackets, carefully remove the interface cable from the cable clip. (See Figure 33.) Avoid any kinks or sharp bends in the cable.

Step 5 Repeat Step 3 and Step 4 for all remaining interface cables, then proceed to Step 6.

Step 6 For multiport line card cable-management brackets, loosen the captive installation screw at each end of the cable-management bracket and remove the bracket from the line card.

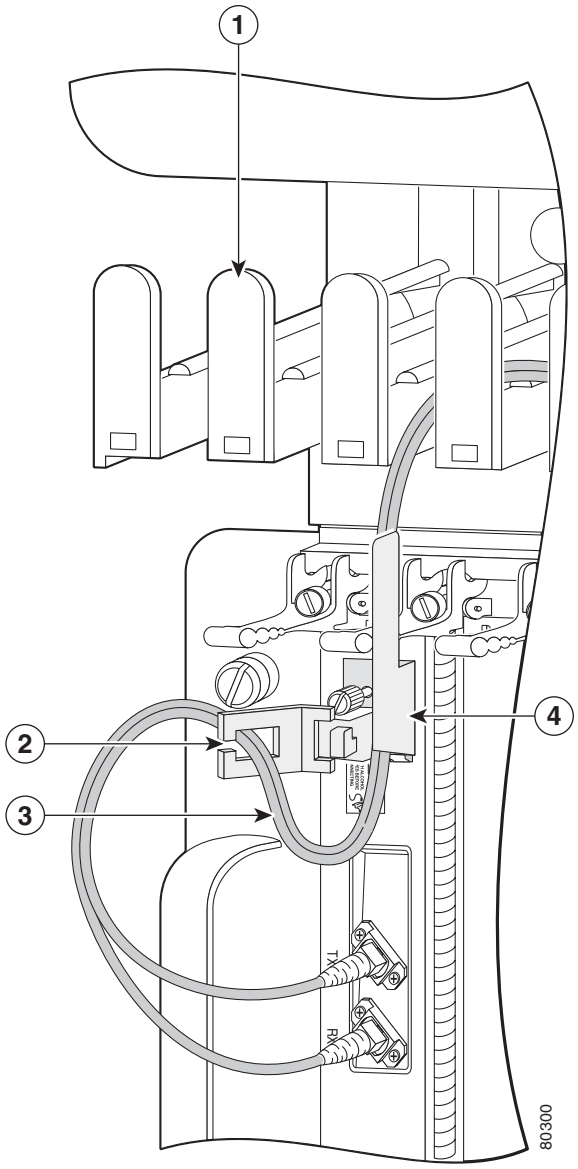
For single-port line card cable-management brackets, loosen the captive installation screw on the cable-management bracket and remove the bracket from the line card.

Figure 32 Multiport Line Card Cable-Management Installation and Removal (4-Port OC-48c/STM-16c DPT Line Card Shown)



1	Chassis cable-management tray	**3**	Line card cable-management bracket
2	Velcro straps	**4**	Fiber cable

Figure 33 Single-Port Line Card Cable-Management Bracket Installation and Removal (1-Port OC-192c/STM-64c DPT Line Card Shown)



1	Chassis cable-management tray	**3**	Interface cable
2	Cable clip	**4**	Line card cable-management bracket

Installing a Line Card Cable-Management Bracket

To install a line card cable-management bracket, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Attach the line card cable-management bracket to the line card as follows:

a. Position the cable-management bracket over the front of the line card faceplate.

b. Insert and tighten the captive screw(s) to secure the bracket to the line card.

c. Starting with the bottom port on the line card, connect each interface cable to the intended port.

Step 3 For multiport line card cable-management brackets, carefully wrap the cables with the supplied Velcro strap. (See Figure 32.)

For single-port line card cable-management brackets, carefully press the interface cable onto the cable clip. (See Figure 33.) Avoid any kinks or sharp bends in the cable.

For information on disconnecting and connecting interface cables, see the "Removing and Installing Fiber-Optic Interface Cables" section on page 52.

Cabling and Specifications

The following sections provide information about specifications and cabling for Ethernet line cards:

Fast Ethernet Interface

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

IEEE 802.3u specifies the following different physical layers for 100BASE-T:

- 100BASE-TX—100BASE-T, half- and full-duplex over Category 5 unshielded twisted-pair (UTP), Electronics Industry Association/Telecommunications Industry Association [EIA/TIA]–568-compliant cable.

Note The 8-Port Fast Ethernet line card provides an RJ-45 connector that follows the Media-Dependent Interface (MDI) port wiring standard, as opposed to the Media-Dependent Interface-crossed (MDI-X) wiring scheme found on many hubs and repeaters.

- 100BASE-FX—100BASE-T, half- and full-duplex over fiber-optic cable.

Note 100BASE-TX and 100BASE-FX are commonly called 100BASE-X rather than 100BASE-T.

- 100BASE-T4—100BASE-T, half- and full-duplex over Category 3, 4, or 5 UTP or shielded twisted-pair (STP) cabling with four pairs, also called 4T+. Two-pair UTP over Category 3 cable is called T2.

Note The 8-Port Fast Ethernet line card supports 100BASE-TX and 100BASE-FX. 100BASE-T4 is not supported.

Table 8 lists the cabling specifications for 100 Mbps Fast Ethernet transmission over UTP, STP, and fiber-optic cables. Table 9 summarizes IEEE 802.3u 100BASE-T physical characteristics for 100BASE-TX and 100BASE-FX.

Table 8 Specification and Connection Limits for 100-Mbps Transmission

Parameter	RJ-45	MII	SC-Type
Cable specification	Category 5[1] UTP[2], 22 to 24 AWG[3]	Category 3, 4, or 5, 150-ohm UTP or STP, or multimode fiber-optic	62.5/125 multimode fiber-optic
Maximum cable length	–	1.64 ft (0.5 m) (MII-to-MII cable[4])	–
Maximum segment length	328 ft (100 m) for 100BASE-TX	3.28 ft (1 m)[5] or 1,312 ft (400 m) for 100BASE-FX	2 km
Maximum network length	656 ft (200 m)[5] (with 1 repeater)	–	4 km[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 FE interface and the appropriate transceiver.
5. This length is specifically between any two stations on a repeated segment.

Table 9 IEEE 802.3u Physical Characteristics

Parameter	100BASE-FX	100BASE-TX
Data rate (Mbps)	100	100
Signaling method	Baseband	Baseband
Maximum segment length (meters)	2 km between repeaters	100 m between DTE[1] and repeaters
Media	SC-type: dual simplex or single duplex for receive (RX) and transmit (TX)	RJ-45MII
Topology	Star or hub	Star or hub

1. DTE = data terminal equipment.

Gigabit Ethernet Interface

This section describes the Gigabit Ethernet interface:

GBIC Laser Optical Transceiver Modules

The Gigabit Interface Converters (GBICs) are field-replaceable modules that plug into receptacles on the line card and provide the Gigabit Ethernet optical interface. The GBICs have two optical interfaces—laser transmit (TX) and laser receive (RX)—and an electrical interface (to the line card). All GBIC module types have dual SC connectors. Different GBICs can be ordered for each port on the line card. The 1-Port Gigabit Ethernet and 3-Port Gigabit Ethernet line cards use GBICs to provide the Gigabit Ethernet optical interface.

The following sections provide information on the GBIC and Coarse Wave Division Multiplexing (CWDM) GBIC in Ethernet line cards:

GBIC Modules

Fiber-optic transmission specifications identify two types of fiber: single-mode and multimode. Signals can travel farther through single-mode fiber than through multimode fiber.

The 1-Port Gigabit Ethernet and 3-Port Gigabit Ethernet line cards support multimode fiber through the WS-G5484= GBIC laser optical transceiver module and single-mode fiber through the WS-G5486=, WS-G5487=. The 3-Port Gigabit Ethernet line card also supports CWDM-GBIC-*xxxx*= GBIC laser optical transceiver modules.

Table 10 describes the operating parameters for available GBIC laser optics.

Table 10 Ethernet GBIC Laser Optic Parameters

GBIC Module/ Connector	Type	Wavelength	Fiber Type	Distance[1]
WS-G5484= SC connector	Shortwave (multimode shorthaul) Defined by 1000BASE-SX standard, IEEE 802.3	850 nm	62.5 micron MMF	902 feet (275 m)
			50 micron MMF	1804 feet (550 m)
WS-G5486= SC connector	Longwave (single-mode longhaul) Compliant with 1000BASE-LX standard, IEEE 802.3	1310 nm	10/9 micron SMF	6.2 miles (10 km)

Table 10 Ethernet GBIC Laser Optic Parameters (continued)

GBIC Module/ Connector	Type	Wavelength	Fiber Type	Distance[1]
WS-G5487= SC connector	Extended distance (single-mode)	1550 nm	10/9 micron SMF	43.5 miles (70 km)
			8 micron SMF[2]	62 miles (100 km)
CWDM-GBIC-*xxx*=[3]	Longwave (single-mode)	1470-1610 nm[4]	SMF 10/9 micron	62 miles (100 km)

1. These distances represent best case conditions, depending on fiber quality, dispersion, and losses due to connectors, nodes, or splices. In the case of the CWDM GBICs, CWDM OADM modules or mux/demux modules are needed for these GBICs to work in any topology other than a point-to-point topology within one building, so the maximum distance is determined by an optical power budget calculation that takes into consideration all sources of loss, including the insertion loss due to the CWDM OADM and mux/demux modules, and might be different from the distance shown in the table. For optical parameter information associated with the CWDM OADM and mux/demux modules, see the "Related CWDM Documentation" section on page 47.
2. Dispersion-shifted single-mode fiber-optic cable required for 100,000-meter distance.
3. Supported by 3-Port Gigabit Ethernet modules
4. The wavelengths of the CWDM GBICs are based on a 20-nanometer (nm) wavelength grid and are available in eight wavelengths: 1470, 1490, 1510, 1530, 1550, 1570, 1590, and 1610 nm.

Note 1000BASE-SX and 1000BASE-LX (LH) were originally part of the IEEE 802.3z standard, which has been incorporated into the IEEE 802.3 standard.

Note Use only GBIC modules supplied by Cisco with your Ethernet line card. They have been tested by Cisco Engineering and, in some cases, a Cisco-supplied GBIC might contain an internal erasable programmable read-only memory (EPROM) that identifies the GBIC to the Cisco IOS software.

The maximum distance for any fiber span in an optical network is determined by the fiber type and quality, as well as the span length, number of splices, and number of optical nodes in the path. If your network design requires the signal to travel close to the theoretical maximum distance (as listed in Table 11), you must calculate the optical power budget and receive (RX) sensitivity for the entire network topology to ensure it is within the specifications of the GBIC option in use.

Note Actual power budget calculations involve a number of variables specific to network topology and design, and are therefore outside the scope of this publication.

Table 11 Optical Parameter Values for Calculating Link Power Budget

GBIC	Transmit Power	Receive Power	Receive Sensitivity	Link Budget	Maximum Distance[1]
WS-G5484=	–9.5dBm to 0 dBm[2]	–17 to 0 dBm	–17 dBm	7.5 dB	1,804 feet (550 m)
WS-G5486=	–11 to –3 dBm	–19 to –3 dBm	–19 dBm	8 dB	6.2 miles (10 km)
WS-G5487=	0 to +5 dBm	–23 to 0 dBm	–23 dBm	23 dB	43.5 to 62 miles (70 to 100 km[3])
CWDM-GBIC-*xxxx*=	+1 to +5 dBm	–31 to –7 dBm	–31 dBm	32 dB	62 miles (100 km)[4]

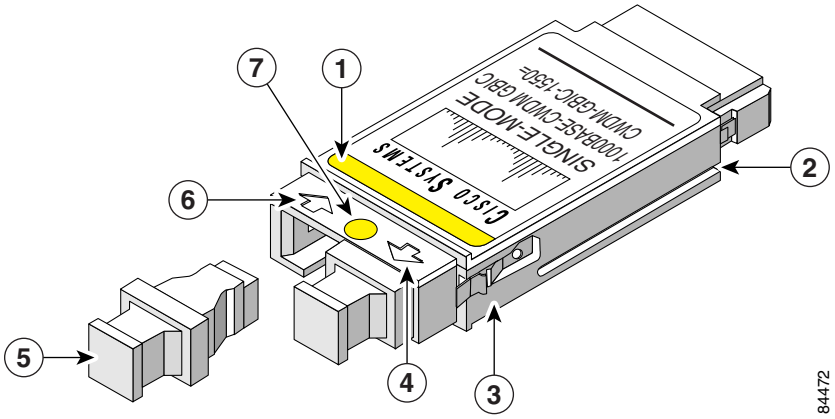
1. These distances represent best case conditions, depending on fiber quality, dispersion, and losses due to connectors, nodes, or splices.

