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Preface

This preface describes the audience, organization, and conventions of the *Cisco ONS 15540 ESP Hardware Installation Guide.* It also provides information about how to obtain related documentation and technical assistance.

The information contained in this document pertains to the entire range of hardware supported on the Cisco ONS 15540 ESP (Extended Services Platform). As new hardware and Cisco IOS software releases are made available for the Cisco ONS 15540 ESP, verification of compatibility becomes extremely important. To ensure that your hardware is supported by your release of Cisco IOS software, see the "New and Changed Information" section on page xii. Also refer to the "Hardware Supported" section of the latest release notes for the Cisco ONS 15540 ESP.

Audience

This guide is intended for experienced network administrators who are responsible for installing and maintaining the Cisco ONS 15540 ESP.

New and Changed Information

This section lists the new and change information for the *Cisco ONS 15540 ESP Hardware Installation Guide*.

Feature	Release	Description	Location
Variable rate SFP optics	12.1(12c)EV3	Two new SFP optics that supports a wide range of data rates.	"Type 2 Extended Range Transponder Modules with SFP Optics" section on page 1-9 "SFP Optics Specifications" section on page A-11
Type 2 extended range transparent transponder module with selectable fixed rate SFP optics	12.1(11b)E	A transponder module that accepts selectable fixed-rate SFP optics supporting specfic protocol rates.	"Type 2 Extended Range Transponder Modules with SFP Optics" section on page 1-9 "Installing the Type 2 Extended Range Transponder Modules with SFP Optics" section on page 2-21 "Removing SFP Optics from the Type 2 Extended Range Transponders" section on page 2-21

Organization

This guide describes how to install the Cisco ONS 15540 and is organized as follows:

Chapter	Title	Description
Chapter 1	Product Overview	Describes the Cisco ONS 15540 chassis and its components
Chapter 2	Installing the Cisco ONS 15540	Describes how to install the Cisco ONS 15540 chassis and its components

Chapter	Title	Description
Chapter 3	Connecting the Cisco ONS 15540	Describes how to install and route the cable connectors in the Cisco ONS 15540
Appendix A	Specifications	Lists the specifications for the Cisco ONS 15540 chassis and components
Appendix B	Maintenance and Network Records	Lists the information to be collected when the system is installed or the configuration is changed

Conventions

Notes use the following conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the publication.

Cautions use the following conventions:

Caution Means *caution should be taken*. Cautions contain information that is important to follow so as not to cause harm to the equipment.

Warnings use the following conventions:

Warning

IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that

accompanied this device. Statement 1071

SAVE THESE INSTRUCTIONS

Related Documentation

Refer to the following documents for additional information about the Cisco ONS 15540 system:

- *Regulatory Compliance and Safety Information for the Cisco ONS 15500 Series*
- *Cisco ONS 15540 ESP Planning Guide*
- *Cisco ONS 15540 ESP and Cisco ONS 15540 ESPx Optical Transport Turn-Up and Test Guide*
- *Cisco ONS 15540 ESP Configuration Guide and Command Reference*
- *Quick Reference for the Cisco ONS 15540 ESP and Cisco ONS 15540 ESPx TL1 Commands*
- *Cisco ONS 15540 ESP System Alarms and Error Messages*
- *Cisco ONS 15540 ESP Troubleshooting Guide*
- *Network Management for the Cisco ONS 15540 ESP*
- *Cisco ONS 15540 ESP MIB Quick Reference*

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.

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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:

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

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- Registered Cisco.com users (Cisco direct customers) can order Cisco product documentation from the Ordering tool:

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

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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:

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- 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:

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- *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

Product Overview

The Cisco ONS 15540 ESP (Extended Services Platform) is an optical transport platform that employs DWDM (dense wavelength division multiplexing) technology. With the Cisco ONS 15540, users can take advantage of the availability of dark fiber to build a common infrastructure that supports data, SANs (storage area networks), and TDM (time-division multiplexing) traffic. For more information about DWDM technology and applications, refer to the *Introduction to DWDM Technology* and the *Cisco ONS 15540 ESP Planning Guide*.

This chapter describes the Cisco ONS 15540 and includes the following sections:

- Cisco ONS 15540 Chassis, page 1-2
- Cisco ONS 15540 Components, page 1-6

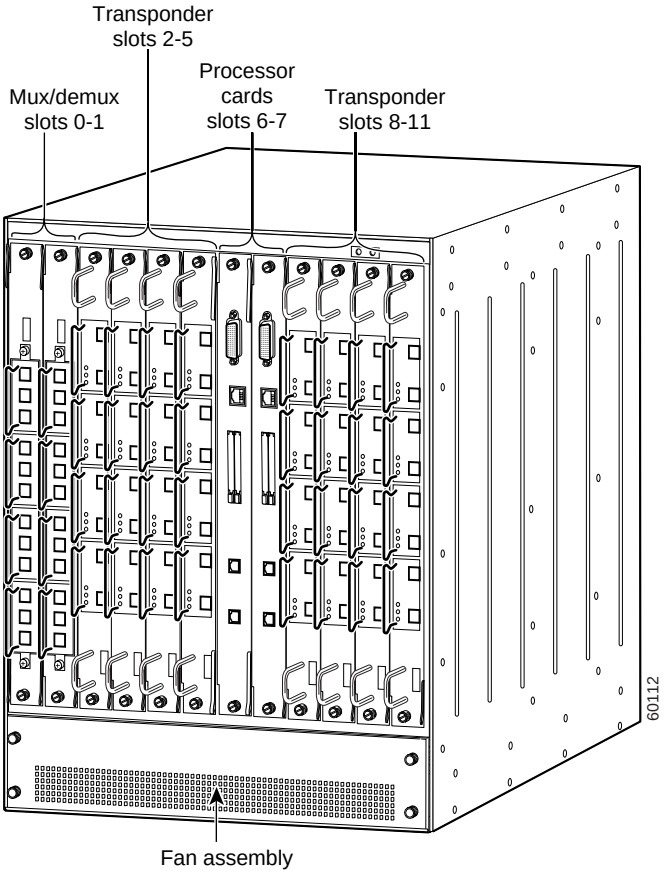
Note Before you install, operate, or service the system, read the *Regulatory Compliance and Safety Information for the Cisco ONS 15500 Series* for important safety information you should know before working with the system.

Note To ensure that your hardware is supported by your release of Cisco IOS software, see the "New and Changed Information" section on page xii. Also refer to the "Hardware Supported" section of the latest release notes for the Cisco ONS 15540 ESP.

Cisco ONS 15540 Chassis

The Cisco ONS 15540 is a 12-slot modular vertical chassis. (See .) The system is powered by redundant -48 VDC inputs. A redundant external AC-input power supply is available or DC-input power can be provided directly. Slots 0 and 1 hold the optical mux/demux motherboards, which are populated with optical

Figure 1-1 Cisco ONS 15540 Shelf



mux/demux modules. Slots 2 to 5 and 8 to 11 hold the line card motherboards, which are populated with transponder modules. Slots 6 to 7 hold the processor cards.

The air intake and fan assembly are located beneath the modular slots. The system has an optical backplane for carrying signals between the transponders and the optical mux/demux modules and an electrical backplane for system control.

Fan Assembly

The Cisco ONS 15540 fan assembly is located at the bottom of the chassis and contains six individual fans and a fan controller board. The controller board monitors the status of each fan and reports the status to the CPU switch modules. If a single fan fails, a minor alarm is reported to the processor card. If two or more fans fail, a major alarm is reported to the processor card. To prevent damage to the cards and modules in the shelf when two or more fans fail, you can configure the system to automatically reset or power off the transponder modules. The transponder modules power off if the hardware version of the line card motherboard is 5.1 or later, otherwise the transponder modules reset. Use the **show hardware** command to determine the hardware version of the 2.5-Gbps line card motherboards.

To recover from fan failure shutdown, you must power-cycle the shelf.

Note Since the system does not know which fans have failed, all the cards and modules on the shelf are powered down or reset.

Caution The fan failure shutdown feature disrupts traffic on the shelf when two or more fans fail.

Fan status is reported to the processor cards. Table 2-2 on page 2-29 lists the LEDs describing the alarm reports for the fan assembly.

Power Supplies

The external power supply is a single-phase, AC-DC, 1050W, -48V output power supply that connects to the chassis through terminal blocks. The external power supply is installed in an external power shelf that fits into a standard equipment rack. Up to three external power supplies can be installed in the external power shelf.

When the chassis is used in the telco environment, DC-input power is directly powered to the chassis through the terminal blocks. The power supply is Ernestine with 52 volts and 1050 watts output.

See the "Powering Up the Shelf" section on page 2-29 for more information about the power supplies.

Backplane

The Cisco ONS 15540 optical backplane has no active components and uses a cable of single mode fibers. The power connectors on the modules connect to the electrical backplane allowing modules to draw up to 100W of power. The backplane used on the chassis provides the optical connections between the line card motherboards and their attached transponder modules on the client side and the mux/demux motherboards and modules on the trunk side.

Refer to the *Cisco ONS 15540 ESP Planning and Design Guide* for more information about the optical backplane and slot mapping.

The alarm signals from the processor card are sent to the alarm card attached to the bottom of the backplane. They connect to the central office alarm via connectors on the backplane. For information about alarm cable connections, see the "Installing Strain Relief Brackets" section on page 2-12.

Alarm Cards

The alarm card has relays and terminal blocks to interface the chassis to the Telco Central Office alarm equipment. It is a separate card that mounts to the back of the chassis and connects to the backplane.

There are six relays on the alarm card. They are audible and visible with three levels for each type:

- critical
- major
- minor

Each relay has two form C contacts. One is used to connect to the terminal block and the outside. The other is used to provide feedback on the state of the relay.

A processor card energizes the relays by driving 3.3 volts to them. Only the primary processor card drives the relays, however, each processor card can tell if the relay is energized by sensing that the feedback line is grounded through the second contact.

Table 1-1 lists the specifications for the alarm cards on the Cisco ONS 15540 ESP.

Table 1-1 Alarm Card Specifications

Connector	Type	Level	Pin	Contact	Notes
P1	Visible	Minor	1	C[1]	Each type and level of alarm is signaled by a contact closure of C to NO and an open from C to NC. Voltage at contacts is limited to 48 VDC. Switched current / load is limited to 1 A resistive. Alarms are signaled when the chassis is unpowered.
			2	NC[2]	
			3	NO[3]	
		Major	4	C	
			5	NC	
			6	NO	
		Critical	7	C	
			8	NC	
			9	NO	
P2	Audible	Minor	1	C	
			2	NC	
			3	NO	
		Major	4	C	
			5	NC	
			6	NO	
		Critical	7	C	
			8	NC	
			9	NO	

1. C = center
2. NC = normally closed
3. NO = normally open

Cisco ONS 15540 Components

The following hardware components can be installed in the Cisco ONS 15540:

- Line card motherboards and transponder modules
- Mux/demux motherboards and modules

- Processor cards
- Blank panels

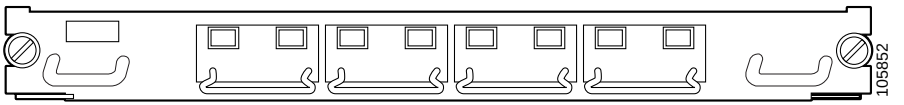
Line Card Motherboards and Transponder Modules

You can install up to eight hot-swappable line card motherboards in slots 2 to 5 and 8 to 11 of the Cisco ONS 15540 chassis. Each line card motherboard holds up to four transponder modules that have a single protocol-transparent and bit-rate transparent external interface to the client side network and an internal interface that connects over the system's backplane to the mux/demux modules. The transponder modules are hot pluggable, allowing in-service upgrades and replacement.

Line Card Motherboards

Line card motherboards are available with or without splitter protection. (See Figure 1-2.)

Figure 1-2 Line Card Motherboard with Four Transponder Modules



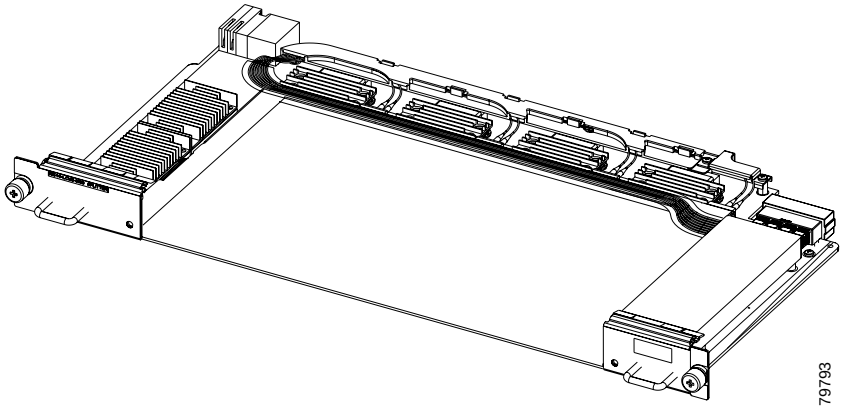
Line Card Motherboard LEDs

Table 1-2 lists the LEDs on the 2.5-Gbps line card motherboard faceplate, their default conditions, and what the conditions indicate. Figure 1-3 shows the 2.5-Gbps line card motherboard without inserts installed.

Table 1-2 2.5-Gbps Line Card Motherboard LEDs

LED	Status	Description
Status	Blinking green	Motherboard has a good system clock from the primary processor and is out of the reset state.
	Solid green	Software initialization is successful.
	Orange	System clock is not present. Board is unavailable.
	Off	Board failure.

Figure 1-3 2.5-Gbps Line Card Motherboard



Transponder Modules

In the transponder module, the client signal is converted to an ITU-compliant wavelength, which is crossconnected over the optical backplane to the mux/demux modules. You can populate the line card motherboard subcard slots with as few or as many transponder modules as required (up to 32) to support the desired number of client signals, or data channels.

The Cisco ONS 15540 supports five types of single interface transponder modules:

- SM (single-mode) transponder modules

- MM (multimode) transponder modules
- Type 2 extended range transponder modules with SFP optics

SM Transponder Modules

SM transponder modules have fixed, non-pluggable transceivers for the single client interface. SM transponder modules accept SM client signals on the 1310-nm wavelength through an SC connector and support client signal clock rates ranging from 16 Mbps to 2.5 Gbps.

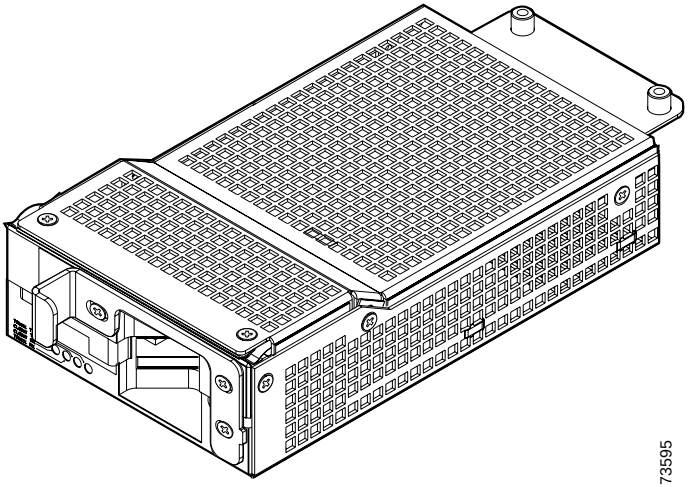
MM Transponder Modules

MM transponder modules have fixed, non-pluggable transceivers for the single client interface. MM transponder modules accept both SM client signals and MM client signals on the 1310-nm wavelength through an SC connector and support client signal clock rates ranging from 16 Mbps to 622 Mbps.

Type 2 Extended Range Transponder Modules with SFP Optics

The Type 2 extended range transponder modules accepts two types of SFP optics, fixed rate and variable rate. (See Figure 1-4.)

Figure 1-4 Type 2 Extended Range Transponder Module



Fixed rate SFP optics modules support specific protocols. Table 1-3 lists the features for the fixed rate SFP optics supported by the Type 2 extended range transponder modules.

Note Only use Cisco-certified SFP optics for the Type 2 extended range transponders.

