Packet-Over-SONET Line Card Installation and Configuration

Document Order Number: DOC-7816412=

This guide contains instructions for installing and configuring Packet-over-SONET (POS) line cards in Cisco 12000 Series Routers. Also included are basic troubleshooting and diagnostic techniques designed to help resolve line card installations that do not successfully come online.

Contents

This installation and configuration guide includes the following sections:

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Important Information

This section contains important information about the following:

POS Line Card Product Numbers

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

Table 1 POS Line Card Product Numbers

POS Line Card	Cisco Product Number
4-Port OC-3c/STM-1c	LC-40C3/POS-MM= LC-40C3/POS-SM= 4OC3/POS-LR-SC=
OC-3c/STM-1c ISE	4OC3X/POS-IR-LC-B= 4OC3X/POS-MM-MJ-B= 4OC3X/POS-LR-LC-B= 8OC3X/POS-IR-LC-B= 8OC3X/POS-MM-MJ-B= 16OC3X/POS-I-LC-B= 16OC3X/POS-M-MJ-B=
8-Port and 16-Port OC-3c/STM-1	16OC3/POS-MM= 16OC3/POS-SM= 8OC3/POS-MM= 8OC3/POS-SM=
OC-12c/STM-4c	LC-1OC12/POS-SM= LC-1OC12/POS-MM=
Enhanced 4-Port OC-12c/STM-4c	4OC12E/POS-IR-SC= 4OC12E/POS-MM-SC= 4OC12/POS-IR-SC-B= 4OC12/POS-MM-SC-B=
4-Port OC-12c/STM-4c	4OC12c/STM-4c POS-IR-SC= 4OC12c/STM-4c POS-MM-SC=
4-Port OC-12c/STM-4c ISE	4OC12X/POS-I-SC-B= 4OC12X/POS-M-SC-B=
OC-48c/STM-16c ISE	OC48X/POS-LR-SC= OC48X/POS-SR-SC=
OC-48c/STM-16c	OC48/POS-SR-SC= OC48/POS-SR-FC=

Table 1 POS Line Card Product Numbers (continued)

POS Line Card	Cisco Product Number
Enhanced OC-48c/STM-16c	OC48E/POS-1550-SC= OC48E/POS-1550-FC= OC48E/POS-SR-SC= OC48E/POS-SR-FC= OC48E/POS-LR-SC-B= OC48E/POS-LR-FC-B= OC48E/POS-SR-SC-B= OC48E/POS-SR-FC-B=
4-Port OC-48c/STM-16c	4OC48/POS-SR-SC= 4OC48/POS-SR-FC= 4OC48/POS-LR-SC= 4OC48/POS-LR-FC= 4OC48E/POS-SR-SC= 4OC48E/POS-LR-SC=
8-Port OC-48c/STM-16c	8OC-48/POS-SFP=
OC-192c/STM-64c	OC192E/POS-VSR= OC192E/POS-SR-SC= OC192E/POS-IR-SC= OC192E/POS-LR-SC= OC192/POS-VSR= OC192/POS-SR-SC= OC192/POS-IR-SC=
2-Port OC-192c/STM-64c	2OC192/POS-SR-SC= 2OC192/POS-IR-SC= 2OC192/POS-VSR-MTP=

Router Hardware Installation

For hardware installation and configuration information for Cisco 12000 Series Routers, refer to the installation and configuration 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-replaceable 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 POS line cards.

Table 2 POS Line Card Supported Router Platforms

POS Line Card	Supported Platforms
4-Port OC-3c/STM-1c	All Cisco 12000 Series Routers
OC-3c/STM-1c ISE	All Cisco 12000 Series Routers
8-Port and 16-Port OC-3c/STM-1	All Cisco 12000 Series Routers
OC-12c/STM-4c	All Cisco 12000 Series Routers
Enhanced 4-Port OC-12c/STM-4c	All Cisco 12000 Series Routers
4-Port OC-12c/STM-4c	All Cisco 12000 Series Routers

Table 2 POS Line Card Supported Router Platforms (continued)

POS Line Card	Supported Platforms
4-Port OC-12c/STM-4c ISE	All Cisco 12000 Series Routers
OC-48c/STM-16c ISE	All Cisco 12000 Series Routers
OC-48c/STM-16c	All Cisco 12000 Series Routers
Enhanced OC-48c/STM-16c	All Cisco 12000 Series Routers
4-Port OC-48c/STM-16c	Cisco 12400 and 12800 Routers
8-Port OC-48c/STM-16c	Cisco 12800 Routers
OC-192c/STM-64c	Cisco 12400 and 12800 Routers
2-Port OC-192c/STM-64c	Cisco 12800 Routers

Note To support Engine 4 or Engine 6 line cards, Cisco 12400 and 12800 Routers must have a full set of switch fabric, specifically, one clock scheduler card (CSC) and three switch fabric cards (SFCs), or five SFCs for a Cisco 12410 or 12810 Router. (Engine 6 line cards can operate in a Cisco 12800 Router only.)

Engine 0, 1, 2, and 3 line card families will operate in a router with one CSC and three SFCs. Only Engine 0 line cards will operate if the switch fabric is degraded, for example, one CSC and two SFCs.

See Table 29 on page 78 for information on the engine of each line card. See the appropriate Cisco 12000 Series Router installation and configuration guide for information about the switch fabric and other related requirements.

Cisco IOS Software Release and Hardware Revision Requirements

To ensure compatibility with the software, your POS line card should have a specific hardware revision number. This number is printed on a label affixed to the component side of the card. The hardware revision number can also be displayed using the **show diags** *slot-number* command.

Table 3 lists the Cisco IOS releases that are compatible with each of the POS line cards as well as their minimum hardware requirements.

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

POS Line Card	Line Card Part Number	Minimum Cisco IOS Software Release	Minimum Required Hardware Version
4-Port OC-3c/STM-1c	LC-40C3/POS-MM= LC-40C3/POS-SM= 40C3/POS-LR-SC=	11.2(9) or later release of 12.0 S, RP microcode Version 1.13 or later, and line card microcode Version 1.14 or later	73-2275-04 Revision B0 for single-mode and 73-2147-04 Revision B0 for multimode
OC-3c/STM-1c ISE	4OC3X/POS-IR-LC-B=	12.0(21)S4 or a later 12.0 S release	73-8090-01 Revision A0
	4OC3X/POS-MM-MJ-B=		73-8091-01 Revision A0
	4OC3X/POS-LR-LC-B=		73-8092-01 Revision A0
	8OC3X/POS-IR-LC-B=		73-8088-01 Revision A0
	8OC3X/POS-MM-MJ-B=		73-8089-01 Revision A0
	16OC3X/POS-I-LC-B=	12.0(21)S1 or a later 12.0 S release 12.0(21)ST or a later 12.0 ST release	73-7614-02 Revision A0
	16OC3X/POS-M-MJ-B=	12.0(21)S1 or a later 12.0S release 12.0(21)ST4 or a later 12.0ST release	73-8087-01 Revision A0

Table 3 POS Line Card and Cisco IOS Release and Hardware Version Compatibility (continued)

POS Line Card	Line Card Part Number	Minimum Cisco IOS Software Release	Minimum Required Hardware Version
8-Port and 16-Port OC-3c/STM-1	16OC3/POS-MM= 16OC3/POS-SM= 8OC3/POS-MM= 8OC3/POS-SM=	12.0(10)S or later 12.0 S release	73-4050-02 Revision A0 for single-mode
OC-12c/STM-4c	LC-1OC12/POS-SM=	11.2(9) or later 12.0 S release, GRP microcode Version 1.13 or later RP version, and line card microcode Version 1.14 or later RP version	73-2184-03 Revision B0
	LC-1OC12/POS-MM=		73-2419-03 Revision B0
Enhanced 4-Port OC-12c/STM-4c	4OC12E/POS-IR-SC=	11.2(18)GS2 or later release of 11.2 GS, 12.0(6)S or a later release of 12.0 S, GRP microcode Version 1.35 or later a RP version	73-3242-03 Revision A0
	4OC12E/POS-MM-SC=		73-3241-03 Revision A0
	4OC12/POS-IR-SC-B=	11.2(19)GS4 or later 11.2 GS release, 12.0(10)S or later 12.0 S release, and GRP microcode Version 1.35 or later RP version.	73-3242-03 Revision A0
	4OC12/POS-MM-SC-B=		73-3241-03 Revision A0
4-Port OC-12c/STM-4c	4OC12c/STM-4c POS-IR-SC= 4OC12c/STM-4c POS-MM-SC=	11.2(14)GS3 or a later 12.0 S release, RP microcode Version 1.13 or later, and line card microcode Version 1.14 or later	73-3074-03 Revision A0 for single-mode and 73-3233-02 Revision A0 for multimode
4-Port OC-12c/STM-4c ISE	4OC12X/POS-I-SC-B=	12.0(21)S1 or a later 12.0 S release, 12.0(21)ST or a later 12.0 ST release	73-7612-01 Revision A0
	4OC12X/POS-M-SC-B=		73-7804-01 Revision A0
OC-48c/STM-16c ISE	OC48X/POS-LR-SC= OC48X/POS-SR-SC=	12.0(21)S1, 12.0(20.3)S or later 12.0 S release	73-5202-05 Revision A0 73-7398-05 Revision A0
OC-48c/STM-16c	OC48/POS-SR-SC= OC48/POS-SR-FC=	11.2(14)GS1 or later 12.0 S release, GRP microcode Version 1.13 or later RP version, and line card microcode Version 1.14 or later RP version	73-3221-03 Revision A0 for single-mode
Enhanced OC-48c/STM-16c	OC48E/POS-1550-SC= OC48E/POS-1550-FC= OC48E/POS-SR-SC= OC48E/POS-SR-FC= OC48E/POS-LR-SC-B= OC48E/POS-LR-FC-B= OC48E/POS-SR-SC-B= OC48E/POS-SR-FC-B=	11.2(18)GS2 or later 11.2 GS release, 12.0(6)S or later 12.0 S release, and RP microcode Version 1.35 or later B versions: 11.2(19)GS4 or later 11.2 GS release, 12.0(10)S or later 12.0 S release, and RP microcode Version 1.35 or later	73-3295-05 Revision A0 for single-mode
4-Port OC-48c/STM-16c	4OC48/POS-SR-SC= 4OC48/POS-SR-FC= 4OC48/POS-LR-SC= 4OC48/POS-LR-FC=	12.0(15)S2 or a later 12.0S release	73-4203-03 Revision A0, 73-4203-04 Revision B0
	4OC48E/POS-SR-SC= 4OC48E/POS-LR-SC=	12.0(21)S or a later 12.0S release	73-7332-03 Revision A0
8-Port OC-48c/STM-16c	8OC-48/POS-SFP=	12.0(27)S or a later 12.0S release	800-24491-01 Revision A0

Table 3 POS Line Card and Cisco IOS Release and Hardware Version Compatibility (continued)

POS Line Card	Line Card Part Number	Minimum Cisco IOS Software Release	Minimum Required Hardware Version
OC-192c/STM-64c	OC192/POS-VSR=	12.0(17)S 12.0S release, 12.0(17)ST or later 12.0ST release	73-7471-03 Revision A0 73-7471-03 Revision B0
	OC192/POS-SR-SC=	12.0(15)S2 or later 12.0S release	73-4202-02 Revision A0 73-4202-03 Revision B0
	OC192/POS-IR-SC=		73-6976-02 Revision A0 73-4202-03 Revision B0
	OC192E/POS-VSR= OC192E/POS-SR-SC= OC192E/POS-IR-SC=	12.0(21)S or later 12.0S release	73-7335-04 Revision A0
	OC192E/POS-LR-SC	12.0(24)S or later 12.0S release	73-7335-04 Revision A0
2-Port OC-192c/STM-64c	2OC192/POS-SR-SC= 2OC192/POS-IR-SC= 2OC192/POS-VSR-MTP=	12.0(27)S or a later 12.0S release	800-20519-01 Revision A0

The **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. 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

POS line card memory options vary by line card. See "Line Card Memory" section on page 77 for more information.

Related Documentation

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

- Cisco 12000 Series Router Installation and Configuration Guide
- *Cisco IOS Configuration Fundamentals Configuration Guide*
- *Cisco IOS Configuration Fundamentals Command Reference*
- *Software Configuration Guide for the Cisco 12000 Series Internet Router*
- *Cisco IOS Release 12.0S Release Notes for Cisco 12000 Series Routers*
- *Regulatory Compliance and Safety Information for Cisco 12000 Series Routers*

- *Cisco IOS Software Configuration for the Cisco 12000 Series 2-Port OC-192c/STM-64 Packet over SONET Line Card*

See the "Obtaining Documentation" section on page 98 for information on how to obtain these publications.

Product Overviews

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

POS Line Card Comparison

Table 4 provides comparative information about POS line cards.

Table 4 POS Line Card Hardware Comparison

POS Line Card	Line Card Part Number	Ports	SFP	Cable and Connector	Wavelength and Optics	Memory (Default Route, Packet)
Optical Carrier 3 (OC-3) Speed						
4-Port OC-3c/STM-1c POS Line Card	LC-4OC3/POS-SM=	4		Single-mode fiber with subscriber connectors (SCs)	1310 nm intermediate-reach (IR)	Engine 0 128 MB, 128 MB
	LC-4OC3/POS-MM=	4		Multimode fiber with SC connectors	1310 nm	Engine 0 128 MB, 128 MB
	40C3/POS-LR-SC=	4		Single-mode fiber with SC connectors	1310 nm long-reach (LR)	Engine 0 128 MB, 128 MB

Table 4 POS Line Card Hardware Comparison (continued)

POS Line Card	Line Card Part Number	Ports	SFP	Cable and Connector	Wavelength and Optics	Memory (Default Route, Packet)
OC-3c/STM-1c ISE POS Line Card	4OC3X/POS-IR-LC-B=	4		Single-mode fiber with Lucent connectors (LCs)	1310 nm IR	Engine 3 256 MB, 512 MB
	4OC3X/POS-MM-MJ-B=	4		Multimode fiber with mechanical transfer registered jack (MTRJ) connectors	1310 nm short-reach (SR)	Engine 3 256 MB, 512 MB
	4OC3X/POS-LR-LC-B=	4		Single-mode fiber with LC connectors	1310 nm LR	Engine 3 256 MB, 512 MB
	8OC3X/POS-IR-LC-B=	8		Single-mode fiber with LC connectors	1310 nm IR	Engine 3 256 MB, 512 MB
	8OC3X/POS-MM-MJ-B=	8		Multimode fiber with MTRJ connectors	1310 nm SR	Engine 3 256 MB, 512 MB
	16OC3X/POS-I-LC-B=	16		Single-mode fiber with LC connectors	1310 nm IR	Engine 3 256 MB, 512 MB
	16OC3X/POS-M-MJ-B=	16		Multimode fiber with MTRJ connectors	1310 nm SR	Engine 3 256 MB, 512 MB
8-Port and 16-Port OC-3c/STM-1 POS Line Card	8OC3/POS-SM=	8		Single-mode fiber with LC connectors	1310 nm IR	Engine 2 128 MB, 256 MB
	8OC3/POS-MM=	8		Multimode fiber with duplex MTRJ connectors	1310 nm SR	Engine 2 128 MB, 256 MB
	16OC3/POS-SM=	16		Single-mode fiber with LC connectors	1310 nm IR	Engine 2 128 MB, 256 MB
	16OC3/POS-MM=	16		Multimode fiber with duplex MTRJ connectors	1310 nm SR	Engine 2 128 MB, 256 MB
OC-12 Speed						
OC-12c/STM-4c POS Line Card	LC-1OC12/POS-SM=	1		Single-mode fiber with SC connectors	1310 nm IR	Engine 0 128 MB, 256 MB
	LC-1OC12/POS-MM=	1		Multimode fiber with SC connectors	1310 nm	Engine 0 128 MB, 256 MB
Enhanced 4-Port OC-12c/STM-4c POS Line Card	4OC12E/POS-IR-SC= 4OC12/POS-IR-SC-B=	4		Single-mode fiber with SC connectors	1310 nm IR	Engine 2 128 MB, 256 MB
	4OC12E/POS-MM-SC= 4OC12/POS-MM-SC-B=	4		Multimode fiber with SC connectors	1310 nm SR	Engine 2 128 MB, 256 MB
4-Port OC-12c/STM-4c POS Line Card	4OC12c/STM-4c POS-IR-SC=	4		Single-mode fiber SC connectors	1310 nm IR	Engine 2 128 MB, 256 MB
	4OC12c/STM-4c POS-MM-SC=	4		Multimode fiber with SC connectors	1310 nm	Engine 2 128 MB, 256 MB
4-Port OC-12c/STM-4c ISE POS Line Card	4OC12X/POS-I-SC-B=	4		Single-mode fiber with SC connectors	1310 nm IR	Engine 3 256 MB, 512 MB
	4OC12X/POS-M-SC-B=	4		Multimode fiber with SC connectors	1310 nm	Engine 3 256 MB, 512 MB

Table 4 POS Line Card Hardware Comparison (continued)

POS Line Card	Line Card Part Number	Ports	SFP	Cable and Connector	Wavelength and Optics	Memory (Default Route, Packet)
OC-48 Speed						
OC-48c/STM-16c ISE POS Line Card	OC48X/POS-SR-SC=	1		Single-mode fiber with SC connectors	1310 nm SR	Engine 3 256 MB, 512 MB
	OC48X/POS-LR-SC=	1		Single-mode fiber with SC connectors	1550 nm LR2	Engine 3 256 MB, 512 MB
OC-48c/STM-16c POS Line Card	OC48/POS-SR-SC=	1		Single-mode fiber with SC connectors	1310 nm SR	Engine 2 128 MB, 256 MB
	OC48/POS-SR-FC=	1		Single-mode fiber with simplex fiber connectors (FCs)	1310 nm SR	Engine 2 128 MB, 256 MB
Enhanced OC-48c/STM-16c POS Line Card	OC48E/POS-SR-SC= OC48E/POS-SR-SC-B=	1		Single-mode with simplex SC connector	1310 nm SR	Engine 2 128 MB, 256 MB
	OC48E/POS-SR-FC= OC48E/POS-SR-FC-B=	1		Single-mode with one simplex FC connector	1310 nm SR	Engine 2 128 MB, 256 MB
	OC48E/POS-LR-FC-B=	1		Single-mode with one simplex FC connector	1550 nm LR	Engine 2 128 MB, 256 MB
	OC48E/POS-LR-SC-B=	1		Single-mode with simplex SC connector	1550 nm LR2	Engine 2 128 MB, 256 MB
	OC48E/POS-1550-SC=	1		Single-mode with simplex SC connector	1550 nm LR	Engine 2 128 MB, 256 MB
	OC48E/POS-1550-FC=	1		Single-mode with one simplex FC connector	1550 nm LR	Engine 2 128 MB, 256 MB
4-Port OC-48c/STM-16c POS Line Card	4OC48/POS-SR-SC=	4		Single-mode fiber with SC connectors	1310 nm SR	Engine 4 256 MB, 512 MB
	4OC48/POS-SR-FC=	4		Single-mode fiber with FC connectors	1310 nm SR	Engine 4 256 MB, 512 MB
	4OC48/POS-LR-SC=	4		Single-mode fiber with SC connectors	1550 nm LR	Engine 4 256 MB, 512 MB
	4OC48/POS-LR-FC=	4		Single-mode fiber with FC connectors	1550 nm LR	Engine 4 256 MB, 512 MB
4-Port OC-48c/STM-16c POS Line Card	4OC48E/POS-SR-SC=	4		Single-mode fiber with SC connectors	1310 nm SR	Engine 4+ 256 MB, 512 MB
	4OC48E/POS-LR-SC=	4		Single-mode fiber with SC connectors	1550 nm LR2	Engine 4+ 256 MB, 512 MB
8-Port OC-48c/STM-16c POS Line Card	8OC-48/POS-SFP=	8	X	Single-mode fiber with LC connectors	Depends on SFP: 1310 nm (SR, IR); 1550 nm (LR)	Engine 6 512 MB, 1 GB

Table 4 POS Line Card Hardware Comparison (continued)

POS Line Card	Line Card Part Number	Ports	SFP	Cable and Connector	Wavelength and Optics	Memory (Default Route, Packet)
OC-192 Speed						
OC-192c/STM-64c POS Line Card	OC192/POS-VSR= OC192E/POS-VSR=	1		Multimode fiber with multiple terminations push-pull latch (MTP) connector	850 nm very-short-reach (VSR1)	Engine 4 or 4+ 256 MB, 512 MB
	OC192/POS-SR-SC = OC192E/POS-SR-SC=	1		Single-mode fiber with SC connectors	1310 nm SR2	Engine 4 or 4+ 256 MB, 512 MB
	OC192/POS-IR-SC= OC192E/POS-IR-SC=	1		Single-mode fiber with SC connectors	1550 nm IR2	Engine 4 or 4+ 256 MB, 512 MB
	OC192E/POS-LR-SC=	1		Single-mode fiber with SC connectors	1550 nm LR2	Engine 4+ 256 MB, 512 MB
2-Port OC-192c/STM-64c POS Line Card	2OC192/POS-SR-SC=	2		Single-mode fiber with SC connectors	1310 nm IR	Engine 6 512 MB, 1 GB
	2OC192/POS-IR-SC=	2		Single-mode fiber with SC connectors	1550 nm IR	Engine 6 512 MB, 1 GB
	2OC192/POS-VSR-MTP=	2		Multimode fiber with MTP connectors	850 nm VSR	Engine 6 512 MB, 1 GB

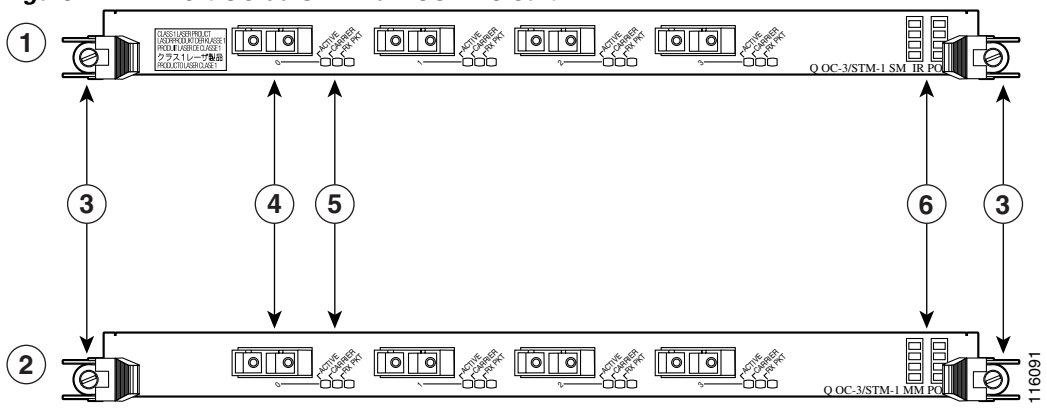
Caution For the 8-Port OC-48c/STM-16c line card, only use small form-factor pluggable modules (SFPs) supplied by Cisco for the Cisco 12000 Series Routers. Each SFP module contains an internal serial number that is security programmed by the SFP module manufacturer with information that provides a way 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 POS line cards. Unapproved SFP modules (those not purchased directly from Cisco) do not work.