2. dBm = decibels referenced to 1 milliwatt.
3. Dispersion-shifted single-mode fiber-optic cable required for 100-km distance.
4. This distance represents best case conditions, depending on fiber quality, dispersion, and losses due to connectors, nodes, or splices. In the case of the CWDM GBICs, CWDM OADM modules or mux/demux modules are needed for these GBICs to work in any topology other than a point-to-point topology within one building, so the maximum distance is determined by an optical power budget calculation that takes into consideration all sources of loss, including the insertion loss due to the CWDM OADM and mux/demux modules, and might be different from the distance shown in the table. For optical parameter information associated with the CWDM OADM and mux/demux modules, see the "Related CWDM Documentation" section on page 47.

Using CWDM GBICs with the 3-Port Gigabit Ethernet Line Card

The 3-Port Gigabit Ethernet line card supports CWDM GBICs. The eight CWDM GBICs available for use with an Ethernet line card are active components that plug into standard GBIC receptacles in the line card. They convert Gigabit Ethernet electrical signals into an optical single-mode fiber (SMF) interface that feeds into a CWDM network through a Cisco optical add/drop multiplexing (OADM) plug-in module or multiplexing/demultiplexing (mux/demux) plug-in module. Figure 34 shows the physical appearance of a CWDM GBIC with one optical port dust plug removed.

Figure 34 CWDM GBIC (Yellow-Coded CWDM-GBIC-1550= Shown)



1	Color band on label	**4**	Transmit optical bore	**6**	Receive optical bore
2	Alignment groove	**5**	Optical bore dust plug	**7**	Color dot
3	Spring clip				

The eight CWDM GBICs available for use with a Gigabit Ethernet line card come in eight wavelengths in a range from 1470 nm to 1610 nm. The color dot between the receive and transmit ports and the color band on the label of the Cisco CWDM GBIC identify the wavelength of the GBIC. Table 12 lists the CWDM GBICs and their associated color codes.

Table 12 Gigabit Ethernet CWDM GBIC Laser Optic Parameters

GBIC Product Number	CWDM GBIC Wavelength	Color Identifier
CWDM-GBIC-1470=	Longwave 1470 nm laser single-mode	Gray
CWDM-GBIC-1490=	Longwave 1490 nm laser single-mode	Violet
CWDM-GBIC-1510=	Longwave 1510 nm laser single-mode	Blue
CWDM-GBIC-1530=	Longwave 1530 nm laser single-mode	Green

Table 12 Gigabit Ethernet CWDM GBIC Laser Optic Parameters (continued)

GBIC Product Number	CWDM GBIC Wavelength	Color Identifier
CWDM-GBIC-1550=	Longwave 1550 nm laser single-mode	Yellow
CWDM-GBIC-1570=	Longwave 1570 nm laser single-mode	Orange
CWDM-GBIC-1590=	Longwave 1590 nm laser single-mode	Red
CWDM-GBIC-1610=	Longwave 1610 nm laser single-mode	Brown

General CWDM GBIC Installation and Usage Guidelines

The Cisco CWDM GBIC solution has two main components: the Cisco CWDM GBICs and the Cisco OADM plug-in modules or mux/demux plug-in modules, which are rack mounted in a Cisco CWDM OADM chassis external to the Cisco 12000 Series Router that contains the Ethernet line card.

The CWDM OADM plug-in modules and mux/demux plug-in modules are passive optical components that multiplex together multiple wavelengths from multiple SMF fiber pairs into one SMF fiber pair. Up to two CWDM plug-in modules can be rack-mounted by using the single-rack-unit CWDM chassis.

The CWDM GBICs plug into the standard GBIC receptacles on the faceplate of the Ethernet line card and are connected to the CWDM OADM or mux/demux plug-in modules in the external CWDM chassis using SMF jumper cables with SC-type connectors.

A Cisco 12000 Series Router equipped with an Ethernet line card and CWDM GBICs can be connected into a CWDM network through external CWDM plug-in modules in the following deployment scenarios:

- **Point-to-point**—Two endpoints are directly connected via a fiber link. You can add or drop up to eight Gigabit Ethernet channels into a pair of single-mode fibers.
- **Hub-and-spoke (ring)**—Multiple nodes (spokes) are connected with a hub location through a ring of single-mode fiber. Each hub/node connection can consist of one or more wavelengths, each carrying a full Gigabit Ethernet channel.
- **Mesh (ring)**—Combines the hub-and-spoke and point-to-point (or even multiple point-to-point) connections in parallel on the same CWDM optic link. The maximum of eight GBIC wavelengths allows different combinations of these scenarios.

Related CWDM Documentation

For more information about CWDM GBIC solution deployment, including the optical parameters (insertion loss and isolation values) for the CWDM OADM and mux/demux plug-in modules, see the following related documentation:

- *Cisco CWDM GBIC Solution, Data Sheet*
- *Cisco CWDM GBIC Solution, Q & A*
- *Installation Note for the CWDM Passive Optical System*

General Connection Rules for CWDM GBICs

Observe the following connection rules for CWDM GBICs:

- Always match the CWDM GBIC color with the equipment port of the same color on the CWDM passive optical system plug-in module.

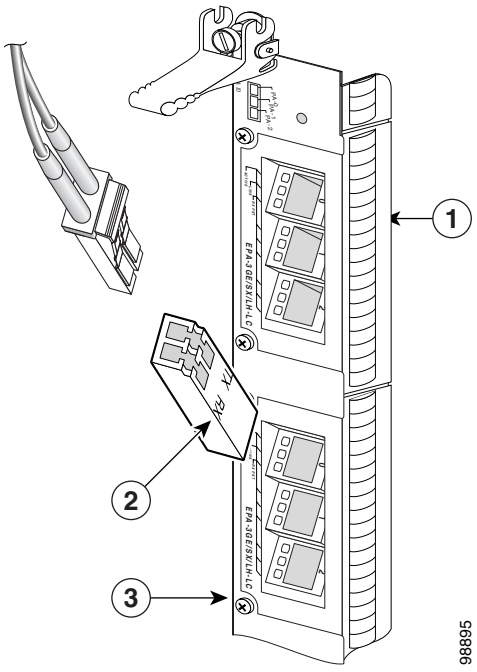
  Use the CWDM passive optical system connector color codes shown in Table 12 to help you connect your router to the CWDM passive optical system.

- Always connect from transmit (TX) to receive (RX) when connecting GBICs to other equipment:
  - Connect GBIC TX to equipment RX
  - Connect GBIC RX to equipment TX
- Optical transceivers—such as the Cisco CWDM GBICs—have a maximum optical receive power, above which damage might occur to the receive diode. The incoming power level might be too high if the fiber lacks sufficient attenuation, which might occur in a short run of fiber (less than approximately 25 km). Attenuators are used to lower the incoming optical signal below the maximum optical receive power of the Cisco CWDM GBIC (–7 dB).
- When the length of the fiber-optic link is less than 15.5 miles (25 km), you must insert a 10-dB inline optical attenuator (Cisco product number AT-10DB-SC=) between the fiber-optic network and the receiving port on the Cisco CWDM GBIC at each end of the link to ensure that the maximum receive power is always less than –7 dBm.

Gigabit Ethernet SFP Modules

The Gigabit Ethernet laser optical transceiver module is a field-replaceable small form-factor pluggable (SFP) module that plugs into the receptacle on the Ethernet port adapter (EPA) located on the Modular Ethernet line card and provides the Gigabit Ethernet optical interface. (See Figure 35.) The module has two optical interfaces—laser transmit (TX) and laser receive (RX)—and an electrical interface (to the line card). The 4-Port Gigabit Ethernet ISE, 10-Port 1-Gigabit Ethernet, and Modular Gigabit Ethernet line cards use SFP modules.

Figure 35 SFP Module and Fiber-Optic Cable



1	Component side of line card	**3**	Card carrier side of line card
2	Top surface of SFP module		

The following SFP module options are available for a Gigabit Ethernet line card:

- GLC-SX-MM—Short wavelength SFP module (850 nm nominal), for use in 1000BASE-SX links.
- GLC-LH-SM—Long-haul or long-wavelength SFP module (1310 nm nominal), for use in 1000BASE-LX links.
- GLC-LX-SM—Single-mode, long-reach
- GLC-ZX-SM=—Single-mode, extended-reach (supported by 4-Port Gigabit Ethernet ISE line card only)

The SFP modules have LC connectors. Different SFP module options allow you to customize the physical interfaces on the line card by using both types of modules on the same line card. The only restriction is that each port must match the specifications on the other end of the cable (short or long wavelength), and must not exceed the recommended cable length for reliable communication.

Fiber-optic transmission specifications identify two types of fiber: single-mode and multimode. The maximum distance for single-mode installations is determined by the amount of light loss in the fiber path. If your environment requires the light to travel close to the typical maximum distance, you should use an optical time domain reflectometer (OTDR) to measure the power loss.

Table 13 describes the operating parameters for the supported SFP modules.

Table 13 Gigabit Ethernet SFP Module Power Budget and Signal Requirements

SFP	Transceiver	Power Budget	Transmit Power	Receive Power	Receive Sensitivity	Typical Maximum Distance
GLC-SX-MM	Short wavelength Multimode, short haul	7.5 dB	–9.5 to -4 dBm[1] at 850 nm[2]	–17 to 0 dBm	–17 dBm	984 feet (300 meters)
GLC-LH-SM[3]	Long wavelength Single-mode, long haul	8.0 dB	–9.5 to –3 dBm at 1310 nm	–19 to -3 dBm		32,808 feet (10,000 meters)
GLC-LX-SM[4]	Single-mode, long-reach	8 dB	–11 to –3 dBm at 1310 nm	–19 to –3 dBm	–19 dBm	
GLC-ZX-SM[5]	Single-mode, extended-reach	23 dB	0 to +5 dBm at 1550 nm	–23 to 0 dBm	–23 dBm	

1. dBm = decibels referenced to 1 milliwatt
2. nm = nanometer
3. Not valid for 4-Port Gigabit Ethernet ISE line card
4. 4-Port Gigabit Ethernet ISE line card only
5. 4-Port Gigabit Ethernet ISE line card only

Table 14 Gigabit Ethernet Laser Optical Transceiver (SFP) Module Operating Parameters

SFP Module	Type	Wavelength	Cable	Distance
GLC-SX-MM	Short wavelength (multimode short haul)	850 nm	MMF 62.5/125 micron	722 feet (220 m)
			MMF 50/125 micron	1640 feet (500 m)
GLC-LH-SM	Long wavelength (single-mode long haul)	1310 nm	SMF 9/125 micron	32,808 feet (10,000 m)

Note Use only the SFP modules supplied by Cisco with your Gigabit Ethernet line card. Each SFP module contains an internal serial EEPROM that is security-programmed by the SFP manufacturer with information that provides a way for Cisco (through the Cisco IOS software) to identify and validate the SFP module as a module type that was tested and qualified by Cisco to operate properly with Cisco Gigabit Ethernet line cards. Unapproved SFP modules (those not purchased directly from Cisco) will not work on the Gigabit Ethernet line card.

10-Gigabit Ethernet

The 1-Port 10-Gigabit Ethernet line card uses single-mode fiber-optic cable. The maximum distance for single-mode installations is determined by the amount of light loss in the fiber path. If your environment requires the light to travel close to the typical maximum distance (as listed in Table 16), you should use an optical time domain reflectometer (OTDR) to measure the power loss.