Table 1-3 Fixed Rate SFP Optics Features

Part Number	Supported Protocols	Fiber Type	Wavelength	Connector Type
15500-XVRA-01A2	ESCON, SONET OC-3 SR, SDH STM-1	MM 50/125 µm MM 62.5/125 µm	1310 nm	MT-RJ
15500-XVRA-02C1	Gigabit Ethernet[1], Fibre Channel (1 Gbps)[2], FICON (1 Gbps), ISC-1 (1-Gbps)	MM 50/125 µm MM 62.5/125 µm	850 nm	LC

Table 1-3 Fixed Rate SFP Optics Features (continued)

Part Number	Supported Protocols	Fiber Type	Wavelength	Connector Type
15500-XVRA-02C2	Fibre Channel (1 Gbps and 2 Gbps)[3], FICON (1 Gbps and 2 Gbps), ISC-3 (1-Gbps and 2-Gbps)	MM 50/125 µm MM 62.5/125 µm	850 nm	LC
15500-XVRA-03B1	Gigabit Ethernet[4], Fibre Channel (1 Gbps)[5], FICON (1 Gbps), ISC compatibility mode (1 Gbps), ISC peer mode (1 Gbps)	SM 9/125 µm	1310 nm	LC
15500-XVRA-03B2	Fibre Channel (1 Gbps[6] and 2 Gbps[7]), FICON (1 Gbps and 2 Gbps), ISC compatibility mode (1 Gbps), ISC peer mode (1 Gbps and 2 Gbps)	SM 9/125 µm	1310 nm	LC
15500-XVRA-06B1	SONET OC-12 SR[8], SDH STM-4	SM 9/125 µm	1310 nm	LC
15500-XVRA-07B1	SONET OC-48 SR, SDH STM-16	SM 9/125 µm	1310 nm	LC

1. 1000BASE-SX
2. FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards
3. FC-0-200-M5-SN-S and FC-0-200-M6-SN-S standards
4. 1000BASE-LX
5. FC-0-100-SM-LC-S standard
6. FC-0-100-SM-LC-S standard
7. FC-0-200-SM-LC-S standard
8. SR = short range

Variable rate SFP optics modules support a range of clock rates. Table 1-4 list the characteristics for the variable rate SFP optics supported by the Type 2 extended range transponder.

Table 1-4 Variable Rate SFP Optics Features

Part Number	Clock Rate Range	Protocol Encapsulations Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-10A1	Low-band 8 Mbps to 200 Mbps	Sysplex (CLO and ETR)[1] (8 Mbps), Fast Ethernet[2] (125 Mbps), SONET OC-3[3] (155.52 Mbps), SDH STM-1 (622 Mbps), ESCON[4] (200 Mbps)	MM 50/125 µm 62.5/125 µm	1310 nm	LC
15500-XVRA-10B1	Low-band 8 Mbps to 200 Mbps	Sysplex (CLO and ETR)[1] (8 Mbps), Fast Ethernet[2] (125 Mbps), SONET OC-3[3] (155.52 Mbps), SDH STM-1 (155.52 Mbps), ESCON[4] (200 Mbps)	SM 9/125 µm	1310 nm	LC
15500-XVRA-11A1	Mid-band 200 Mbps to 622 Mbps	ESCON[4] (200 Mbps), SONET OC-12[3] (622 Mbps), SDH STM-4 (622 Mbps)	MM 50/125 µm 62.5/125 µm	1310 nm	LC

Table 1-4 Variable Rate SFP Optics Features (continued)

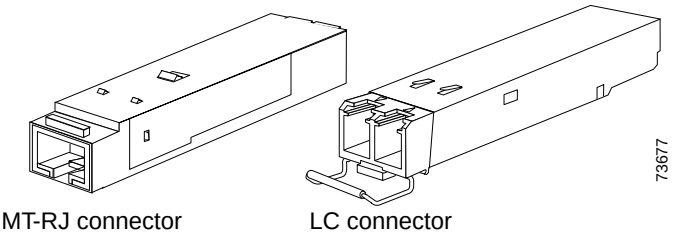
Part Number	Clock Rate Range	Protocol Encapsulations Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-11B1	Mid-band 200 Mbps to 1.25 Gbps	ESCON[4] (200 Mbps), SONET OC-12[3] (622 Mbps), SDH STM-4 (622 Mbps), FC[4] (1.062 Gbps), FICON (1.062 Gbps), GE[4] (LX) (1.250 Gbps) ISC compatibility mode (1.062 Gbps), ISC peer mode (1.062 Gbps)	SM 9/125 µm	1310 nm	LC
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps	FC[4] (1.062 Gbps and 2.125 Gbps), FICON (1.062 Gbps and 2.125 Gbps), GE[4] (LX) (1.250 Mbps), SONET OC-48 (2.488 Gbps), SDH STM-16 (2.488 Gbps), ISC compatibility mode (1.062 Gbps), ISC peer mode (1.062 Gbps and 2.125 Gbps)	SM 9/125 µm	1310 nm	LC

1. Manchester coded
2. 4B/5B coded
3. Scrambler 2^{23-1}
4. 8B/10B coded

Figure 1-5 shows the two types of SFP optics that the Type 2 extended range transponders support.

Note The SFP optics pictured below may not match your equipment exactly.

Figure 1-5 Type 2 Extended Range Transponder Module SFP Optics



For information on how to install the SFP optics onto the transponder module, see the "Installing the Type 2 Extended Range Transponder Modules with SFP Optics" section on page 2-21.

Transponder Module LEDs

Table 1-5 lists the LEDs on the transponder module faceplate, their default conditions, and what the conditions indicate. (See Figure 1-6.)

Table 1-5 SM and MM Transponder Module LEDs

LED	Status	Description
LCL RX OK	Green	Data is received on the client side.
TRUNK RX OK	Green	Data is received on the trunk side.
LCL TX ENABLE	Green	Client side transmit laser is enabled.
TRUNK TX ENABLE	Green	Trunk side transmit laser is enabled.

Figure 1-6 SM and MM Transponder Module LEDs

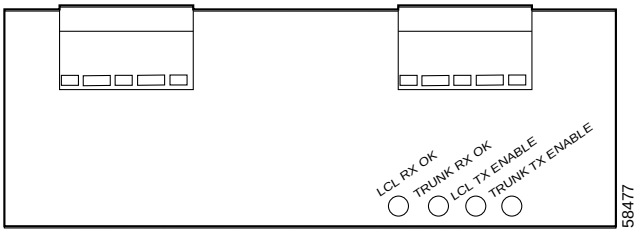
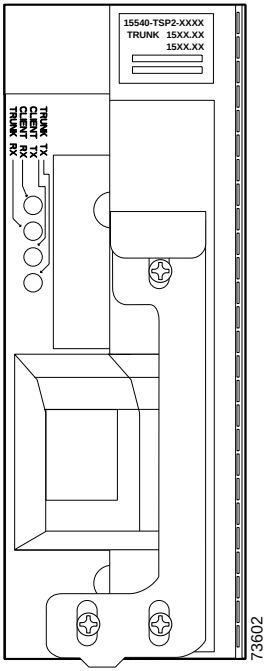


Table 1-6 lists the LEDs for the Type 2 extended range transponder module. Figure 1-7 shows the LEDs.

Table 1-6 Type 2 Extended Range Transponder Module LEDs

LED	Status	Description
CLIENT RX	Green	Data is received on the client side.
TRUNK RX	Green	Data is received on the trunk side.
CLIENT TX	Green	Client side transmit laser is enabled.
TRUNK TX	Green	Trunk side transmit laser is enabled.

Figure 1-7 Type 2 Extended Range Transponder Module LEDs



Y-Cables

Y-cables are 2:1 combiner cables used for splitter protection on the transponder modules. Using a y-cable enables full protection on the Cisco ONS 15540 and offers protection against both facility failures and transponder card failures.

For detailed information about the hardware rules, refer to the *Cisco ONS 15540 ESP Planning Guide*. To attach y-cables to your system, see the "Powering Up the Shelf" section on page 2-29.

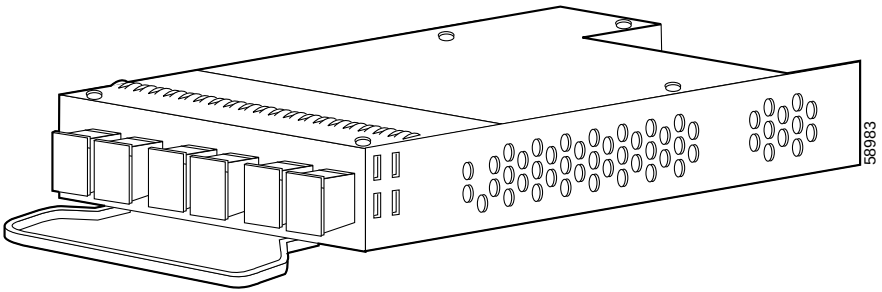
Mux/Demux Motherboards and Modules

The optical mux/demux motherboards occupy slots 0 and 1 of the Cisco ONS 15540 chassis. The chassis uses one optical mux/demux motherboard for unprotected operation or two per system for protected operation. Each mux/demux motherboard can accept up to four mux/demux modules. The modular mux/demux motherboards are available with or without OSC (optical supervisory channel) and can be populated according to user needs. There are three types of mux/demux modules available:

- 4-channel
- 8-channel
- 16-channel

Up to four 4-channel or 8-channel optical add/drop mux/demux modules can be installed in a mux/demux motherboard. Each module can multiplex and demultiplex a band of 4 or 8 channels, for a maximum of 32 channels. Channels not filtered are passed on to the next mux/demux module. The add/drop mux/demux modules connect to the trunk side and to the transponder modules over the optical backplane. (See Figure 1-8.)

Figure 1-8 Mux/Demux Module with OSC



Two 16-channel optical terminal mux/demux modules can be installed in a mux/demux motherboard. Each terminal mux/demux module can multiplex and demultiplex a band of 16 channels, for a maximum of 32 channels. All of the channels received by the module are terminated, none are passed through. The terminal mux/demux modules connect to the trunk side and to the transponder modules over the backplane. (See Figure 1-9 and Figure 1-10.)

Figure 1-9 16-Channel Terminal Mux/Demux Module with OSC

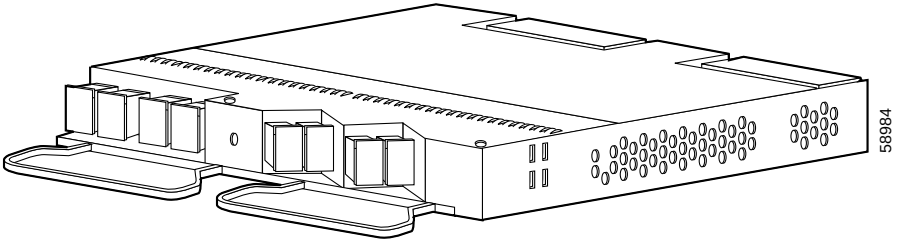
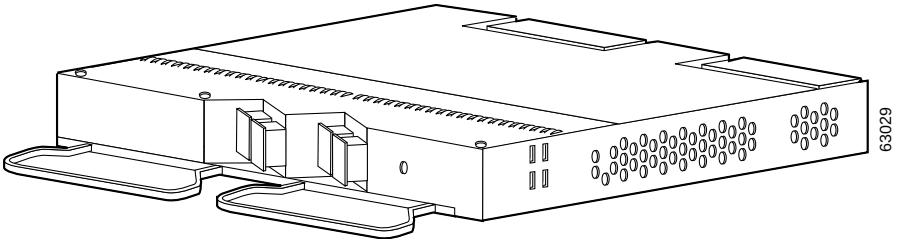


Figure 1-10 16-Channel Terminal Mux/Demux Module without OSC



Note You must have a 16-channel mux/demux module with OSC installed and operating to use a 16-channel mux/demux module without OSC.

Mux/Demux Motherboard LEDs

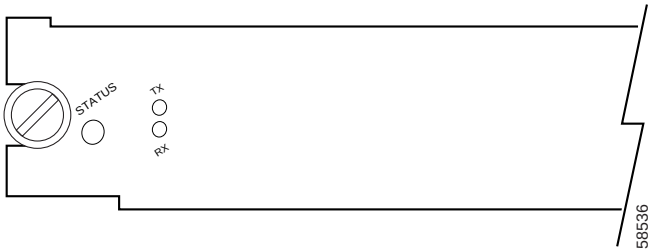
Table 1-7 lists the LEDs on the mux/demux motherboard with OSC faceplate, their default conditions and what the conditions indicate. (See Figure 1-11.)

Note Mux/demux motherboards without OSC have no LEDs.

Table 1-7 Mux/Demux Motherboard with OSC LEDs

LED	Status	Description
Status	Blinking green	The motherboard has a good system clock from the primary processor and is out of the reset state.
	Orange	System clock is not present.
	Solid green	Software initialization is successful.
	Off	Board failure.
Tx	Solid green	OSC is present and the optical laser output is enabled.
	Off	OSC is not present and the optical laser output is disabled.
Rx	Solid green	OSC is present and the optical data stream is being received.
	Off	OSC is not present and the optical data stream is not being received.

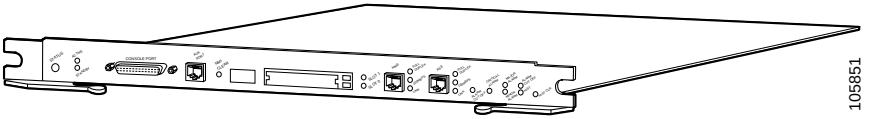
Figure 1-11 Mux/Demux Motherboard with OSC LEDs



Processor Cards

Slots 6 and 7 of the Cisco ONS 15540 chassis hold processor cards. The processor cards support redundancy and online insertion and removal. In a redundant system, the processor cards monitor each other using the Ethernet backplane and signals. The processor card monitors the fan assembly operation and airflow temperature. (See Figure 1-12.) During a fan failure or an out-of-temperature range condition, the processor card activates an alarm. See Table 2-2 on page 2-29 for fan assembly status.

Figure 1-12 Processor Card



Processor cards manage communication functions for the system. The cards monitor all modules in the chassis and determine the state of the system. Each module determines its state from feedback at various system monitoring points. The processor generates clocking to all the modules and some additional components in the system.

Processor Card LEDs

Table 1-8 lists the LEDs on the processor card faceplate, their default conditions, and what the conditions indicate. Figure 1-13 and Figure 1-14 show the processor card LEDs.

Table 1-8 Processor Card LEDs

LED	Status	Description
Status	Red	A board reset or initial power on.
	Orange	System initialization.
	Green	Full initialization and operational.
Active	Green	This board is the primary processor and is running IOS software.
Standby	Green	This board is the secondary processor.
Slot 0	Green	Flash PC Card is present.
Slot 1	Green	Flash PC Card is present.
NME		
Full Duplex	Green	Full duplex is running.
	Off	Half duplex is running.
100 Mbps	Green	Operating at 100 Mbps.
	Off	Operating at 10 Mbps.

Table 1-8 Processor Card LEDs (continued)

LED	Status	Description
Link	Green	Link is up.
	Off	Link is down.
ASE		
Full Duplex	Green	Full duplex is running.
	Off	Half duplex is running.
100 Mbps	Green	Operating at 100 Mbps.
	Off	Operating at 10 Mbps.
Link	Green	Link is up.
	Off	Link is down.
Critical alarm	Yellow	A critical alarm condition exists.
Major alarm	Yellow	A major alarm condition exists.
Minor alarm	Yellow	A minor alarm condition exists.
Alarm cutoff	Yellow	A major or minor alarm condition exists and the cutoff button has been pushed. Turns off by software when the original alarm clears or any new alarm occurs. See Table 1-11.
History	Yellow	A major or minor alarm occurred. Clears if the Clear button is pushed and no alarm exists. See Table 1-11.

Figure 1-13 Processor Card LEDs (Left Side)

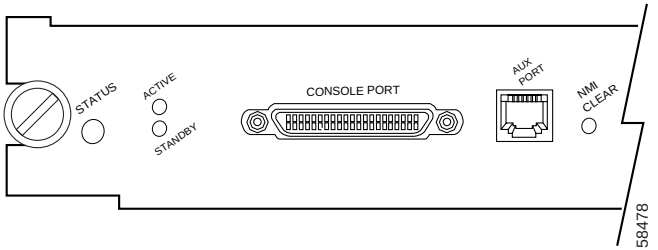
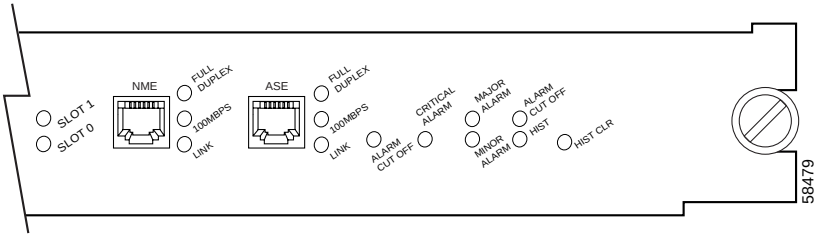


Figure 1-14 Processor Card LEDs (Right Side)



Note The ASE port on the processor card cannot be used as a management port. Do not make any connections to this port.

Management Ports

The console port is a female data communications equipment (DCE), DB-25 receptacle used for connection to a console terminal or modem. Table 1-9 lists the console port pinouts.

Table 1-9 Console Port Pinouts DB-25 DCE

Pin Number	Console		
	Direction	Circuit	Function
1	N/A	gnd	Ground
2	Input	rxd	N/A
3	Output	txd	N/A
4	N/A	RTS	Tied together
5	N/A	CTS	Tied together
6	Output	DCD	N/A
7	N/A	gnd	Ground
8	Output	DCD	N/A
11	N/A	rsvd	N/A
13	N/A	gnd	Ground

Table 1-9 Console Port Pinouts DB-25 DCE (continued)

Pin Number	Console		
19		rsvd (y cable)	
20	Input	DTR	

The auxiliary port is a female RJ-45 receptacle used for connection to a modem. A three inch RJ-45 cable ships with the processor card for use with the auxiliary port. This cable is necessary for proper use of the auxiliary port. Attach this cable to the auxiliary port before attaching your own cables to it using the proper coupler. See Table 1-10 for the auxiliary port pinouts on the processor card.