4-Port OC-3c/STM-1c POS Line Card

The 4-port OC-3c/STM-1c POS line card provides the Cisco 12000 Series Router with four POS ports on a single card. The card interfaces with the router switch fabric and provides four OC-3c/STM-1c duplex SC SONET connections. These connections are concatenated, which increases efficiency by eliminating the need to partition the bandwidth.

Figure 1 shows the front view of the card.

Figure 1 4-Port OC-3c/STM-1c POS Line Card



1	Single-mode	**4**	Port 0
2	Multimode	**5**	Status LEDs
3	Ejector lever	**6**	Alphanumeric LEDs

Use a single-mode or multimode, fiber-optic interface cable to connect your Cisco 12000 Series Router to another router or switch. For SONET/SDH single-mode and multimode fiber-optic connections, use one duplex SC-type connector or two simplex SC-type connectors.

The default line card route and packet memory configuration is 128 MB. See the "Line Card Memory" section on page 77 for more information.

OC-3c/STM-1c ISE POS Line Card

Note Unless otherwise specified, throughout this publication the 4-port, 8-port and 16-port OC-3c/STM-1c ISE POS line cards are all referred to as the OC-3c/STM-1c ISE POS line card.

These line cards provide Cisco 12000 Series Routers with 155 Mbps of bandwidth for each interface and are concatenated, which provides for increased efficiency by eliminating the need to partition the bandwidth. Table 5 lists the different versions of the OC-3c/STM-1c ISE POS line card that are available.

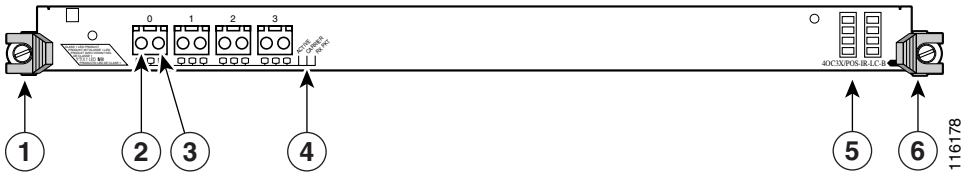
Table 5 OC-3c/STM-1c ISE POS Line Card Versions

Line Card	Product Code	Ports	Reach[1]	Optic Type	Connector Type
4-Port OC-3c/STM-1c ISE	4OC3X/POS-IR-LC-B=	4	IR	Single-mode	LC
	4OC3X/POS-MM-MJ-B=	4	SR	Multimode	MTRJ
	4OC3X/POS-LR-LC-B=	4	LR	Single-mode	LC
8-Port OC-3c/STM-1c ISE	8OC3X/POS-IR-LC-B=	8	IR	Single-mode	LC
	8OC3X/POS-MM-MJ-B=	8	SR	Multimode	MTRJ
16-Port OC-3c/STM-1c ISE	16OC3X/POS-I-LC-B=	16	IR	Single-mode	LC
	16OC3X/POS-M-MJ-B=	16	SR	Multi-mode	MTRJ

1. Intermediate-reach (IR), short-reach (SR), long-reach (LR)

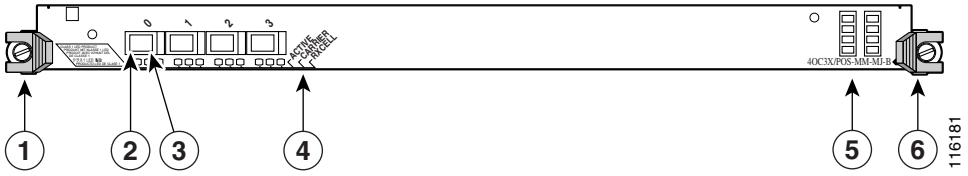
Figure 2 and Figure 3 show the 4-port versions of the line card.

Figure 2 4-Port OC-3c/STM-1c ISE POS Line Card, LC Version



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

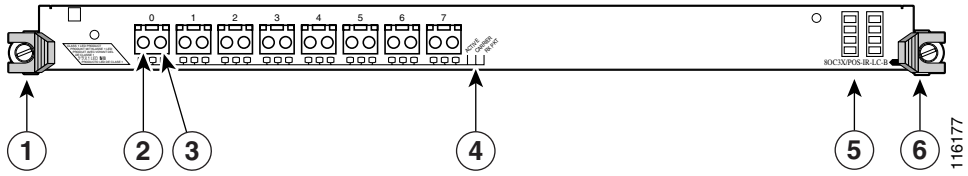
Figure 3 4-Port OC-3c/STM-1c ISE POS Line Card, MTRJ Version



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

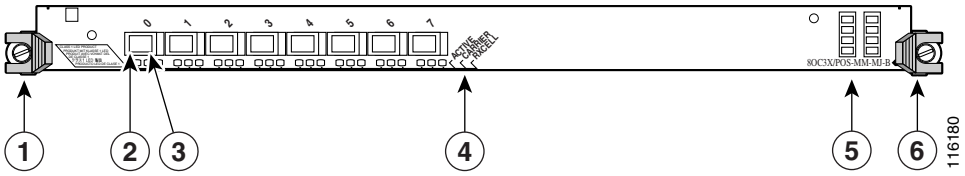
Figure 4 and Figure 5 show the 8-port versions of the line card.

Figure 4 8-Port OC-3c/STM-1c ISE POS Line Card, LC Version



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

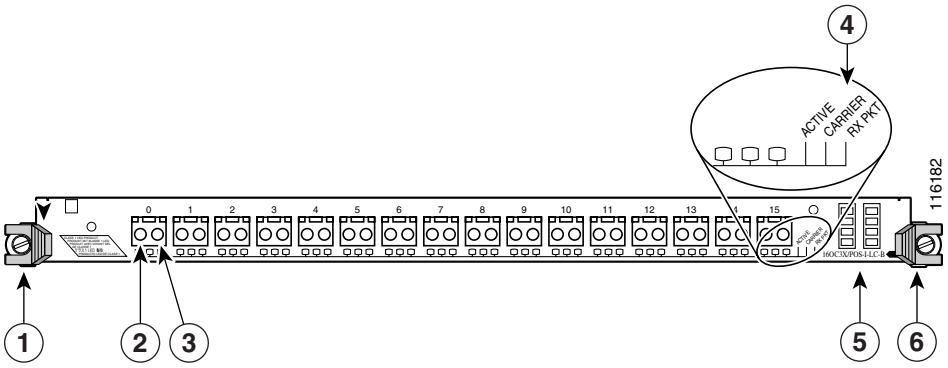
Figure 5 8-Port OC-3c/STM-1c ISE POS Line Card, MTRJ Version



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

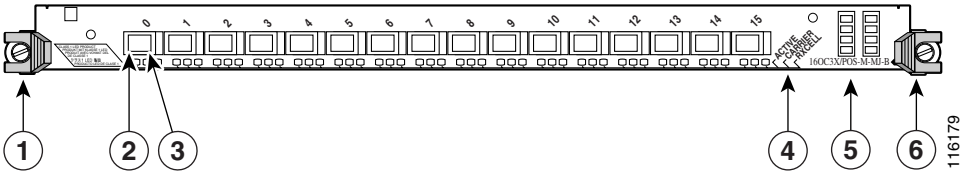
Figure 6 and Figure 7 show the 16-port versions of the line card.

Figure 6 16-Port OC-3c/STM-1c ISE POS Line Card, LC Version



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

Figure 7 16-Port OC-3c/STM-1c ISE POS Line Card, MTRJ Version



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

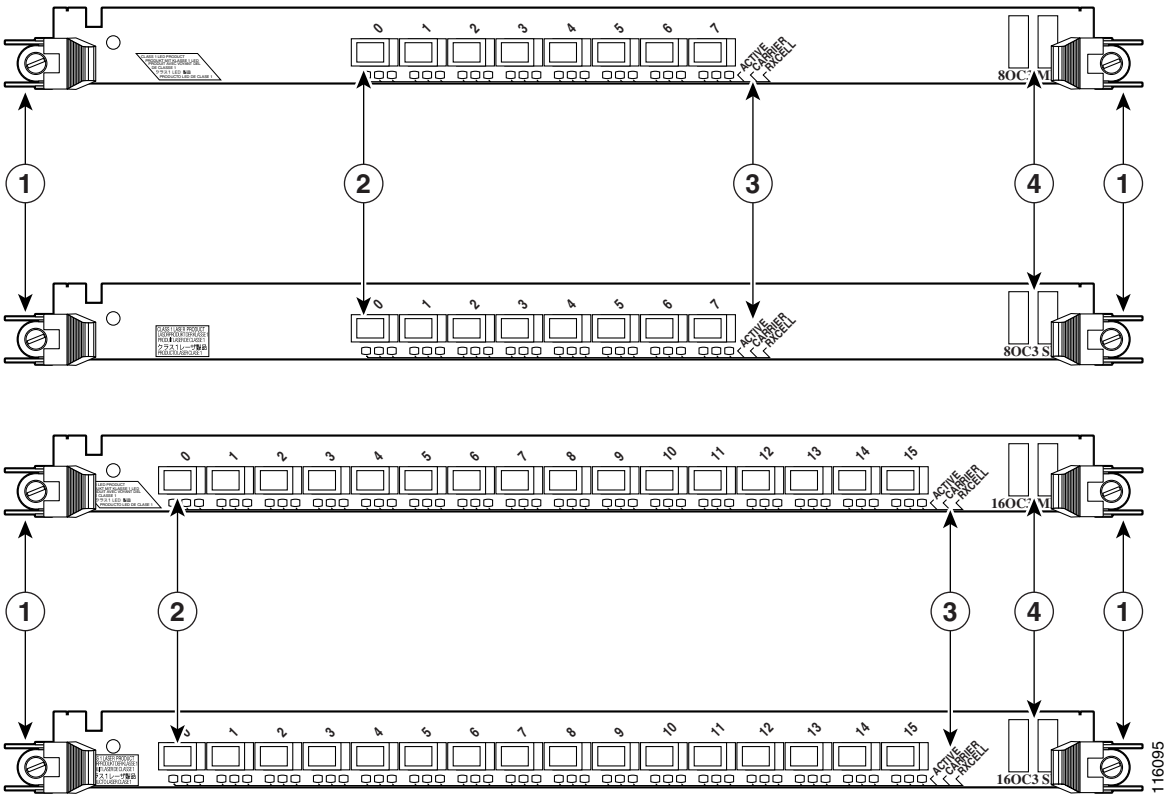
The OC-3c/STM-1c ISE POS line card ships with 512 MB of packet memory, which is not field serviceable. Additionally, the line card route processor memory has a default configuration of 256 MB and can be upgraded to 512 MB. See the "Line Card Memory" section on page 77 for more information.

8-Port and 16-Port OC-3c/STM-1 POS Line Card

The single-mode or multimode 8-port and 16-port OC-3c/STM-1 POS line cards allows Cisco 12000 Series Routers to aggregate large amounts of data on existing fiber networks.

Figure 8 shows the front view of the 8-port and 16-port OC-3c/STM-1 POS line card.

Figure 8 8-Port and 16-Port OC-3c/STM-1 POS Line Cards



1	Ejector lever	**3**	Status LEDs
2	Port 0	**4**	Alphanumeric LEDs

For SONET/SDH single-mode fiber-optic connections, use a MTRJ duplex connector or an LC duplex connector.

You need an adapter if you are connecting these line cards to ports with SC connectors. For the 8-port OC-3c/STM-1 POS line card, you will need eight SC-to-LC duplex cable adaptors for the single-mode fiber interface, or eight SC-to-MTRJ duplex cable adaptors for the multimode fiber interface. For the 16-Port OC-3c/STM-1 POS line card, you will need sixteen SC-to-LC duplex cable adaptors for the single-mode fiber interface, or sixteen SC-to-MTRJ duplex cable adaptors for the multimode fiber interface. Cisco does not provide cable adaptors for these line cards. Cisco recommends that you contact a vendor to order the required cable adaptors in Table 6, and specify the length of the cable connection. The default cable length is 10 feet.

Table 6 Duplex Cable Adaptor Types

Single-mode Duplex Cable Adaptors	Multimode Duplex Cable Adaptors
SC-to-LC	SC-to-MTRJ

Note Cisco does not provide the cables or adaptors for the 8-port and 16-port OC-3c/STM-1 POS line cards.

If you order an 8-Port or 16-Port OC-3c/STM-1 POS line card as a spare, field-replaceable unit, you must order the cables at an additional cost.

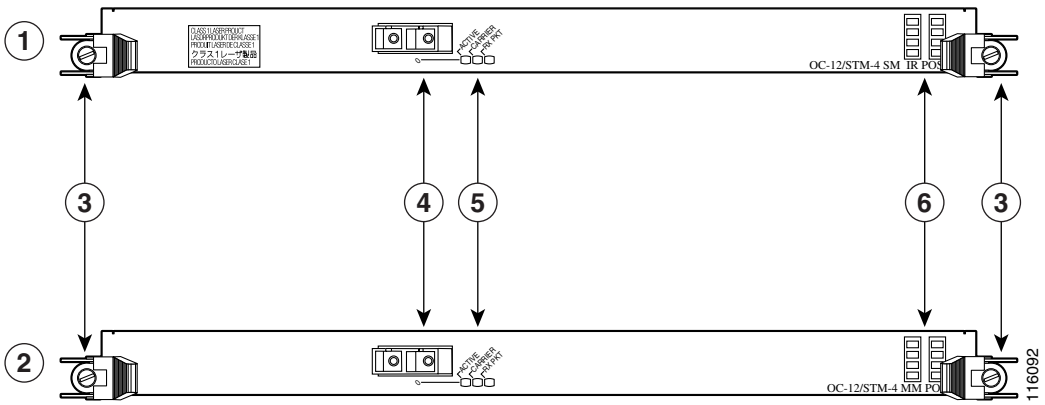
The default route memory is 128 MB and the default packet memory is 256 MB. They are field serviceable. See the "Line Card Memory" section on page 77 for more information.

OC-12c/STM-4c POS Line Card

The OC-12c/STM-4c POS line card provides the Cisco 12000 Series Router with a single 622-Mbps POS interface on a single card. The card interfaces with the switch fabric of the Cisco 12000 Series Router and provides one OC-12c/STM-4c duplex SC single-mode or multimode SONET/SDH connection. This connection is concatenated, which provides for increased efficiency by eliminating the need to partition the bandwidth.

Figure 9 shows the front view of the line card.

Figure 9 OC-12c/STM-4c POS Line Card



1	Single-mode	**4**	Port 0
2	Multimode	**5**	Status LEDs
3	Ejector lever	**6**	Alphanumeric LEDs

Use a single-mode or multimode fiber-optic interface cable to connect your Cisco 12000 Series Router to another router or switch.

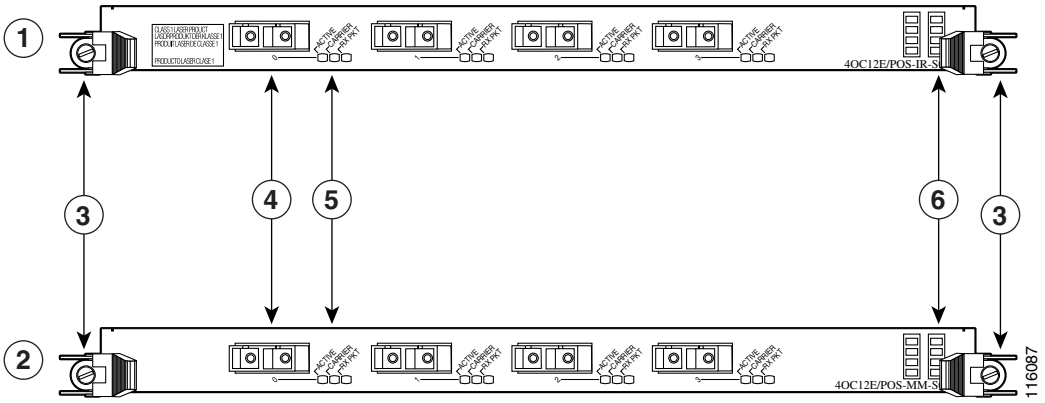
The default line card route memory configuration is 128 MB. The default packet memory is 256 MB. See the "Line Card Memory" section on page 77 for more information.

Enhanced 4-Port OC-12c/STM-4c POS Line Card

The enhanced 4-port OC-12c/STM-4c POS line card provides Cisco 12000 Series Routers with four 622-Mbps POS interfaces on a single card. The card interfaces with the switch fabric in the Cisco 12000 Series Router and provides four OC-12c/STM-4c duplex SONET connections through SC connectors. Each connection is concatenated, which provides for increased efficiency by eliminating the need to partition the bandwidth.

Figure 10 shows the front view of the line card.

Figure 10 Enhanced 4-Port OC-12c/STM-4c POS Line Card



1	Single-mode	**4**	Port 0
2	Multimode	**5**	Status LEDs
3	Ejector lever	**6**	Alphanumeric LEDs

Note The older versions and the newer -B versions of the enhanced 4-port OC-12c/STM-4c POS line card are identical in form, fit, and function when running IOS Release 12.0(10)S or later. The product numbers with -B at the end are the latest versions of the enhanced 4-port OC-12c/STM-4c POS line card and will eventually supersede the older models.

The enhanced 4-port OC-12c/STM-4c POS line cards have SC-type fiber-optic interface connectors. Use a single-mode or multimode fiber-optic interface cable, as appropriate, to connect your Cisco 12000 Series Router to another router or switch. You can use either one duplex SC-type connector or two simplex SC-type connectors.

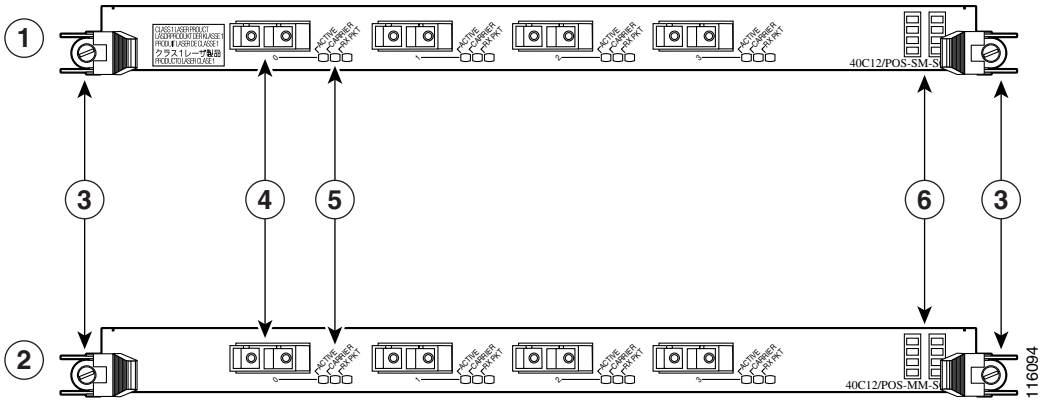
This POS line card comes equipped with a 128 MB route memory module and 256 MB packet memory module, which can be replaced if necessary. See the "Line Card Memory" section on page 77 for more information.

4-Port OC-12c/STM-4c POS Line Card

The 4-port OC-12c/STM-4c POS line card provides Cisco 12000 Series Routers with four 622.080 Mbps POS interfaces on a single card. The card interfaces with the switch fabric in the router and provides four OC-12c/STM-4c duplex SC single-mode and multimode connections. This connection is concatenated, which provides for increased efficiency by eliminating the need to partition the bandwidth.

Figure 11 shows the front view of the 4-port OC-12c/STM-4c POS line card.

Figure 11 4-Port OC-12c/STM-4c POS Line Card



1	Single-mode	**4**	Port 0
2	Multimode	**5**	Status LEDs
3	Ejector lever	**6**	Alphanumeric LEDs

Use a single-mode or multimode fiber-optic interface cable to connect your Cisco 12000 Series Router to another router or switch. The 4-port OC-12c/STM-4c POS line card supports single-mode and multimode versions of the line card. For SONET/SDH single-mode or multimode fiber-optic connections, use one duplex or two simplex SC-type connectors.

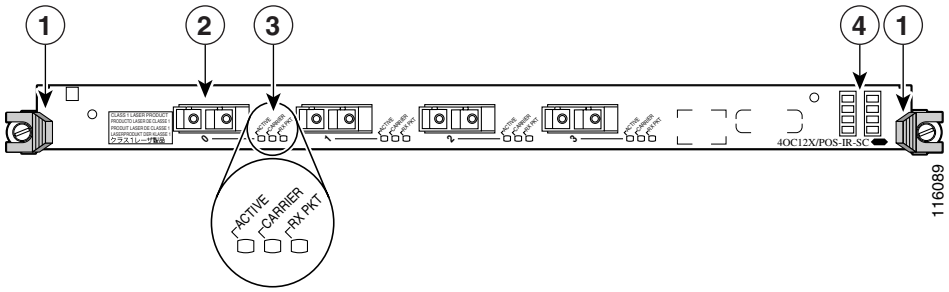
The default line card route memory configuration is 128 MB. The default packet memory is 256 MB. Both are upgradeable. See the "Line Card Memory" section on page 77 for more information.

4-Port OC-12c/STM-4c ISE POS Line Card

The 4-port OC-12c/STM-4c ISE POS line card provides the Cisco 12000 Series Routers with four 622-Mbps concatenated POS interfaces on a single card and provides four OC-12c/STM-4c full-duplex single-mode intermediate-reach interfaces or multimode short-reach interfaces.

Figure 12 shows a front view of the 4-port OC-12c/STM-4c ISE POS line card.

Figure 12 4-Port OC-12c/STM-4c ISE POS Line Card Front Panel



1	Ejector lever	**3**	Status LEDs
2	Port 0	**4**	Alphanumeric LEDs

For SONET fiber-optic connections, use one duplex SC-type connector or two simplex SC-type connectors.

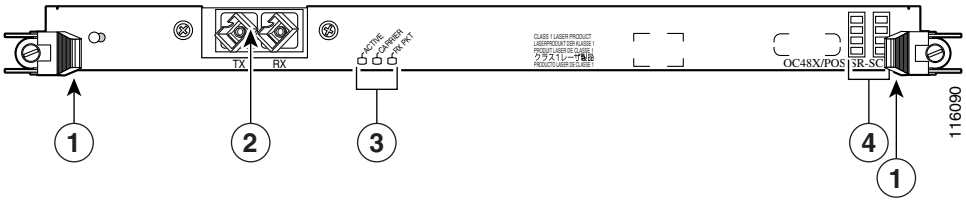
The 4-port OC-12c/STM-4c ISE POS line card route memory default is 256 MB and is upgradeable to 512 MB. It has 512 MB of packet memory. See the "Line Card Memory" section on page 77 for more information.

OC-48c/STM-16c ISE POS Line Card

The OC-48c/STM-16c ISE POS line card provides the Cisco 12000 Series Router with a single 2.5-Gbps POS interface on a single card and an OC-48/STM-16 full duplex single-mode interface. There is a short-reach and a long-reach version of the line card.

Figure 13 shows a front view of the OC-48c/STM-16c ISE POS line card.