The Ethernet line card is offered in two transceiver options:

- Long haul or long wavelength, 1310 nanometers (nm) nominal, used for 1000BASE-LR links.
- Long haul or long wavelength, 1550 nm nominal, used for 1000BASE-ER links.

Table 15 describes the operating parameters for the transceiver options.

Table 15 10-Gigabit Ethernet Laser Optical Transceiver Operating Parameters

Transceiver Option	Type	Wavelength	Cable	Distance
LR	Long wavelength (single-mode long haul)	1310 nm	SMF 9/125 micron	6.2 miles (10 km)
ER	Long wavelength (single-mode long haul)	1550 nm	SMF 9/125 micron	24.9 miles (40 km)

Table 16 lists the power ratings and maximum distances of both models of the Ethernet line cards. The actual distance in any given case depends on the quality of the fiber connected to the transceiver.

Table 16 Transceiver Module Power Budget and Signal Requirements

Transceiver Option	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
LR	6.2 dB	–8.2 to +0.5 dBm at 1310 nm	–14.4 to +0.5 dBm	6.2 miles (10 km)
ER	11.1 dB	–4.7 to +4 dBm at 1550 nm	–15.8 to –1 dBm	24.9 miles (40 km)

Fiber-Optic Interface Cables

Depending on the line card (refer to Table 4 on page 4), use a single-mode or multimode fiber-optic interface cable with LC-type or SC-type connectors to connect an Ethernet interface on the Ethernet line card in your Cisco XR 12000 Series Router to another Ethernet interface, router, or switch.

Note Fiber optic cables are not available from Cisco Systems. They can be purchased from cable vendors.

The following types of cables are used with Ethernet line cards to connect your router to another router or switch:

- Single-mode—Generally yellow in color.
- Multimode—Generally gray or orange in color. Multimode cables are multifiber cables that carry 12 channels of fiber data.

Note For network applications using CWDM GBICs in Ethernet line cards, the CWDM GBICs use SMF patch cords only. Verify that all your patch cords are yellow (SMF), rather than orange (MMF).

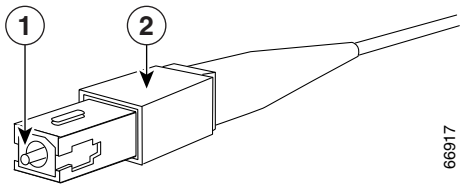
The following types of cable connectors are used with Ethernet line cards:

- Subscriber connector (SC)—See Figure 36 and Figure 37
- Lucent connector (LC)— See Figure 38 and Figure 39

You can use two cables with simplex connectors, or one cable with dual, keyed connectors.

Warning **Invisible laser radiation can be emitted from the aperture of the port when no cable is connected. Avoid exposure to laser radiation and do not stare into open apertures.**

Figure 36 Simplex SC Cable Connector (Single-mode)



1	SC cable connector	**2**	Spring-action disconnect latch

Figure 37 Duplex SC Cable Connector

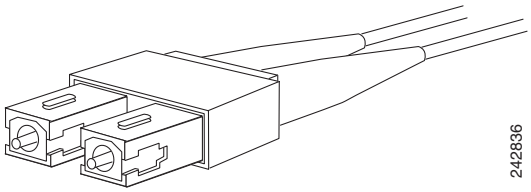
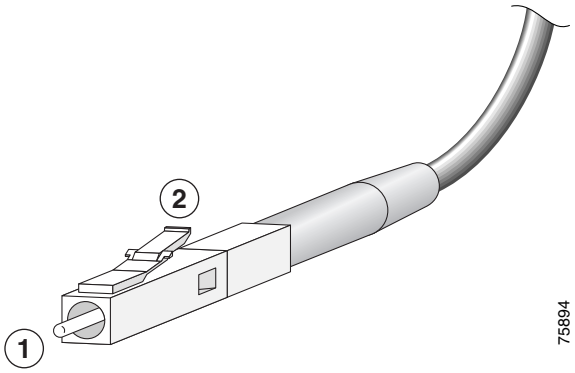
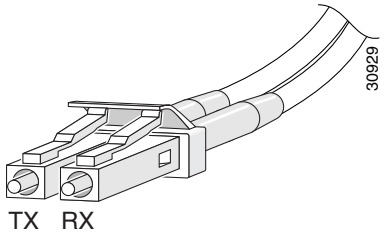


Figure 38 Simplex LC Cable Connector



1	LC connector	**2**	Spring-action disconnect latch

Figure 39 Duplex LC Cable Connector



Note Connectors on the fiber-optic cables must be free of dust, oil, or other contaminants. Before connecting the cable to the line card, carefully clean the fiber-optic connectors using an alcohol wipe or other suitable cleanser. Refer to the "Cleaning Fiber-Optic Connectors" section on page 56 for more information.

The connector on the cable might be supplied with a dust cover. If it is, remove the dust cover before trying to connect the cable to the line card port.

Removing and Installing Fiber-Optic Interface Cables

This section contains information on removing and installing fiber-optic interface cables to connect your router to another router or switch.

Note The procedures in the following sections use illustrations of an Ethernet line card to support the descriptions of removing and installing interface cables. Although the line cards differ, the process of removing and installing interface cables is basically the same. Therefore, separate procedures and illustrations are not included in this publication.

Removing Fiber-Optic Interface Cables

To remove line card interface cables, refer to Figure 40 (showing one possible arrangement) and follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap to your wrist and follow its instructions for use.

Step 2 Press on the spring-action disconnect latch to disconnect the interface cable connectors from the line card interface ports.

Warning **Invisible laser radiation can be emitted from the aperture of the port when no cable is connected. Avoid exposure to laser radiation and do not stare into open apertures.**

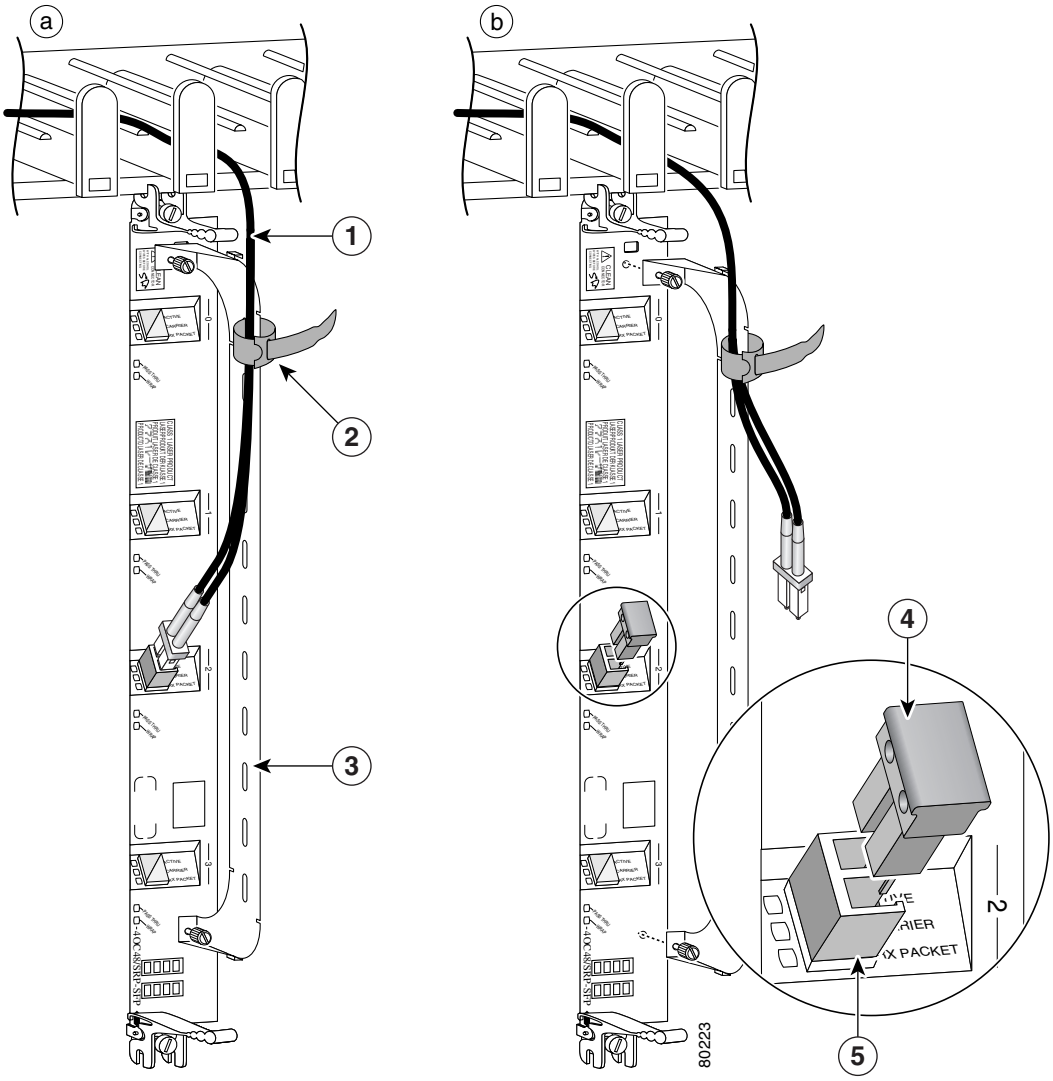
Note You do not have to remove the interface cables from the line card cable-management bracket.

Step 3 Insert a dust plug into the optical port openings of each port that is not being used.

Step 4 Use a screwdriver to loosen the captive installation screws at the ends of the line card cable-management bracket.

Step 5 Detach the line card cable-management bracket and optical fiber cable bundle from the line card and place it carefully out of the way. (See Figure 40B.)

Figure 40 Disconnecting Line Card Interface Cables



1	Fiber cable	**3**	Cable-management bracket	**5**	SFP module
2	Velcro strap	**4**	Dust plug		

Installing Fiber-Optic Interface Cables

Use two simplex SC or LC connectors or one duplex SC or LC connector (refer to Figure 41 on page 55 and Figure 42 on page 56).

Note Optical fiber cables are available from cable vendors. These cables are not available from Cisco Systems.

Warning **Invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, so avoid exposure to radiation and do not stare into open apertures.**

Warning **Class 1 laser product.**

Warning **Class 1 LED product (multimode).**

Note Connectors on the fiber-optic cables must be free of dust, oil, or other contaminants. Before connecting the cable to the line card, carefully clean the fiber-optic connectors using an alcohol wipe or other suitable cleanser. Refer to the "Cleaning Fiber-Optic Connectors" section on page 56 for more information.

To install a cable, follow these steps:

Step 1 Remove the connector dust cover if one is present.