Table 1-10 Auxiliary Port Pinouts for the Cisco ONS 15540 ESP

Pin Number	Direction	Circuit	Function
1	Output	DSR	Data set ready
2	Input	DCD	Data carrier detect
3	Input	DTR	Data terminal ready
4	S/gnd	N/A	Signal ground
5	Output	TXD	Transmit data
6	Input	RXD	Receive data
7	Output	CTS	Clear to send
8	Input	RTS	Request to send
9	P/gnd	N/A	Protective ground

Alarms

The processor generates three alarm signals: critical, major, and minor. (See Table 1-8.) These signals from the alarm card generate visual and audible alarm signals to the backplane. The alarm card is a separate card that mounts on the back of the chassis to the backplane. The alarm card has relays and terminal blocks to interface the system to the telco central office alarms. LEDs on the processor card front panel display the status of the critical, major, and minor alarm signals, plus the status of alarm cutoff (ACO) and history conditions.

Push button switches on the front panel provide for the alarm cutoff and history clear functions. (See Table 1-11.)

Table 1-11 Alarm Cutoff and History Clear Buttons

Label	Location	Description
Alarm cutoff	Recessed push-button switch	When pushed, software should turn off all external alarm relay control bits until the next new alarm condition.
History CLR	Recessed push-button switch	When pushed, software should turn off the HIST LED if there are no major or minor alarm conditions.

Note To clear the switch alarms, use a thin tool (such as a small screwdriver) to press and release the button.

Flash SIMM

The processor card Flash SIMM is a 16 MB, 80-pin SIMM that contains a compressed Cisco IOS image that is loaded and executed automatically by ROMMON upon powerup.

Flash PC Card Slots

The processor card has two Flash PC Card slots that are accessible from the front panel. Either slot can be a memory or an I/O device.

The Flash PC Cards are typically used to copy system images and save standard configurations. Flash PC Cards are a type of Flash memory that provide expanded file storage for your system. Flash PC Cards, unlike the onboard Flash SIMM (bootflash), are not required for the operation of the system.

Note Not all cards that are commercially available are supported. Only cards requiring 3.3V or 5V power are supported. No 12 VDC power supply is available to the Flash PC Card slots.

Table 1-12 lists the Flash PC Card slot LEDs on the processor faceplate and what the conditions indicate.

Table 1-12 Flash PC Card Slot LEDs

LED	Status	Description
Slot 0	Green	Flash PC Card slot 0 is being accessed.
Slot 1	Green	Flash PC Card slot 1 is being accessed.

NMI Clear

A recessed push button, labeled NMI CLR, is accessible through the faceplate to clear an NMI (non-maskable interrupt).

Note To activate the switch, use a thin tool (such as a small screwdriver) to press and release the button.

NME Interface

The NME (network management Ethernet) interface supports 10-Mbps or 100-Mbps UTP (unshielded twisted-pair) ports. This RJ-45 interface supports full-duplex or half-duplex connections.

The NME port on the processor card is a management port that allows multiple simultaneous Telnet or SNMP network management sessions. The Ethernet port on the processor card does not route or bridge traffic to other Ethernet ports on the Cisco ONS 15540. This Ethernet port is a management port only and cannot be configured as a routing port.

Table 1-13 describes the LEDs used to confirm and troubleshoot the operation of the NME interface. The LEDs on the processor faceplate indicate the status of the NME interface.

Table 1-13 NME LEDs

LED	Status	Description
Link	Green	NME interface is receiving the link integrity signal.
100 MPS	Green	Interface is operating at 100 Mbps.
Full Duplex	Green	Interface is operating in full duplex mode.

Blank Panels

You can install blank panels in any of the 12 slots of the Cisco ONS 15540 ESP chassis or in the line card motherboards and mux/demux motherboards. Blank panels have connectors that protect the backplane from dust and particles and are also required for proper airflow in the chassis.

The blank panels are specific to what slot you use them in. They are available as follows:

- Mux/demux motherboard blank panels (slots 0 and 1)
- Line card motherboard blank panels (slots 2 to 5 and 8 to 11)
- 4-channel and 8-channel blank panels (any motherboard installed in slots 0 and 1)
- Transponder module blank panel (any line card motherboard installed in slots 2 to 5 and 8 to 11 without a full compliment of transponder modules)

Installing the Cisco ONS 15540

This chapter describes the installation procedures for the Cisco ONS 15540 chassis and its components. This chapter includes the following sections:

- Before Installing, page 2-2
- Rack-Mounting the Shelf, page 2-4
- Installing the Shelf, page 2-7
- Grounding the Shelf, page 2-9
- Installing Strain Relief Brackets, page 2-12
- Installing and Removing Motherboards and Processor Cards, page 2-14
- Installing and Removing Modules, page 2-17
- Installing and Removing the Fan Assembly, page 2-28
- Powering Up the Shelf, page 2-29
- Using Y-Cable, page 2-51

Note Before you install, operate, or service the system, read the *Regulatory Compliance and Safety Information for the Cisco ONS 15500 Series* for important safety information you should know before working with the system.

Note To ensure that your hardware is supported by your release of Cisco IOS software, see the "New and Changed Information" section on page xii. Also refer to the "Hardware Supported" section of the latest release notes for the Cisco ONS 15540 ESP.

Warning **During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.**

Before Installing

Before you install the shelf, you must complete the following tasks:

- Unpack and inspect the shelf.
- Maintain a network record.
- Mount the shelf.

Caution Use extreme care when removing or installing connectors so you do not damage the connector housing or scratch the end-face surface of the fiber. Always install protective covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

Unpacking and Inspecting the Shelf

The Cisco ONS 15540 shelf comes with the standard mounting set. The shelf is thoroughly inspected before shipment. If any damage has occurred during transportation or if any item is missing, notify your Cisco customer service representative immediately.

Upon receipt, inspect the equipment as follows:

Step 1 Take inventory.

Compare the equipment inside with the packing slip and the equipment list provided by customer service. If there are any discrepancies, notify the Customer Service Center.

Step 2 Check for external damage.

Visually check all components and immediately report any shipping damage to your customer service representative. Have the following information ready:

- Invoice number of shipper (see packing slip)
- Model and serial number of the damaged unit
- Description of damage
- Effect of damage on the installation

Maintaining a Network Record

Fill out the information in Appendix B, "Maintenance and Network Records," so you will have a record of all of your hardware, configuration options, and network settings.

Mounting the Shelf

The unit is designed for rack-mounting in a cabinet rack. Use star-type lock washers on the rack screws to ensure a good conductive connection between the chassis and the rack. For information about installing the units in a customer cabinet, see the instructions from the cabinet manufacturer.

Note A value added reseller can configure a Cisco ONS 15540 ESP in a rack, but all hardware with optical connectors need to be repacked and shipped out in separate boxes and reinstalled at customer sites.

Rack-Mounting the Shelf

You can install the Cisco ONS 15540 ESP chassis in a standard 19-inch rack, a 21-inch rack, or a 23-inch rack. Table 2-1 lists the correct L bracket part number required for each installation.

Table 2-1 L Bracket Part Numbers

Rack	L Bracket Part Number
19-inch	700-15196-01
21-inch	700-15176-01
23-inch	700-18074-01

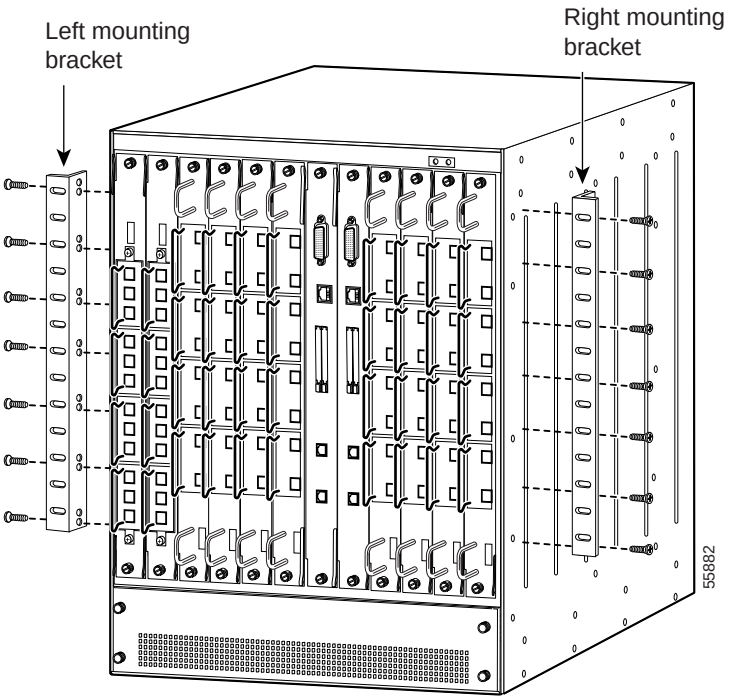
Three chassis fit in a standard rack. However, if you use the external AC-input power supply, you can install two chassis with the power supply.

To rack-mount the shelf, follow these steps:

Step 1 Place the L brackets on the sides of the chassis.

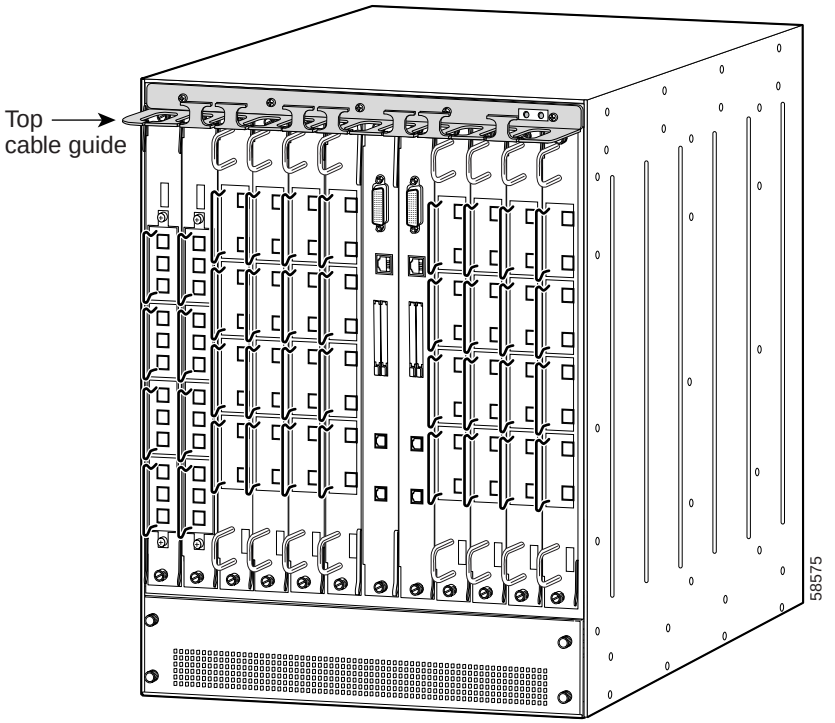
Step 2 Secure the L brackets to the chassis using the 14 M4 Phillips countersunk-head screws provided in the rack-mount kit. (See Figure 2-1.) Use seven screws on each L bracket on the sides of the chassis.

Figure 2-1 Attaching L Brackets



Step 3 Place the top cable guide over the top of the chassis. Ensure that the earth contact is visible through the cable guide. (See Figure 2-2.)

Figure 2-2 Cable Guide on the Shelf



Step 4 Secure the cable guide to the shelf with five 6-32 screws.

Tip Install the bottom cable management guide after you install the shelf in the rack.

Installing the Shelf

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

To install the chassis in the rack, follow these steps:

Step 1 Grasp the bottom edge of the chassis with one hand near the front and the other near the back. With one person at each side of the chassis, slowly lift the chassis in unison.

Step 2 Position the chassis in the rack.

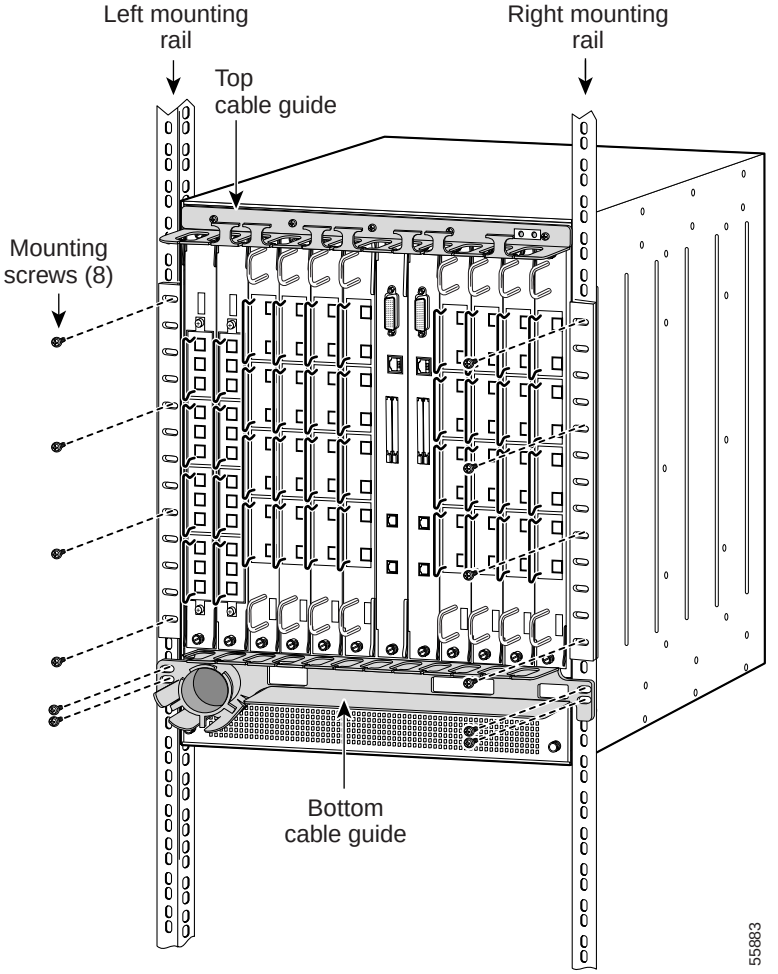
Step 3 Align the mounting holes in the L bracket and the bottom cable management guide with the mounting holes in the equipment rack. (See Figure 2-3.)

Step 4 Install the 12–24 or 10–32 screws through the elongated holes in the L bracket and into the threaded holes in the mounting post.

Step 5 Place the bottom cable guides over the fan assembly.

Step 6 Secure the cable guide to the rack with the 6-32 screws. (See Figure 2-3.)

Figure 2-3 Installing the Shelf in the Rack



Grounding the Shelf

Two system (earth) grounding holes are provided in an enclosure near the top of the chassis.

Shelf Grounding Guidelines

To make an adequate grounding connection, you need the following parts and tools:

- Grounding lug.
- Lug mounting adapter.
- Two M4 (metric) hex-head screws with locking washers.
- One grounding wire (6 AWG recommended). The length of the grounding wires depends on the location of your Cisco ONS 15540 within the site and its proximity to proper grounding facilities.
- Number 2 Phillips head screwdriver.
- Crimping tool. This tool must be large enough to accommodate the girth of the grounding lug when you crimp the grounding cable into the lug.
- Wire-stripping tool.

Note The grounding lugs, grounding wire, and M4 screws are included in your accessory kit that ships with the system.

Shelf Grounding Procedures

This section describes how to connect the Cisco ONS 15540 to earth ground. You must complete this procedure before connecting system power or powering up your shelf.

Tip If you use the cable management guides, install the grounding equipment *after* you install the top cable management guide.

To ground the shelf, follow these steps:

Step 1 Use a wire-stripping tool to remove approximately 0.75 inch (20 mm) of the covering from the end of the grounding wire.

Step 2 Insert the stripped end of the grounding wire into the open end of the grounding lug.

Step 3 Use the crimping tool to secure the grounding wire in place in the grounding lug.

Step 4 Locate the grounding receptacle on the chassis. (See Figure 2-4.)

Step 5 Remove the label that covers the grounding receptacle.

Note Step 6 is optional if you are not using the top cable management guide.

Step 6 Place the lug mounting adapter against the grounding receptacle at the top of the chassis.