Figure 13 OC-48c/STM-16c ISE POS Line Card Front Panel and Backplane Connector



1	Ejector lever	**3**	Status LEDs
2	Port 0	**4**	Alphanumeric LEDs

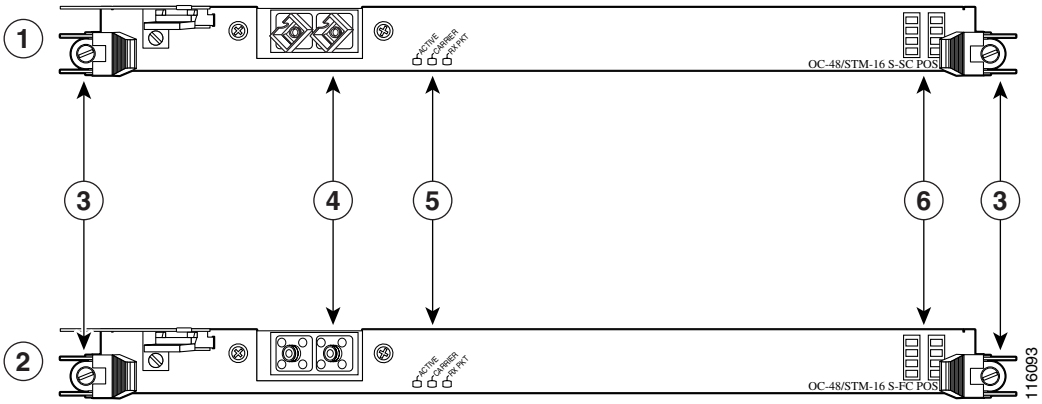
The line card route memory default is 256 MB and is upgradeable to 512 MB. It has 512 MB of packet memory. See the "Line Card Memory" section on page 77 for more information.

OC-48c/STM-16c POS Line Card

The OC-48c/STM-16c POS line card provides Cisco 12000 Series Routers with a single 2.5-Gbps POS interface on a single card. The card interfaces with the switch fabric in the Cisco 12000 Series Router and provides one OC-48c/STM-16c duplex SC or FC single-mode connection.

Figure 14 shows the front view of the line card.

Figure 14 OC-48c/STM-16c POS Line Card



1	Single-mode	**4**	Port 0
2	Multimode	**5**	Status LEDs
3	Ejector lever	**6**	Alphanumeric LEDs

Use a single-mode fiber-optic interface cable to connect your Cisco 12000 Series Router to another router or switch. The OC-48c/STM-16c POS line card supports single-mode only. For SONET/SDH single-mode fiber-optic connections, use one simplex SC-type connector or one simplex FC-type connector.

The default line card route memory configuration is 128 MB. The default packet memory is 256 MB. They are field-serviceable. See the "Line Card Memory" section on page 77 for more information.

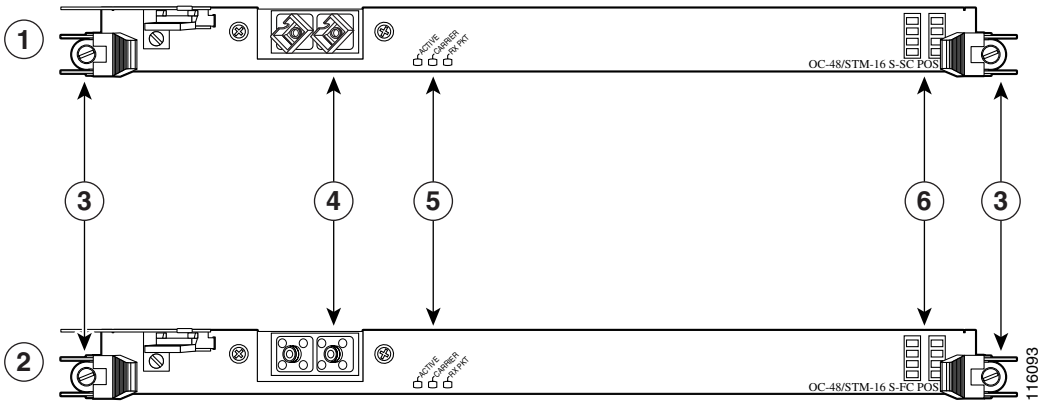
Enhanced OC-48c/STM-16c POS Line Card

The enhanced OC-48c/STM-16c POS line card provides Cisco 12000 Series Routers with a single 2.5-Gbps POS interface on a single card. The card interfaces with the switch fabric in the Cisco 12000 Series Router and provides one OC-48c/STM-16c duplex SC or FC single-mode connection. This connection is concatenated, which provides for increased efficiency by eliminating the need to partition the bandwidth.

The product numbers with the -B at the end are the latest models of the enhanced OC-48c/STM-16c POS line cardand will eventually supersede the older models.

Note The older versions and newer -B versions of the enhanced OC-48c/STM-16c POS line card are identical in form, fit, and function when running IOS Release 12.0(10)S or later.

Figure 15 Enhanced OC-48c/STM-16c POS Line Card



1	Single-mode	**4**	Port 0
2	Multimode	**5**	Status LEDs
3	Ejector lever	**6**	Alphanumeric LEDs

Use a single-mode fiber-optic interface cable to connect your Cisco 12000 Series Router to another router or switch. The enhanced OC-48c/STM-16c POS line card supports single-mode only. For SONET/SDH single-mode fiber-optic connections, use one simplex SC-type connector or one simplex FC-type connector.

The default line card route memory configuration is 128 MB. The default packet memory is 256 MB; it is field serviceable. See the "Line Card Memory" section on page 77 for more information.

4-Port OC-48c/STM-16c POS Line Card

The 4-port OC-48c/STM-16c POS line card and the 4-port OC-48c/STM-16c Service Enhanced POS line card provide four 2.5-GB POS interfaces on a single card. The line cards are available in the following versions:

- Short-reach, single-mode
- Long-reach, single-mode

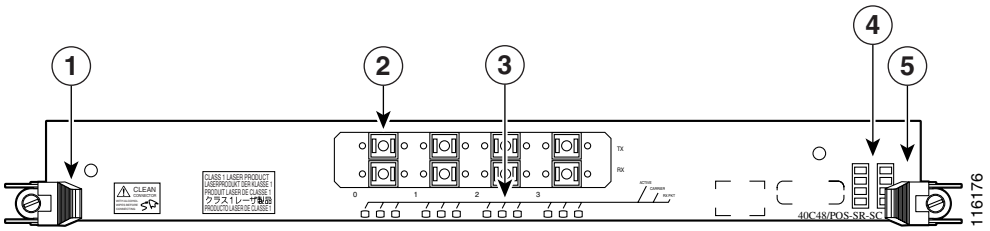
These line cards interface with the router high-speed switch fabric and provide four OC-48c/STM-16c duplex SC or FC single-mode connections in the standard 4-port OC-48c/STM-16c POS line card.

Only SC-type connectors are used with the 4-port OC-48c/STM-16c Service Enhanced POS line card. These connections are concatenated, which provides for increased efficiency by eliminating the need to partition the bandwidth.

Note Unless otherwise specified, throughout this publication both the standard 4-port OC-48c/STM-16c POS line card and the 4-port OC-48c/STM-16c Service Enhanced POS line card are called the 4-port OC-48c/STM-16c POS line card.

Figure 16 shows the front view of the SC version of the line card.

Figure 16 4-Port OC-48c/STM-16c POS Line Card



1	Ejector lever	**4**	Alphanumeric LEDs
2	Port 0	**5**	Ejector lever
3	Status LEDs		

Note The standard 4-port OC-48c/STM-16c POS line card and the 4-port OC-48c/STM-16c Service Enhanced POS line card appear identical. To distinguish between the two, view the card horizontally and look at the lower right corner of the front panel label. The 4-port OC-48c/STM-16c Service Enhanced POS line card includes an "E" in the product number.

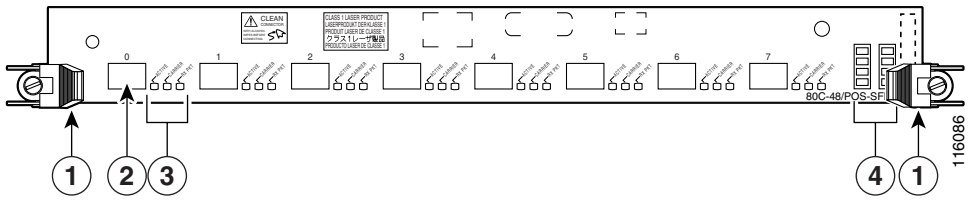
The 4-port OC-48c/STM-16c POS line card ships with 256 MB of route processor memory and 512 MB of packet memory. This memory is not user servicable. See the "Line Card Memory" section on page 77 for more information.

8-Port OC-48c/STM-16c POS Line Card

The 8-Port OC-48c/STM-16c POS line card provides Cisco 12000 Series Routers with eight OC-48c/STM-16c, fiber-optic LC duplex ports, through the use of interchangeable small form-factor pluggable modules (SFPs). This line card uses single-mode cable.

This line card is shown in Figure 17; an SFP module is shown in Figure 18. The available SFP modules are color-coded according to their optics type, as specified in Table 7.

Figure 17 8-Port OC-48c/STM-16c POS Line Card



1	Ejector lever	**3**	Status LEDs
2	Port 0	**4**	Alphanumeric LEDs

Figure 18 SFP Module

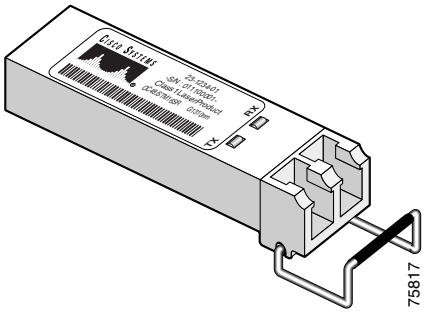


Table 7 SFP Module Product Numbers

Optics	Color-coding	Product Number
Short-reach	Gray	POM-OC48-SR-LC
Intermediate-reach	Yellow	POM-OC48-IR1-LC
Long-reach	White	POM-OC48-LR2-LC

The standard memory configuration is 512 MB of route memory and 1 GB of packet memory. Route memory is field serviceable. See the "Line Card Memory" section on page 77 for more information.

OC-192c/STM-64c POS Line Card

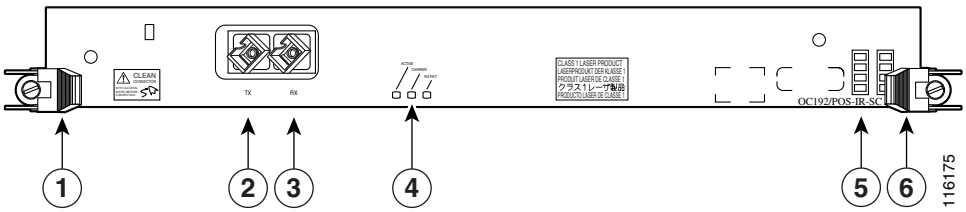
The OC-192c/STM-64c POS Line Card provides supported Cisco 12000 Series Routers with one 10-Gbps POS interface on a single line card.

The short-, intermediate-, and long-reach line cards interface with the router high-speed switch fabric and provide one OC-192c/STM-64c duplex SC single-mode connection. The very-short-reach line card provides one OC-192c/STM-64c duplex MTP multimode connection. The connection is concatenated, which provides for increased efficiency by eliminating the need to partition the bandwidth.

Note Unless otherwise noted, throughout this publication both the standard OC-192c/STM-64c POS line card and the OC-192c/STM-64c Enhanced Services line card are called the OC-192c/STM-64c POS line card.

Figure 16 shows the single-mode, SC version of the line card.

Figure 19 OC-192c/STM-64c POS Line Card



1	Ejector lever	**4**	Interface status LEDs
2	TX port	**5**	Alphanumeric display LEDs
3	RX port	**6**	Ejector lever

The standard OC-192c/STM-64c POS line card and the OC-192c/STM-64c Enhanced Services line card appear identical. To distinguish between them, view the card horizontally and look at the lower right corner of the front panel label. The OC-192c/STM-64c Enhanced Services line card includes an "E" in the product number.

The standard memory configuration for the OC-192c/STM-64c POS line card is 256 MB of route memory and 512 MB of packet memory. None of the memory is field serviceable. See the "Line Card Memory" section on page 77 for more information.

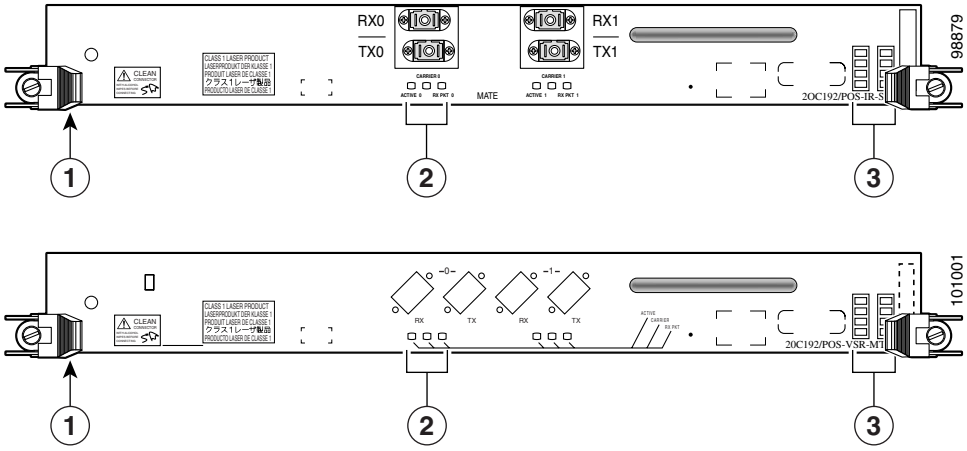
2-Port OC-192c/STM-64c POS Line Card

The 2-Port OC-192c/STM-64c POS line card provides the Cisco 12000 Series Router with two 10-Gbps POS interfaces on a single line card.

The intermediate-reach line card interfaces with the high-speed switch fabric on the router and provides two OC-192c/STM-64c duplex SC single-mode connections. The very-short-reach line card provides two OC-192c/STM-64c duplex MTP multimode connections. The connection is concatenated, which provides for increased efficiency by eliminating the need to partition the bandwidth.

This line card is shown in Figure 20; the optics and connector types for this line card are listed in Table 8.

Figure 20 2-Port OC-192c/STM-64c POS Line Card (IR/SR—top; VSR—bottom)



1	Ejector lever (one at each end)	**3**	Alphanumeric LEDs
2	Status LEDs		

Table 8 2-Port OC-192c/STM-64c POS Line Card Optics and Connector Types

Line Card Optics	Connection Method	Connection Type
Very short reach	Multimode duplex	MTP connector
Short reach	Single-mode duplex	SC connector
Intermediate-reach	Single-mode duplex	SC connector

The standard memory configuration is 512 MB of route memory and 1 GB of packet memory. Route memory is field serviceable. See the "Line Card Memory" section on page 77 for more information.

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, see the "Laser Safety" section on page 97.

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. Cisco recommends 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 POS 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 POS 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 POS line cards and clothing. The wrist strap only protects the board from ESD voltages on the body; 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 POS line cards:

- Flat-blade or Phillips screwdriver
- ESD-preventive wrist or ankle strap and instructions
- Interface cables to connect the POS line card with another router or switch
- Any SFP modules or memory you need to install that 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 7 for more information. Table 4 on page 7 summarizes the hardware requirements for each POS line card.

See the "Line Card Interface Cables" section on page 55 for information on required interface cables.

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 26 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 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 will hang and subsequently crash.

For line card configuration information, see the "Configuring and Troubleshooting Line Card Interfaces" section on page 65.

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 21 as a reference and follow these steps:

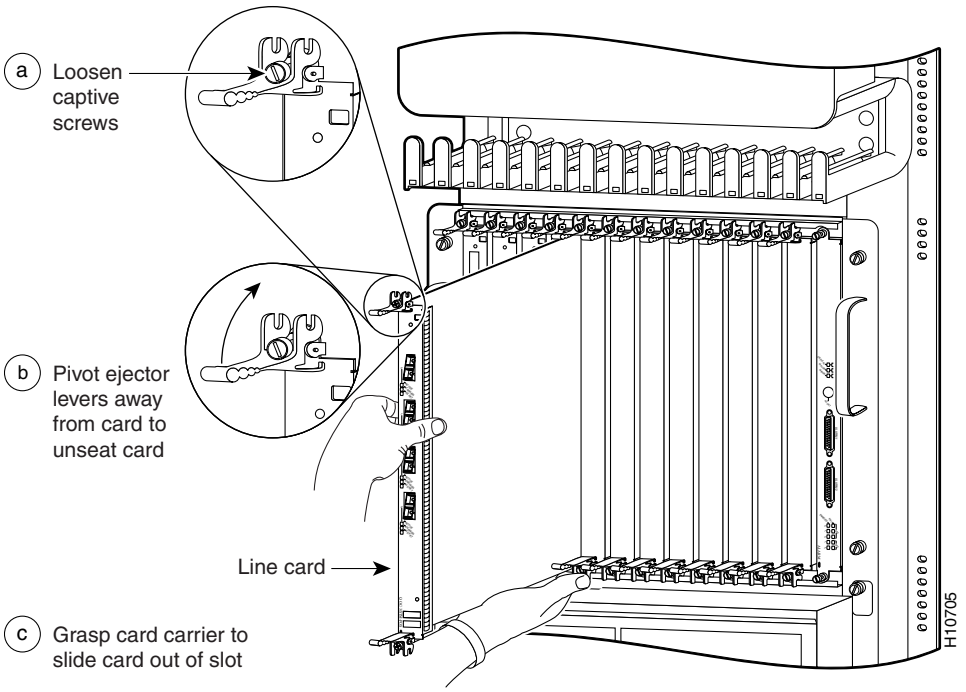
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

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 21a.)

Figure 21 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 21b.)

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 21c.) 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.

Note The following warning applies to removing very-short-reach line cards.

Warning **Class 1M laser radiation when open. Do not view directly with optical instruments.**

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 Interface Cables" section on page 57.

For information on removing the cable-management bracket, see the "Line Card Cable-Management Bracket" section on page 42.

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.

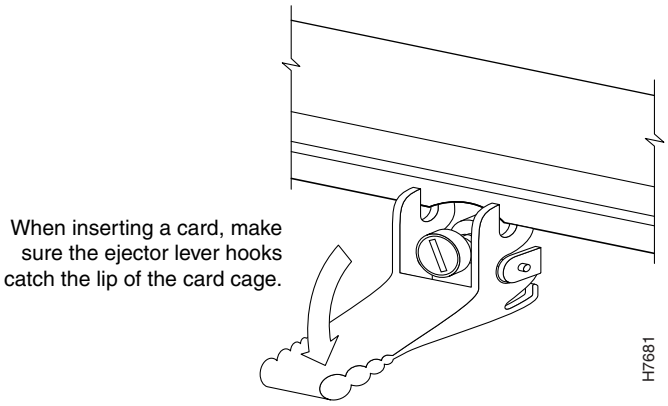
Step 2 Choose an available line card slot for the line card, and verify that the line card interface cable is long enough for you to connect the line card with any external equipment.

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 22.)

Figure 22 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 47.

For information on installing SFP modules, see the "Removing and Installing SFP Modules" section on page 31.

For information on installing interface cables, see the "Removing and Installing Interface Cables" section on page 57.

For information on verifying and troubleshooting the hardware installation, see the "Verifying and Troubleshooting the Line Card Installation" section on page 59.

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 97.

POS line cards use various optics and connectors. See the "Cabling and Specifications" section on page 48 for optics and cabling specifications.

Before removing SFP modules, you must first disconnect any connected interface cables. See the "Removing and Installing Interface Cables" section on page 57.

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: The optics will not work correctly when obstructed with dust.

Caution Removing and inserting an SFP module can shorten its useful life, so remove and insert them only when absolutely necessary.

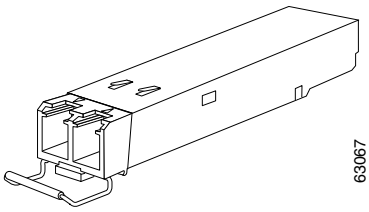
SFP modules use one of four different latching devices to install and remove the module from a port. The four types of SFP module latching devices are described in the following sections:

- Bale Clasp SFP Module
- Mylar Tab SFP Module
- Actuator Button SFP Module
- Slide Tab SFP Module

Bale Clasp SFP Module

The bale clasp SFP module has a clasp that you use to remove or install the SFP module. (See Figure 23.)

Figure 23 Bale Clasp SFP Module



Removing a Bale Clasp SFP Module

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

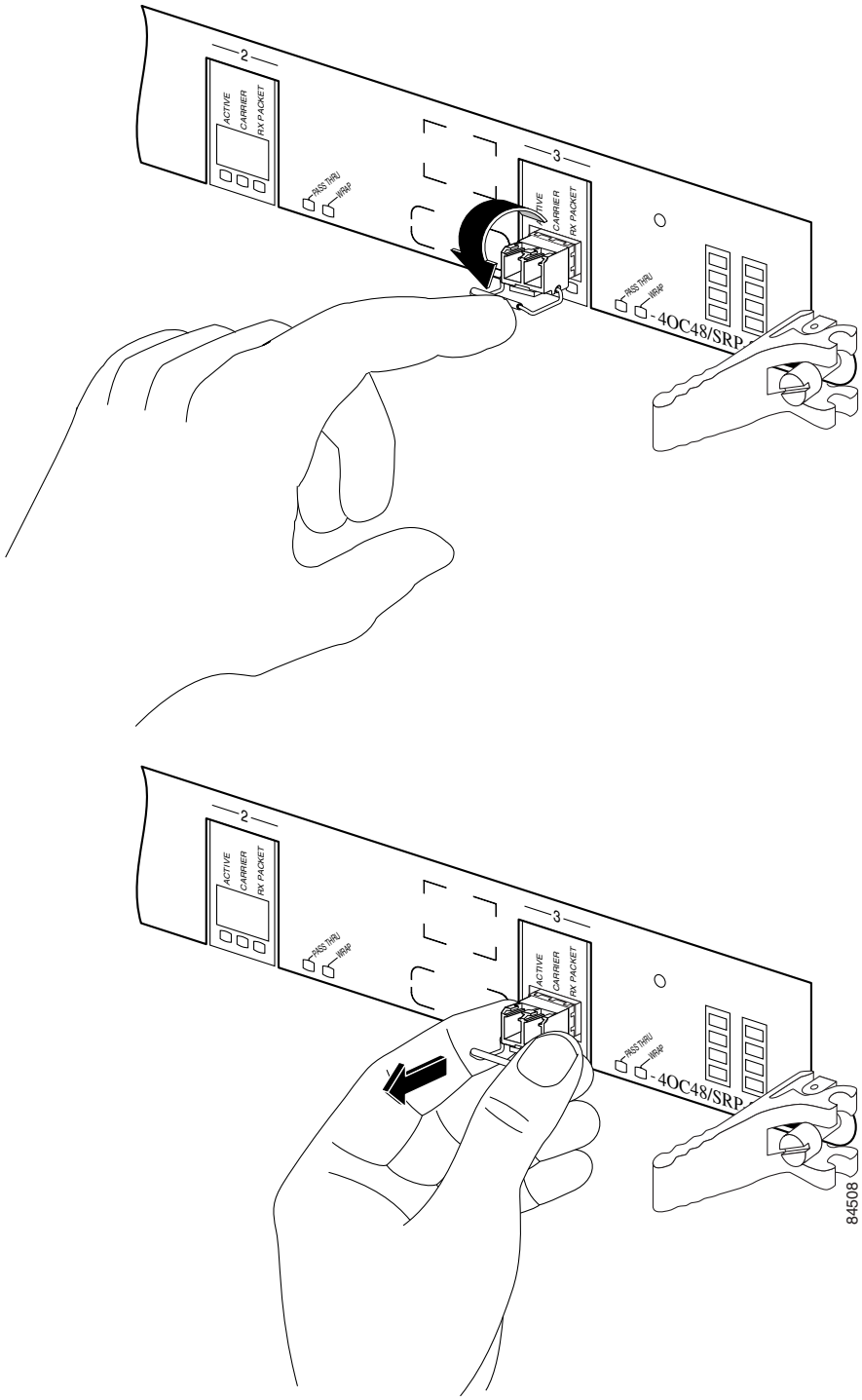
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

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 24. 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 24.