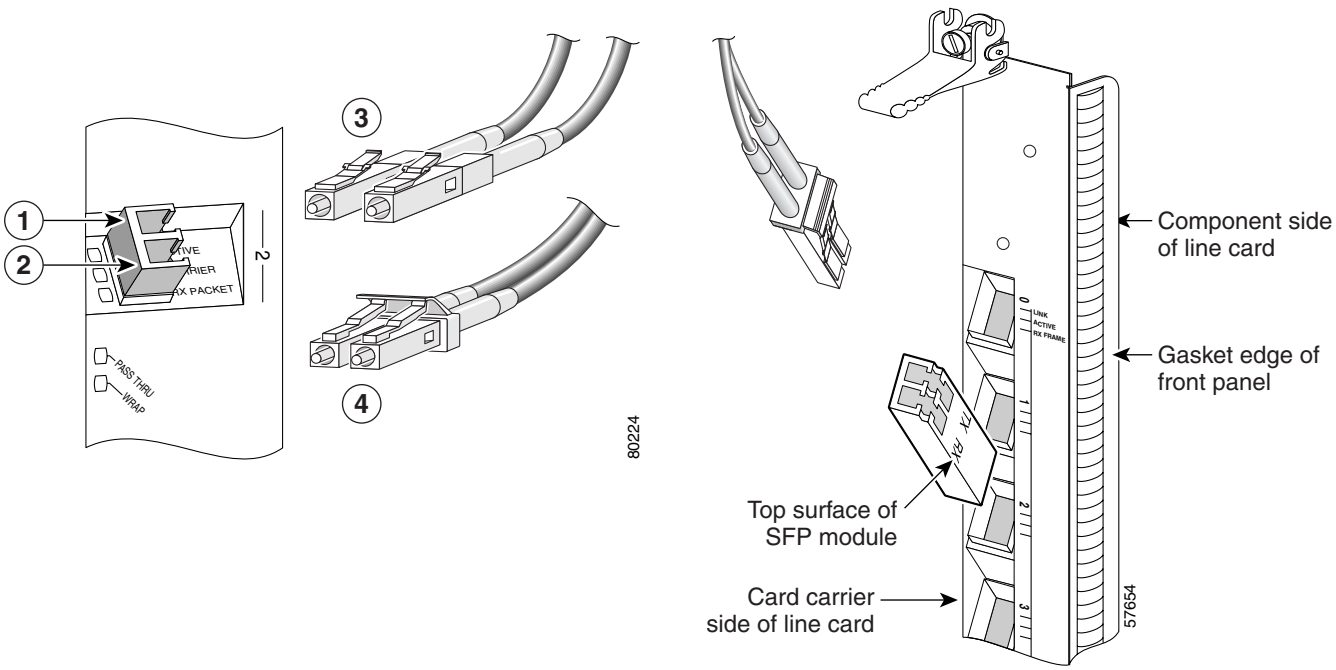
Step 2 Align the connector end of the cable to the appropriate port. Observe the receive (RX) and transmit (TX) cable relationship on the cables, as shown in Figure 41 and Figure 42.

Step 3 Attach fiber cable between the port in the line card and the device to which the line card is connected.

Step 4 Insert the fiber cable connector until it clicks and locks into place.

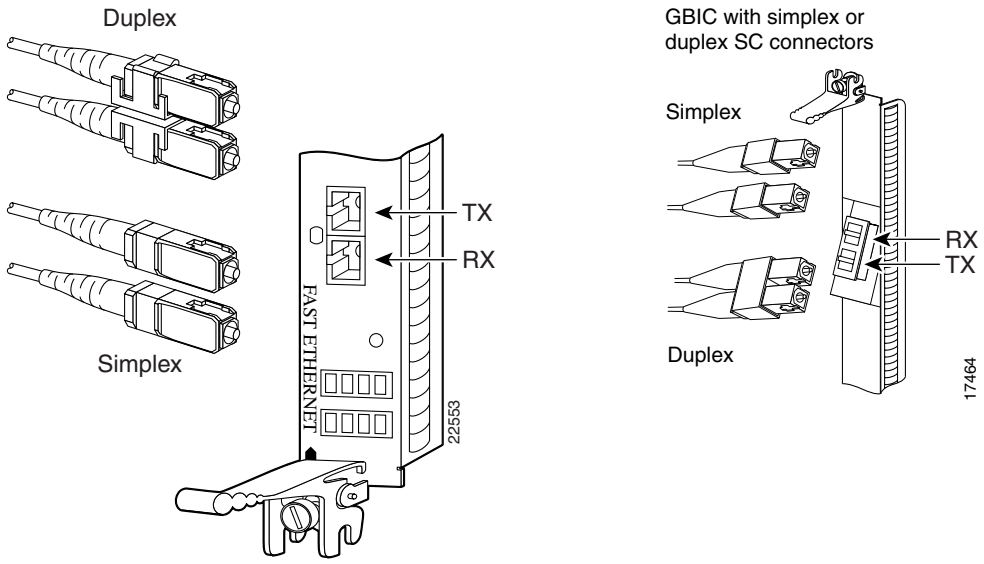
Step 5 Repeat these steps until all cabling is complete.

Figure 41 Attaching Simplex or Duplex Fiber Cables (SFP Module)



1	TX connector	**3**	Simplex cables
2	RX connector	**4**	Duplex cable

Figure 42 Attaching Simplex or Duplex Fiber Cables (Line Card Port or GBIC)



Note The fiber-optic connectors must be free of dust, oil, or other contaminants. Carefully clean the fiber-optic connectors using an alcohol wipe or other suitable cleanser.

Cleaning Fiber-Optic Connectors

Fiber-optic connectors are used to connect two fibers together. When these connectors are used in a communication system, proper connection becomes a critical factor. They can be damaged by improper cleaning and connection procedures. Dirty or damaged fiber-optic connectors can result in communication that is inaccurate or not repeatable.

Fiber-optic connectors differ from electrical or microwave connectors. In a fiber-optic system, light is transmitted through an extremely small fiber core. Because fiber cores are often 62.5 microns or less in diameter, and dust particles range from a tenth of a micron to several microns in diameter, dust and any other contamination at the end of the fiber core can degrade the performance of the connector interface where the two cores meet. Therefore, the connector must be precisely aligned and the connector interface must be absolutely free of foreign material.

Connector loss, or insertion loss, is a critical performance characteristic of a fiber-optic connector. Return loss is also an important factor. Return loss specifies the amount of reflected light: the lower the reflection, the better the connection. The best physical contact connectors have return losses of better than –40 dB, but –20 to –30 dB is more common.

The connection quality depends on two factors: the type of connector and the proper cleaning and connection techniques. Dirty fiber connectors are a common source of light loss. Keep the connectors clean at all times, and keep the dust plugs or covers installed when the connectors are not in use.

Before installing any type of cable or connector, use a lint-free alcohol pad from a cleaning kit to clean the ferrule, the protective tube or cone that surrounds the fiber core, and the end-face surface of the fiber core.

As a general rule, any time you detect a significant, unexplained loss of light, clean the connectors. To clean the optical connectors, use a CLETOP fiber optic cleaning cassette (Type A for SC connectors) and follow the manufacturer's usage instructions.

If a CLETOP cleaning cassette is not available, follow these steps:

Step 1 Use a lint-free tissue soaked in 99 percent pure isopropyl alcohol and gently wipe the end-face of the fiber core. Wait 5 seconds for the surfaces to dry and wipe the surfaces a second time.

Step 2 Use clean, dry, oil-free compressed air to remove any residual dust from the connector.

Warning **Invisible laser radiation can be emitted from the aperture of the port when no cable is connected. Avoid exposure to laser radiation and do not stare into open apertures.**

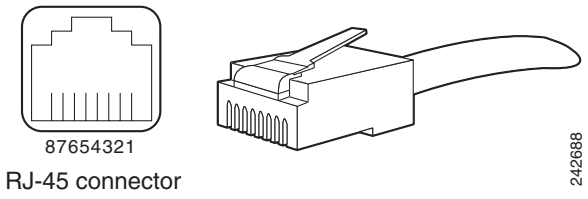
Step 3 Use a magnifying glass or inspection microscope to inspect the ferrule at angle. Do not look directly into the aperture. If you detect any contamination, repeat Step 1 and Step 2.

Type RJ-45 100BASE-T Copper Cables

For an 8-Port Fast Ethernet line card with RJ-45 ports, use an EIA/TIA–568-compliant cable with MDI wiring and RJ-45 connectors to connect your Cisco XR 12000 Series Router to another router or switch. Figure 43 shows a typical RJ-45 connector.

Note EIA/TIA–568-compliant cable with MDI wiring and RJ-45 connectors are available from a wide variety of sources. These cables are not available from Cisco Systems.

Figure 43 RJ-45 Cable Connector



Removing and Installing RJ-45 100BASE-T Copper Cable

This section contains information on removing and installing RJ-45 copper cables to connect your router to another router or switch.

Removing RJ-45 Cables

To remove line card cables, follow these steps (refer to Figure 44 on page 58):

Step 1 Attach an ESD-preventive wrist or ankle strap to your wrist and follow its instructions for use.

Step 2 Disconnect the interface cable connectors from the line card interface ports.

Note You do not have to remove the interface cables from the line card cable-management bracket.

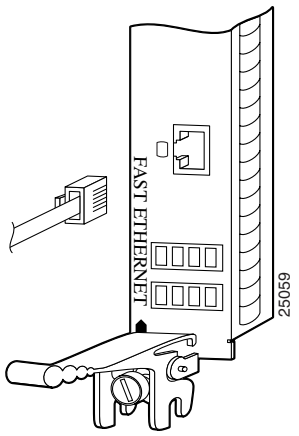
Step 3 Use a screwdriver to loosen the captive installation screws at the ends of the line card cable-management bracket.

Step 4 Detach the line card cable-management bracket and optical fiber cable bundle from the line card and place it carefully out of the way.

Installing RJ-45 Cables

Insert the RJ-45 connector into an open port until the connector clicks and locks into place. Attach one cable between each line card interface and the device to which the line card is connected. Figure 44 shows the relationship between the RJ-45 interface on the line card and the cable connector.

Figure 44 Attaching RJ-45 Copper Cables



Verifying and Troubleshooting the Installation

After installing the hardware, you need to look at the LEDs to verify that the Ethernet line card was installed correctly. If it was not, you need to troubleshoot to find the problem. The following sections provide information about how to verify and troubleshoot line card installations:

- Initial Boot Process, page 59
- Status LEDs, page 59
- Alphanumeric LEDs, page 60

- Troubleshooting the Installation, page 64

Initial Boot Process

Note Many new line cards are designated as *administratively down* by default. Status LEDs are off until you configure the interfaces and use the **no shutdown** command.

During a typical line card boot process, the following events occur:

1. The line card maintenance bus (MBus) module receives power and begins executing the MBus software.
2. The line card MBus module determines the type of card on which it resides, performs internal checks, and prepares to accept the Cisco IOS software from the RP.
3. The RP powers up the line card and loads the line card with its Cisco IOS software.

To verify that the line card is working properly, perform the following operational checks:

- During the line card boot process, observe the line card alphanumeric LEDs to ensure that the card is running the typical initialization sequence. The sequence should end with IOS RUN.
- Observe the line card status LEDs to verify that the Active LED (Link LED or status LED for line cards with no Active LED) is on. If an Active LED is not on, verify that the associated interface is not shut down.

Status LEDs

The Gigabit Ethernet line cards and the 8-Port Fast Ethernet line card have different status LEDs.

Gigabit Ethernet Status LEDs

After installing the line card and connecting the interface cables, verify that the line card is working properly by observing the LEDs on the faceplate. For the locations of the LEDs, refer to the figures in the "Product Overviews" section on page 4.

Status LEDs show the status of each fiber-optic connector:

- LINK—When lit, indicates that the Gigabit Ethernet (GE) MAC layer is receiving comma characters from a connected GE device.
- ACTIVE—When lit, indicates that the interface is active.
- RX FRAME—When lit, indicates that the interface has received a packet.

Alphanumeric LEDs explain the state of the line card and are made up of two, four-digit alphanumeric LED displays. (See the "Alphanumeric LEDs" section on page 60.)

The status LEDs might not go on until after you have configured the line card interfaces (or turned them on, if they were shut down).

The different operating states of the status LEDs on the Gigabit Ethernet line card are shown in Table 17.

Table 17 Status LED Descriptions

LED	Color/Activity	Description
LINK	Green	• A signal is detected. • There is RX synchronization. • The GBIC or SFP module is inserted and has no fault conditions. • The line card is connected to another functioning Gigabit Ethernet interface and has received comma-detect characters.
	Off	• Loss of signal (LOS). Occurs when the signal is lost at the optical input. For example, removing a GBIC or SFP or removing a cable causes both an LOS and a loss of synchronization. • Loss of RX synchronization. Occurs when the receiver cannot detect commas. For example, removing the local RX cable or the remote TX cable will cause loss of synchronization. • Invalid word received. To maintain receiver alignment and synchronization, the receiver looks for a unique detectable code-bit pattern. An invalid word condition occurs because the receiver detects an incorrect or unsupported character or sequence of characters, resulting in a loss of synchronization and a link down condition.
ACTIVE	Green	• When the line protocol is up. For example, you enter a **no shutdown** command as part of the interface configuration. • During the line card hardware initialization sequence.
	Off	• The line is down because of a link failure or problem with the GBIC or SFP module. • Hardware initialization fails. • The line card interface is shut down, because a GBIC or SFP module was removed and replaced or was administratively shut down. Note that a newly inserted line card is designated administratively down, so the Active LED for the interface remains off until the interface is configured. The Active LED on the line card does not go on until you configure the line card interface (or turn the interface on if it was shut down). As an operational check, you can verify that the card is receiving power by looking at the alphanumeric display LEDs, which go on when a line card is inserted correctly into the chassis and is powered on.
RX FRAME	Green	Packets are being received on this interface.
	Off	Packets are not being received on this interface.