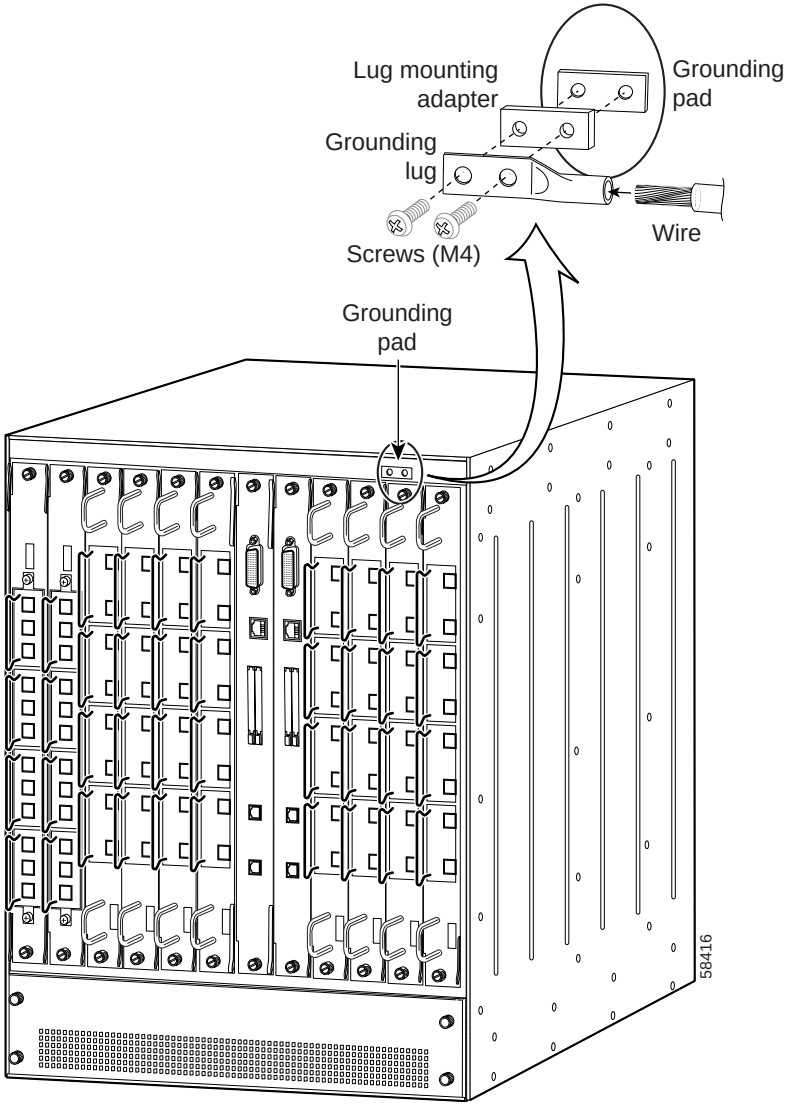
Step 7 Place the grounding lug against the lug mounting adapter.

Step 8 Insert two screws through the holes in the grounding lug and the grounding receptacle. Ensure that the grounding lug does not interfere with other hardware or rack equipment. (See Figure 2-4.)

Step 9 Install the locking washers and nuts; tighten them to secure the grounding lug to the grounding receptacle.

Step 10 Prepare the other end of the grounding wire and connect it to an appropriate grounding point in your site to ensure adequate earth ground for the Cisco ONS 15540.

Figure 2-4 Grounding Receptacle



Installing Strain Relief Brackets

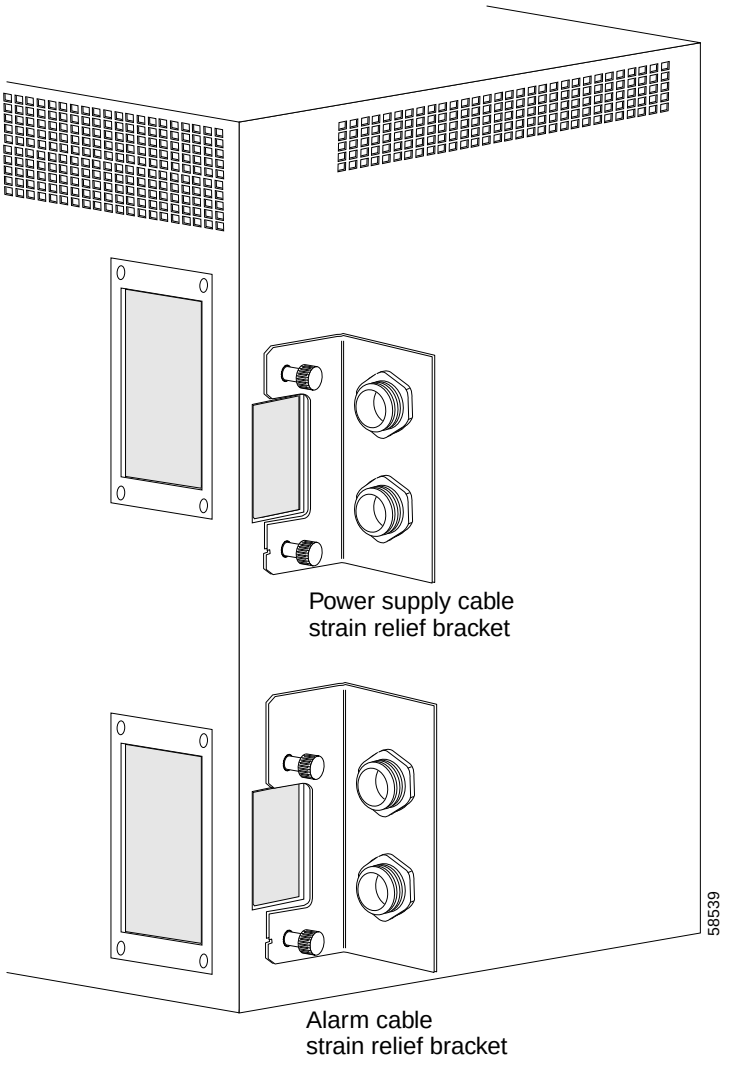
The Cisco ONS 15540 system uses a power supply cable strain relief bracket for connections to its power supply and an alarm cable strain relief bracket for alarm cable connections. The strain relief brackets must be installed after the shelf is rack mounted and installed in the rack. The brackets are required for proper function of the power supply and alarm cables.

To install the strain relief brackets, follow these steps:

Step 1 Place the strain relief bracket over the designated slots on the back panel. (See Figure 2-5.)

Step 2 Use the two screws provided to secure the strain relief bracket to the shelf.

Figure 2-5 Cable Strain Relief Brackets



To power the system, see the "Powering Up the Shelf" section on page 2-29.

Installing and Removing Motherboards and Processor Cards

The mux/demux motherboards, line card motherboards, and processor cards are hot-swappable. This section describes the procedures for installing and removing the motherboards and processor cards from the chassis.

Installing Mux/Demux Motherboards and Processor Cards

To install a mux/demux motherboard or processor card, follow these steps:

Step 1 Remove the failed motherboard, processor card, or filler motherboard from the shelf.

Step 2 Take the new motherboard or processor card from the shipping container.

Step 3 Insert the motherboard carefully into the chassis slot while guiding the upper and lower edges of the motherboard or processor card in the tracks until its connectors come into contact with the backplane connectors.

Step 4 Use your thumb and forefinger of each hand to simultaneously push the motherboard or processor card in until it is fully seated in the backplane connector.

Step 5 Use a 3/16-inch flat-blade screwdriver to tighten the captive installation screws.

Step 6 Check the LED to ensure proper installation. See Table 1-2 on page 1-8 for line card motherboard LED descriptions, Table 1-7 on page 1-19 for mux/demux motherboard LED descriptions, and Table 1-8 on page 1-20 for processor card LED descriptions.

Save the filler motherboards with the packaging material.

Removing Mux/Demux Motherboards and Processor Cards

To remove the mux/demux motherboards and processor cards, follow these steps:

Step 1 Remove all cables from the modules installed in the motherboard, if applicable, or the processor card.

Step 2 Install appropriate dust covers on the fiber cable connectors and the blind plugs into the connectors on the motherboard or processor card.

Step 3 Use a 3/16-inch flat-blade screwdriver to loosen the captive installation screws.

Step 4 Use the captive installation screws to pull the motherboard or processor card out of the slot in the chassis.

Place the removed motherboard or processor card in a container appropriate for shipping and storage. To install a replacement motherboard or processor card, see the "Installing Mux/Demux Motherboards and Processor Cards" section on page 2-14.

Installing Line Card Motherboards

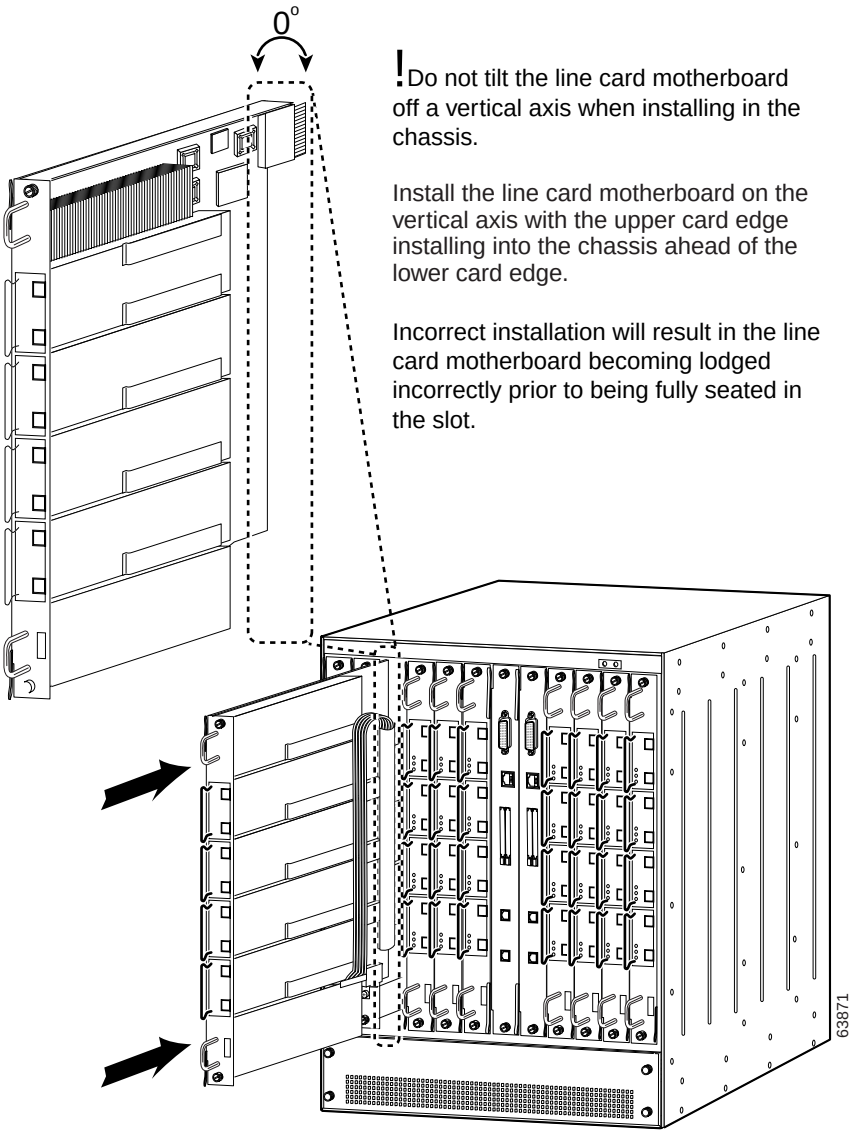
To install a line card motherboard, follow these steps:

Step 1 Remove the failed line card motherboard from the shelf.

Step 2 Take the new line card motherboard from the shipping container.

Step 3 Align the top of the line card motherboard and slide the line card motherboard into the chassis slot. (See Figure 2-6.)

Figure 2-6 Installing a Line Card Motherboard



! Do not tilt the line card motherboard off a vertical axis when installing in the chassis.

Install the line card motherboard on the vertical axis with the upper card edge installing into the chassis ahead of the lower card edge.

Incorrect installation will result in the line card motherboard becoming lodged incorrectly prior to being fully seated in the slot.

Step 4 Use the handles to push the line card motherboard in until it is fully seated in the backplane connector.

Step 5 Use a 3/16-inch flat-blade screwdriver to tighten the captive installation screws.

Step 6 Check the LED to ensure proper installation. See Table 1-2 on page 1-8 for line card motherboard LED descriptions.

Removing Line Card Motherboards

To remove the line card motherboards, follow these steps:

Step 1 Remove all cables from the modules installed in the line card motherboard if applicable.

Step 2 Install appropriate dust covers on the fiber cable connectors and the blind plugs into the connectors on the line card motherboard.

Step 3 Use a 3/16-inch flat-blade screwdriver to loosen the captive installation screws.

Step 4 Use the handles to pull the line card motherboard out of the slot in the chassis.

Place the removed line card motherboard in a container appropriate for shipping and storage. To install a replacement line card motherboard, see the "Installing Line Card Motherboards" section on page 2-15.

Installing and Removing Modules

The mux/demux modules and transponder modules are hot-swappable. This section describes the procedure for installing and removing modules from the motherboards.

Warning **During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.**

Installing Modules

This section describes how to install mux/demux and transponder modules. If you are installing a 16-channel mux/demux module, see the "Installing 16-Channel Mux/Demux Modules" section on page 2-19. If you are installing an Type 2 extended range transponder with selectable transceivers, see the "Installing the Type 2 Extended Range Transponder Modules with SFP Optics" section on page 2-21.

To install the mux/demux modules or transponder modules, follow these steps:

Step 1 Remove the failed module or the filler module from the motherboard.

Step 2 Take a new module from the shipping container.

Step 3 Insert the module carefully into the motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Note Make sure the module has no cables attached to it before installing it into the line card motherboard.

Step 4 Attach the appropriate cables.

Note Wait one minute before installing another module into the motherboard.

Step 5 Save the filler modules with the packaging material.

Installing 16-Channel Mux/Demux Modules

This section describes the procedure for replacing 4-channel or 8-channel mux/demux modules with 16-channel terminal mux/demux modules.

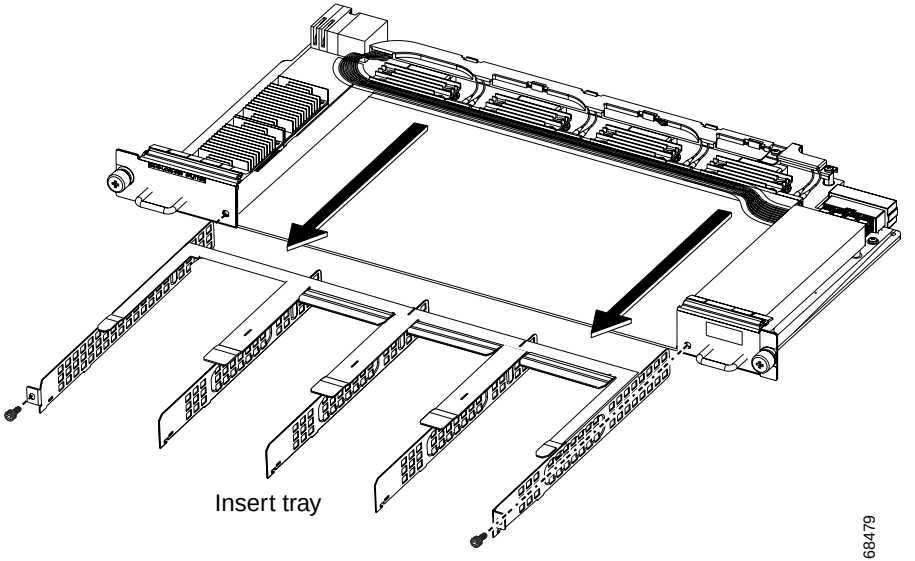
To install the 16-channel terminal mux/demux module, follow these steps:

Step 1 Remove all cables, including the OSC cables, from all of the mux/demux modules in the line card motherboard.

Step 2 Remove the modules from the line card motherboard. See the "Removing Modules" section on page 2-28.

Step 3 Loosen the screws on the inset tray and use the screws to pull the tray out of the line card motherboard. (See Figure 2-7.)

Figure 2-7 Removing the Insert Tray



Step 4 Insert the correct inset tray for the 16-channel mux/demux module and secure the tray to the line card motherboard by tightening the screws.

Step 5 Take a new module from the shipping container.

Step 6 Insert the 16-channel mux/demux module with OSC carefully into the top motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Note Make sure the module has no cables attached to it before installing it into the line card motherboard.

Step 7 Insert the 16-channel mux/demux module without OSC carefully into the bottom motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Step 8 Attach the OSC cables and all other appropriate cables. The connections on the 16-channel mux/demux modules are one-to-one.

Step 9 Check the LEDs to ensure proper installation. See Table 1-7 on page 1-19 for LED descriptions.

Installing Mux/Demux and 2.5 Gbps Transponder Modules

To install the mux/demux modules or 2.5 transponder modules follow these steps:

Step 1 Remove the failed module or the filler module from the motherboard.

Step 2 Take a new module from the shipping container.

Step 3 Insert the module carefully into the motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Step 4 Attach the appropriate cables.

Save the filler modules with the packaging material.

Installing the Type 2 Extended Range Transponder Modules with SFP Optics

Note Only use Cisco-certified SFP optics for the Type 2 extended range transponders.