Figure 24 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

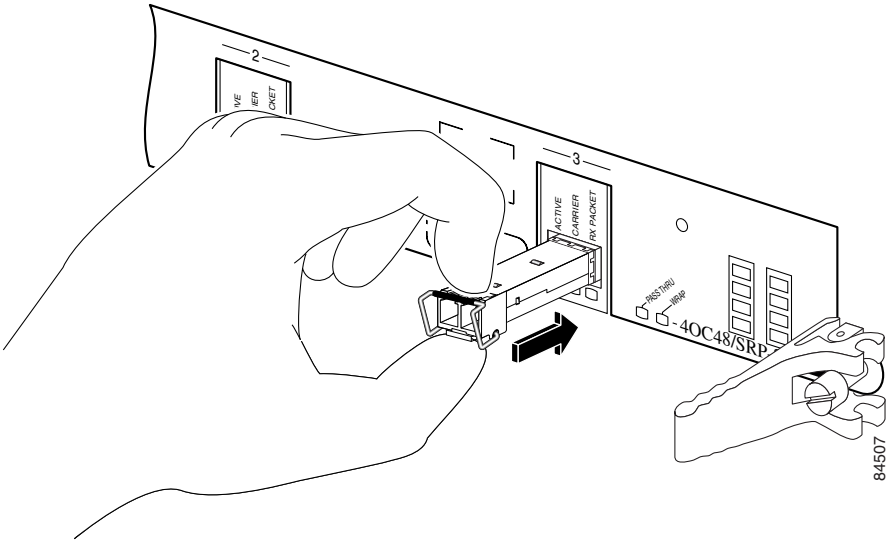
To install this type of SFP module, follow these steps:

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 25.)

Figure 25 Installing a Bale Clasp SFP Module into a Port

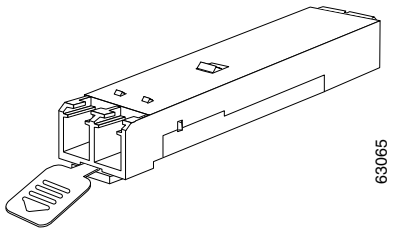


Note Verify that the SFP modules are completely seated and secured in their assigned receptacles on the line card by firmly pushing on each SFP module. If the SFP module was not completely seated and secured in the receptacle, you will hear a click as the triangular pin on the bottom of the SFP module 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 26.)

Figure 26 Mylar Tab SFP Module



Removing a Mylar Tab SFP Module

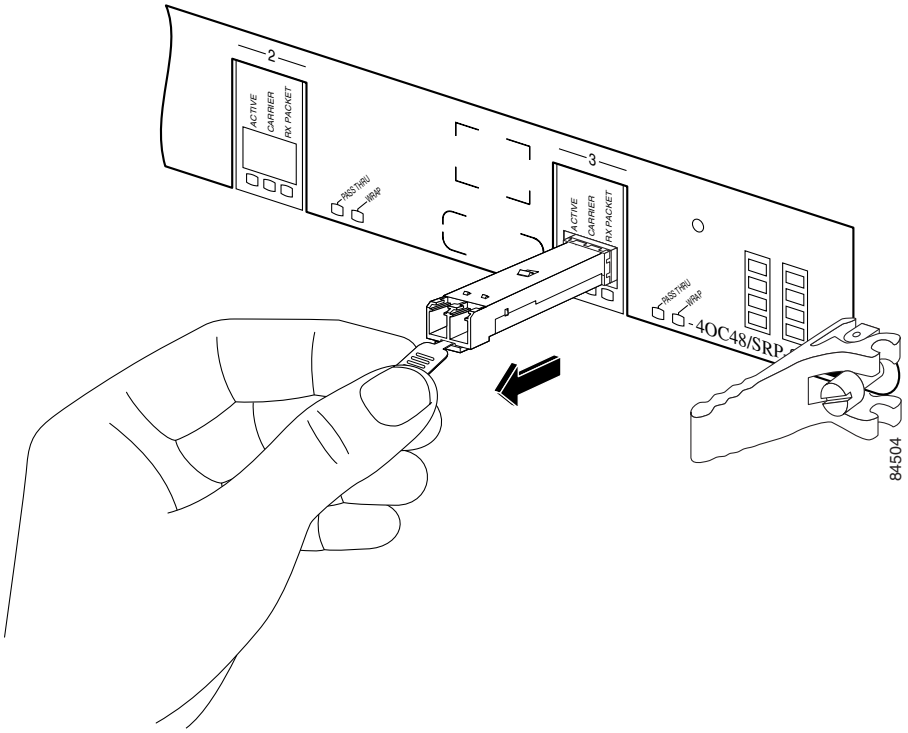
To remove this type of SFP module, follow these steps:

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 27.)

Figure 27 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.

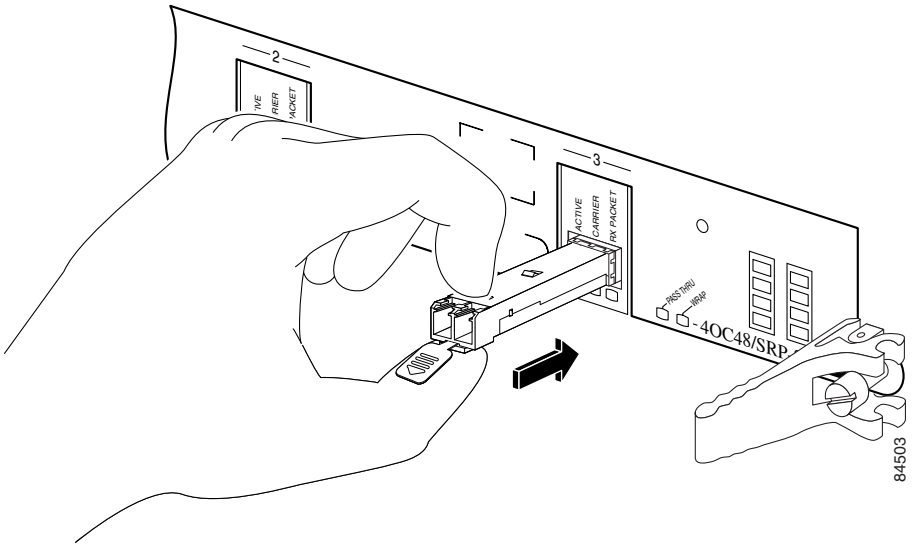
Installing a Mylar Tab SFP Module

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 28.)

Figure 28 Installing a Mylar Tab SFP Module

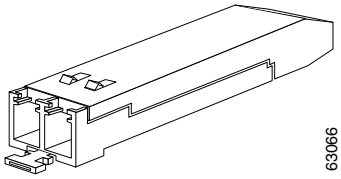


Note Verify that the SFP modules are completely seated and secured in their assigned receptacles on the line card by firmly pushing on each SFP module. If the SFP module was not completely seated and secured in the receptacle, you will hear a click as the triangular pin on the bottom of the SFP module 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 29.)

Figure 29 Actuator Button SFP Module



Removing an Actuator Button SFP Module

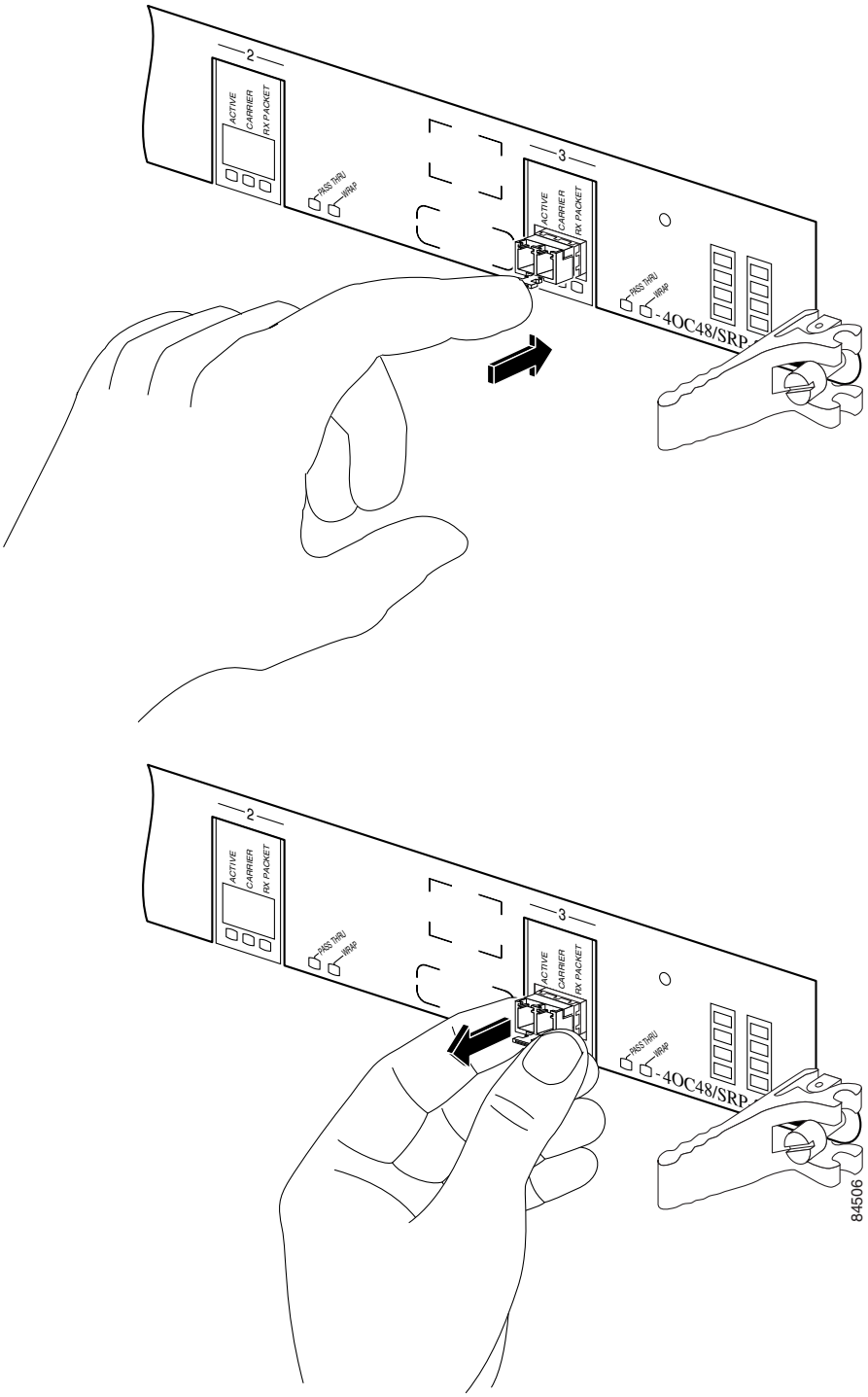
To remove this type of SFP module, follow these steps:

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 30.)

Figure 30 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.

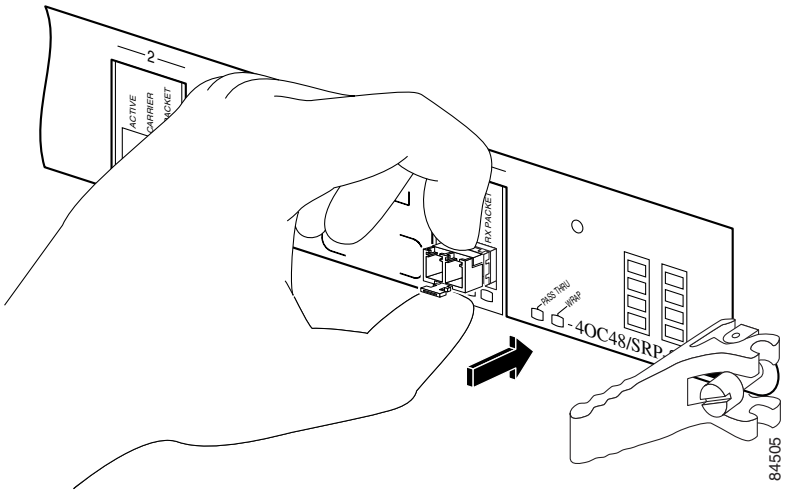
Installing an Actuator Button SFP Module

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 31.) 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 31 Installing an Actuator Button SFP Module

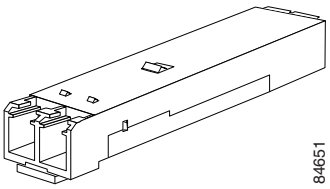


Note Verify that the SFP modules are completely seated and secured in their assigned receptacles on the line card by firmly pushing on each SFP module. If the SFP module was not completely seated and secured in the receptacle, you will hear a click as the triangular pin on the bottom of the SFP module 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 32.)

Figure 32 Slide Tab SFP Module



Removing a Slide Tab SFP Module

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

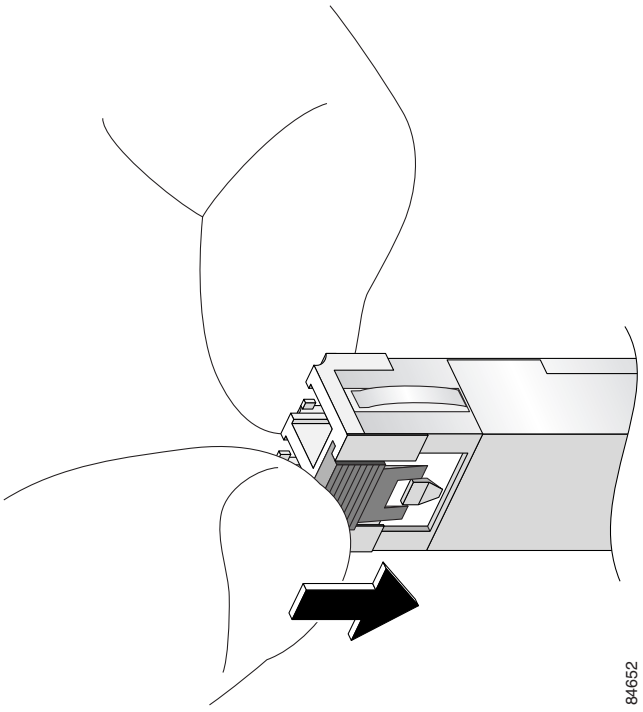
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

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 33.)

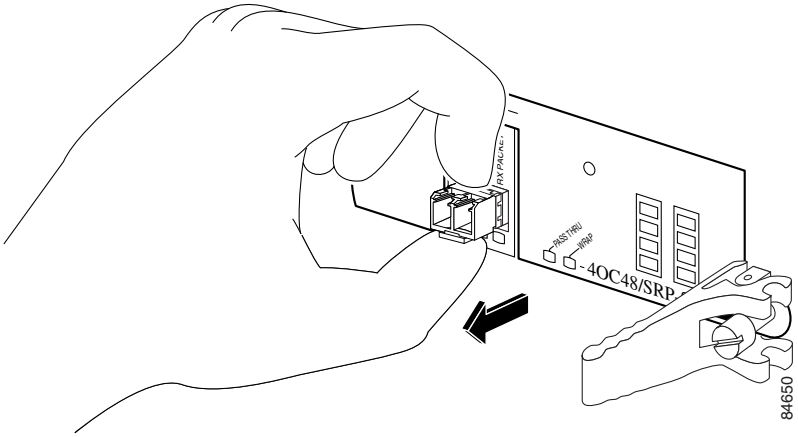
Figure 33 Disengaging the Slide Tab



Step 5 With the tab still pushed, carefully pull the SFP module from the port as shown in Figure 34.

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 34 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:

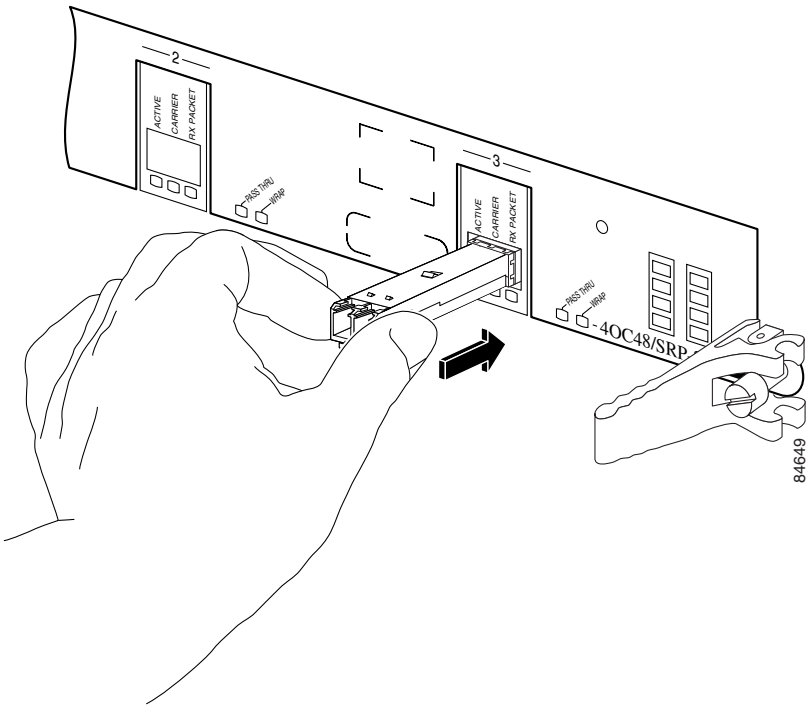
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

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 35.)

Figure 35 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 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 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 36 shows the single-port line card cable-management bracket; Figure 37 shows the multiport line card cable-management bracket.

Figure 36 Single-Port Line Card Cable-Management Bracket

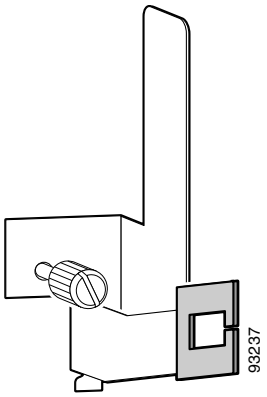
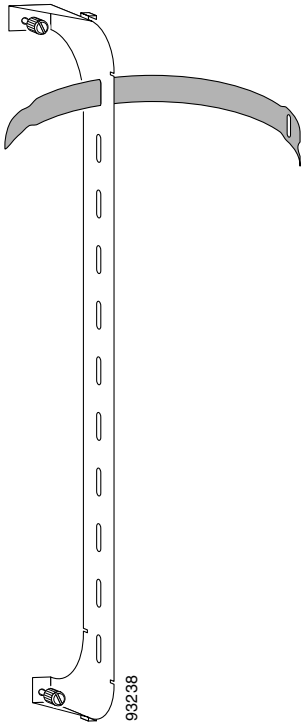


Figure 37 Multiport Line Card Cable-Management Bracket

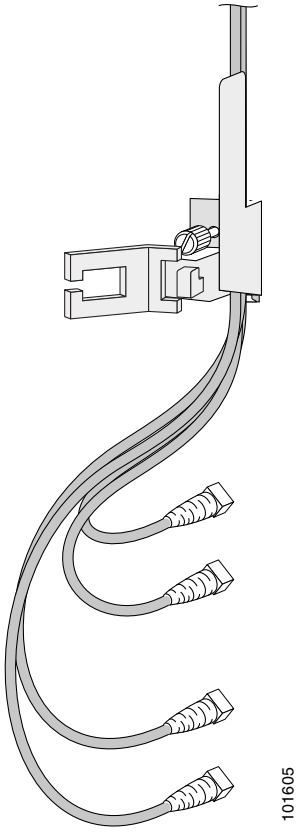


Note When shipped with spare line card orders, the cable-management bracket is not attached to the line card. You must attach the cable-management bracket to the line card before you insert the line card into the router.

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.

The 2-Port OC-192c/STM-64c POS line card uses the single-port line card cable-management bracket. When more than two fibers are used, they should not loop through the rubber hook, but should pass through the bracket as shown in Figure 38.

Figure 38 Single-Port Line Card Cable-Management Bracket with Multiple Fibers



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

- Removing a Line Card Cable-Management Bracket, page 44
- Installing a Line Card Cable-Management Bracket, page 47

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 39.)

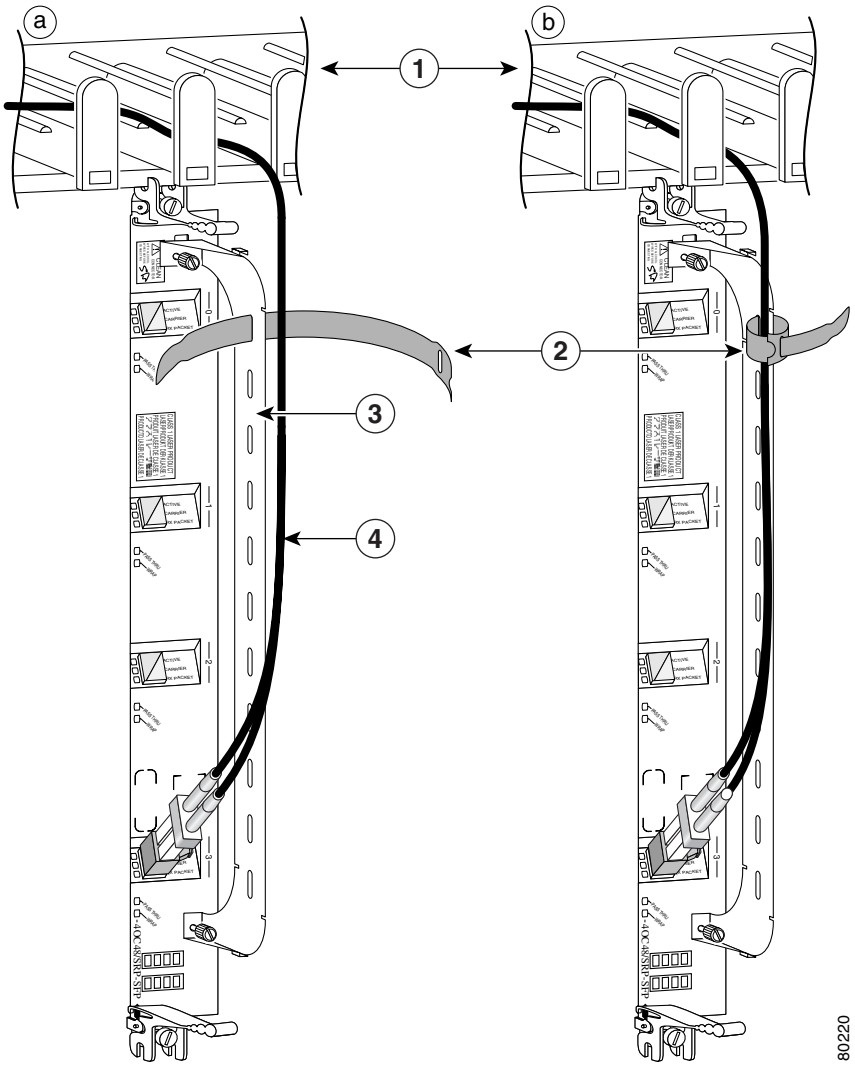
For single-port line card cable-management brackets, carefully remove the interface cable from the cable clip. (See Figure 40.) Avoid any kinks or sharp bends in the cable.