Alphanumeric LEDs

Ethernet line cards have two four-digit alphanumeric LED displays at one end of the faceplate, near the ejector lever, that display a sequence of messages indicating the state of the card. In general, the LEDs do not turn on until the RP recognizes and powers up the card. As it boots, the line card displays a sequence of messages similar to those in Table 18.

Note It is normal for some displayed messages to appear too briefly to be read. Also, some messages listed in Table 18 and Table 19 may not appear on your line card.

Table 18 Alphanumeric LED Messages During a Typical Initialization Sequence

LED Display[1]	Meaning	Source
MROM *nnnn*	MBus microcode execute; *nnnn* is the microcode version number.	MBus controller
LMEM TEST	Low memory on the line card is being tested.	Line card ROM monitor
LROM RUN	Low memory test has been completed.	Line card ROM monitor
BSS INIT	Main memory is being initialized.	Line card ROM monitor
RST SAVE	Contents of the reset reason register are being saved.	Line card ROM monitor
IO RST	Reset I/O register is being accessed.	Line card ROM monitor
EXPT INIT	Interrupt handlers are being initialized.	Line card ROM monitor
TLB INIT	TLB is being initialized.	Line card ROM monitor
CACH INIT	CPU data and instruction cache is being initialized.	Line card ROM monitor
MEM INIT	Size of the main memory on the line card is being discovered.	Line card ROM monitor
LROM RDY	ROM is ready for the download attempt.	Line card ROM monitor
ROMI GET	ROM image is being loaded into line card memory.	RP IOS software
ROM VGET[2]	ROM image is receiving a response.	RP IOS software
FABI WAIT	Line card is waiting for the fabric downloader to load.[3]	RP IOS software
FABM WAIT[2]	Line card is waiting for the fabric manager to report that the fabric is usable.	RP IOS software
FABL DNLD	Fabric downloader is being loaded into line card memory.	RP IOS software
FABL STRT	Fabric downloader is being launched.	RP IOS software
FABL RUN	Fabric downloader has been launched and is running.	RP IOS software
IOS DNLD	Cisco IOS software is being downloaded into line card memory.	RP IOS software
IOS FABW[2]	Cisco IOS software is waiting for the fabric to be ready.	RP IOS software

Table 18 Alphanumeric LED Messages During a Typical Initialization Sequence (continued)

LED Display[1]	Meaning	Source
IOS VGET[2]	Line card is obtaining the Cisco IOS version.	RP IOS software
IOS RUN	Line card is enabled and ready for use.	RP IOS software
IOS STRT	Cisco IOS software is being launched.	RP IOS software
IOS TRAN	Cisco IOS software is transitioning to active.	RP IOS software
IOS UP	Cisco IOS software is running.	RP IOS software

1. The entire LED sequence shown in Table 18 might occur too quickly for you to read; therefore, this sequence is provided in this tabular form as a baseline for how a line card should function at startup.
2. This LED sequence only appears in Cisco IOS release 12.0(24)S or later.
3. The fabric downloader loads the Cisco IOS software image onto the line card.

Table 19 lists other messages displayed on the line card alphanumeric LED displays.

Table 19 Other Alphanumeric LED Messages

LED Display	Meaning	Source
MAL FUNC	Line card malfunction reported by field diagnostics.	RP
MISM ATCH[1]	Line card type mismatch in paired slots.	RP
PWR STRT[1]	Line card has been newly powered on.	RP
PWR ON	Line card is powered on.	RP
IN RSET	In reset.	RP
RSET DONE	Reset complete.	RP
MBUS DNLD	MBus agent downloading.	RP
MBUS DONE	MBus agent download complete.	RP
ROMI DONE	Acquisition of ROM image complete.	RP
MSTR WAIT	Waiting for mastership determination.	RP
CLOK WAIT	Waiting for slot clock configuration.	RP

Table 19 Other Alphanumeric LED Messages (continued)

LED Display	Meaning	Source
CLOK DONE	Slot clock configuration done.	RP
FABL LOAD	Loading fabric downloader[2] complete.	RP
IOS LOAD	Downloading of Cisco IOS software is complete.	RP
BMA ERR	Cisco IOS software BMA error.	RP
FIA ERR	Cisco IOS fabric interface ASIC configuration error.	RP
CARV ERR	Buffer carving failure.	RP
DUMP REQ	Line card requesting a core dump.	RP
DUMP RUN	Line card dumping core.	RP
DUMP DONE	Line card core dump complete.	RP
DIAG MODE	Diagnostic mode.	RP
DIAG LOAD	Downloading field diagnostics over the MBus.	RP
DIAG F_LD	Downloading field diagnostics over the fabric.	RP
DIAG STRT	Launching field diagnostics.	RP
DIAG HALT	Cancel field diagnostics.	RP
DIAG TEST	Running field diagnostics tests.	RP
DIAG PASS[1]	Field diagnostics were completed successfully.	RP
POST STRT	Launching power-on self-test (POST).	RP
UNKN STAT	Unknown state.	RP
ADMN DOWN	Line card is administratively down.	RP
SCFG PRES[1]	Incorrect **hw-module slot srp** command entered.	RP
SCFG[1] REDQ	Required **hw-module slot srp** command not entered.	RP

1. This LED sequence only appears in Cisco IOS release 12.0(24)S or later.
2. The fabric downloader loads the Cisco IOS software image onto the line card.

Troubleshooting the Installation

Note Many new line cards are designated as *administratively down* by default. Status LEDs are off until you configure the interfaces and use the **no shutdown** command.

If the Active LED (Link LED or status LED for line cards with no Active LED) or the alphanumeric display LEDs on a line card do not go on, there is either a problem with the line card installation or a hardware failure. To verify that the line card is installed correctly, follow these steps:

Step 1 If the Active LED fails to go on, but the alphanumeric display LEDs on the line card indicate activity, verify that the initialization sequence ends with IOS RUN. If this is the case, verify that the interface is not shut down. If it is not, suspect a circuitry problem with the Active LED and contact a service representative for further assistance.

Step 2 If the Active LED on the line card fails to go on or the alphanumeric display LEDs do not indicate IOS RUN, check the router connections as follows:

a. Verify that the line card board connector is fully seated in the backplane. Loosen the captive installation screws and firmly pivot the ejector levers toward each other until both are perpendicular to the line card faceplate. Tighten the captive installation screws.

b. Verify that all power cords and data cables are firmly connected at both ends.

c. Verify that all memory modules on the card are fully seated and secured to their sockets.

After the line card reinitializes, the Active LED on the line card should go on. If the Active LED goes on, the installation is complete; if the Active LED does not go on, proceed to the next step.

Step 3 If the Active LED still fails to go on, remove the Ethernet line card and try installing it in another available line card slot.

- If the Active LED goes on when the line card is installed in the new slot, suspect a failed backplane port in the original line card slot.
- If the Active LED and alphanumeric display LEDs still do not go on, halt the installation. Contact a service representative to report the faulty equipment and obtain further instructions.

Step 4 If an error message displays on the console terminal during the line card initialization, see the appropriate reference publication for error message definitions. If you experience other problems that you cannot solve, contact a service representative for assistance.

For more information on troubleshooting and diagnostics, refer to the installation and configuration guide that came with your Cisco 12000 Series Router.

Step 5

Note If you perform online insertion or removal of the GBIC or SFP without shutting down the interface, a warning message is displayed on the console device.

Line Card Memory

This section contains information about the following:

You can replace the route memory on Ethernet line cards. Route memory modules are installed into 144-pin small-outline DIMM (SODIMM) sockets. Route memory runs the Cisco IOS software image and stores the updated network routing tables downloaded from the route processor.

Table 20 provides information about the various hardware engines available with the Ethernet line cards. The engine determines where the memory is placed.

Table 20 Ethernet Line Card Engines

Ethernet Line Card	Hardware Engine
8-Port Fast Ethernet	Engine 1
Gigabit Ethernet	
3-Port Gigabit Ethernet	Engine 2
4-Port Gigabit Ethernet ISE	Engine 3, Internet Services Engine (ISE)
10-Port 1-Gigabit Ethernet	Engine 4+ Enhanced Services (ES)
1-Port 10-Gigabit Ethernet	
Modular Gigabit Ethernet	

Line Card Memory Locations

The following sections contain general line card memory information for each Ethernet line card:

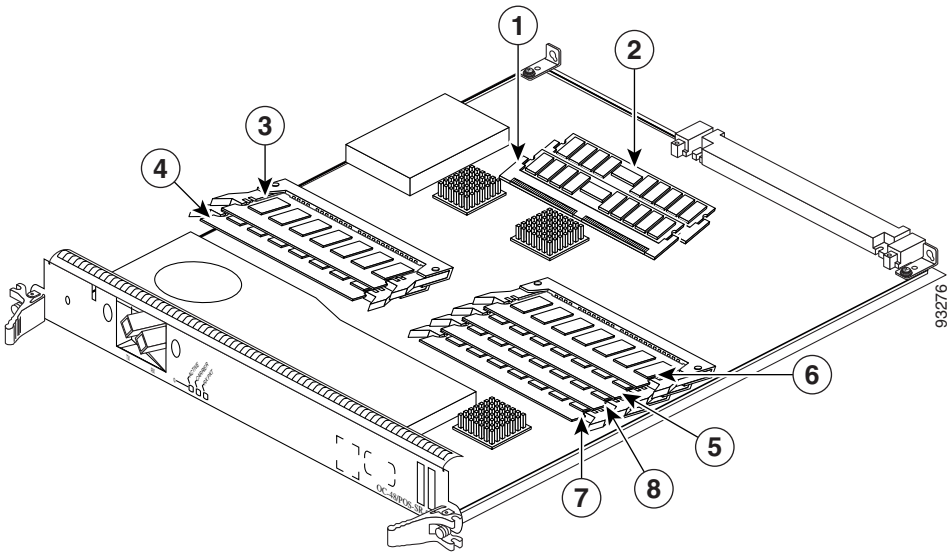
Memory removal and installation instructions are found in the "Removing and Installing Line Card Memory" section on page 69.