To install the Type 2 extended range transponders with SFP optics, follow these steps:

Step 1 Take the desired transceiver from the shipping container.

Step 2 Install the SFP by inserting it into the extended reach transponder. Push the SFP until it is securely set in the module.

Step 3 Insert the extended reach transponder module carefully into the motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Step 4 Push the latch on the module down to secure the module in place.

Step 5 Attach the appropriate cables.

Removing SFP Optics from the Type 2 Extended Range Transponders

There are two types of SFP optics that can be installed in the extended reach transponder modules. The connectors on the SFP optics are:

- MT-RJ connector
- LC connector

The MT-RJ connector is typically used for lower rate connections (ESCON and OC-3). The LC connector is typically used for higher rate connections (Gigabit Ethernet and Fibre Channel). Each connector requires a different method of removal. Each type of SFP requires a different method of removal.

Note Use the **show hardware** command to see what SFP optic you have currently installed in your module.

Removing SFP Optics with MT-RJ Connectors

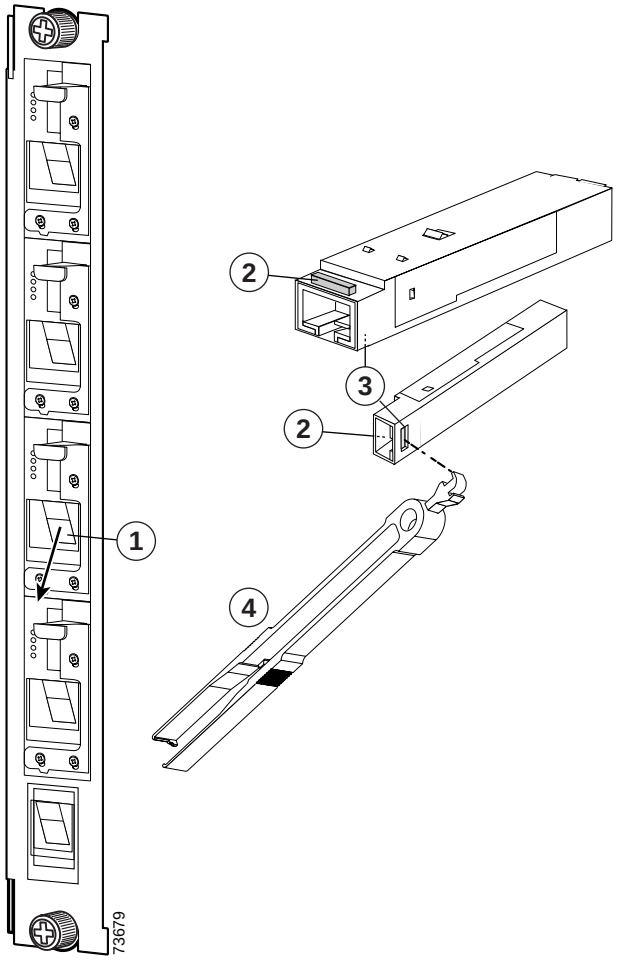
Note You need the cable installation and removal tool to remove the SFP with the MT-RJ connector.

To remove an SFP with an MT-RJ connector from the extended reach transponder module, follow these steps:

Step 1 Remove the cable from the desired SFP.

Step 2 Remove the SFP from the module by pushing against the lever on the SFP to release it from the module. (See Figure 2-8.)

Figure 2-8 Removing the SFP with MT-RJ Connector



1	SFP placement in the module	**3**	Hole where the SFP extraction end of the tool is inserted
2	Lever on the SFP (two views)	**4**	SFP extraction and cable installation and removal tool

Step 3 Use the tool to remove the ADP by inserting the tool into the side of the transceiver and pulling it out of the module.(See Figure 2-8.)

Step 4 Place the removed SFP in a container appropriate for shipping and storage.

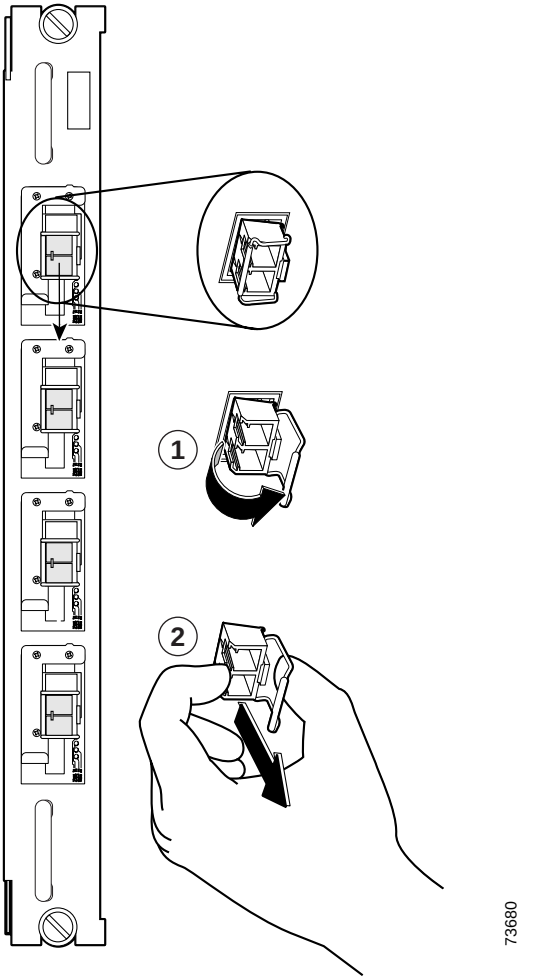
Removing SFP Optics with LC Connectors

To remove an SFP with an LC connector from the extended reach transponder module, follow these steps:

Step 1 Remove the cable from the desired SFP.

Step 2 Remove the SFP from the module by pulling the latch on top of the SFP to release it from the module. (See Figure 2-9.)

Figure 2-9 Removing the SFP with the LC Connector



1	Release latch	**2**	SFP removal

Step 3 Continue to pull the latch down and use the latch to pull the SFP out of the module. (See Figure 2-9.)

Step 4 Place the removed SFP in a container appropriate for shipping and storage.

Using CLI Prior to 2.5-Gbps Transponder Module Removal

Removing a 2.5-Gbps transponder module from the Cisco ONS 15540 ESP causes bit rate errors on other transponder modules in the 2.5-Gbps line card motherboard. Although these errors do not affect system traffic, you can avoid them using the following privileged EXEC command before removing the transponder module:

Command	Purpose
hw-module subslot *slot/subslot* **power off**	Turns off the power to a 2.5-Gbps transponder module.

Note The **hw-module subslot power** command is only supported on modules installed in 2.5-Gbps line card motherboards with hardware version 5.1, or later, and with LRC (line card redundancy controller) functional image version 2.72, or later.

To determine the functional image and hardware versions on your system, use the show hardware detail command.

Note Wait 60 seconds after removing a 2.5-Gbps transponder module before inserting a 2.5-Gbps transponder module into the same subcard position in the 2.5-Gbps line card motherboard.

Example

The following example shows how to turn off the power to a 2.5-Gbps transponder module before removing it:

```
Switch# hw-module subslot 8/1 power off
Warning: Power OFF subcard 8/1.  Continue? [confirm]y
Switch#
```

Verifying 2.5-Gbps Transponder Module Power Status

To verify the status of the power to a 2.5-Gbps transponder module, use the following privileged EXEC command:

Command	Purpose
show hardware linecard *slot*	Displays hardware information for a specific slot in the shelf.

Example

The following example shows how to display the power status of the subcards in a 2.5-Gbps line card motherboard:

```
Switch# show hardware linecard 8
------------------------------------------------------------------------
Slot Number             : 8/*
Controller Type         : XpndrMotherboard
On-Board Description    : TRANSPONDER_MOTHER_PHASE_0
Orderable Product Number: N/A
Board Part Number       : 73-5813-05
Board Revision          : 05
Serial Number           : CAB0517HLRV
Manufacturing Date      : 03/30/2001
Hardware Version        : 5.1
RMA Number              : 0x00
RMA Failure Code        : 0x00
Functional Image Version: 2.55
Subcard Power Control   : 0:ON, 1:OFF, 2:ON, 3:ON
<Information deleted.>
```

Removing Modules

Warning **High-performance devices on this card can get hot during operation. To remove the card, hold it by the faceplate and bottom edge. Allow the card to cool before touching any other part of it or before placing it in an antistatic bag.**

Note You can avoid bit rate errors that can cause the system to issue alarms if an alarm threshold is exceeded by turning off the power to the online module with the **how-module subset power** command before removing a transponder module. Use the **show hardware linecard** command to display the status of the power to a transponder module.

To remove a module from your unit without interrupting system operation, follow these steps:

Step 1 Remove all cables from the desired module.

Step 2 Remove the module by carefully pulling it out of the slot in the motherboard.

Step 3 Reinstall the blank filler module.

Step 4 Place the removed module in a container appropriate for shipping and storage.

Installing and Removing the Fan Assembly

The fan assembly is hot-swappable. Fan status is reported to the processor cards. Table 2-2 lists the status for the fan assembly. If a major alarm occurs, the fan assembly should be replaced.

Note Use the **show facility-alarm status** command to verify it is the fan that is causing the major alarm. If the output shows “Fan” as the source, replace the fan assembly.

Table 2-2 Fan Assembly Status

Fan Failure	Status
None	Normal
One	Minor
Two or more	Major

To replace the fan assembly in the Cisco ONS 15540, follow these steps:

Step 1 Carefully remove the bottom cable management guide secured over the fan assembly by loosening the 6-32 screws from the rack and pulling it off of the shelf.

Step 2 Place the cable management guide near the rack.

Step 3 Unscrew the captive installation screws on the fan assembly.

Step 4 Grasp the fan assembly captive installation screws and pull them towards you.

Step 5 Pull the fan assembly out of the bay and put it aside.

Step 6 Place the new fan assembly into the front chassis cavity so it rests on the chassis. Lift the fan assembly up slightly and align the top and bottom guides.

Step 7 Push the fan assembly into the chassis until the captive installation screws meet the chassis.

Step 8 Tighten each of the captive installation screws.

Step 9 Power up the system and verify fan assembly operation by checking the fan assembly status. The fan status is normal when operating properly.

Powering Up the Shelf

The system is powered by redundant -48 VDC inputs. Two models (15540-PWR-AC and 15540-ACPS-N-E) of redundant external AC-input power supplies are available or DC-input power can be provided directly.

The external power supplies are single-phase, AC-DC, 1050 W, -48 V output power supplies. The external power supplies are installed in an external power shelf that fits into a standard equipment rack. The following note and warnings apply to direct DC-connected installations.

Note The DC return is to remain isolated from the system frame and chassis (DC-I).

Warning **A readily accessible disconnect device must be incorporated in the building's installation wiring.**

Warning **This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a Listed and Certified fuse or circuit breaker 25A, minimum 60 VDC, is used on all current-carrying conductors.**

If an external AC-input power supply is not used, proceed to the "Connecting DC-Input Power from the 15540-PWR-AC Power Supply" section on page 2-37.

Rack-Mounting the 15540-PWR-AC External Power Shelf

The external power shelf is available in two models. This section describes the installation of the 15540-PWR-AC external power shelf. See the "Rack-Mounting the 15540-ACPS-N-E External Power Shelf" section on page 2-41 for the other model.

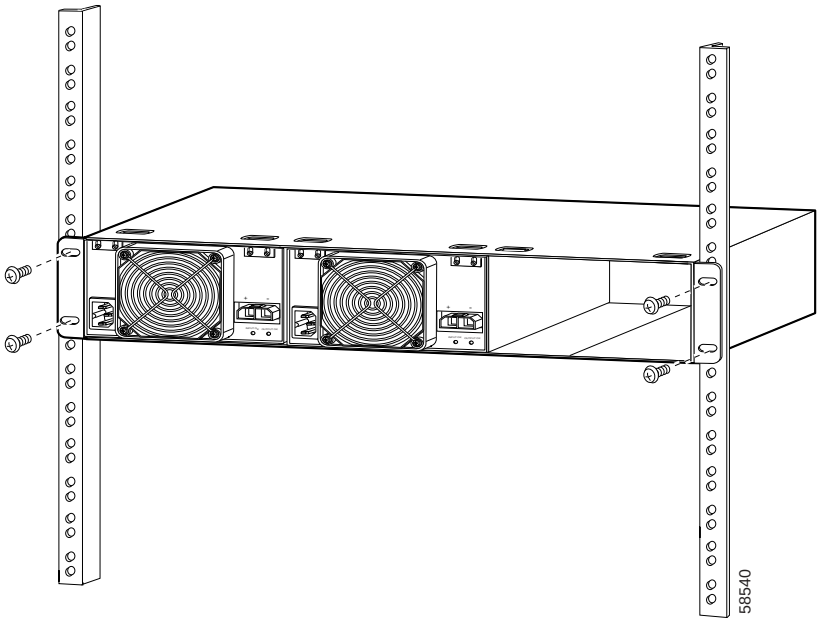
Note Make sure you install the 15540-PWR-AC external power shelf close enough to your chassis so that you can connect all power cords to the chassis and to the power outlet. We recommend that you install the 15540-PWR-AC external power shelf directly above your Cisco ONS 15540 chassis, leaving one half inch of space between the chassis and the power shelf or in a directly adjacent rack. The external power shelf is a 19-inch (483 mm) wide rack mount shelf, 3.5 inches (86 mm) high and 12 inches (305 mm) deep.

To install the 15540-PWR-AC external power shelf in an equipment rack, follow these steps:

Step 1 Align the mounting holes in the L brackets with the mounting holes in the equipment rack.

Step 2 Secure the 15540-PWR-AC external power shelf using four (two per side) 12-24 x 3/4-inch screws through the elongated holes in the L bracket and into the threaded holes in the mounting post. (See Figure 2-10.)

Figure 2-10 Installing the 15540-PWR-AC External Power Shelf in the Rack



Step 3 Use a tape measure and level to ensure that the 15540-PWR-AC external power shelf is installed straight and level.

Installing and Connecting the 15540-PWR-AC External Power Supply

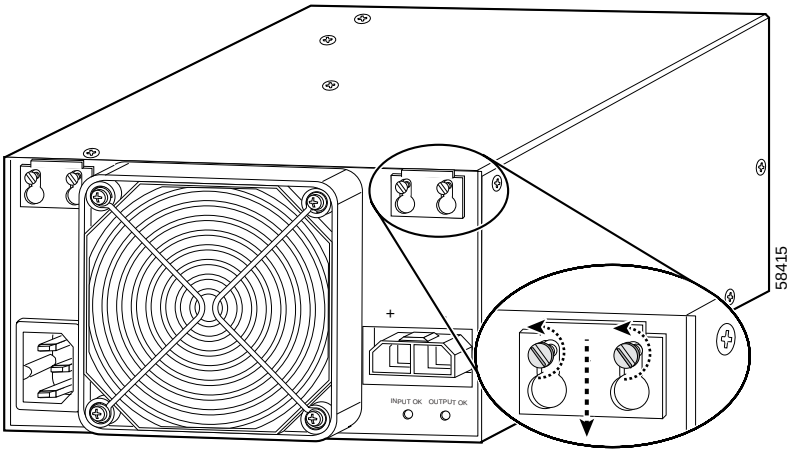
After you have installed the 15540-PWR-AC external power shelf in the equipment rack, you can install the 15540-PWR-AC power supplies. If you have not installed the 15540-PWR-AC external power shelf, see the "Rack-Mounting the 15540-PWR-AC External Power Shelf" section on page 2-30.

To install a 15540-PWR-AC power supply, follow these steps:

Step 1 Make sure that the 15540-PWR-AC power supply you are installing is not plugged in to a power outlet.

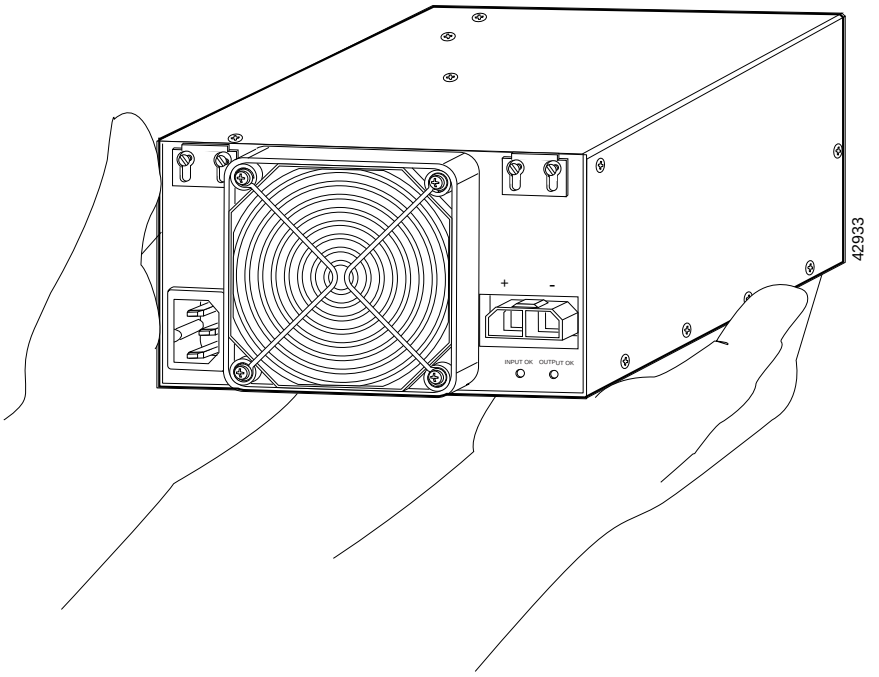
Step 2 Loosen the screws on the attachment plates on the upper left and right corners of the external power supply so you can slide the attachment plates down. (See Figure 2-11.)