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.

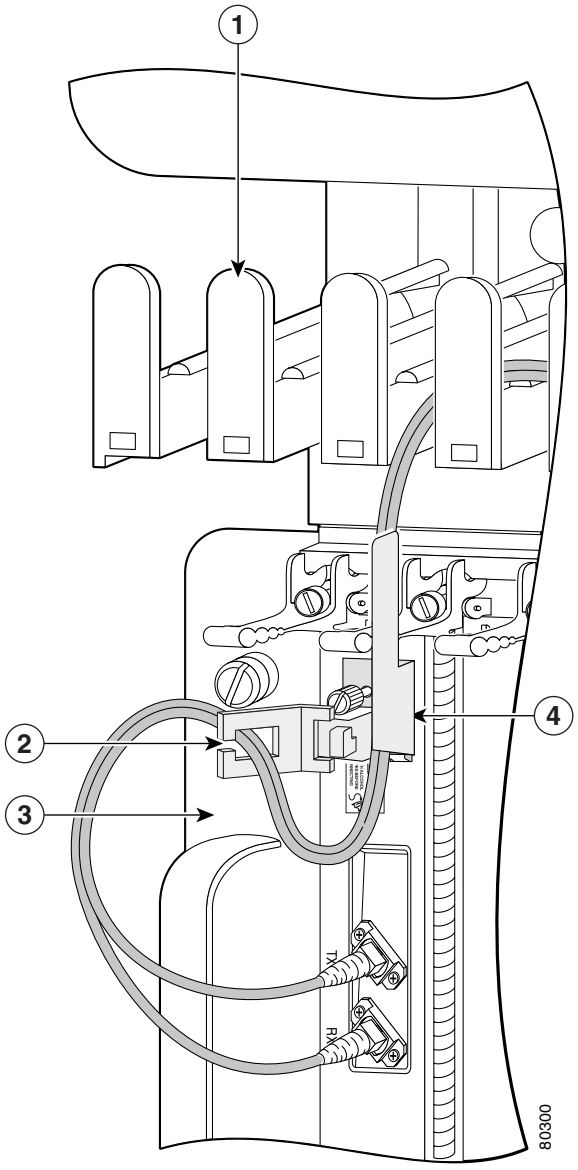
For single-port line card cable-management brackets, loosen the captive installation screw on the cable-management bracket and remove the bracket from the line card.

Figure 39 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 40 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 39.)

For single-port line card cable-management brackets, carefully press the interface cable onto the cable clip. (See Figure 40.) Avoid any kinks or sharp bends in the cable.

For information on disconnecting and connecting interface cables, see the "Removing and Installing Interface Cables" section on page 57.

Cabling and Specifications

The following sections provide informaton about specifications and cabling for POS line cards:

Packet-Over-SONET Interface

POS is a high-speed method of transporting Internet Protocol (IP) traffic between two points. This technology combines the Point-to-Point Protocol (PPP) with Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) interfaces.

PPP was designed as a standard method of communicating over point-to-point links. Initial deployment was over short local lines, leased lines, and plain-old-telephone-service (POTS) (also called *basic telephone service*) for users of modems. As new packet services and higher speed lines are introduced, PPP can be deployed easily in these environments as well.

SONET is an octet-synchronous multiplex scheme defined by the American National Standards Institute (ANSI) standard (T1.1051988) for optical digital transmission at hierarchical rates from 51.840 Mbps to 2.5 Gbps (Synchronous Transport Signal, STS-1 to STS-48) and greater. SDH is an equivalent international standard for optical digital transmission at hierarchical rates from 155.520 Mbps (STM-1) to 2.5 gigabits per second (Gbps) (STM-16) and greater. SONET electrical specifications have been defined for single-mode fiber, multimode fiber, and CATV 75-ohm coaxial cable. (For example, the 4-port OC-3c/STM-1c POS line card allows transmission over single-mode and multimode optical fiber at Optical Carrier 3 [OC-3] rates. OC-3 is the Optical Carrier 3 specification for SONET STS-3c and SDH STM-1 transmission rates.)

SONET/SDH transmission rates are integral multiples of 51.840 Mbps. The following transmission multiples are currently specified and commonly used:

- OC-3c/STM-1c—155.520 Mbps
- OC-12c/STM-4c—622.080 Mbps

- OC-48c/STM-16c—2488.320 Mbps
- OC-192c/STM-64c—9953.280 Mbps

The POS specification (RFC 1619) describes the use of PPP encapsulation over SONET/SDH links. Because SONET/SDH is, by definition, a point-to-point circuit, PPP is well-suited for use over these links. PPP treats SONET/SDH transport as octet-oriented full-duplex synchronous links. PPP presents an octet interface to the physical layer. The octet stream is mapped into the SONET/SDH Synchronous Payload Envelope (SPE), with the octet boundaries aligned with the SPE octet boundaries. The PPP frames are located by row within the SPE payload. Because frames are variable in length, the frames are allowed to cross SPE boundaries.

The basic rate for POS is OC-3/STM-1, which is 155.520 Mbps. The available information bandwidth is 149.760 Mbps, which is the OC-3c/STM-1 SPE with section, line, and path overhead removed.

Power Budget and Signal Specifications

The SONET specification for fiber-optic transmission defines two types of fiber: single-mode and multimode. Signals can travel farther through single-mode fiber than through multimode fiber.

The maximum distance for installations is determined by the amount of light loss in the fiber path. If your environment requires the signal to travel close to the typical maximum distance, you should use an optical time domain reflectometer (OTDR) to measure the power loss.

This section contains the following:

4-Port OC-3c/STM-1c POS Line Card Power Specifications

Good quality single-mode fiber with very few splices can carry an OC-3c/STM-1c signal 9.3 miles (15 km) or more. Good quality multimode fiber can carry a signal up to 1.3 miles (2 km). If your environment requires the signal to travel close to the typical maximum distance (as listed in Table 9), use an OTDR to measure the power loss.

Caution If you use a loopback cable with the single-mode line cards, use a loopback cable with a minimum 10 dB attenuator to avoid damage to the parts.

Table 9 4-Port OC-3c/STM-1c POS Line Card Power Specifications

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, long-reach	29 dB	–5 to 0 dBm at 1280 to 1335 nm	–34 to –8dBm	26 miles (40 km)
Single-mode, intermediate-reach	16 dB	–28 to –8 dBm at 1270 to 1380 nm	–31 to –8 dBm	9.3 miles (15 km)
Multimode	11.5 dB	–18.5 to –14 dBm at 1270 to 1380 nm	–30 to –14 dBm	1.3 miles (2 km)

OC-3c/STM-1c ISE POS Line Card Power Specifications

All OC-3c/STM-1c ISE POS line cards provide155 Mbps laser-based SONET/SDH-compliant interfaces. Table 10 lists the power ratings and distances of each line card. The actual distance in any given case depends on the quality of the fiber attached to the transceiver.

All versions of the line card meet both the EN60825\IEC60825 and FDA - Code of Federal Regulations (USA) laser safety standards.

Table 10 OC-3c/STM-1c ISE POS Line Card Power Specifications

Transceiver[1]	Power Budget[2]	Transmit Power[3]	Receive Power	Typical Maximum Distance
Multimode, short-reach	9 dBm	-20 dBm to -14 dBm	-30 dBm to -14 dBm	1.2 miles (2 km)
Single-mode, intermediate-reach	12 dBm	-20 dBm to -14 dBm	-28 to -8 dBm	9.3 miles (15 km)
Single-mode, long-reach	28 dBm	-20 dBm to -14 dBm	-34 dBm to -10 dBm	24.8 miles (40 km)

1. IR optic is standard compliant with G.957 S-1.1 and GR-235 IR-1. LR optic is standard compliant with G.957 L-1.1 and GR-235 LR-1.
2. All power budgets include a 1 dB optical path penalty.
3. Measurement Conditions:Transmit power is measured at the end of 1 meter of 62.5/125um, numerical aperture =0.275 unattenuated optical fiber with cladding modes removed. When using 50/125um unattenuated optical fiber with cladding modes removed, the numerical aperture = 0.20 Fiber for the test, and the minimum optical power is -23.5dBm.

8-Port and 16-Port OC-3c/STM-1 POS Line Card Power Specifications

The 8-port and 16-port OC-3c/STM-1 POS line cards support single-mode and multimode fiber-optic interface cables.

Good quality fiber with very few splices can carry a single-mode or multimode signal 15 km or more. If your environment requires the signal to travel close to the typical maximum distance (as listed in Table 11), you should use an OTDR to measure the power loss.

Table 11 Power Budget and Signal Requirements

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, intermediate-reach	12 dBm	–15 to –8 dBm at 1261~1360 nm	–28 to –8 dBm	9.3 miles (15 km)
Multimode, short-reach	9 dBm	–20 to –14 dBm at 1261~1360 nm	–30 to –14 dBm	1.2 miles (2 km)

OC-12c/STM-4c POS Line Card Power Specifications

Good quality single-mode fiber with very few splices can carry an OC-12c/STM-4c signal 15 km or more, and good quality multimode fiber can carry the signal up to 500 meters.

If your environment requires the signal to travel close to the typical maximum distance (as listed in Table 12), you should use an OTDR to measure the power loss.

Table 12 Power Budget and Signal Requirements

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode	12 dB	–15 to –8 dBm at 1270 to 1380 nm	–28 to –8 dBm	9.3 miles (15 km)
Multimode	6 dB	–20 to –14 dBm at 1270 to 1380 nm	–26 to –14 dBm	1640.4 feet (500 m)

Enhanced 4-Port OC-12c/STM-4c POS Line Card Power Specifications

The enhanced 4-port OC-12c/STM-4c POS line card supports single-mode and multimode fiber connections. Good quality single-mode fiber with very few splices can carry an OC-12c/STM-4c intermediate-reach signal 15 kilometers or more. Good quality multimode fiber with very few splices can carry an OC-12c/STM-4c short-reach signal 500 meters or more. See Table 13.

Table 13 Quad OC-12c/STM-4c Power Budget and Signal Requirements

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, intermediate-reach 1310 nm	13 dBm	–15 to –8 dBm at 1274 to 1356 nm	–28 to –7 dBm	9.32 miles (15 km)
Multimode, short-reach, 1310 nm	6 dBm	–20 to –14 dBm at 1270 to 1380 nm	–26 to –14 dBm	1640 feet (500 m)

4-Port OC-12c/STM-4c POS Line Card Power Specifications

Good quality single-mode fiber with very few splices can carry an OC-12c/STM-4c signal 9.3 miles (15 km) or more. Good quality multimode fiber can carry the signal up to 1640 feet (500 meters). If your environment requires the signal to travel close to the typical maximum distance (as listed in Table 14), use an OTDR to measure the power loss.

Table 14 4-Port OC-12c/STM-4c POS Line Card Power Specifications

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, 1310 nm	12 dB	–15 to –8 dBm	–28 to –7 dBm	9.3 miles (15 km)
Multimode, 1310 nm	6 dB	–19 to –14 dBm	–26 to –14 dBm	1640.4 feet (500 m)

4-Port OC-12c/STM-4c ISE POS Line Card Power Specifications

Table 15 lists the specifications for these line cards.

Table 15 4-Port OC-12c/STM-4c POS/SDH ISE Power Budget and Signal Requirements

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, intermediate-reach, 1310 nm	16 dB	–15 to –8 dBm	–28 to –7 dBm	9.3 miles (15 km)
Multimode, 1310 nm	6 dB	–20 to –14 dBm	–26 to –14 dBm	0.625 mile (1 km)

OC-48c/STM-16c ISE POS Line Card Power Specifications

Good quality single-mode fiber with very few splices can carry the short-reach and long-reach compliant OC-48/STM-16 signals. If your environment requires the light to travel close to the typical maximum distance (as listed in Table 16), use an OTDR to measure the power loss.

Table 16 OC-48c/STM-16c ISE POS Line Card Power Specifications

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, short-reach, 1310 nm	8 dB	–10 to –3 dBm	–18 to 0 dBm	1.25 miles (2 km)
Single-mode, long-reach, 1550 nm	26 dB	–2 to +3 dBm	–28 to –9 dBm	50 miles (80 km)

OC-48c/STM-16c POS Line Card Power Specifications

The OC-48c/STM-16c POS line card supports single-mode only.

Good quality single-mode fiber with very few splices can carry an OC-48c/STM-16c short-reach signal 1.2 miles (2 km) or more. If your environment requires the signal to travel close to the typical maximum distance (as listed in Table 17), you should use an OTDR to measure the power loss.

Table 17 OC-48c/STM-16c POS Line Card Power Specifications

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, short-reach, 1310 nm	8 dBm	–10 to –3 dBm	–18 to 0 dBm	1.2 miles (2 km)

Enhanced OC-48c/STM-16c POS Line Card Power Specifications

The enhanced OC-48c/STM-16c POS line card supports single-mode only.

Good quality single-mode fiber with very few splices can carry an OC-48c/STM-16c short-reach signal 1.2 miles (2 km) or more. If your environment requires the signal to travel close to the typical maximum distance (as listed in Table 18), you should use an OTDR to measure the power loss.

Table 18 Power Budget and Signal Requirements

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, short-reach, 1310 nm	8 dBm	–10 to –3 dBm	–18 to 0 dBm	1.2 miles (2 km)
Single-mode, long-reach, 1550 nm	24 dBm	–2 to 3 dBm	–28 to –9 dBm	37 miles (60 km)

4-Port OC-48c/STM-16c POS Line Card Power Specifications

The 4-port OC-48c/STM-16c POS line card supports single-mode only.

All 4-port OC-48c/STM-16c POS line cards provide a full-duplex, 10-Gbps, laser-based SONET/SDH-compliant interface. Table 19 lists the power ratings and distances of each line card. The actual distance in any given case depends on the quality of the fiber attached to the transceiver. If your environment requires the signal to travel close to the typical maximum distance, you should use an OTDR to measure the power loss.

All versions of the line card meet both the EN60825\IEC60825 and FDA - Code of Federal Regulations (USA) laser safety standards.

Table 19 4-Port OC-48c/STM-16c POS Line Card Power Specifications

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, short-reach, 1310 nm	7 db	–10 to –3 dBm	–18 to 0 dBm	1.2 miles (2 km)
Single-mode, long-reach, 1550 nm	24 db	–2 to 3 dBm	–28 to –9 dBm	50 miles (80 km)

8-Port OC-48c/STM-16c POS Line Card Power Specifications

The 8-Port OC-48c/STM-16c POS line card uses SFP modules that support single-mode operation only. All SFP modules provide a full-duplex, 10-Gbps, laser-based SONET/SDH-compliant interface. Table 20 lists the power ratings and distances of each SFP module. The actual distance in any given case depends on the quality of the fiber attached to the transceiver.

Table 20 SFP Module Power Specifications

SFP	Attenuation	Transmit Power	Receive Power	Typical Maximum Distance
Single-mode, short-reach, 1310 nm	0 to 7 dB	–10 to –3 dBm	–18 to –3 dBm	7.5 miles (12 km)
Single-mode, intermediate-reach, 1310 nm	0 to 12 dB	–5 to 0 dBm	–18 to 0 dBm	13 miles (21 km)
Single-mode, long-reach, 1550 nm	10 to 24 dB	–2 to +3 dBm	–28 to –9 dBm	52.8 miles (85 km)

Note Only use SFP modules supplied by Cisco. Each SFP contains an internal serial number 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 as a module type that is qualified by Cisco to operate with 8-Port OC-48c/STM-16c POS line cards. Unapproved SFP modules (those not purchased directly from Cisco) will not work.

OC-192c/STM-64c POS Line Card Power Specifications

Table 21 lists the power ratings and distances of each line card by optical transceiver type. If your environment requires the signal to travel close to the typical maximum distance, you should use an OTDR to measure the power loss.

All OC-192c/STM-64c POS line cards provide a full-duplex, 10-Gbps, laser-based SONET/SDH-compliant interface. When equipped with very-short-reach optics, the OC-192c/STM-64c POS line card VSR physical layer is not SONET/SDH-compliant at the physical layer, but is compliant with the Optical Internetworking Forum VSR implementation agreement VSR4-01. When equipped with long-reach optics, the OC-192c/STM-64c POS line card LR physical layer is based on the SONET/SDH physical layer, but with an offset power budget to account for available technology limitations.

All versions of the line card meet both the EN60825\IEC60825 and FDA - Code of Federal Regulations (USA) laser safety standards.

Table 21 OC-192c/STM-64c POS Line Card Power Specifications

Transceiver	Power Budget	Transmit Power	Receive Power	Typical Maximum Distance[1]
Multimode, very-short-reach, 850 nm	6 dB	–10 to –3 dBm	–16 to –3 dBm	0.1 mile (300 m)
Single-mode, short-reach, 1310 nm	5 dB	–6 to –1 dBm	–11 to –1 dBm	1.2 miles (2 km)
Single-mode, intermediate-reach, 1550 nm[2]	13 dB	–1 to 2 dBm	–14 to –3 dBm	25 miles (40 km)
Single-mode, long-reach, 1550 nm, nominal	26 dB	4 to 7 dBm	–22 to –9 dBm	50 miles (80 km)

1. These distances assume worst-case conditions for factors in the transmission path, including fiber quality, dispersion, and losses due to splices, connectors, nodes, or patch panels. Nominal conditions might increase the margin and permit longer transmission distances.
2. The receive optics on this line card are wideband; they can receive a range of wavelengths from 1310 nm to 1550 nm.

2-Port OC-192c/STM-64c POS Line Card Power Specifications

The 2-Port OC-192c/STM-64c POS line card provides a full-duplex, 10-Gbps, laser-based SONET/SDH-compliant interface. When equipped with very-short-reach optics, the 2-Port OC-192c/STM-64c POS line card VSR physical layer is not SONET/SDH-compliant at the physical layer, but is compliant with the Optical Internetworking Forum VSR implementation agreement VSR4-01. See Table 22.

All versions of the line card meet both the EN60825\IEC60825 and FDA - Code of Federal Regulations (USA) laser safety standards.

Table 22 2-Port OC-192c/STM-64c POS Line Card Power Specifications

Transceiver	Attenuation	Transmit Power	Receive Power	Typical Maximum Distance
Multimode[1], very-short-reach, 850 nm	6 dB	–10 to –3 dBm	–16 to –3 dBm	0.1 mile (300 m)
Single-mode, short-reach, 1310 nm	0 to 4 dB	–6 to –1 dBm	–11 to –1 dBm	4.3 miles (7 km)
Single-mode, intermediate-reach, 1550 nm	3 to 11 dB	–1 to +2 dBm	–14 to –1 dBm	25 miles (40 km)

1. Runs on multimode fiber only

Line Card Interface Cables

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

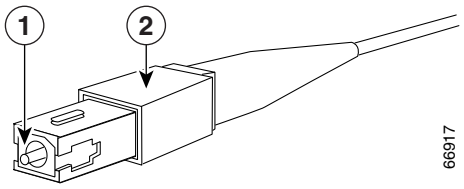
- Single-mode—Generally yellow in color.
- Multimode—Generally gray or orange in color. Multimode cables are also multifiber cables that carry 12 channels of fiber data.

Note Fiber cables are not available from Cisco Systems. They can be purchased from cable vendors. The plug on the cable may be supplied with a dust cover. If it is, remove it before trying to connect it to the line card port.

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

- Subscriber connector (SC)—See Figure 41 and Figure 42.
- Multiple terminations push-pull latch (MTP)—See Figure 43.
- Lucent connector (LC)— See Figure 44.
- Fiber connector (FC)—See Figure 45. FC connectors do not have a spring-action disconnect latch.
- Mechanical transfer registered jack (MTRJ) connector—See Figure 46.

Figure 41 Simplex SC Cable Connector (Single-mode)



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

Figure 42 Duplex SC Cable Connector

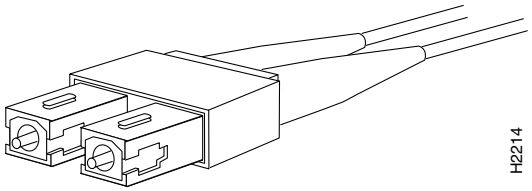
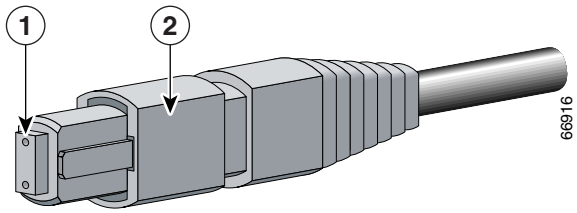
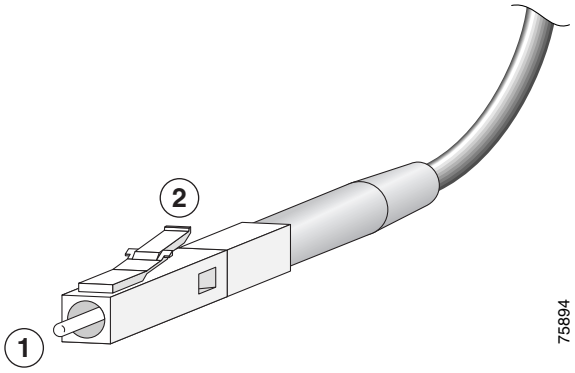


Figure 43 Simplex MTP Cable Connector (Multimode - VSR Only)



1	MTP female connector	**2**	Spring-action disconnect latch

Figure 44 Simplex LC Cable Connector



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

Figure 45 Simplex FC Cable Connector

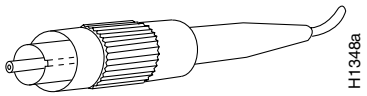
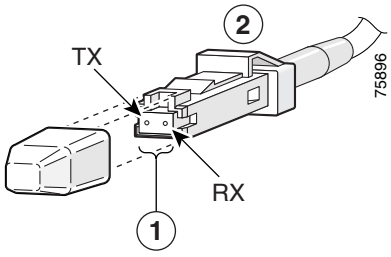


Figure 46 MTRJ Cable Connector (Orange)



1	MTRJ fiber cable	**2**	Spring-action disconnect latch

Attach one simplex or duplex fiber cable between the line card and the device to which the line card is connected. Observe the receive (RX) and transmit (TX) cable relationship shown in Figure 47.

Table 23 lists the required specifications for very-short-reach (VSR) cables.

Note You must use multimode fiber cables with fiber ribbon that meets these specifications.

Table 23 VSR Cable Specifications

Parameter	Specification
Fiber	62.5-micrometer fiber
Fiber cable maximum attenuation	3.75 dB/km
Minimum modal bandwidth	400 MHz/km at 850 nm
Link power budget	6.0 dB
Unallocated margin in link power budget	0.60 dB
Maximum number of connectors	4
Maximum connector loss (per connector)	0.5 dB
Minimum operating range	2-300 m

Removing and Installing Interface Cables

To remove an interface cable, 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 cable from the interface ports. (See Figure 41 through Figure 45.) FC connectors do not have a spring-action disconnect latch.

Step 3 Slowly pull the connector from the port.

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.**

Warning **Class 1 laser product (single-mode).**

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

Step 4 Insert a dust plug into the optical port openings of each interface that is not being used.