Engine 2 Line Card Memory Locations

Figure 45 shows the DIMM socket locations on an Engine 2 line card. This line card is equipped with eight DIMM sockets:

- Two route memory DIMM sockets
- Two pairs of packet memory DIMM sockets (RX and TX pairs)
- One pointer look-up (PLU) memory DIMM socket (not user serviceable)
- One table look-up (TLU) memory DIMM socket (not user serviceable)

Figure 45 Engine 2 Line Card Memory Locations



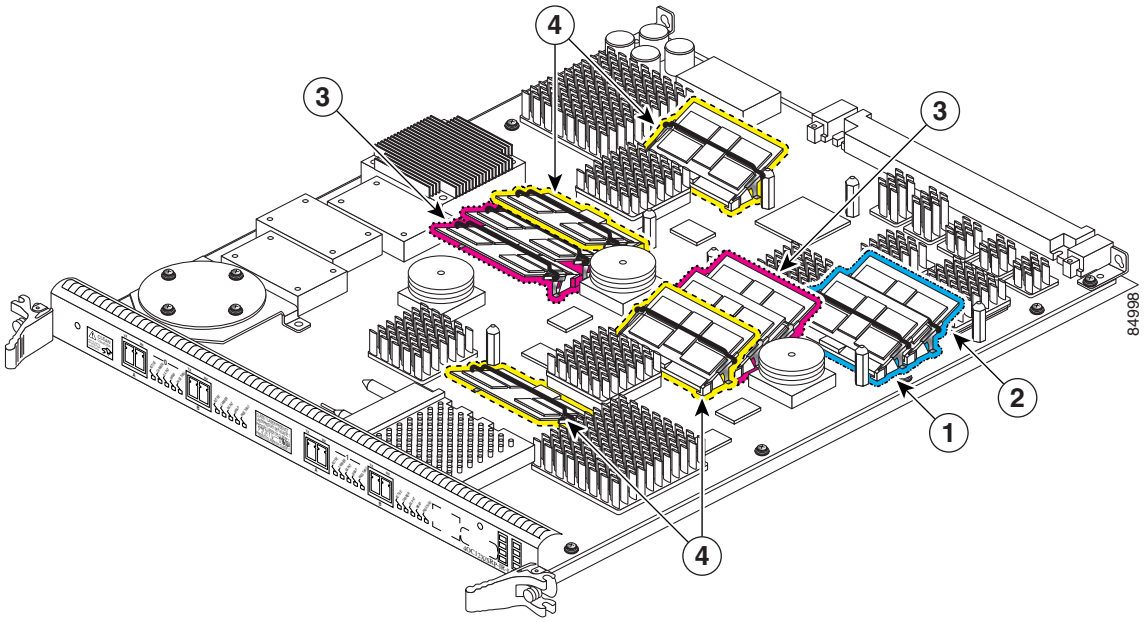
1	Route memory DIMM0	**5**	Packet memory RX DIMM0
2	Route memory DIMM1	**6**	Packet memory RX DIMM1
3	Packet memory TX DIMM0	**7**	PLU DIMM (not user serviceable)
4	Packet memory TX DIMM1	**8**	TLU DIMM (not user serviceable)

ISE Line Card Memory Locations

Figure 46 shows the small outline DIMM (SODIMM) socket locations on an ISE line card. This line card is equipped with 10 SODIMM sockets:

- Two route memory SODIMM sockets
- Four packet memory sockets (not user serviceable)
- Four TLU/PLU memory sockets (not user serviceable)

Figure 46 ISE Line Card Memory Locations



1	Route memory SODIMM0	**3**	Four packet memory SODIMM sockets (not field serviceable)
2	Route memory SODIMM1	**4**	Four TLU/PLU memory SODIMM sockets (not field serviceable)

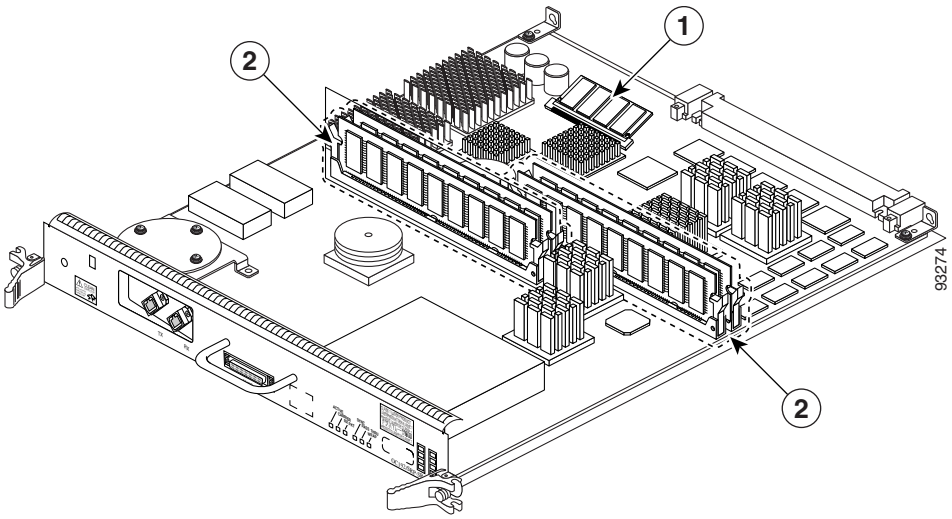
Engine 4 Line Card Memory Locations

Figure 47 shows the DIMM socket locations on an Engine 4 line card. These line cards are equipped with five DIMM sockets:

- One route memory small-outline DIMM (SODIMM) socket
- Two pairs of packet memory DIMM sockets (not user serviceable)

The route memory module is installed to a 144-pin SODIMM socket. Route memory runs the Cisco IOS software image and stores the updated network routing tables downloaded from the route processor.

Figure 47 Engine 4 Line Card Memory Locations



1	Route memory SODIMM	**2**	Packet memory DIMMs (not user serviceable)

Ethernet Line Card Route Memory Options

Route memory runs the Cisco IOS software image and stores updated network routing tables downloaded from the route processor (RP). Line card route memory ranges from 128 MB to 256 MB. Table 21 lists the available route memory configurations and associated product numbers of the memory modules used for upgrading route memory on Ethernet line cards.

Table 21 Route Memory Configurations for Ethernet Line Cards

Total Route Memory	Cisco Product Number	DIMM Module	Route Memory DIMM Sockets
64 MB	MEM-GRP/LC-64=[1]	1 64-MB DIMM	DIMM0 or DIMM1
128 MB	MEM-DFT-GRP/LC-128	1 128-MB DIMM	DIMM0 or DIMM1
128 MB	MEM-GRP/LC-128=	1 128-MB DIMM	DIMM0 or DIMM1

Table 21 Route Memory Configurations for Ethernet Line Cards (continued)

Total Route Memory	Cisco Product Number	DIMM Module	Route Memory DIMM Sockets
256 MB	MEM-GRP/LC-256=	2 128-MB DIMMs	DIMM0 and DIMM1
256 MB	MEM-LC4-256=[2]	1 256-MB SODIMM	Varies

1. This option adds a second 64-MB DIMM for a total of 128 MB for line cards that are equipped with 64 MB.
2. This option is only compatible with the 4-Port Ethernet line cards and is for replacement only.

If you are upgrading or replacing line card route and packet memory, refer to the *Cisco XR 12000 Series Router Memory Replacement Instructions* publication for installation procedures and the most up-to-date memory options.

Ethernet Line Card Packet Memory Options

Line card packet memory temporarily stores data packets awaiting switching decisions by the line card processor. Once the line card processor makes the switching decisions, the packets are propagated into the router switch fabric for transmission to the appropriate line card.

Table 22 lists the packet memory options for Ethernet line cards.

Table 22 Ethernet Line Card Packet Memory Options

Total Packet Memory[1]	Cisco Product Number	DIMM Modules	DIMM Sockets
256 MB	MEM-LC1-PKT-256=	2 RX 64-MB DIMMs 2 TX 64-MB DIMMs	RX DIMM0 and RX DIMM1 TX DIMM0 and TX DIMM1
512 MB (upgrade)	MEM-PKT-512-UPG=	2 RX 128-MB DIMMs 2 TX 128-MB DIMMs	RX DIMM0 and RX DIMM1 TX DIMM0 and TX DIMM1

1. The SDRAM DIMMs installed in a given buffer (either receive or transmit) must be the same type and size, but the individual receive and transmit buffers can operate with different memory capacities.

Removing and Installing Line Card Memory

Before beginning the memory replacement procedures in this section, ensure that you have the proper tools and equipment at hand, and that you are using appropriate ESD-prevention equipment and techniques. Before removing or installing memory, observe the following guidelines:

- Route memory DIMMs
  - Route memory DIMM0 socket must always be populated.
  - For certain memory configurations, the route memory DIMM1 socket can remain empty.
  - DIMMs must be 3.3V devices.
- Packet memory DIMMs
  - All four DIMM sockets for SDRAM buffer memory must be populated.
  - Both DIMM sockets for a given buffer pair (either those for the transmit buffer or those for the receive buffer) must be populated with SDRAM DIMMs of the same type and size.

- Size of the DIMMs in the transmit buffer need not match the size of the SDRAM DIMMs in the receive buffer.
- DIMMs must be 3.3V devices.

Instructions are in the following sections:

Removing a DIMM

To remove a DIMM from a line card, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Place the line card on an antistatic mat so that the faceplate is nearest to you.

Step 3 Locate the DIMM sockets on the line card.

Note Some line cards use DIMM sockets equipped with dual release levers, as shown in Figure 48; other line cards use DIMM sockets equipped with a single release lever, as shown in Figure 49. Both DIMM sockets operate in the same general way.

Figure 48 DIMM Socket with Dual Release Levers

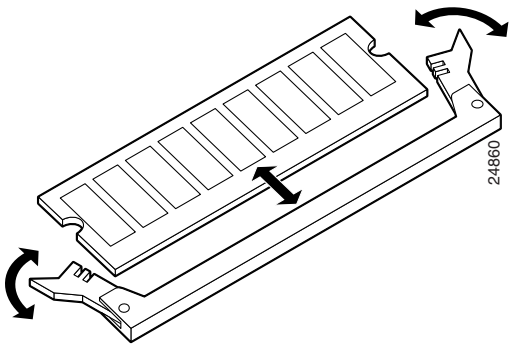
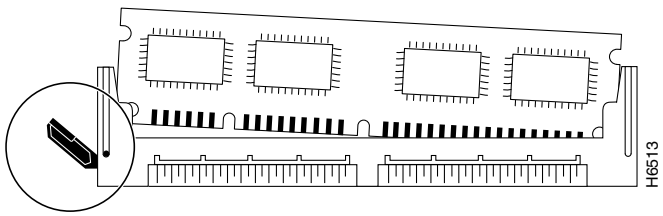


Figure 49 DIMM Socket with Single Release Lever



Step 4 Use the socket release levers to eject the DIMM.

- For a socket with dual release levers (see Figure 48), pull down both levers at the same time to eject the DIMM.

  or

- For a socket with a single release lever (see Figure 49), pull the lever to eject the DIMM.

Caution Handle the edges of the DIMM only. Do not touch the integrated circuit devices on the DIMM, the metal traces, or fingers, along the edge of the DIMM, or the pins in the DIMM socket.

Step 5 As one end of the DIMM is released, grasp the top corners of the DIMM with the thumb and forefinger of each hand and pull the DIMM completely out of its socket.

Step 6 Immediately place the DIMM in an antistatic bag to protect it from ESD damage.

Step 7 Repeat Step 4 through Step 6 for any remaining DIMMs that you want to remove.

Installing a DIMM

This section contains instructions for installing DIMM memory into a line card.

Note If you are upgrading packet memory, both DIMM sockets of a given pair (either the transmit buffer or the receive buffer) must be populated with a DIMM of the same type and size.

To install DIMMs in a line card, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Place the line card on an antistatic mat so that the faceplate is nearest to you.

Caution To prevent router and memory problems, all DIMMs installed in the line card must be 3.3V devices.

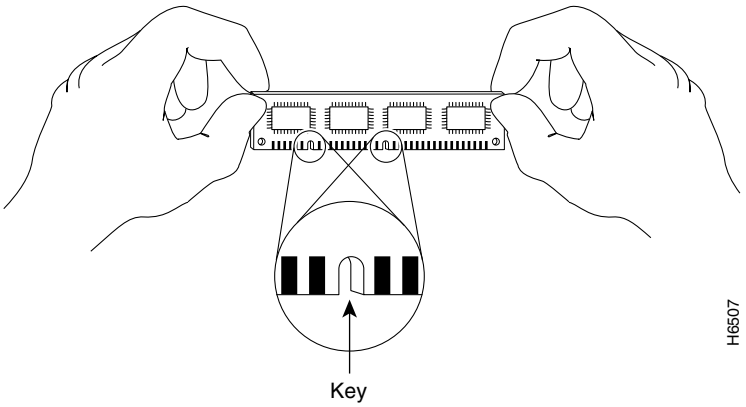
Step 3 Remove the new DIMM from its protective antistatic bag.

Step 4 Grasp the edges of the DIMM only. Do not touch the integrated circuit devices on the DIMM, the metal traces, or fingers, along the edge of the DIMM, or the pins in the DIMM socket. (See Figure 50.)

Step 5 To position the DIMM for insertion, orient it at the same angle as the DIMM socket. The two notches (keys) on the bottom edge of the module ensure that the DIMM edge connector is registered properly in the socket. (See Figure 50.)