Figure 2-11 Sliding the External Power Supply Attachment Plates Down



Step 3 Grasp the 15540-PWR-AC power supply handle with one hand. Place your other hand underneath to support the bottom of the external power supply. (See Figure 2-12.)

Figure 2-12 Handling the 15540-PWR-AC Power Supply

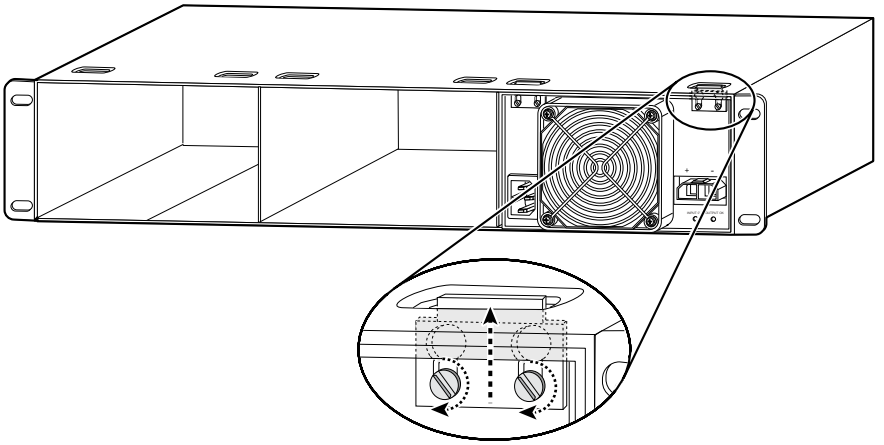


Caution Use both hands to install and remove the 15540-PWR-AC power supply.

Step 4 Slide the 15540-PWR-AC power supply all the way into the 15540-PWR-AC external power shelf bay, aligning the attachment plates with the slots on the top of the external power shelf.

Step 5 Slide each attachment plate up so that the upper edge is wedged into the 15540-PWR-AC external power shelf slot and use a screwdriver to tighten the two screws on each attachment plate. (See Figure 2-13.)

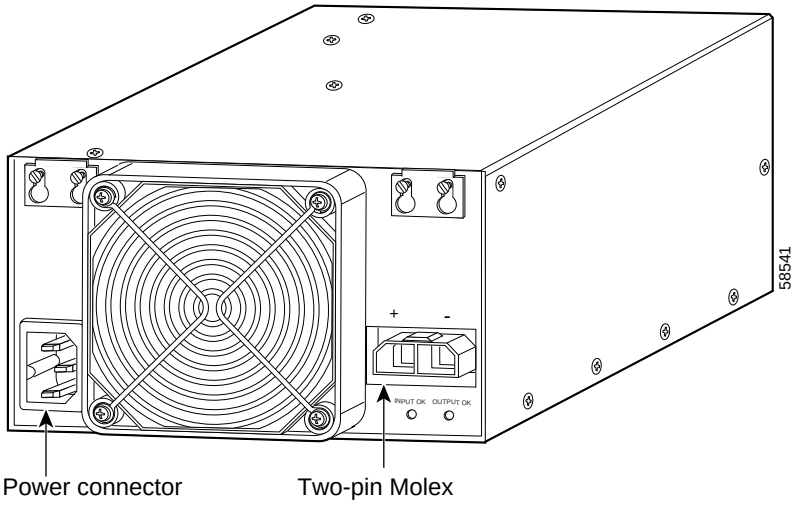
Figure 2-13 Tightening the Attachment Plates



Step 6 Ensure that all site power and grounding requirements described in the *Regulatory Compliance and Safety Information for the Cisco ONS 15500 Series* have been met before you connect the external power supply to a power source.

Step 7 Plug one end of the two-pin Molex cord into the external power supply. (See Figure 2-14.)

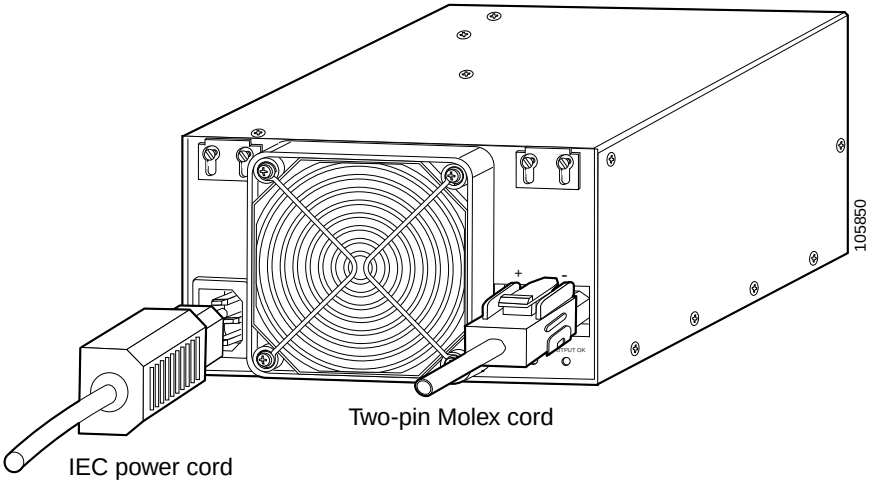
Figure 2-14 Power Connector and Two-Pin Molex Connector



Step 8 Connect the other end of the two-pin Molex cord to the chassis.

Step 9 Connect the other end of the power cord to an AC-power input source. (See Figure 2-15.)

Figure 2-15 Connecting the 15540-PWR-AC Power Supply to the Chassis



Caution In a system with multiple 15540-PWR-AC power supplies, connect each power supply to a separate AC-input power source. In case of a power source failure, the second source is still available and can maintain maximum overcurrent protection for each power connection.

Step 10 Verify 15540-PWR-AC power supply operation by checking the power supply front panel LEDs:

- INPUT OK LED is on.
- OUTPUT OK LED is on.

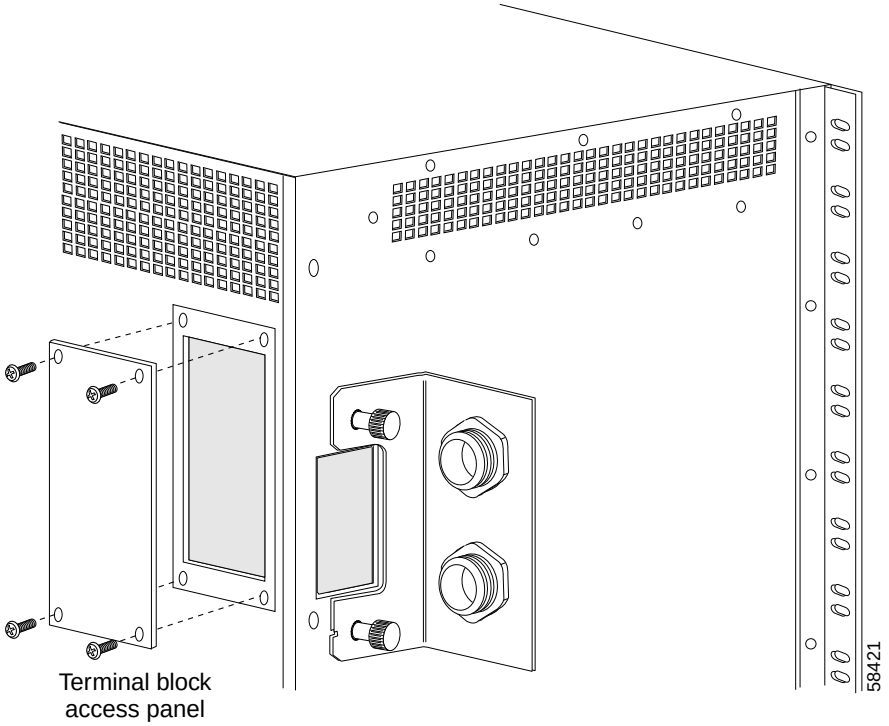
Step 11 Check the external power supply status from the system console by entering the **show hardware** command. For more information on commands, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

Connecting DC-Input Power from the 15540-PWR-AC Power Supply

To apply DC-input power to your Cisco ONS 15540 shelf, follow these steps:

Step 1 Remove the four screws from the terminal block access panel on the back panel of the chassis. (See Figure 2-16.)

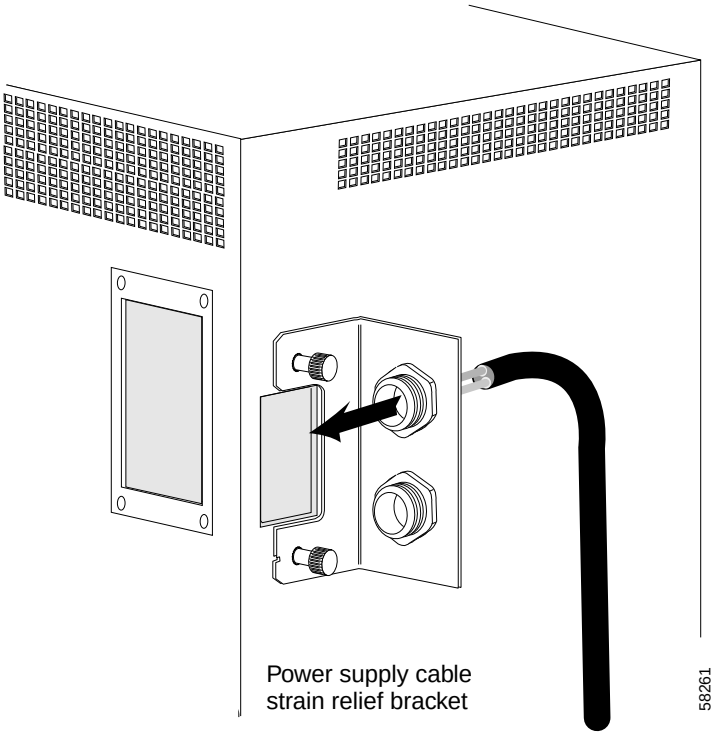
Figure 2-16 Removing the Terminal Block Access Panel



Step 2 Remove the insulation of each wire on both ends of the interconnection cables at a length of about a 1/4 inch (6 mm).

Step 3 Insert the cord through the power supply cable strain relief on the back left side of the chassis. (See Figure 2-17.)

Figure 2-17 Inserting the Cord Through the Power Supply Cable Strain Relief



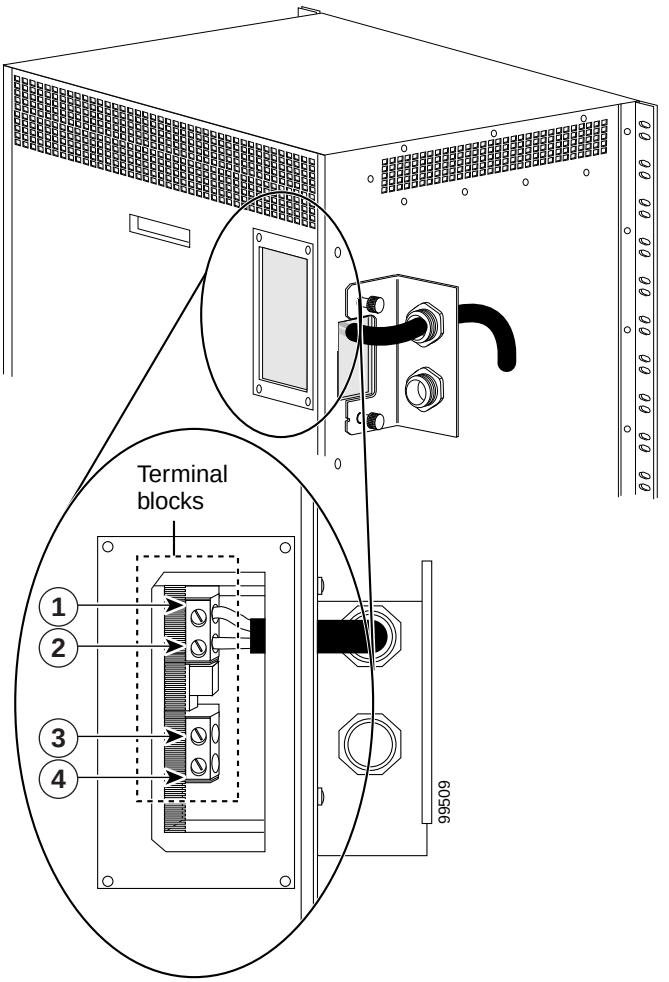
Step 4 Connect the wires of the cables to the terminal blocks. (See Figure 2-18.) Wire the cables in the following sequence:

- Red lead to the terminal labeled RTNA.
- Black lead to the terminal labeled -48A.

Note The ground connections should always be connected first and disconnected last.

Note The second power supply cable should be connected to the terminals labeled RTNB and -48B.

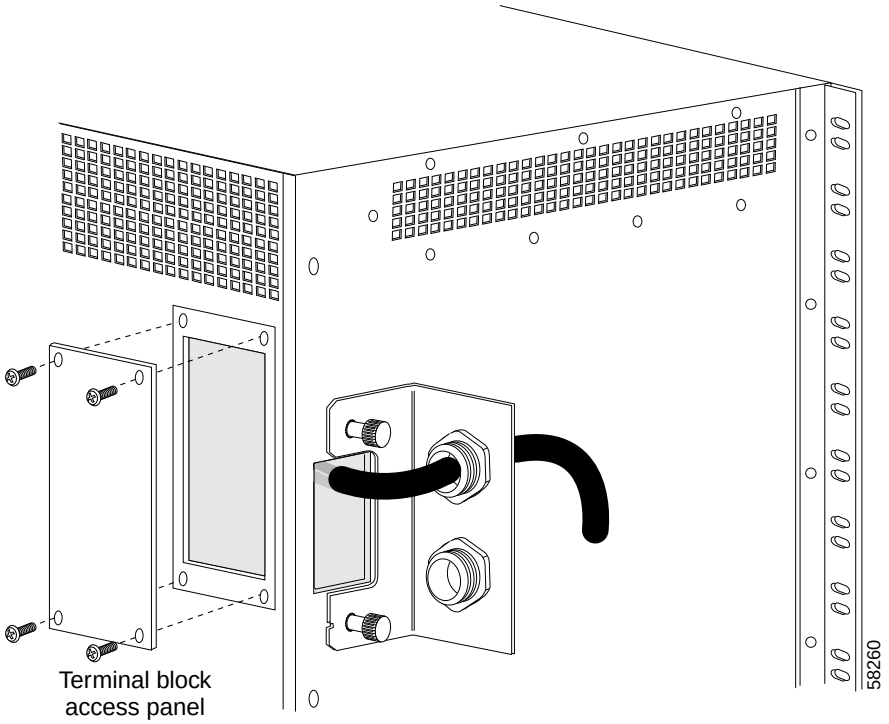
Figure 2-18 Connecting Cable Wires to the Terminal Blocks



1	RTNA	**3**	RTNB
2	–48VA	**4**	–48VB

Step 5 Reinstall the terminal block access panel onto the chassis. Use the same four screws used in Step 1 to secure the panel. (See Figure 2-19.)

Figure 2-19 Reinstalling the Terminal Block Access Panel



Step 6 Turn the power on using the corresponding power switch of the power supply.

Rack-Mounting the 15540-ACPS-N-E External Power Shelf

This section describes the installation of the 15540-ACPS-N-E external power shelf.

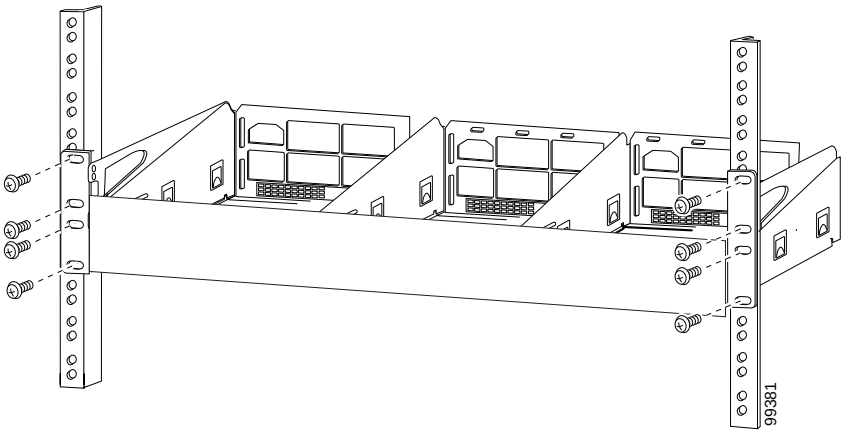
Note Make sure you install the 15540-ACPS-N-E external power shelf close enough to your chassis so that you can connect all power cords to the chassis and to the power outlet. We recommend that you install the 15540-ACPS-N-E external power shelf directly above your Cisco ONS 15540 chassis, leaving one-half inch of space between the chassis and the power shelf or in a directly adjacent rack. The external power shelf is a 19-inch (483 mm) wide rack mount shelf, 3.5 inches (86 mm) high and 12 inches (305 mm) deep.