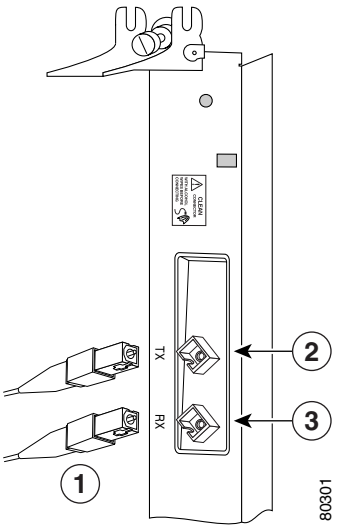
To install an interface cable, follow these steps:

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

Step 2 Remove the connector dust cover, if one is present.

Step 3 Align the connector end of the cable to the appropriate port. Observe the receive (RX) and transmit (TX) cable relationship, as shown in Figure 47.

Figure 47 Attaching Fiber Cables (Simplex, SC Connectors Shown)



1	Simplex fiber cables
2	TX port
3	RX port

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

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.

Verifying and Troubleshooting the Line Card Installation

The following sections describe how to verify and troubleshoot line card installation:

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.

If one of these conditions is not met, refer to the "Advanced Line Card Troubleshooting" section on page 71 to identify any possible problems.

Alphanumeric LEDs

POS 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 24.

Note It is normal for some displayed messages to appear too briefly to be read. Also, some messages listed in Table 24 and Table 25 may not appear on your line card.

Table 24 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

Table 24 Alphanumeric LED Messages During a Typical Initialization Sequence (continued)

LED Display[1]	Meaning	Source
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
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 24 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 25 lists other messages displayed on the line card alphanumeric LED displays.

Table 25 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

Table 25 Other Alphanumeric LED Messages (continued)

LED Display	Meaning	Source
MSTR WAIT	Waiting for mastership determination.	RP
CLOK WAIT	Waiting for slot clock configuration.	RP
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

Table 25 Other Alphanumeric LED Messages (continued)

LED Display	Meaning	Source
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.

Status LEDs

Interface status LEDs show the status of each fiber-optic connector. POS line cards contain the following status LEDs:

- Active—Indicates the active condition of this port
- Carrier—Indicates the status of SONET framing reception on this port
- RX PKT or RX Packet—Indicates the status of packet reception on this port. It flashes when data is being received.

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). To verify correct operation of each interface, complete the configuration procedures for the line card. (See the "Configuring and Troubleshooting Line Card Interfaces" section on page 65.)

The different operating states of the status LEDs are shown in Table 26 and Table 27.

Table 26 POS Line Card Status LED Descriptions

LED	Color/Activity	Description
ACTIVE[1]	Green	Port is active.
	Yellow (blinking)	Fiber misconnection detected (for example, side A is connected to neighbor side A).
	Off	Port is not active.
CARRIER	Green	SONET frames are being received on this port.
	Off	SONET frames are not being received on this port.
RX PKT	Green	Packets are being received on this port.[2]
	Off	Packets are not being received on this port.

1. This LED remains on even if the interface is administratively down or if the link to the network is lost.
2. Packets forwarded back onto the ring do not trigger this LED.

Table 27 Explanation of Status LEDs

LED State			Explanation
Active	**Carrier**	**RX Pkt**	
Off	Off	Off	Port is off.
On	Off	Off	Port is on.
On	On	Off	Line protocol is up.
On	On	Flash	Line card is receiving data.

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 POS 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.

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.

SONET/SDH Clocking Issues

This section provides an overview of SONET/SDH clocking issues. A POS line card supports both line and internal clocking functions. Line clocking is derived from the incoming signal from a given port. Internal clocking is derived from the clock that is internal to the line card.

Each port can be configured independently of any other in a line-timed setup, going back as far as the first payload processor. However, on a POS line card, the second level of payload processing ties the ports to a common clock source which is timed from only one port. This can result in pointer justifications if the remaining ports are not synchronous. However, with a properly configured router, these pointer justifications can be limited to provide the same performance as a SONET cross-connect device.

Note Pointer justifications do not affect data throughput. All configurations of a POS line card provide total data throughput regardless of pointer justifications. Under no circumstances does any data loss occur. All configurations provide 100 percent error-free data flow.

The line card uses Stratum3 (S3) as the internal clock reference. However, if one of the ports is Stratum1 (S1) accurate, it can be used as the local reference for the system clock. In this case, pointer justifications are very limited. If the system clock is timed from an S1 clock source, from a valid SONET network, then there will be no pointer justifications on any synchronous interface. There are minimal pointer justifications (limited to S1 pointer justifications) on any asynchronous interface if it is on another SONET network. Pointer justification in this case is proportional to the accuracy of the other port clock.

A POS line card has the ability to select an input port as the source of synchronization for the system clock. This eliminates pointer justifications on any port that is synchronous with the selected port. Any other port on that line card that is not synchronous to the selected reference port will encounter pointer justifications at a rate proportional to clock accuracy of the port.

If the port is locally timed, it is Stratum3. If the port is line-timed, it depends on the attached network. It could be another Stratum3 clock, a Stratum1, or something much worse. This issue only applies to multiport cards and can be avoided if all ports on the line card are connected to the same SONET/SDH network.

Configuring and Troubleshooting Line Card Interfaces

The following sections detail how to configure and troubleshoot line card interfaces:

Initial Configuration

After you verify that a new line card is installed correctly (the Active LED goes on), you can configure it. First, enter the privileged level of the EXEC command interpreter (privileged EXEC mode) by using the **enable** command. The system will prompt you for a password if one is set. Next, use the **configure** command to access configuration mode. If you want to change the default configuration values on the line card, use the **configure terminal** command to enter global configuration mode. Then, use the **interface** command to specify the interface and enter interface configuration mode, where you can configure the new interface. Be prepared with the information you will need, such as the interface IP address.

A Cisco 12000 Series Router identifies an interface address by its line card slot number and port number, in the format *slot/port*. For example, the slot/port address of an interface on a 2-Port OC-192c/STM-64c POS line card installed in line card slot 2 and port 0 is 2/0.

Table 28 lists some configuration commands you may want to use and the default values. Refer to Cisco IOS documentation for complete information about these commands.

Table 28 POS Line Card Configuration Default Values

Parameter	Configuration Command	Default Value
Keepalive	[**no**] **keepalive** [0..32767]	keepalive[1]
Encapsulation	**encapsulation** [**hdlc** | **ppp**]	hdlc
CDP[2]	[**no**] **cdp enable**	cdp enable for all POS line cards except the 4-port OC-48c/STM-16c POS line card
Framing	**pos framing** {**sdh** | **sonet**}	SONET
Loop internal	[**no**] **loop** [**internal** | **line**] or [**no**] **loopback** [**internal** | **network**]	no loopback
Cyclic redundancy check	**crc** [**16** | **32**]	32
Clock source	**clock-source** {**internal** | **line**}	line
POS SPE scrambling	[**no**] **pos scramble-atm**	no pos scramble-atm for all cards except 2-port OC-192c/STM-64c POS line card, 8-port OC-48c/STM-16c POS line card, OC-192c/STM-64c POS line card and 4-port OC-48c/STM-16c POS line card

1. Cisco recommends not changing this default value
2. CDP=Cisco Discovery Protocol

Configuring The Interface

The following procedure is for creating a basic configuration—enabling an interface and specifying IP routing. This process may vary depending on the requirements for your router configuration.

To configure a POS line card, follow these steps:

Step 1 Enter privileged EXEC mode:

```
Router> enable
```

If the system prompts you for a password, enter it.

Step 2 Confirm that the router recognizes the line card by entering the **show version** command:

```
Router# show version
```

Step 3 Check the status of each port by entering the **show interface** command:

```
Router# show interface
```

Step 4 Enter configuration mode by entering the **configure terminal** command and specify that the console terminal is the source of the configuration subcommands:

```
Router# configure terminal
```

Step 5 Enable IP routing by entering the **ip routing** command:

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

Step 6 Specify the new interface to configure by entering the **interface** command, followed by the *type* (**pos**) and slot/port (line card slot number/port number). The example that follows is for an OC-192c/STM-64c POS line card in line card slot 1:

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

Step 7 Assign an IP address and subnet mask to the interface using the **ip address** configuration subcommand:

```
Router(config-if)# ip address 10.1.2.3 255.0.0.0
```

Step 8 Verify that HDLC encapsulation is correct for this interface. If you need to change the encapsulation, use the **encapsulation** command:

```
Router(config-if)# encapsulation encapsulation-type
```

where *encapsulation-type* is one of the keywords **hdlc** or **ppp**.

Step 9 Verify that the default value for clock source is correct. The default value is *line* and is used whenever clocking is derived from the network.

The **clock source internal** command is typically used when two Cisco 12000 Series Routers are connected back-to-back, or are connected over dark fiber where a clocking source is not available. In either case, each device should have its clock source set to internal.

```
Router(config-if)# clock source {line | internal}
```

Step 10 Change the shutdown state to up and enable the interface using the **no shutdown** command:

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

The **no shutdown** command passes an **enable** command to the POS line card. It also causes the line card to configure itself based on the previous configuration commands sent.

Step 11 Turn on or off keepalive messages as desired:

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

Cisco 12000 Series Routers do not require keepalive messages, but they are useful for encapsulated protocols such as HDLC. The keepalive default is on.

Step 12 Turn off the Cisco Discovery Protocol (CDP) using the **no cdp enable** command:

```
Router(config-if)# no cdp enable
```

Note Cisco 12000 Series Routers do not require CDP.

Step 13 Turn off IP multicast fast switching using the **no mroute-cache** command:

```
Router(config-if)# no mroute-cache
```

Note The line card cable is connected to both a Cisco 12000 Series Router device and another device—a high-end router or switch. Step 11 to Step 13 applies to both the Cisco 12000 Series Router device and the other device.

Step 14 Set the cyclic redundancy check (CRC) value to 32 (on both devices) using the **crc 32** command:

```
Router(config-if)# crc 32
```

Note If the device to which the line card cable is attached does not support a CRC value of 32, set both devices to use a value of 16 by entering the command **crc 16**.

Step 15 Add any other configuration subcommands required to enable routing protocols and adjust the interface characteristics.

Step 16 After including all the configuration subcommands to complete the configuration, enter **Ctrl-Z** (hold down the **Control** key while you press **Z**) to exit configuration mode.

Step 17 Write the new configuration to memory:

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

The router displays an OK message when the configuration is stored.

After you have completed your configuration, you can check it using **show** commands. For an explanation of **show** commands, see the "POS Line Card Configuration Examples" section on page 71.

Verifying Software and Hardware Versions

The **show version**, **show diag** *slot_number*, 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. Table 3 on page 4 lists the required versions for each line card. 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.

In the following example of the **show version** command, the Cisco IOS software version is displayed in italics.

```
Router> show version
Cisco Internetwork Operating System Software
IOS (tm) GS Software (GSR-P-M), Experimental Version 12.0(7)S.1113 [soma-v120_7]
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Sat 13-Nov-99 20:35 by soma
Image text-base: 0x60010908, data-base: 0x60F62000t
ROM: System Bootstrap, Version 11.2(19980529:213507) [zzhang-bfr_112.debug 86],E
BOOTFLASH: GS Software (GSR-BOOT-M), Version 11.2(9)GS7, EARLY DEPLOYMENT, RELE)
```

The **show diag** command displays the GRP microcode version and the line card microcode version (shown in italics in the following example):

```
router# show diag 1
SLOT 1  (RP/LC 1 ): 4 Port Packet Over SONET OC-12c/STM-4 Multi Mode
  MAIN: type 40,  800-5424-01 rev 71 dev 0
        HW config: 0x01    SW key: 00-00-00
  PCA:  73-3241-03 rev 71 ver 3
        HW version 1.0  S/N SAK0340006Y
  MBUS: Unknown (12)  65535-16777215-255 rev V7 dev 16777215
        HW version 255.255  S/N
        Test hist: 0x00    RMA#: 00-00-00    RMA hist: 0x00
  DIAG: Test count: 0x00000000    Test results: 0x00000000
  MBUS Agent Software version 01.39 (RAM) (ROM version is 02.00)
  Using CAN Bus A
  ROM Monitor version 10.04
  Fabric Downloader version used 03.01 (ROM version is 03.01)
  Primary clock is CSC 1
  Board is analyzed
  Board State is Line Card Enabled (IOS  RUN )
  Insertion time: 00:00:11 (1d20h ago)
  DRAM size: 67108864 bytes
  FrFab SDRAM size: 134217728 bytes, SDRAM pagesize: 8192 bytes
  ToFab SDRAM size: 134217728 bytes, SDRAM pagesize: 8192 bytes
  0 crashes since restart
```

If the displays indicate that theCisco IOS software or RP microcode 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.

Line Card Alarm and Event Detection

The POS line cards do not have an LED for alarm and event detection, but you can enter the **show controllers pos** EXEC command to verify whether the alarm and event detection messages are active or inactive. Most alarm and event detection messages are short-lived, because if problems occur, the line card clears the error condition, but records the event to verify line card operation status.

Some of the alarm and signal events for the line card are enabled for reporting by default. Others can be enabled individually. The **show controllers pos** privileged EXEC command output display depends on the configuration of the POS port.

The following partial output example from the **show controllers pos** privileged EXEC command shows alarm and event information for the second POS controller in slot 2 of a Cisco 12000 Series Router:

```
router# show controllers pos 2/0
POS2/0
SECTION
  LOF = 0          LOS    = 0                            BIP(B1) = 0
LINE
  AIS = 0          RDI    = 0          FEBE = 0          BIP(B2) = 0
PATH
  AIS = 0          RDI    = 0          FEBE = 0          BIP(B3) = 0
  LOP = 0          NEWPTR = 0          PSE  = 0          NSE     = 0

Active Defects:None
Active Alarms: None
Alarm reporting enabled for:SF SLOS SLOF B1-TCA B2-TCA PLOP B3-TCA
Framing:SONET
APS
COAPS = 0          PSBF = 0
  State:PSBF_state = False
  ais_shut = FALSE
  Rx(K1/K2):00/00  S1S0 = 00, C2 = CF
  Remote aps status non-aps; Reflected local aps status non-aps
CLOCK RECOVERY
  RDOOL = 0
  State:RDOOL_state = False
PATH TRACE BUFFER :STABLE
  Remote hostname :MFR2
  Remote interface:POS7/0
  Remote IP addr  :2.0.1.2
  Remote Rx(K1/K2):00/00  Tx(K1/K2):00/00
BER thresholds: SF = 10e-3  SD = 10e-6
TCA thresholds: B1 = 10e-6  B2 = 10e-6  B3 = 10e-6

Optical Power Monitoring
Laser Bias = 33.6 mA
Receiver Power = -5.80 dBm (+/- 2 dBm)
```

The Optical Power Monitoring information is available on Engine 4 and Engine 6 line cards only.

POS Line Card Configuration Examples

The following is an example of configuration file commands for a Cisco 12000 Series Router (first router) with POS line card in slot 3 connected back-to-back with a Cisco 7500 Series Router (second router) with a POSIP card in slot 3:

First router:

```
interface pos 3/0
ip address 10.1.2.3 255.0.0.0
clock source internal
no shutdown
no keepalive
no cdp enable
no ip mroute-cache
crc 32
```

Second router:

```
interface pos 3/0
ip address 10.1.2.4 255.0.0.0
clock source internal
no shutdown
no keepalive
no cdp enable
crc 32
```

The following configuration example shows the configuration commands for a Cisco 12000 Series Router with a 4-port OC-12c/STM-4c ISE line card in slot 5:

```
router# configure terminal
router(config)# interface pos 5/0
router(config-if)# ip address 10.0.1.1 255.255.255.0
router(config-if)# no shutdown
router(config-if)# exit
```

Advanced Line Card Troubleshooting

This section provides advanced troubleshooting information in the event of a line card failure. It also provides pointers for identifying whether or not the failure is hardware related. This section does not include any software-related failures, except for those that are often mistaken for hardware failures.

Note This section assumes that you possess basic proficiency in the use of Cisco IOS software commands.

By reading this section and by following the troubleshooting steps, you should be able to determine the nature of the problems you are having with your line card. The first step is to identify the cause of the line card failure or console errors that you are seeing. To discover which card may be at fault, it is essential to collect the output from the following commands:

- **show context summary**
- **show logging**
- **show logging summary**
- **show diag** *slot*

- **show context slot** *slot*

Along with these **show** commands, you should also gather the following information:

- Console Logs and Syslog Information—This information is crucial if multiple symptoms are occurring. If the router is configured to send logs to a Syslog server, you may see some information on what has occurred. For console logs, it is best to be directly connected to the router on the console port with logging enabled.
- Additional Data—The **show tech-support** command is a compilation of many different commands, including **show version**, **show running-config**, and **show stacks**. This information is required when working on issues with the Cisco Technical Assistance Center (TAC).

Note It is important to collect the **show tech-support** data before doing a reload or power cycle. Failure to do so can cause all information about the problem to be lost.

Note Output from these commands will vary slightly depending on which line card you are using, but the basic information will be the same.

Output Examples

The following are examples of system output that you may see if your Cisco 12000 Series Router line card fails. Key data in the output is underlined.

- show context summary Output
- show logging Output
- show diag slot Output
- show context slot Output

show context summary Output

```
Router# show context summary
CRASH INFO SUMMARY
Slot 0 : 0 crashes
Slot 1 : 1 crashes
1 . crash at 10:36:20 UTC Wed Dec 19 2001
Slot 2 : 0 crashes
Slot 3 : 0 crashes
Slot 4 : 0 crashes
Slot 5 : 0 crashes
Slot 6 : 0 crashes
(remainder of output omitted)
```

show logging Output

```
Router# show logging
Syslog logging: enabled (2 messages dropped, 0 messages rate.limited, 0 flushes,
0 overruns)
Console logging: level debugging, 24112 messages logged
Monitor logging: level debugging, 0 messages logged
Buffer logging: level debugging, 24411 messages logged
Logging Exception size (4096 bytes)
Trap logging: level informational, 24452 message lines logged
5d16h: %LCINFO.3.CRASH: Line card in slot 1 crashed
```

```
5d16h: %GRP.4.RSTSLOT: Resetting the card in the slot: 1,Event: 38
5d16h: %IPCGRP.3.CMDOP: IPC command 3
5d16h: %CLNS.5.ADJCHANGE: ISIS: Adjacency to malachim2 (GigabitEthernet1/0) Up,
n8 (slot1/0): linecard is disabled
.Traceback= 602ABCA8 602AD8B8 602B350C 602B3998 6034312C 60342290 601A2BC4 601A2BB0
5d16h: %LINK.5.CHANGED: Interface GigabitEthernet1/0, changed state to
administratively down
5d16h: %LINEPROTO.5.UPDOWN: Line protocol on Interface GigabitEthernet1/0,
changed state to down
5d16h: %GRP.3.CARVE_INFO: Setting mtu above 8192 may reduce available buffers
on Slot: 1.
SLOT 1:00:00:09: %SYS.5.RESTART: System restarted ..
(remainder of output omitted)
```

show diag *slot* Output

```
Router# show diag 1
SLOT 1 (RP/LC 1 ): 3 Port Gigabit Ethernet
MAIN: type 68, 800.6376.01 rev E0 dev 0
HW config: 0x00 SW key: 00.00.00
PCA: 73.4775.02 rev E0 ver 2
HW version 2.0 S/N CAB0450G8FX
MBUS: Embedded Agent
Test hist: 0x00 RMA#: 00.00.00 RMA hist: 0x00
DIAG: Test count: 0x00000001 Test results: 0x00000000
FRU: Linecard/Module: 3GE.GBIC.SC=
Route Memory: MEM.GRP/LC.64=
Packet Memory: MEM.LC1.PKT.256=
L3 Engine: 2 . Backbone OC48 (2.5 Gbps)
MBUS Agent Software version 01.46 (RAM) (ROM version is 02.10)
Using CAN Bus A
ROM Monitor version 10.06
Fabric Downloader version used 05.01 (ROM version is 05.01)
Primary clock is CSC 0 Board is analyzed
Board State is Line Card Enabled (IOS RUN )
Insertion time: 00:00:10 (5d16h ago)
DRAM size: 67108864 bytes
FrFab SDRAM size: 134217728 bytes, SDRAM pagesize: 8192 bytes
ToFab SDRAM size: 134217728 bytes, SDRAM pagesize: 8192 bytes
1 crash since restart
```

show context slot Output

```
Router# show context slot 2
CRASH INFO: Slot 2, Index 1, Crash at 12:24:22 MET Wed Nov 28 2001
VERSION:
GS Software (GLC1.LC.M), Version 12.0(18)S1, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Compiled Fri 07.Sep.01 20:13 by nmasa
Card Type: 3 Port Gigabit Ethernet, S/N
System exception: SIG=23, code=0x24, context=0x4103FE84
System restarted by a Software forced crash
STACK TRACE:
.Traceback= 400BEB08 40599554 4004FB64 4005B814 400A1694 400A1680
CONTEXT:
$0 : 00000000, AT : 41040000, v0 : 00000032, v1 : 4103FC00
a0 : 4005B0A4, a1 : 41400A20, a2 : 00000000, a3 : 00000000
t0 : 41D75220, t1 : 8000D510, t2 : 00000001, t3 : FFFF00FF
t4 : 400C2670, t5 : 00040000, t6 : 00000000, t7 : 4150A398
s0 : 0000003C, s1 : 00000036, s2 : 4103C4D0, s3 : 41D7EC60
s4 : 00000000, s5 : 00000001, s6 : 41027040, s7 : 00000000
t8 : 41A767B8, t9 : 00000000, k0 : 415ACE20, k1 : 400C4260
GP : 40F0DD00, SP : 41D7EC48, s8 : 4102D120, ra : 40599554
```

```
EPC : 0x400BEB08, SREG : 0x3400BF03, Cause : 0x00000024
ErrorEPC : 0x400C6698, BadVaddr : 0xFFBFFFFB
.Process Traceback= No Extra Traceback
SLOT 2:00:00:09: %SYS.5.RESTART: System restarted ..
(remainder of output omitted)
```

The type of failure that has occurred in the **show context slot 2** example is identified by the underlined *SIG=* value. The three most common types of line card failures are:

- Software Forced Crash (SIG=23)
- Bus Error (SIG=10)
- Cache Parity Exception (SIG=20)

In the example above, the line card has failed and has caused a reload because of a *software forced crash* exception. Once you have determined the cause and collected the necessary output, you can check for any caveats in your Cisco IOS software release using the Bug Toolkit (available to registered Cisco.com users only).

Checking the Current Status of the Line Card

Once you have determined if the problems are caused by system errors in the log or an actual crash, it is important to check the current status of the line card to see if it has recovered from the failure. The status of individual line cards can be identified either by examining the alphanumeric LEDs located on the front of the line card, or by issuing the **show led** command.

show led Output

```
Router# show led
SLOT 1 : RUN IOS
SLOT 6 : DNLD FABL
SLOT 7 : RP ACTV
SLOT 10 : RUN IOS
SLOT 11 : RUN IOS
SLOT 13 : RUN IOS
SLOT 14 : RUN IOS
```

Note It is possible for the value of an alphanumeric LED to be reversed. For example, IOS RUN may be displayed as RUN IOS.

If the alphanumeric LEDs on the line card display anything other than IOS RUN, or the RP is neither the active Master/Primary nor the Slave/Secondary, there is a problem and the line card has not fully loaded correctly. Before replacing the line card, try fixing the problem by following these steps:

Step 1 Reload the microcode using the global configuration **microcode reload** *slot* command.