If necessary, rock the DIMM back and forth gently to align it in the socket.

Figure 50 Handling a DIMM



Caution When inserting DIMMs into a socket, apply firm, but not excessive, pressure. If you damage a DIMM socket, you must return the line card for repair.

Step 6 Gently insert the DIMM into the socket and push until the DIMM snaps into place and the release lever is flush against the side of the socket.

Step 7 Verify that the release lever is flush against the side of the socket. If it is not, the DIMM might not be seated properly. On a socket with dual release levers, both levers should be flush against the sides of the DIMM.

If the module appears misaligned, carefully remove it and reseat it, ensuring that the release lever is flush against the side of the DIMM socket.

Step 8 Repeat Step 3 through Step 7 to install any remaining DIMMs for your memory configuration.

Removing a SODIMM

To remove a SODIMM, follow these steps:

Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Place the line card on an antistatic mat so that the faceplate is nearest to you.

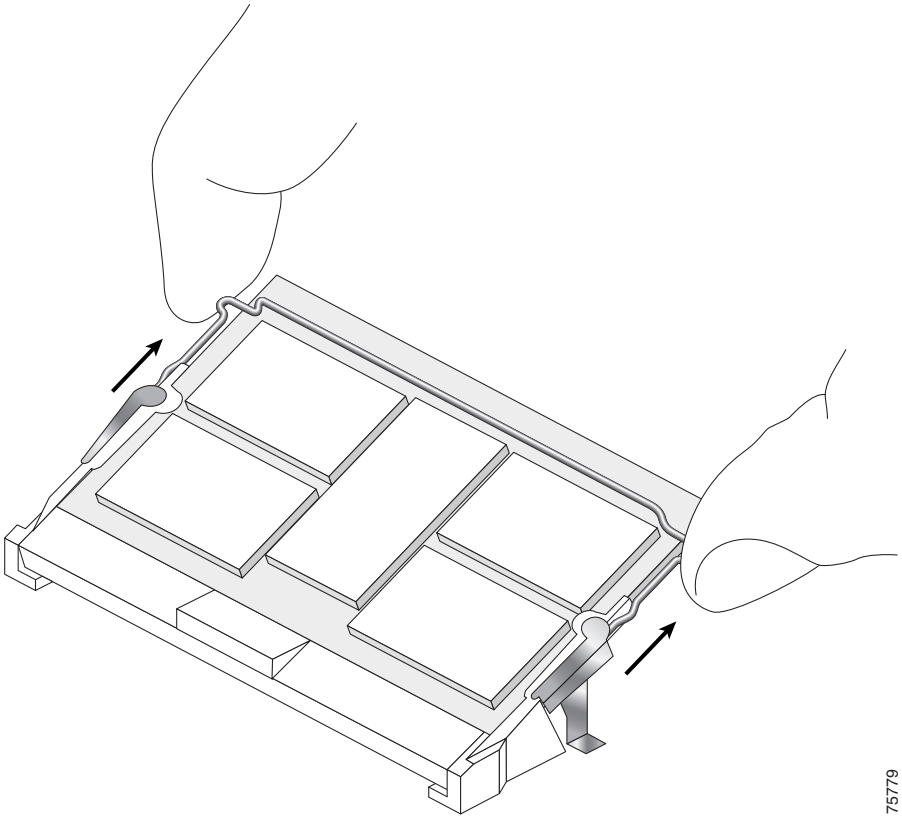
Step 3 Locate the route memory socket on the line card.

Step 4 If present, remove the SODIMM retaining clip from the memory module socket. Grasp the latch arm intersection located on each side of the clip and gently slide the clip out. (See Figure 51.) Save the retaining clip.

Note Some line cards do not require a retaining clip.

Caution If the retaining clip is bent or damaged, do not attempt to fix or reuse it. This can cause serious damage to the line card. Each SODIMM replacement ships with a spare retaining clip, in case there is any damage to the existing clip.

Figure 51 Remove Retaining Clip from Memory Module Socket

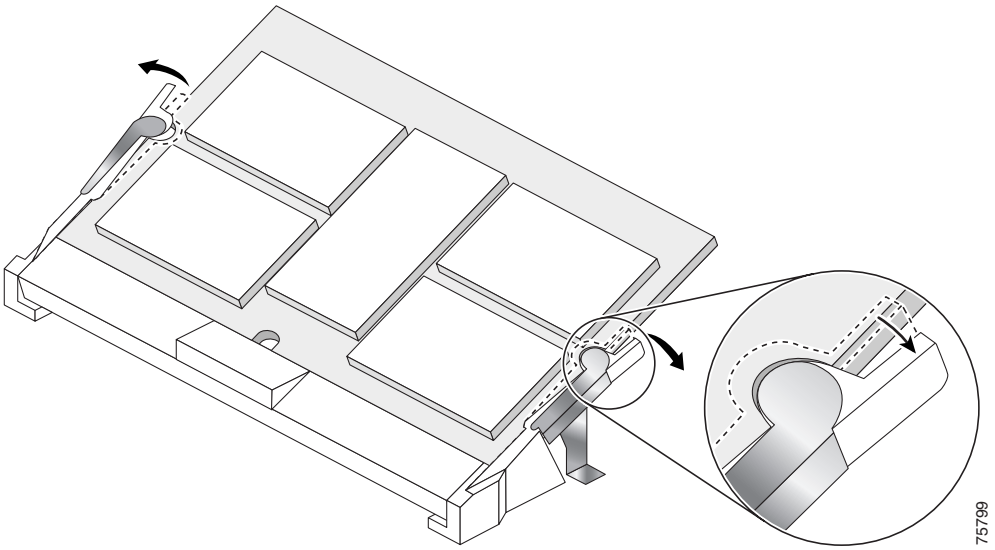


Step 5 Remove the SODIMM by gently moving the plastic latches in an outward direction, parallel to and away from the memory module, until it releases and rotates to a 45-degree angle. (See Figure 52 and Figure 53a.)

Caution The plastic latch on the SODIMM socket is enclosed by the metal strain-relief latch. The plastic latch should *never* be moved past the metal strain-relief latch.

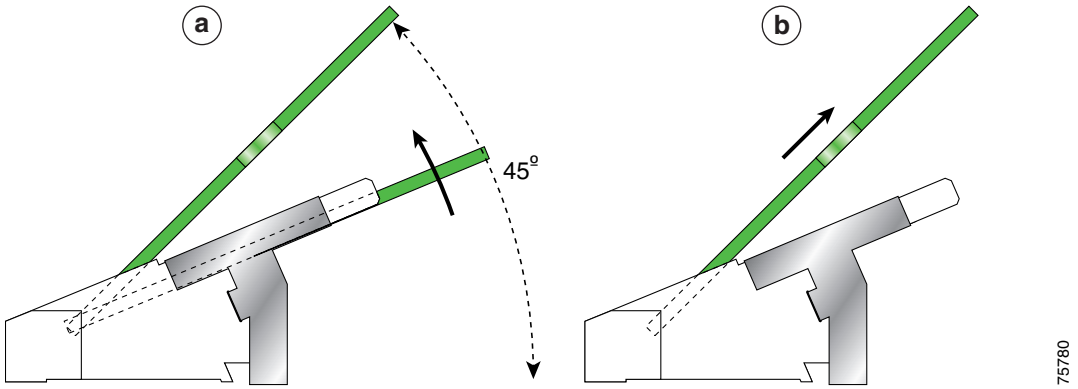
Caution Handle the edges of the SODIMM only. Do not touch the integrated circuit devices on the SODIMM; the metal traces, or fingers, along the edge of the SODIMM; or the pins in the SODIMM socket.

Figure 52 Moving the Plastic Latch Away from the SODIMM



Step 6 As the SODIMM is released, it positions itself at a 45-degree angle. Gently pull the SODIMM module out of the socket. Continue to keep the module at a 45-degree angle until it is completely removed from the socket guides. (See Figure 53b.)

Figure 53 Removing a 144-pin SODIMM Module



Step 7 Immediately place the SODIMM in an antistatic bag to protect it from ESD damage.

Installing a SODIMM

To install a SODIMM module, follow these steps:

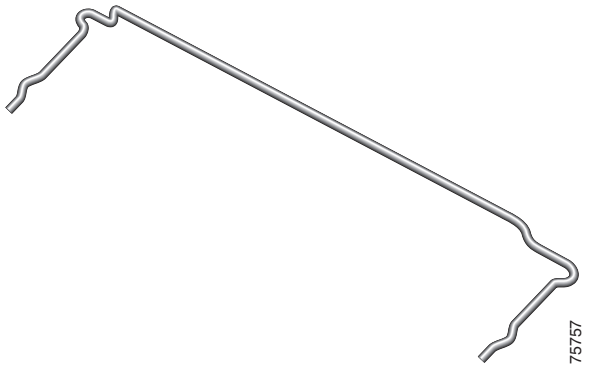
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

Step 2 Place the line card on an antistatic mat so that the faceplate is nearest to you.

Step 3 If there is a retaining clip, check to make sure that it has not been damaged or bent. (See Figure 54.)

Note Some line cards do not require a retaining clip.

Figure 54 SODIMM Socket Retaining Clip



Caution If the retaining clip is damaged, do not use it. This can damage the SODIMM socket.

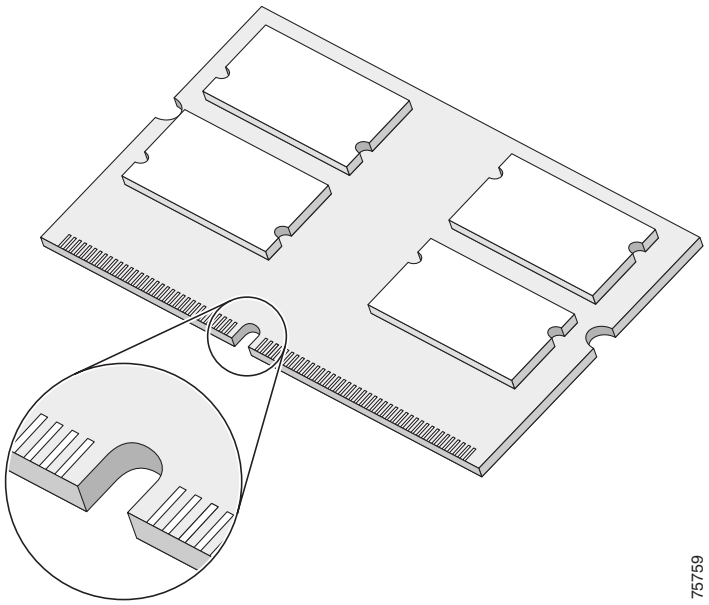
Step 4 Locate the route memory socket on the line card.

Step 5 Remove the new SODIMM from its protective antistatic bag.

Caution Grasp the edges of the SODIMM only. Do not touch the integrated circuit devices on the SODIMM; the metal traces, or fingers, along the edge of the SODIMM; or the pins in the SODIMM socket.

Step 6 Line up the SODIMM key with the key in the board socket. (See Figure 55.)

Figure 55 SODIMM with Key in Face-up Position



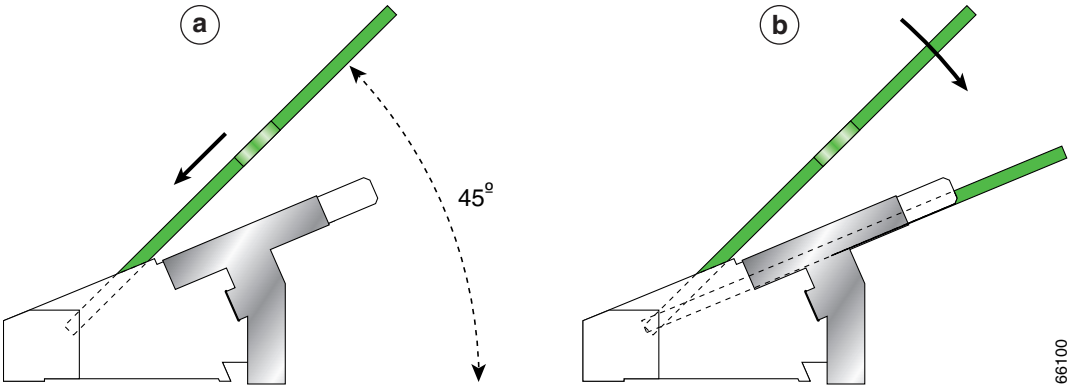
Step 7 The SODIMM must be lined up at a 45-degree angle. (See Figure 56a.)