To install the 15540-ACPS-N-E external power shelf in an equipment rack, follow these steps:

Step 1 Align the mounting holes of the external power shelf with the mounting holes in the equipment rack.

Step 2 Secure the external power shelf using eight (four per side) 12-24 x 3/4-inch screws through the holes in the external power shelf and into the threaded holes in the mounting post. (See Figure 2-20.)

Figure 2-20 Installing the 15540-ACPS-N-E External Power Shelf in the Rack



Step 3 Use a tape measure and level to ensure that the external power shelf is installed straight and level.

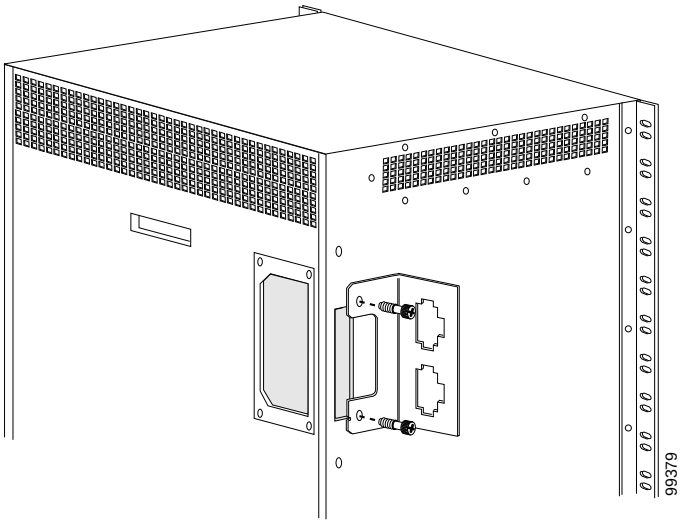
Step 4 Remove the spacer bar after the external power shelf is secured to the rack.

Connecting DC-Input Power from the 15540-ACPS-N-E External Power Shelf

To apply DC-input power to your Cisco ONS 15540 shelf, you must install a cable strain relief bracket and two DC power cables. The two DC power cables are connected to each other at the cable strain relief bracket. To complete the connections, follow these steps:

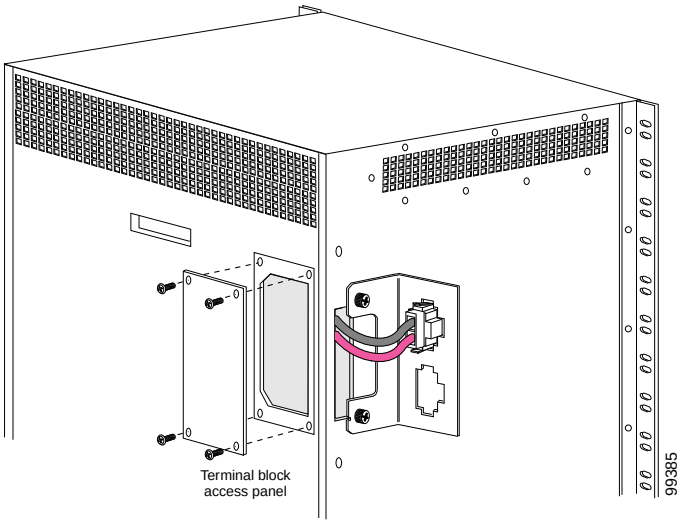
Step 1 Attach the cable strain relief bracket to the side of the Cisco 15540 chassis. (See Figure 2-21.)

Figure 2-21 Installing the Cable Strain Relief Bracket



Step 2 Remove the four screws from the terminal block access panel on the back panel of the chassis. (See Figure 2-22.)

Figure 2-22 Removing the Terminal Block Access Panel



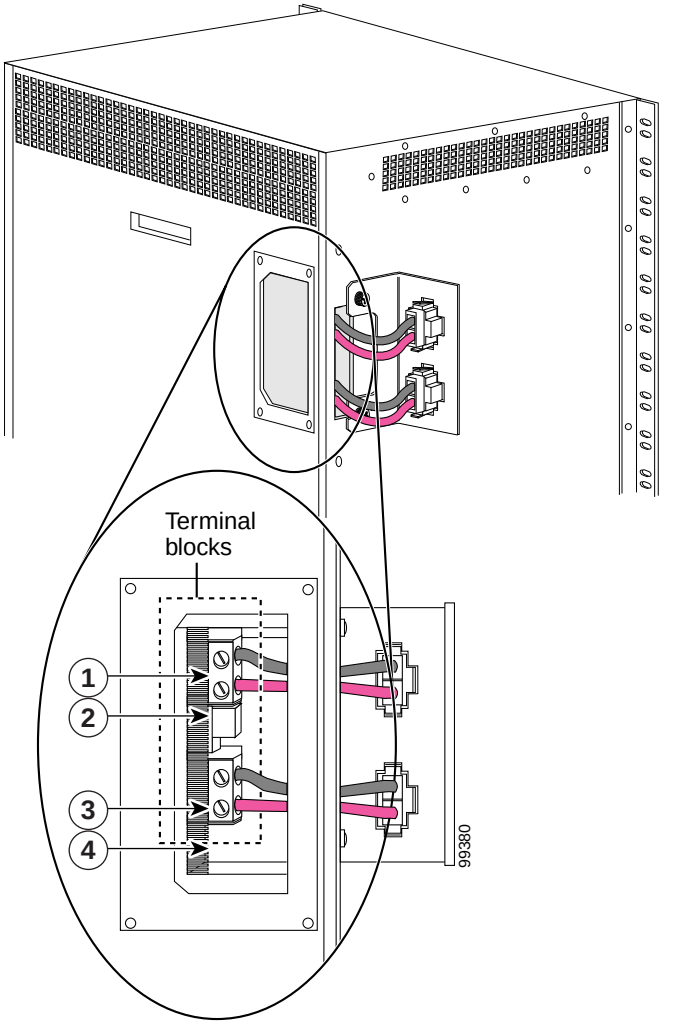
Step 3 Snap the cable connector of the short DC power cable into the cable strain relief bracket. (See Figure 2-22.)

Step 4 Insert the cable through the left rear of the chassis and connect the leads to the terminal blocks (see Figure 2-23) in the following sequence:

- Black lead to RTNA.
- Red lead to –48A.

Note The ground connections should always be connected first and disconnected last.

Figure 2-23 Connecting Cable Wires to the Terminal Blocks



1	RTNA	**3**	RTNB
2	–48VA	**4**	–48VB

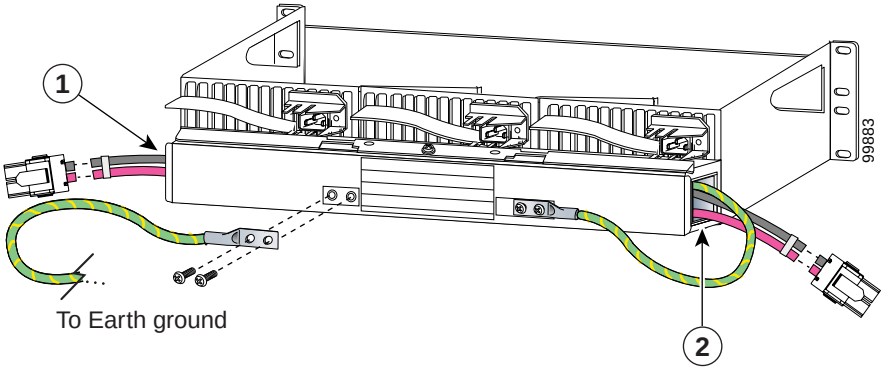
Step 5 Repeat Step 3 and Step 4, connecting the second set of cables in the following sequence:

- Black lead to RTNB.
- Red lead to –48B.

Step 6 Reinstall the terminal block access panel onto the chassis. Use the same four screws used in Step 2 to secure the panel. (See Figure 2-22.)

Step 7 Use two number 10 screws to attach the earth ground lead to the ground lugs on the rear of the 15540-ACPS-N-E external power shelf. (See Figure 2-24.)

Figure 2-24 Connecting to Earth Ground

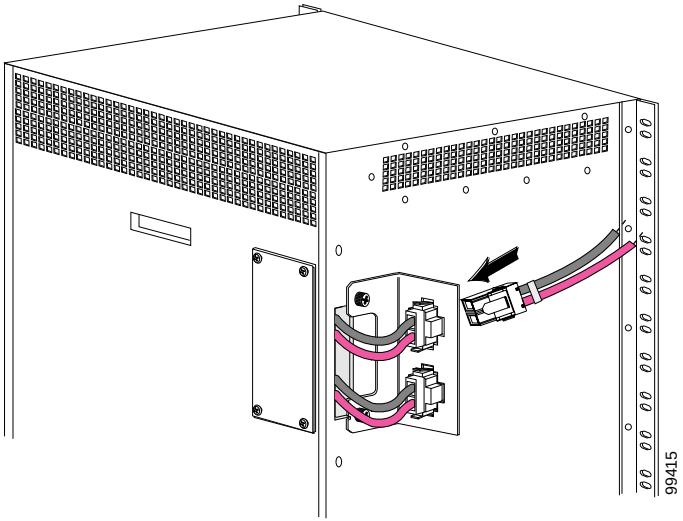


1	Side B	**2**	Side A

Step 8 Connect the earth ground lead to an appropriate ground source.

Step 9 Attach the side A and side B cable ends to the short DC power cables at the cable strain relief bracket. (See Figure 2-25.)

Figure 2-25 Connecting the DC Power Cables



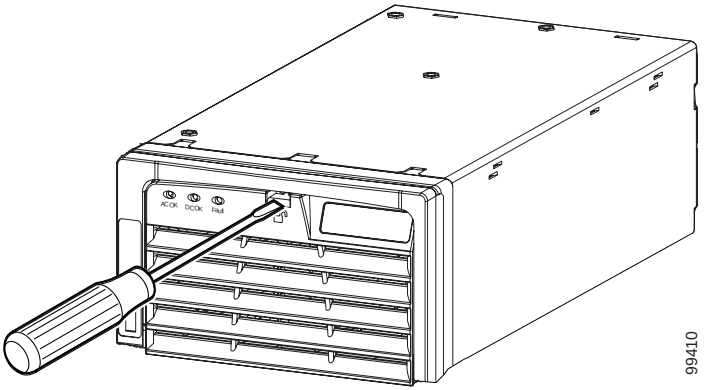
Installing and Connecting the 15540-ACPS-N-E External Power Supply

After you have installed the 15540-ACPS-N-E external power shelf in the equipment rack, you can install the external power supplies. If you have not installed the external power shelf, see the "Rack-Mounting the 15540-ACPS-N-E External Power Shelf" section on page 2-41.

To install the 15540-ACPS-N-E power supply, follow these steps:

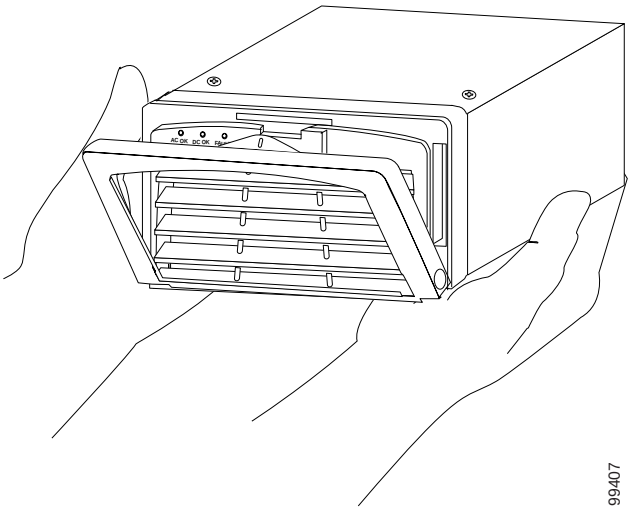
Step 1 Use a flat blade screwdriver to push in on the release handle latch until the release handle opens. (See Figure 2-26.)

Figure 2-26 Opening the Release Handle



Step 2 With the release handle partially open, place both hands underneath the bottom of the external power supply and carry it to the external power shelf. (See Figure 2-27.)

Figure 2-27 Handling the 15540-ACPS-N-E Power Supply

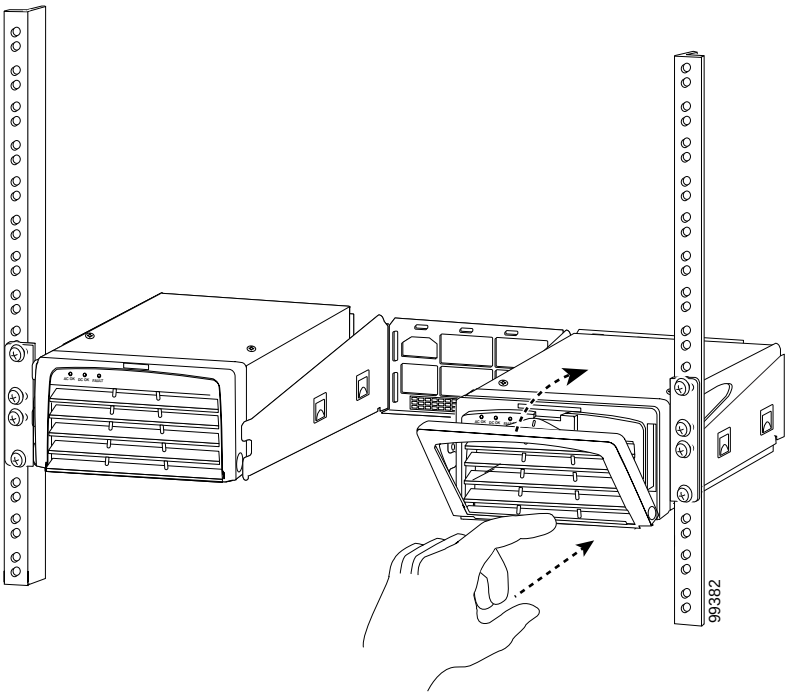


Caution Use both hands to install and remove the 15540-ACPS-N-E power supply.

Step 3 Slide the 15540-ACPS-N-E power supply all the way into the 15540-ACPS-N-E external power shelf bay until the release handle closes. (See Figure 2-28.)

Note The 15540-ACPS-N-E power supply will not function in the center bay of the 15540-ACPS-N-E external power shelf. Install the blank power supply in the center bay.

Figure 2-28 Installing the 15540-ACPS-N-E Power Supply

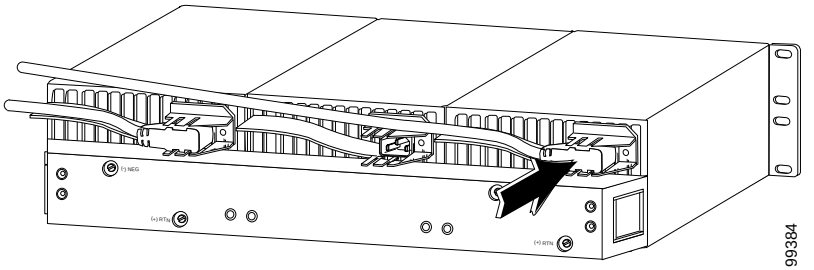


Step 4 Ensure that all site power and grounding requirements described in the *Regulatory Compliance and Safety Information for the Cisco ONS 15500 Series* have been met before you connect the 15540-ACPS-N-E power supply to a power source.

Caution In a system with multiple power supplies, connect each power supply to a separate AC-input power source. In case of a power source failure, the second source is still available.

Step 5 Connect the power cord to the 15540-ACPS-N-E external power shelf. (See Figure 2-29.)

Figure 2-29 Installing the AC Power Cord



Step 6 Verify 15540-ACPS-N-E power supply operation by checking the power supply front panel LEDs:

- AC OK LED is on.
- DC OK LED is on.

Step 7 Check the external power supply status from the system console by entering the **show hardware** command. For more information on commands, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

Using Y-Cable

Using an external 2:1 combiner (the y-cable), connections between the client equipment and the transponder interfaces are duplicated. This means each input and output client signal is connected to two transponder interfaces, one active and one standby. During any interval, one of the transmitters at the client interface is turned on and is generating the required optical signal, and the second transmitter is off.

Refer to the *Cisco ONS 15540 ESP Planning Guide* for y-cable configuration guidelines.