Step 2 Reload the line card using the **hw-module slot** reload command. This causes the line card to reset and download the MBus and fabric downloader software modules before attempting to download the Cisco IOS software.

or

Step 3 Reset the line card manually. This may rule out any problems that are caused by a bad connection to the MBus or switching fabric.

Fabric Ping Failure

Fabric ping failures occur when either a line card or the secondary RP fails to respond to a fabric ping request from the primary RP over the switch fabric. Such failures are a problem symptom that should be investigated. They are indicated by the following error messages:

```
%GRP-3-FABRIC_UNI: Unicast send timed out (1)
%GRP-3-COREDUMP: Core dump incident on slot 1, error: Fabric ping failure
%LCINFO-3-CRASH: Line card in slot 1 crashed
```

You can find more information about this issue on Cisco.com in the *Troubleshooting Fabric Ping Timeouts and Failures on the Cisco 12000 Series Internet Router* publication.

Error Messages

If you receive any error message related to a line card, you can use the Error Message Decoder Tool (on Cisco.com) to find the meaning of this error message. Some errors point to a hardware issue, while others indicate a Cisco IOS software caveat or a hardware issue on another part of the router. This publication does not cover all these messages.

Note Some messages related to Cisco Express Forwarding (CEF) and Inter Process-Communication (IPC) are explained on Cisco.com in the *Troubleshooting CEF-Related Error Messages* publication.

Line Card Diagnostics Using Cisco IOS Software Release 12.0(22)S and Later

Note Output from this procedure will vary slightly depending on which line card you are using, but the basic information will be the same.

Line card field diagnostic software is designed to identify any faulty line card within a Cisco 12000 Series Router. Before Cisco IOS Software Release 12.0(22)S, the field diagnostic software was imbedded within the Cisco IOS software. Starting with Cisco IOS Software Release 12.0(22)S, this software is unbundled from the main image and must be downloaded from Cisco.com using the IOS Upgrade Planner.

Cisco initiated this change to accommodate users with 20-MB Flash memory cards. Field diagnostics are now stored and maintained as a separate image under the following name:

c12k-fdiagsbflc-mz-xxx-xx.s (where xxx-xx is the version number)

This image must be available on a separate Flash memory card, Flash disk, or TFTP boot server in order to load line card field diagnostics. The latest version is always available on Cisco.com. RP and fabric tests remain embedded within the main Cisco IOS software image.

While the diagnostic test is running, the line card does not function normally and cannot pass any traffic for the duration of the testing (5 to 20 minutes depending upon the complexity of the line card). Without the *verbose* keyword, the command provides a truncated output message. When communicating with the Cisco TAC, the verbose mode is helpful in identifying specific problems. The output of the diagnostic test without the verbose command appears like the following example:

```
Router# diag 7 tftp://223.255.254.254/diagnostic/award/c12k.fdiagsbflc.mz.120-25.s
Running DIAG config check
```

```
Fabric Download for Field Diags chosen: If timeout occurs, try 'mbus' option.
Runnning Diags will halt ALL activity on the requested slot. [confirm]
Launching a Field Diagnostic for slot 7
Downloading diagnostic tests to slot 7 via fabric (timeout set to 300 sec.)
5d20h: %GRP.4.RSTSLOT: Resetting the card in the slot: 7,Event:
EV_ADMIN_FDIAGLoading diagnostic/award/c12k.fdiagsbflc.mz.120-25.s from 223.255.254.254
(via Ethernet0): !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
5d20h: Downloading diags from tftp file tftp://223.255.254.254/diagnostic/award/
c12k.fdiagsbflc.mz.120-25.s
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK . 13976524 bytes]
FD 7> **************************************************
FD 7> GSR Field Diagnostics V6.05
FD 7> Compiled by award on Tue Jul 30 13:00:41 PDT 2002
FD 7> view: award.conn_isp.FieldDiagRelease
FD 7> **************************************************
Executing all diagnostic tests in slot 7
(total/indiv. timeout set to 2000/600 sec.)
FD 7> BFR_CARD_TYPE_OC12_4P_POS testing...
FD 7> Available test types 2
FD 7> 1
FD 7> Completed f_diags_board_discovery() (0x1)
FD 7> Test list selection received: Test ID 1, Device 0
FD 7> running in slot 7 (30 tests from test list ID 1)
FD 7> Skipping MBUS_FDIAG command from slot 2
FD 7> Just into idle state
Field Diagnostic ****PASSED**** for slot 7
Shutting down diags in slot 7
Board will reload
(remainder of output omitted)
```

The line card reloads automatically only after passing the test. If the line card fails the test, it will not reload automatically. You can manually reload the line card by using the **hw-module slot** *slot* **reload** command.

Field diagnostic results are stored in an electrically erasable programmable read-only memory (EEPROM) on the line card. It is possible to view the results of the last diagnostic test performed on the line card by executing the **diag** *slot* **previous** command.

There are some caveats that exist that cause diagnostic tests to fail, even though the line card is not faulty. As a precaution, if the line card fails and had been replaced previously, you should review this output with the Cisco TAC.

Line Card Diagnostics Using Cisco IOS Software Releases Prior to 12.0(22)S

Note Output from this procedure will vary slightly depending on which line card you are using, but the basic information will be the same.

Line card field diagnostic software is bundled with the main Cisco IOS software to enable you to test whether a suspect line card is faulty. To use this feature, you must be in privileged enable mode, and issue the **diag** *slot* [*verbose*] command.

While the diagnostic test is running, the line card does not function normally and cannot pass any traffic for the duration of the testing. Without the *verbose* keyword, the command provides a truncated output message. When communicating with the Cisco TAC, the verbose mode is helpful in identifying specific problems. The output of the diagnostic test without the verbose command appears like the following example:

```
Router#diag 3
Running DIAG config check
Running Diags will halt ALL activity on the requested slot
[confirm]
Router#
Launching a Field Diagnostic for slot 3
Downloading diagnostic tests to slot 3 (timeout set to 600 sec.)
*Nov 18 22:20:40.237: %LINK.5.CHANGED: Interface GigabitEthernet3/0,
changed state to administratively down
Field Diag download COMPLETE for slot 3
FD 3> ************************************************
FD 3> GSR Field Diagnostics V4.0
FD 3> Compiled by award on Thu May 18 13:43:04 PDT 2000
FD 3> view: award.conn_isp.FieldDiagRelease
FD 3> ************************************************
FD 3> BFR_CARD_TYPE_1P_GE testing...
FD 3> running in slot 3 (83 tests)
Executing all diagnostic tests in slot 3
(total/indiv. timeout set to 600/200 sec.)
Field Diagnostic: ****TEST FAILURE**** slot 3: last test run 51,
Fabric Packet Loopback, error 3
Shutting down diags in slot 3
slot 3 done, will not reload automatically
```

The line card reloads automatically only after passing the test. In the example above, the line card failed the test and did not reload automatically. You can manually reload the line card by using the **hw-module slot** *slot* **reload** command.

Field diagnostic results are stored in an EEPROM on the line card. It is possible to view the results of the last diagnostic test performed on the line card by executing the **diag** *slot* **previous** command.

There are some caveats that exist that cause diagnostic tests to fail, even though the line card is not faulty. As a precaution, if the line card fails and had been replaced previously, you should review this output with the Cisco TAC.

Line Card Memory

This section contains information about the following:

You can replace the route memory on POS 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 29 provides information about the various hardware engines available with the POS line cards. The engine determines where the memory is placed.

Table 29 POS Line Card Engines

POS Line Card	Hardware Engine
4-Port OC-3c/STM-1c	Engine 0
OC-12c/STM-4c	
8-Port and 16-Port OC-3c/STM-1	Engine 2
Enhanced 4-Port OC-12c/STM-4c	
4-Port OC-12c/STM-4c	
OC-48c/STM-16c	
Enhanced OC-48c/STM-16c	
OC-3c/STM-1c ISE	Engine 3, Internet Services Engine (ISE)
4-Port OC-12c/STM-4c ISE	
OC-48c/STM-16c ISE	
4-Port OC-48c/STM-16c	Engine 4 Engine 4+ Enhanced Services (ES)
OC-192c/STM-64c	
8-Port OC-48c/STM-16c	Engine 6
2-Port OC-192c/STM-64c	

Caution The user serviceability of memory modules varies from line card to line card. Read this section carefully before attempting to remove or install any line card memory module.

Line Card Memory Locations

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

- Engine 0 and Engine 1 Line Card Memory Locations, page 79
- Engine 2 Line Card Memory Locations, page 80
- ISE Line Card Memory Locations, page 80
- Engine 4 Line Card Memory Locations, page 82
- Engine 6 Line Card Memory Locations, page 82
- POS Line Card Route Memory Options, page 83
- POS Line Card Packet Memory Options, page 84

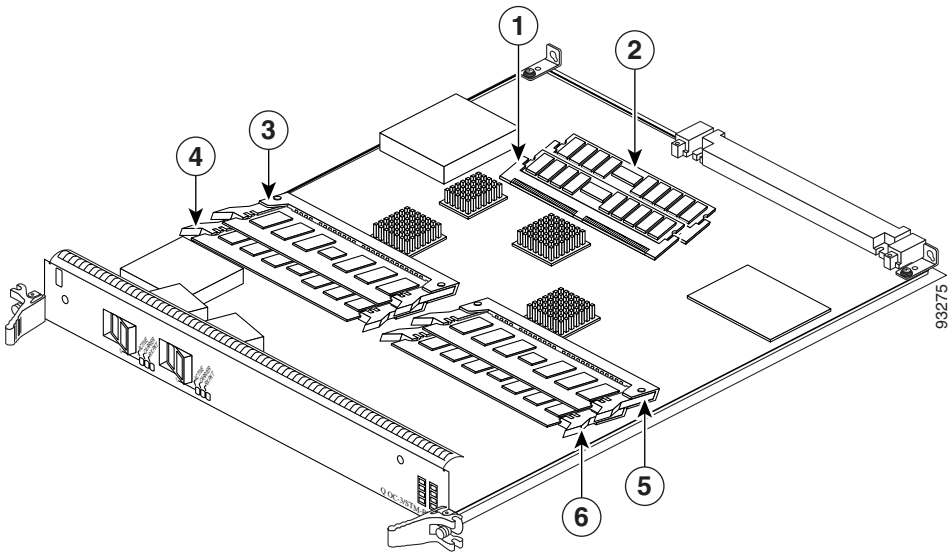
Memory removal and installation instructions are found in the "Removing and Installing Line Card Memory" section on page 84.

Engine 0 and Engine 1 Line Card Memory Locations

Figure 48 shows the dual in-line memory module (DIMM) socket locations on an Engine 0 or Engine 1 line card. This line card is equipped with six DIMM sockets:

- Two route memory DIMM sockets
- Two pairs of packet memory DIMM sockets (RX and TX pairs)

Figure 48 Engine 0 and Engine 1 Line Card Memory Locations



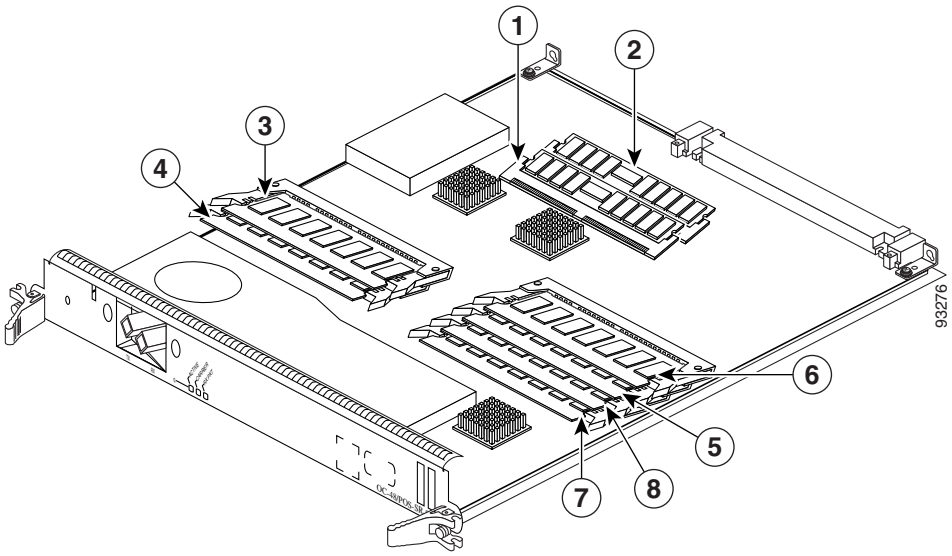
1	Route memory DIMM0	**4**	Packet memory RX DIMM1
2	Route memory DIMM1	**5**	Packet memory TX DIMM0
3	Packet memory RX DIMM0	**6**	Packet memory TX DIMM1

Engine 2 Line Card Memory Locations

Figure 49 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 49 Engine 2 Line Card Memory Locations



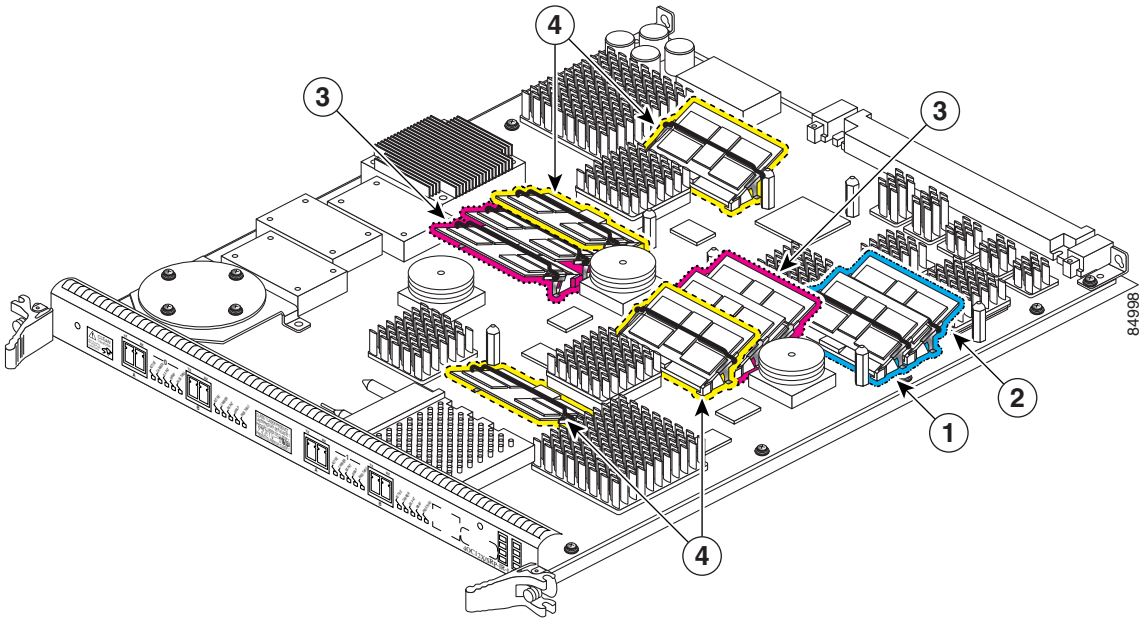
1	Route memory DIMM0	**5**	Packet memory RX DIMM0
2	Route memory DIMM1	**6**	Packet memory RX DIMM1
3	Packet memory TX DIMM0	**7**	PLU DIMM (not user serviceable)
4	Packet memory TX DIMM1	**8**	TLU DIMM (not user serviceable)

ISE Line Card Memory Locations

Figure 50 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 50 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)

There are two route memory sockets on ISE (Engine 3) line cards that support the addition of route memory modules. Table 30 describes the various memory upgrade options.

Table 30 ISE/Engine 3 Line Card Memory Upgrade Options

Line Cards	Current Configuration	Memory Upgrade[1]
OC-3c/STM-1c OC-48c/STM-16c 4-Port OC-12c/STM-4c	• Two 128 MB memory modules	• Upgrade to 512 MB by installing two 256 MB memory modules.[2] • Upgrade to 512 MB by installing one 512 MB memory module.[3]
	• Two 256 MB memory modules • One 512 MB memory module	• Upgrade to 1 GB by installing two 512 MB memory modules.[2,3] • Upgrade to 1 GB by installing a second 512 MB memory module.[2, 3]

1. If you need to upgrade beyond 2 x 512 MB modules you must contact the Cisco Technical Assistance Center (TAC) for instructions.
2. Do not mix memory sizes. Both DIMMs must be the same size memory.
3. Requires Cisco IOS Release 12.0(31)S or later, and you must upgrade the route processor ROMMON code to Version 1.13 or later *before* installing the upgraded memory.

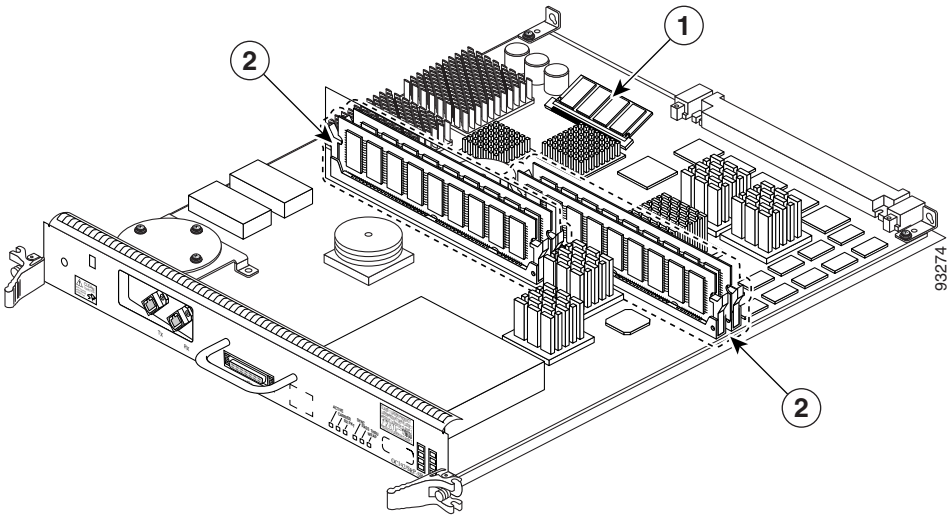
Engine 4 Line Card Memory Locations

Figure 52 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 51 Engine 4 Line Card Memory Locations



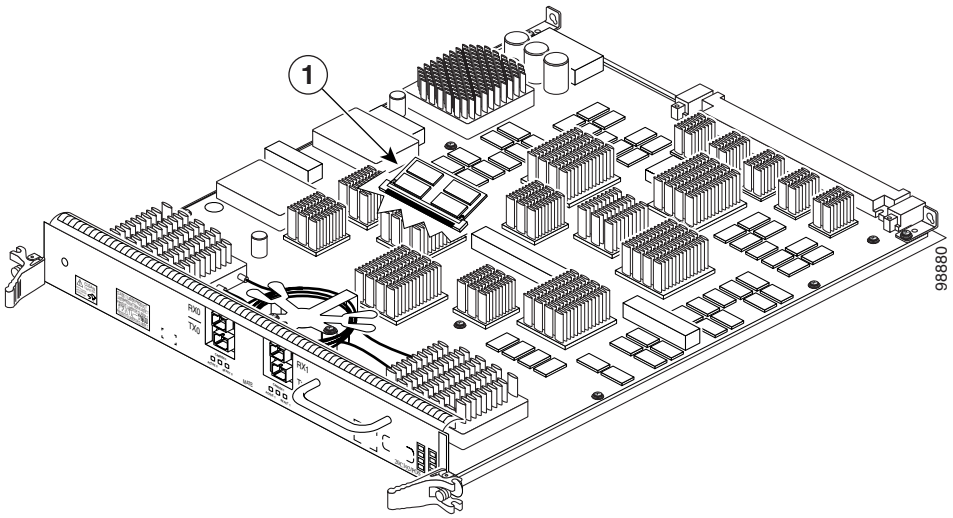
1	Route memory SODIMM	**2**	Packet memory DIMMs (not user serviceable)

Engine 6 Line Card Memory Locations

Figure 52 shows the DIMM socket locations on an Engine 6 line card. These line cards are equipped with one router memory small-outline DIMM (SODIMM) socket.

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 52 Engine 6 Line Card Memory Locations



1	Route memory SODIMMs

POS 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 512 MB. Table 31 lists the available route memory configurations and associated product numbers of the memory modules used for upgrading route memory on POS line cards. For the most up-to-date memory options, refer to *Cisco 12000 Series Router Memory Replacement Instructions* publication.

Table 31 Route Memory Configurations for POS Line Cards

Total Route Memory Ordered	Cisco Product Number	DIMM Module	Route Memory DIMM Sockets	Line Card Engine Type
64 MB	MEM-GRP/LC-64=[1]	1 64-MB DIMM	DIMM0 or DIMM1	0, 1, 2
128 MB	MEM-DFT-GRP/LC-128[2]	1 128-MB DIMM	DIMM0 or DIMM1	0, 1, 2
128 MB	MEM-GRP/LC-128=[3]	1 128-MB DIMM	DIMM0 or DIMM1	0, 1, 2
256 MB	MEM-GRP/LC-256=	2 128-MB DIMMs	DIMM0 and DIMM1	0, 1, 2
256 MB	MEM-LC4-256=[4]	1 256-MB SODIMM	J15	4, 4+
512 MB	MEM-LC-ISE-512=[5]	2 256-MB DIMMs	DIMM0 and DIMM1	ISE

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. Standard (default) DRAM DIMM configuration for the processor on a line card is 128 MB.
3. This option allows the customer to order a spare module or add a second 128-MB DIMM for a total of 256 MB for line cards that are already equipped with one 128 MB DIMM.
4. This option is only compatible with the Engine 4/4+ line cards and is for replacement only.
5. This option is the upgrade. The standard default DIMM configuration is 2 x 128 MB

POS 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 32 lists the packet memory options for POS line cards that have replaceable packet memory.

Caution Not all line cards support replaceable packet memory. See the "Line Card Memory Locations" section on page 78 for more information.

Table 32 POS Line Card Packet Memory Options

Total Packet Memory[1]	Cisco Product Number	DIMM Modules	DIMM Sockets
128 MB	MEM-LC-PKT-128=	2 RX 32-MB DIMMs 2 TX 32-MB DIMMs	RX DIMM0 and DIMM1 TX DIMM0 and DIMM1
256 MB	MEM-LC1-PKT-256=	2 RX 64-MB DIMMs 2 TX 64-MB DIMMs	RX DIMM0 and DIMM1 TX DIMM0 and DIMM1
512 MB (upgrade)	MEM-PKT-512-UPG=[2]	2 RX 128-MB DIMMs 2 TX 128-MB DIMMs	RX DIMM0 and DIMM1 TX DIMM0 and DIMM1

1. The 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.
2. Only applicable to Engine 2 line cards.

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. When removing or installing memory, observe the guidelines in the following sections:

- Removing a DIMM, page 84
- Installing a DIMM, page 86
- Removing a SODIMM, page 87
- Installing a SODIMM, page 89
- Checking the Installation of Line Card Memory, page 93

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 53; other line cards use DIMM sockets equipped with a single release lever, as shown in Figure 54. Both DIMM sockets operate in the same general way.