Note When the key is in the face-up position, the metal traces on the left side of the key measure 0.9 inch (23.20 mm). The metal traces on the right side of the key measure 1.29 inches (32.80 mm). The SODIMM can not be inserted until the keys are lined up properly.

Step 8 Place both thumbs at the end of the socket and use your index fingers to guide the module into the socket until it is fully seated.

Be sure that your index fingers are located on the outer corners of the SODIMM to maintain even pressure when the module is being seated in the socket.

Figure 56 Inserting a 144-pin SODIMM Module



Step 9 Gently press the SODIMM down using your index fingers, distributing even pressure across the module until it locks into the tabs. (See Figure 56b.)

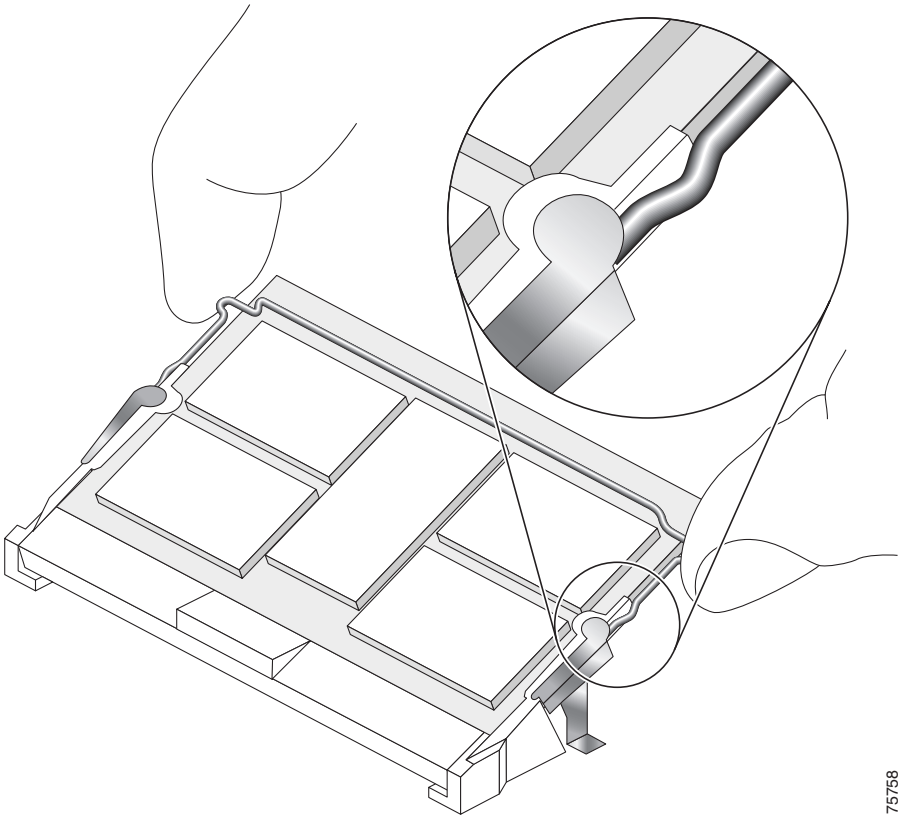
Caution Excessive pressure can damage a SODIMM socket.

Step 10 Verify that the release levers are flush against the side of the socket. If they are not, the SODIMM might not be seated properly.

Step 11 If the module appears misaligned, carefully remove it and reseat it, ensuring that the release lever is flush against the side of the SODIMM socket.

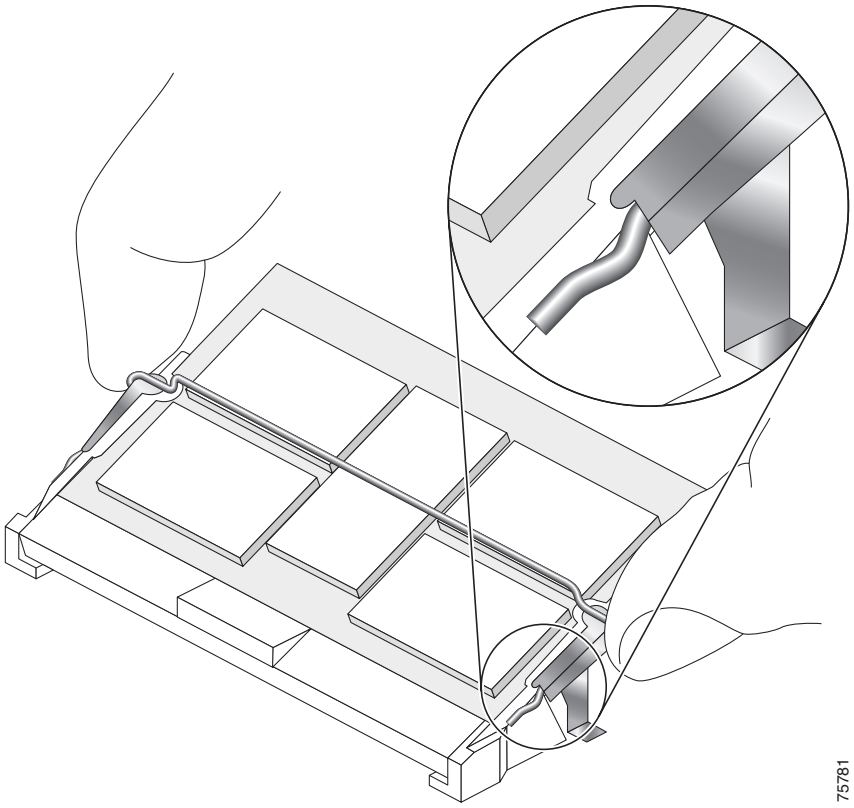
Step 12 If there is a retaining clip, insert it by sliding the clip between the metal strain relief and the plastic latch. (See Figure 57.)

Figure 57 Inserting the Retaining Clip



The clip is properly installed when the clip detente protrudes below the strain relief and plastic latch. (See Figure 58.)

Figure 58 Retaining Clip Completely Installed into Module Latch



Checking the Installation of Line Card Memory

After you install line card memory and reinstall the line card in the router, the router reinitializes the line card and detects the memory change as part of the reinitialization cycle. The time required for the router to initialize can vary with different router configurations and memory configurations.

If the line card does not reinitialize properly after you upgrade memory, or if the console terminal displays a checksum or memory error, verify that you installed the correct DIMMs and that they are installed correctly on the line card.

To check the installation of line card memory, follow these steps:

Step 1 Check the packet memory DIMMs to verify that both DIMMs are the same type, size, and speed. DIMMs must operate at 60 ns or faster. The speed of the DIMM is printed along one of its edges.

Step 2 Check the alignment of the DIMMs by looking at them across the horizontal plane of the card. The DIMMs should be aligned at the same angle and be fully inserted into their respective sockets. If a DIMM is not correctly aligned, remove it and reinsert it.

Step 3 Reinstall the line card and perform another installation check.

If the router fails to restart properly after several attempts and you are unable to resolve the problem, access Cisco.com or contact your Cisco service representative for assistance. Before calling, however, make note of any console error messages, unusual LED states, or other router indications or behaviors that might help to resolve the problem.

Regulatory, Compliance, and Safety Information

This section includes regulatory, compliance, and safety information in the following sections:

Translated Safety Warnings and Agency Approvals

The complete list of translated safety warnings and agency approvals is available in the *Regulatory Compliance and Safety Information for Cisco 12000 Series Internet Routers* publication. (Document Number 78-4347-xx.)

Electromagnetic Compatibility Regulatory Statements

This section contains the following information:

FCC Class A Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case users will be required to correct the interference at their own expense.

Modifying the equipment without Cisco's authorization may result in the equipment no longer complying with FCC requirements for Class A digital devices. In that event, your right to use the equipment may be limited by FCC regulation and you may be required to correct any interference to radio or television communication at your own expense.

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

- Turn the television or radio antenna until the interference stops.
- Move the equipment to one side or the other of the television or radio.
- Move the equipment farther away from the television or radio.
- Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

CISPR 22

This apparatus complies with CISPR 22/EN55022 Class B radiated and conducted emissions requirements.

Canada

English Statement of Compliance

This class A digital apparatus complies with Canadian ICES-003.

French Statement of Compliance

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Europe (EU)

This apparatus complies with EN55022 Class B and EN55024 standards when used as ITE/TTE equipment, and EN300386 for Telecommunications Network Equipment (TNE) in both installation environments, telecommunication centers and other indoor locations.

Class A Notice for Hungary

Warning

This equipment is a class A product and should be used and installed properly according to the Hungarian EMC Class A requirements (MSZEN55022). Class A equipment is designed for typical commercial establishments for which special conditions of installation and protection distance are used.

Figyelmeztetés a felhasználói kézikönyv számára: Ez a berendezés "A" osztályú termék, felhasználására és üzembe helyezésére a magyar EMC "A" osztályú követelményeknek (MSZ EN 55022) megfeleloen kerülhet sor, illetve ezen "A" osztályú berendezések csak megfelelo kereskedelmi forrásból származhatnak, amelyek biztosítják a megfelelo speciális üzembe helyezési körülményeket és biztonságos üzemelési távolságok alkalmazását.

Class A Notice for Taiwan and Other Traditional Chinese Markets

Warning

This is a Class A Information Product, when used in residential environment, it may cause radio frequency interference, under such circumstances, the user may be requested to take appropriate countermeasures. Statement 257

警告 這是甲類資訊產品，在居住環境中使用時，可能會造成射頻干擾，
在這種情況下，使用者會被要求採取某些適當的對策。

VCCI Class A Notice for Japan

Warning

This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio disturbance may arise. When such trouble occurs, the user may be required to take corrective actions. Statement 191

警告　これは、情報処理装置等電波障害自主規制協議会（VCCI）の規定に基づくクラスA装置です。
この装置を家庭環境で使用すると、電波妨害を引き起こすことがあります。この場合には、
使用者が適切な対策を取るように要求されることがあります。

Class A Notice for Korea

Warning

This is a Class A Device and is registered for EMC requirements for industrial use. The seller or buyer should be aware of this. If this type was sold or purchased by mistake, it should be replaced with a residential-use type. Statement 294

주의　A급 기기 이 기기는 업무용으로 전자파 적합 등록을 한 기기이
오니 판매자 또는 사용자는 이 점을 주의하시기 바라며 만약
잘못 판매 또는 구입하였을 때에는 가정용으로 교환하시기 바랍니다.

Laser Safety

Single-mode Ethernet line cards (all of the line cards except 8-Port Fast Ethernet) are equipped with a Class 1 laser. Multimode Ethernet line cards (Gigabit Ethernet and 4-Port Gigabit Ethernet ISE) are equipped with a Class 1 LED. These devices emit invisible radiation. Do not stare into operational line card ports. The following laser warnings apply to the Ethernet line cards:

- Class 1 Laser Product Warning (Single-mode), page 83
- Class 1 LED Product Warning (Multimode), page 83
- General Laser Warning, page 83

Class 1 Laser Product Warning (Single-mode)

Warning **Class 1 laser product.**

Class 1 LED Product Warning (Multimode)

Warning **Class 1 LED product.**

General Laser Warning

Warning **Invisible laser radiation can be emitted from the aperture of the port when no cable is connected. Avoid exposure to laser radiation and do not stare into open apertures.**

For translated safety warnings, refer to the *Regulatory Compliance and Safety Information for Cisco 12000 Series Internet Routers* publication (Document Number 78-4347-xx).

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS Version 2.0.

This document is to be used in conjunction with the installation guide for your Cisco XR 12000 Series Router.