Figure 53 DIMM Socket with Dual Release Levers

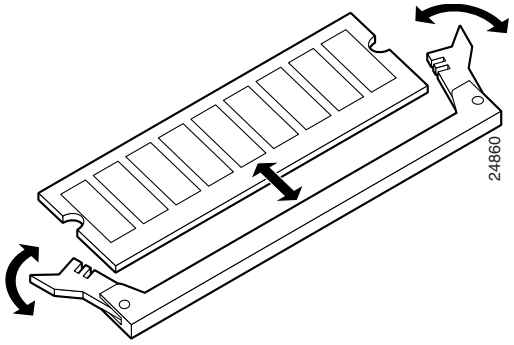
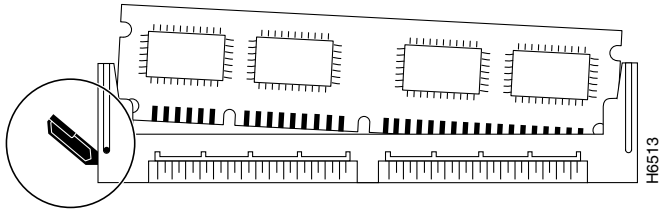


Figure 54 DIMM Socket with Single Release Lever



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

- For a socket with dual release levers (see Figure 53), pull down both levers at the same time to eject the DIMM.

  or

- For a socket with a single release lever (see Figure 54), 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.

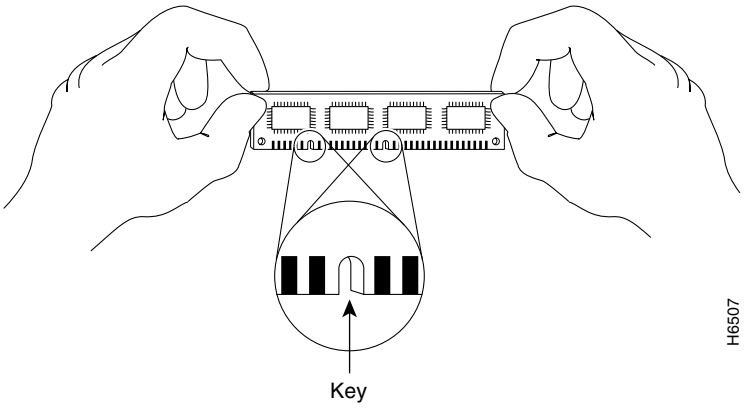
Step 3 Remove the new DIMM from its protective antistatic bag.

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 55.)

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 55.)

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

Figure 55 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.

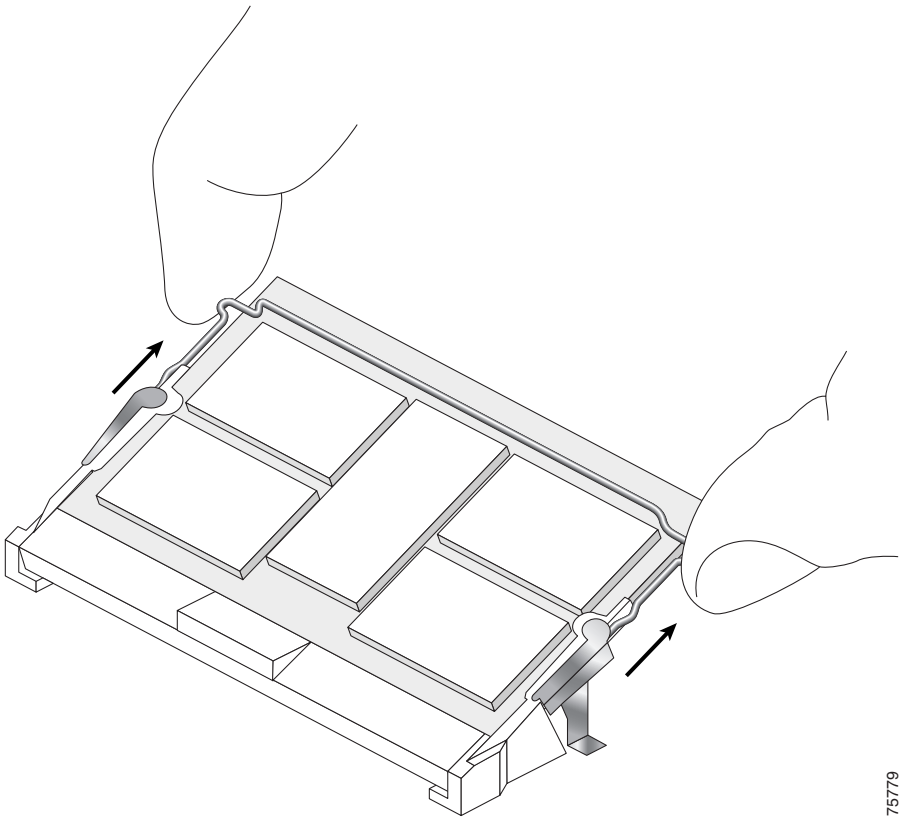
Step 3 Locate the route memory socket on the line card.

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 56.) 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 56 Remove Retaining Clip from Memory Module Socket

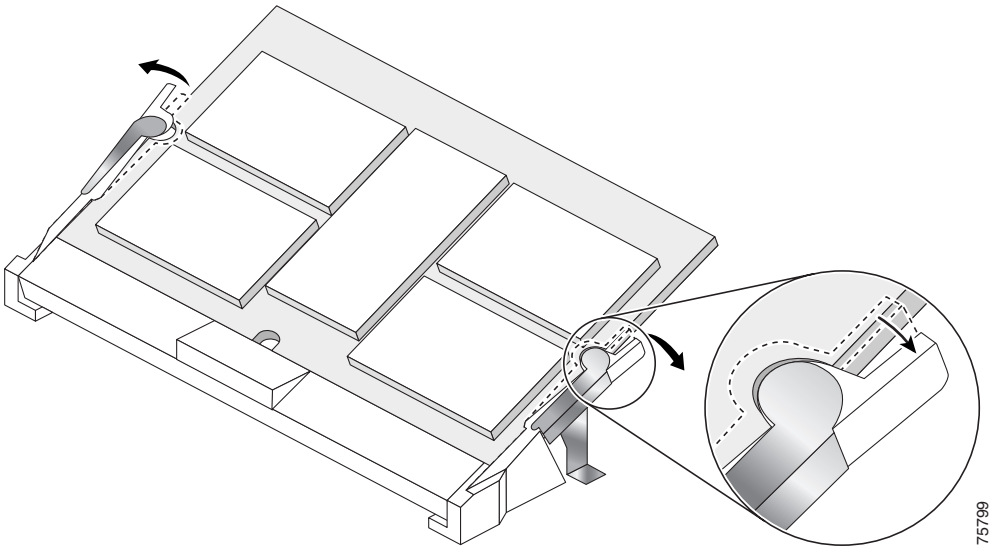


Step 5 Remove the SODIMM by gently moving the plastic latches in an outward direction, parallel to and away from the memory module, until it releases and rotates to a 45-degree angle. (See Figure 57 and Figure 58a.)

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.

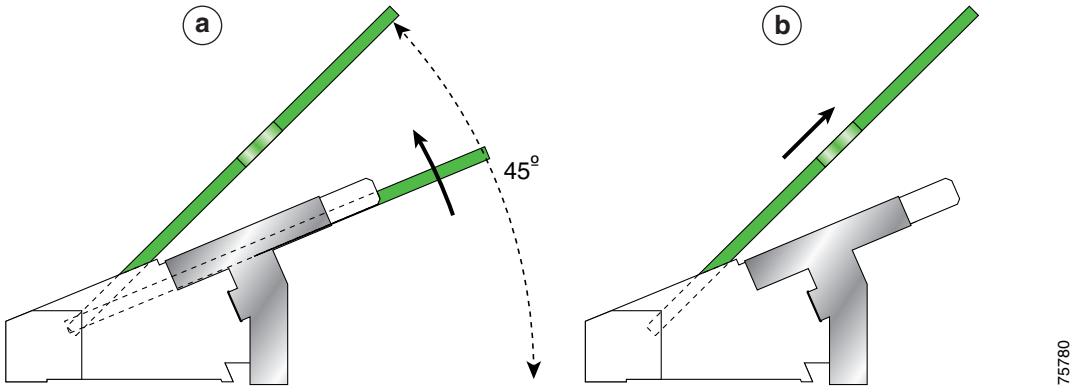
Caution Handle the edges of the SODIMM only. Do not touch the integrated circuit devices on the SODIMM, the metal traces, or fingers, along the edge of the SODIMM, or the pins in the SODIMM socket.

Figure 57 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 58b.)

Figure 58 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:

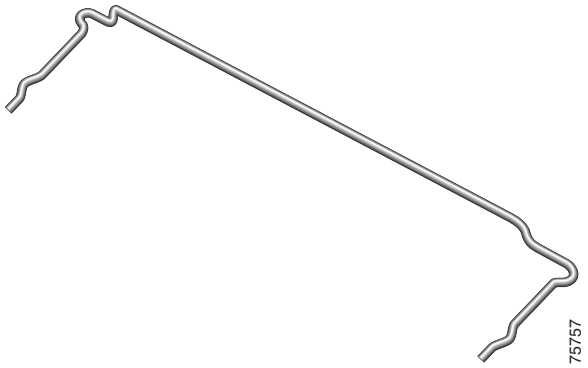
Step 1 Attach an ESD-preventive wrist or ankle strap and follow its instructions for use.

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 59.)

Note Some line cards do not require a retaining clip.

Figure 59 SODIMM Socket Retaining Clip



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

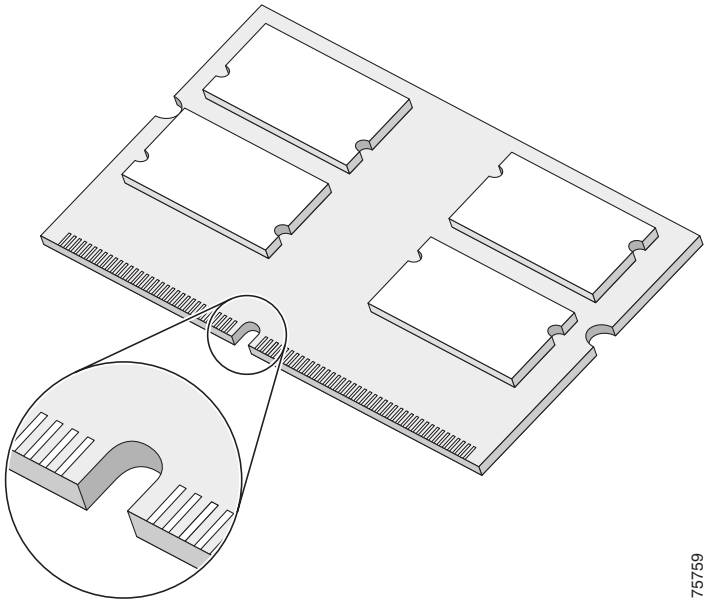
Step 4 Locate the route memory socket on the line card.

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 60.)

Figure 60 SODIMM with Key in Face-Up Position



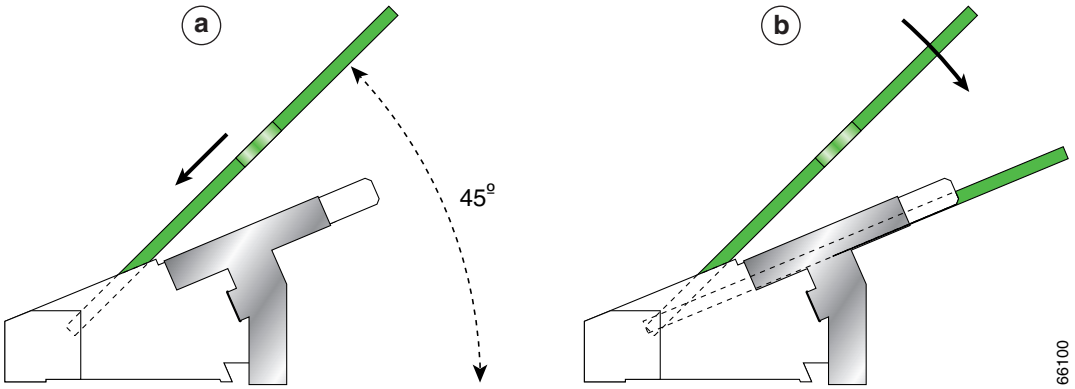
Step 7 The SODIMM must be lined up at a 45-degree angle. (See Figure 61a.)

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 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 61 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 61b.)

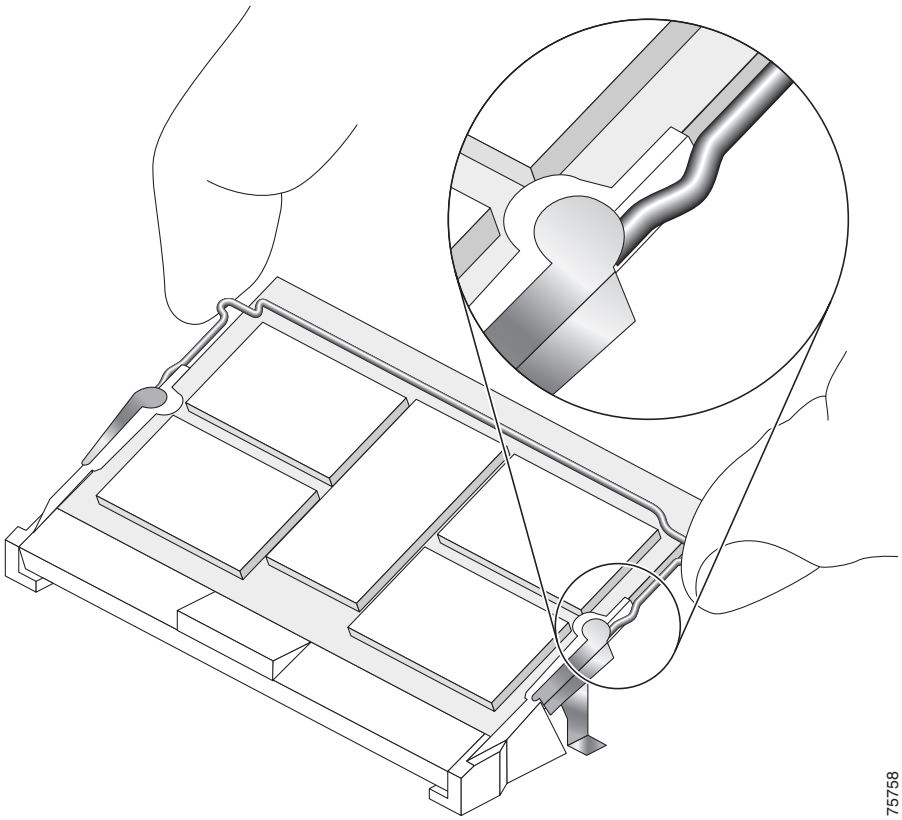
Caution Excessive pressure can damage a SODIMM socket.

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.

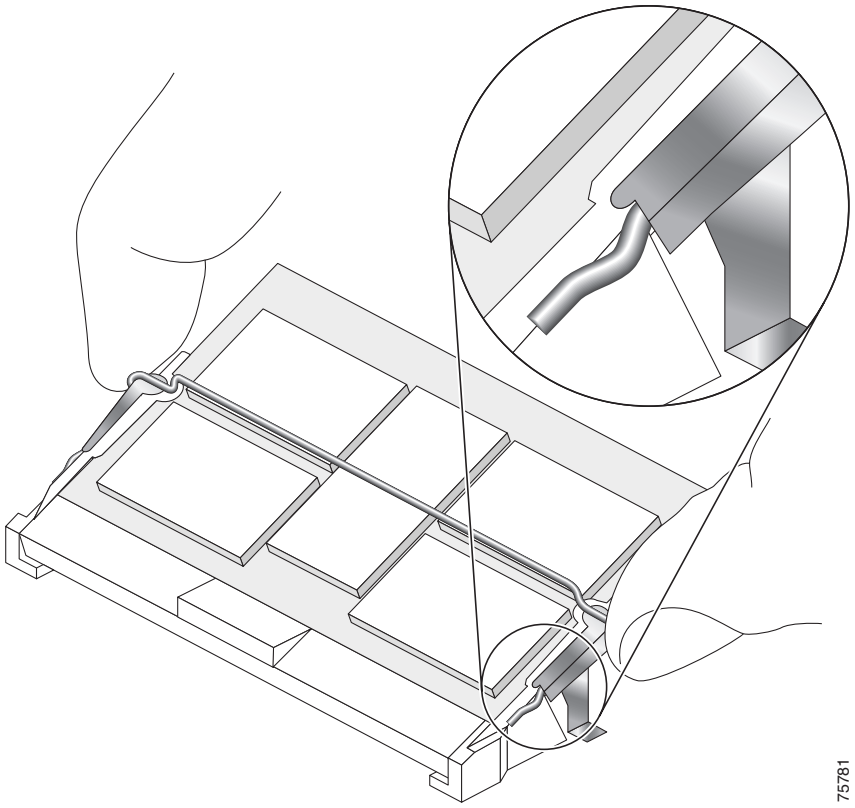
Step 12 If there is a retaining clip, insert it by sliding the clip between the metal strain relief and the plastic latch. (See Figure 62.)

Figure 62 Inserting the Retaining Clip



The clip is properly installed when the clip detente protrudes below the strain relief and plastic latch. (See Figure 63.)

Figure 63 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 SODIMMs and that they are installed correctly on the line card.

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

Step 1 Check that the SODIMM is fully inserted into the socket.

Step 2 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 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.

Figyelem **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.**

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 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 Compliance for Class B Equipment

Warning

This is a Class B product based on the standard of the Voluntary Control Council for Interference from Information Technology Equipment (VCCI). If this is used near a radio or television receiver in a domestic environment, it may cause radio interference. Install and use the equipment according to the instruction manual. Statement 157

警告　VCCI準拠クラスB機器（日本）
この機器は、Information Technology EquipmentのVoluntary Control Council for Interference（VCCI）の規格に準拠したクラスB製品です。この機器をラジオやテレビ受信機の近くで使用した場合、混信を発生する恐れがあります。本機器の設置および使用に際しては、取扱い説明書に従ってください。

The 8-Port OC-48c/STM-16c and 2-Port OC-192c/STM-64c POS line cards are Class B products.

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 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며 만약 잘못 판매 또는 구입하였을 때에는 가정용으로 교환하시기 바랍니다.

Laser Safety

POS line cards are equipped with a Class 1 laser (VSR is Class 1M), which emits invisible radiation. Do not stare into operational line card ports. The following laser warnings apply to POS line cards:

- Class 1 Laser Product Warning
- Class 1M Laser Product Warnings (VSR Only)
- General Laser Warning

Class 1 Laser Product Warning

The following warning applies to single-mode SR, IR, and LR optics:

Warning **Class 1 laser product.**

Class 1M Laser Product Warnings (VSR Only)

The following warnings apply to line cards with VSR optics:

Warning **Laser radiation. Do not view directly with optical instruments. Class 1M laser product.**

Warning **For diverging beams, viewing the laser output with certain optical instruments within a distance of 100 mm may pose an eye hazard. For collimated beams, viewing the laser output with certain optical instruments designed for use at a distance may pose an eye hazard.**

Warning **Class 1M laser radiation when open. Do not view directly with optical instruments.**

General Laser Warning

The following warning applies to all POS line cards:

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

Cisco documentation and additional literature are available on Cisco.com. Cisco also provides several ways to obtain technical assistance and other technical resources. These sections explain how to obtain technical information from Cisco Systems.

Cisco.com

You can access the most current Cisco documentation on the World Wide Web at this URL:

http://www.cisco.com/univercd/home/home.htm

You can access the Cisco website at this URL:

http://www.cisco.com

International Cisco websites can be accessed from this URL:

http://www.cisco.com/public/countries_languages.shtml

Ordering Documentation

You can find instructions for ordering documentation at this URL:

http://www.cisco.com/univercd/cc/td/doc/es_inpck/pdi.htm

You can order Cisco documentation in these ways:

- Registered Cisco.com users (Cisco direct customers) can order Cisco product documentation from the Networking Products MarketPlace:

  http://www.cisco.com/en/US/partner/ordering/index.shtml

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco Systems Corporate Headquarters (California, USA) at 408 526-7208 or, elsewhere in North America, by calling 800 553-NETS (6387).

Documentation Feedback

You can submit e-mail comments about technical documentation to bug-doc@cisco.com.

You can submit comments by using the response card (if present) behind the front cover of your document or by writing to the following address:

Cisco Systems
Attn: Customer Document Ordering
170 West Tasman Drive
San Jose, CA 95134-9883

We appreciate your comments.

Obtaining Technical Assistance

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, the Cisco Technical Assistance Center (TAC) provides 24-hour-a-day, award-winning technical support services, online and over the phone. Cisco.com features the Cisco TAC website as an online starting point for technical assistance. If you do not hold a valid Cisco service contract, please contact your reseller.

Cisco TAC Website

The Cisco TAC website provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The Cisco TAC website is available 24 hours a day, 365 days a year. The Cisco TAC website is located at this URL:

http://www.cisco.com/tac

Accessing all the tools on the Cisco TAC website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a login ID or password, register at this URL:

http://tools.cisco.com/RPF/register/register.do

Opening a TAC Case

Using the online TAC Case Open Tool is the fastest way to open P3 and P4 cases. (P3 and P4 cases are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Case Open Tool automatically recommends resources for an immediate solution. If your issue is not resolved using the recommended resources, your case will be assigned to a Cisco TAC engineer. The online TAC Case Open Tool is located at this URL:

http://www.cisco.com/tac/caseopen

For P1 or P2 cases (P1 and P2 cases are those in which your production network is down or severely degraded) or if you do not have Internet access, contact Cisco TAC by telephone. Cisco TAC engineers are assigned immediately to P1 and P2 cases to help keep your business operations running smoothly.

To open a case by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)
EMEA: +32 2 704 55 55
USA: 1 800 553-2447

For a complete listing of Cisco TAC contacts, go to this URL:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

TAC Case Priority Definitions

To ensure that all cases are reported in a standard format, Cisco has established case priority definitions.

Priority 1 (P1)—Your network is “down” or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.

Priority 2 (P2)—Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.

Priority 3 (P3)—Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.

Priority 4 (P4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- Cisco Marketplace provides a variety of Cisco books, reference guides, and logo merchandise. Go to this URL to visit the company store:

  http://www.cisco.com/go/marketplace/

- The Cisco *Product Catalog* describes the networking products offered by Cisco Systems, as well as ordering and customer support services. Access the Cisco Product Catalog at this URL:

  http://cisco.com/univercd/cc/td/doc/pcat/

- *Cisco Press* publishes a wide range of general networking, training and certification titles. Both new and experienced users will benefit from these publications. For current Cisco Press titles and other information, go to Cisco Press online at this URL:

  http://www.ciscopress.com

- *Packet* magazine is the Cisco quarterly publication that provides the latest networking trends, technology breakthroughs, and Cisco products and solutions to help industry professionals get the most from their networking investment. Included are networking deployment and troubleshooting tips, configuration examples, customer case studies, tutorials and training, certification information, and links to numerous in-depth online resources. You can access Packet magazine at this URL:

  http://www.cisco.com/packet

- *iQ Magazine* is the Cisco bimonthly publication that delivers the latest information about Internet business strategies for executives. You can access iQ Magazine at this URL:

  http://www.cisco.com/go/iqmagazine

- *Internet Protocol Journal* is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:

  http://www.cisco.com/ipj

- Training—Cisco offers world-class networking training. Current offerings in network training are listed at this URL:

  http://www.cisco.com/en/US/learning/index.html

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

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