Attaching the Y-Cable

To attach the y-cable to the transponder modules, follow these steps:

Step 1 Read the configuration guidelines in the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

Step 2 Choose which ports you will use.

Step 3 Lift the shutters on the two intended ports and attach one end of the two-sided cable to each of the ports.

Step 4 Attach the other end to the client equipment if not already attached.

Connecting the Cisco ONS 15540

The Cisco ONS 15540 uses SC and MU connectors on the faceplates of the modules. Fiber optic cables are routed to the cable management guides that are at the top and bottom of the shelf. The Cisco ONS 15540 is powered using -48 VDC power. Positive and negative power terminals are accessible on the backplane.

You can mount the Cisco ONS 15540 in a 19-inch rack. The shelf assembly weighs approximately 153 pounds with all motherboards and modules installed and features a fan tray module for cooling and fiber-management space.

This chapter describes how to connect the Cisco ONS 15540 to the network and contains the following sections:

- Preparing for Network Connections, page 3-2
- Cleaning the Shelf and Connectors, page 3-2
- Connecting the Processor Card to a Network, page 3-6
- Connecting Mux/Demux Modules, page 3-8
- Connecting Transponder Modules, page 3-9

Note For power supply cable and alarm cable connecting information, see the "Powering Up the Shelf" section on page 2-29.

Note To ensure that your hardware is supported by your release of Cisco IOS software, see the "New and Changed Information" section on page xii. Also refer to the "Hardware Supported" section of the latest release notes for the Cisco ONS 15540 ESP.

Preparing for Network Connections

When preparing your site for network connections to the Cisco ONS 15540 shelf, consider the following for each type of interface:

- Cabling required for each type
- Distance limitations for each signal type
- Additional interface equipment needed

Before installing the component, have all additional external equipment and cables on hand.

Cleaning the Shelf and Connectors

Be careful with the airflow system when you clean the chassis. If the cleaning process must be done while the system is running, be aware that the airflow system is in operation. Clean the chassis with a damp cloth only and be careful of the following:

- Do not touch the airflow system while fans are operating.
- Do not use wet tissues for cleaning the chassis.
- Do not use any harsh or abrasive cleaning agents.

Warning **Invisible laser radiation may be emitted from the end of the fiber or connector. Do not stare into the beam or view directly with optical instruments.**

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

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

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

Note MU terminators are shipped with the system. These are used to terminate the pass through ports of the OADM that are not used. For instance, the pass through in must be terminated if it is unused, otherwise the return loss at Trunk IN will be unacceptably high.

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

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

When cleaning fiber components, procedures must be followed precisely and carefully with the goal of eliminating any dust or contamination. A clean component connects properly; a dirty component may transfer contamination to the connector, or it may even damage the optical contacts. Inspecting, cleaning, and re-inspecting are critical steps that must be done before making any fiber connection.

As a general rule, whenever there is a significant, unexplained loss of light, clean the connectors.

Caution Use extreme care when removing or installing connectors so you do not damage the connector housing or scratch the end-face surface of the fiber. Always install filler modules on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

Use a swab saturated with isopropyl alcohol to clean the end-surfaces. Use dry, oil-free compressed air after applying the isopropyl alcohol.

To clean the optical connectors, follow these steps:

Step 1 Wipe the ferrules and end-face surfaces of the connector gently with an alcohol pad from the cleaning kit. Be sure that the pad makes full contact with the end-face surfaces. Wait five seconds for the surfaces to dry and repeat.

Step 2 Blow dry the connectors with canned, dry, oil-free, compressed air.

Step 3 Use a magnifying glass to inspect the ferrule.

The connectors used inside the system have been cleaned by the manufacturer and connected to the adapters in the proper manner. The operation of the system should be error free if the customer provides clean connectors on the application side, follows the previous directions, and ensures the following:

- Clean the connectors using lens tissues before connecting to the adapters. Use pure alcohol to remove soil.
- Do not clean the inside of the connector adapters.
- Do not use force or quick movements when connecting the fiber optic connectors in the adapters.
- Cover the connector adapters to avoid soiling or contaminating the inside of the adapters while cleaning the chassis.
- Cover the connectors and adapters to avoid the inside of the adapters or the surface of the connectors from getting dirty when not using the connectors.

Note If the surface is not clean or does not have a uniform shine, repeat the process using a fresh surface of the alcohol pad.

Connecting the Processor Card to a Network

Before connecting the processor card to a network, consider the following types of cable required for each interface:

- Straight-through EIA/TIA for the DB-25 console port
- Aux port cable that ships with the shelf for the auxiliary port
- Straight-through RJ-45 for the NME port

Note The ASE port is not functional.

Connecting the Console Port

The console port is a female, DCE (data communications equipment), DB-25 receptacle used for connection to a console terminal or modem.

To connect cables to the console port, follow these steps:

Step 1 Place the DB-25 connector in front of the console port on the processor card faceplate.

Step 2 Align the male DB-25 connector with the female console port.

Step 3 Gently push the DB-25 connector into the console port and secure it into place by tightening the side screws on the DB-25 connector.

Step 4 Route the cable up into the cable management tray on the top of the shelf.

Step 5 Route the fiber cables from the cable management tray out of the right side of the shelf assembly through cutout holes from the cable management tray.

Connecting the Auxiliary Port

The auxiliary port supports hardware flow control and modem control and uses the aux port cable that is shipped with the Cisco ONS 15540.

To connect cables to the auxiliary port, follow these steps:

Step 1 Place the aux port cable connector in front of the auxiliary port on the processor card faceplate.

Step 2 Align the keyed ridge of the cable connector with the receiving slot on the faceplate connection point.

Step 3 Gently push the cable connector into the faceplate connection point until the connector snaps into place.

Step 4 Route the cable up into the cable management tray on the top of the shelf.

Step 5 Route the fiber cables from the cable management tray out of the right side of the shelf assembly through cutout holes from the cable management tray.

Connecting the NME Port

The NME (network management Ethernet) port uses a straight-through RJ-45 cable connector.

To connect cables to the NME port, follow these steps:

Step 1 Place the RJ-45 connector in front of the NME port on the processor card.

Step 2 Align the keyed ridge of the cable connector with the receiving slot on the processor card connection point.

Step 3 Gently push the RJ-45 cable connector into the faceplate connection point until the connector snaps into place.

Step 4 Route the cable up into the cable management tray on the top of the shelf.

Step 5 Route the fiber cables from the cable management tray out of the right side of the shelf assembly through cutout holes from the cable management tray.

Connecting Mux/Demux Modules

The Cisco ONS 15540 fiber optic mux/demux modules use MU connectors. To install fiber optic cables in the Cisco ONS 15540, a fiber cable with the corresponding connector type must be connected to the transmit and receive ports on the modules. On Cisco ONS 15540 optical ports, the top connector is Transmit and the bottom connector is Receive. Cisco recommends that the transmit and receive and the working and protection fibers be labeled at each end of the fiber span to avoid confusion with cables that are similar in appearance.

Caution Follow all directions and warning labels when working with optical fibers. To prevent eye damage, never look directly into a fiber or connector.

To attach and route fiber optic cables to the mux/demux modules, follow these steps:

Step 1 Place the MU connector in front of the connection point on the mux/demux faceplate. Each mux/demux module supports at least one transmit and one receive connector to create an optical carrier port.

Step 2 Align the keyed ridge of the cable connector with the receiving slot on the faceplate connection point.

Step 3 Gently push the cable connector into the faceplate connection point until the connector snaps into place.

Step 4 Route the fiber cables through the cable retaining clips on the optical card faceplate into the cable management tray on the bottom of the shelf assembly.

Step 5 Route the fiber cables from the cable management tray out of the right side of the shelf assembly through cutout holes from the cable management tray.

Note Clean all fiber connectors thoroughly. Dust particles can degrade performance. Put caps on any fiber connectors that are not used.

Connecting Transponder Modules

The Cisco ONS 15540 fiber optic transponder modules use three types of connectors. SM and MM transponders use SC connectors. Type 2 extended range transponders with MT-RJ connector transceivers use MT-RJ connector cables. Type 2 extended range transponders with LC connectors use LC connector cables. To install fiber optic cables in the Cisco ONS 15540, a fiber cable with the corresponding connector type must be connected to the transmit and receive ports on the modules. On Cisco ONS 15540 optical ports, the top connector is Transmit and the bottom connector is Receive. We recommend that the transmit and receive and the working and protection fibers be labeled at each end of the fiber span to avoid confusion with cables that are similar in appearance.

Step 1 Place the SC connector in front of the connection point on the transponder module faceplate. Each transponder module supports at least one transmit and one receive connector to create an optical carrier port.

Step 2 Align the keyed ridge of the cable connector with the receiving slot on the faceplate connection point.

Step 3 Gently push the cable connector into the faceplate connection point until the connector snaps into place.

Step 4 Route fiber cables through the cable retaining clips on the optical card faceplate into the cable management tray on the bottom of the shelf assembly.

Step 5 Route the fiber cables from the cable management tray out of the right side of the shelf assembly through cutout holes from the cable management tray.

Specifications

This appendix describes the specifications for the line card motherboards and transponder modules, and the mux/demux motherboards and modules used in the Cisco ONS 15540 ESP system. This appendix includes the following sections:

- Chassis Specifications, page A-2
- Channel to Wavelength Mapping, page A-3
- Mux/Demux Motherboard Specifications, page A-5
- 4-Channel OADM Module Specifications, page A-6
- 8-Channel OADM Module Specifications, page A-7
- 16-Channel OADM Module Specifications, page A-8
- Line Card Motherboard Specifications, page A-8
- 2.5-Gbps Transponder Module Specifications, page A-9
- Type 2 Extended Range Transponder Module Specifications, page A-11

Note For more information about optical power budgets and network planning, refer to the *Cisco ONS 15540 ESP Planning Guide*.

Chassis Specifications

Table A-1 lists the specifications for the Cisco ONS 15540 ESP chassis.

Table A-1 Cisco ONS 15540 ESP Specifications

Description	Specification
Environmental	
Temperature, ambient operating	32 to 104°F (0° to +40°C)
Humidity (RH[1]), ambient (noncondensing) operating	90 to 95 percent
Physical Characteristics	
Dimensions (H x W x D)	24.5 x 17.3 x 12 in. (62.2 x 43.9 x 30.4 cm)
Weight	Chassis and Power Cord: 51 lbs (23.1 kg) Chassis fully loaded:153 lbs (69.40 kg)
Optical ports	SC, MU, MT-RJ, LC, MPX
Fan assembly	2.5A at -48 VDC
Processor card	5.5 lbs (2.50 kg) 18 x 9 in. (45.7 x 22.9 cm)
AC-Input Power	
AC-input voltage	100 to 240 VAC (nominal) 85 to 264 VAC (full range)
Current maximum	13.2A (100 VAC), 6.6A (200 VAC)
Power consumption maximum	1320W
Heat dissipation	4500 BTU/hr
DC-Input Power	
DC-input voltage	-48 to -60 VDC (nominal) -40.5 to -72 VDC (full range)
Power consumption maximum	1125W
Heat dissipation	3840 BTU/hr

1. RH = relative humidity

Channel to Wavelength Mapping

Table A-2 lists the channels, wavelengths, and frequencies for each band.

Table A-2 Channel to Wavelength Mapping

Cisco ONS 15540 ESP Band	Cisco ONS 15540 ESP Channel	ITU Channels	ITU Wavelength[1]	ITU Frequency[2]
OSC[3]		19	1562.23	191.900
A	1	21	1560.61	192.100
	2	22	1559.79	192.200
	3	23	1558.98	192.300
	4	24	1558.17	192.400
B	5	26	1556.55	192.600
	6	27	1555.75	192.700
	7	28	1554.94	192.800
	8	29	1554.13	192.900
C	9	31	1552.52	193.100
	10	32	1551.72	193.200
	11	33	1550.92	193.300
	12	34	1550.12	193.400
D	13	36	1548.51	193.600
	14	37	1547.72	193.700
	15	38	1546.92	193.800
	16	39	1546.12	193.900
E	17	41	1544.53	194.100
	18	42	1543.73	194.200
	19	43	1542.94	194.300
	20	44	1542.14	194.400

Table A-2 Channel to Wavelength Mapping (continued)

Cisco ONS 15540 ESP Band	Cisco ONS 15540 ESP Channel	ITU Channels	ITU Wavelength[1]	ITU Frequency[2]
F	21	46	1540.56	194.600
	22	47	1539.77	194.700
	23	48	1538.98	194.800
	24	49	1538.19	194.900
G	25	51	1536.61	195.100
	26	52	1535.82	195.200
	27	53	1535.04	195.300
	28	54	1534.25	195.400
H	29	56	1532.68	195.600
	30	57	1531.90	195.700
	31	58	1531.12	195.800
	32	59	1530.33	195.900

1. Wavelengths in vacuum in nm
2. Frequency in THz, 100 GHz grid
3. OSC = optical supervisory channel

Mux/Demux Motherboard Specifications

Table A-3 lists the specifications for the mux/demux motherboard.

Table A-3 Mux/Demux Motherboard Specifications

Description	**Specification**	
Fiber type	SM[1] 9 micron	
Connector	MU	
Output wavelength	1562.23 nm, ITU channel	
Dimensions	3.7 x 9 in. (9.4 x 22.9 cm)	
Weight	3.5 lbs (1.59 kg)	
Receiver	**Minimum**	**Maximum**
Receive sensitivity	-19 dBm	
Receive overload		-1.5 dBm
Input wavelength	1530.33 nm	1562.23 nm
Optical reflectance	-27 dB	
Side mode suppression	30 dB	
Transmitter	**Minimum**	**Maximum**
Transmitter power	4 dBm	8 dBm
Output wavelength	1530.33 nm	1560.61 nm
Dispersion tolerance		1800 ps/nm[2] [3]

1. SM = single mode
2. ps/nm = picoseconds per nanometer
3. 1800 ps/nm at OC-48 rate

4-Channel OADM Module Specifications

Table A-4 lists the specifications for the 4-channel and 4-channel with OSC OADM module.

Table A-4 4-Channel and 4-Channel with OSC Mux/Demux Modules

Description	Specification
Dimensions	1.0 x 3.3 x 7.7 in. (+1.5 in. for handle) (2.5 x 8.4 x 19.6 cm [+3.8 cm for handle])
Weight	0.5 lbs (.23 kg)
Fiber	ITU-T G.652 compliant
OSC[1]	1562.23 nm
Connector	MU
Operating temperature	32 to 104°F (0 to 40°C)
Storage temperature	-40 to 85°F (-40 to 29.4°C)
Channel mapping	Bands A to H[2]
Maximum relative humidity	90 to 95%

1. OSC = optical supervisory channel.
2. See Table A-2 for band A to H wavelengths.

8-Channel OADM Module Specifications

Table A-5 lists the specifications for the 8-channel and 8-channel with OSC OADM module.

Table A-5 8-Channel and 8-Channel with OSC OADM Modules

Description	Specification
Dimensions	1.0 x 3.3 x 7.7 in. (+1.5 in. for handle) (2.5 x 8.4 x 19.6 cm [+3.8 cm for handle])
Weight	1.0 lbs (0.45 kg)
Fiber	ITU-T G.652 compliant
OSC[1]	1562.23 nm
Connector	MU
Operating temperature	32 to 104°F (0 to 40°C)
Storage temperature	-40 to 85°F (-40 to 29.4°C)
Channel mapping	Channels AB, CD, EF, and GH[2]
Maximum relative humidity	90 to 95%

1. OSC = optical supervisory channel.
2. See Table A-2 for band A to H wavelengths.

16-Channel OADM Module Specifications

Table A-6 lists the specifications for the 16-channel OADM module.

Table A-6 16-Channel OADM Modules

Description	Specification
Dimensions	1.0 x 6.6 x 7.7 in. (+1.5 in.for handle) (2.5 x 2.0 x 19.6 cm [+3.8 cm for handle])
Weight	1.5 lbs (0.68 kg)
Fiber	ITU-T G.652 compliant
OSC[1]	1562.23 nm
Connectors	MU
Operating temperature	0 to 65°C
Storage temperature	-40 to 85 °C
Wavelengths	32, ITU G.692

1. OSC = optical supervisory channel

Line Card Motherboard Specifications

Table A-7 lists the specifications for the 2.5-Gbps line card motherboard.

Table A-7 2.5-Gbps Line Card Motherboard Specifications

Description	Specification
Dimensions	18 x 9 in. (45.72 x 22.86 cm)

Table A-8 lists the specifications for the 10-Gbps line card motherboard.

Table A-8 10-Gbps Line Card Motherboard Specifications

Description	Specification
Dimensions	1.3 x 9.1 x 18.1 in. (3.3 x 23.11 x 45.97 cm)

2.5-Gbps Transponder Module Specifications

Table A-9 lists the client side optical specifications for the 2.5-Gbps transponder module.

Table A-9 2.5-Gbps SM and MM Transponder Client Side Specifications

Description	Specification			
Dimensions	3 x 7.5 in. (7.6 x 19.1 cm)			
Weight				
Connector	SC			
Trunk connector	MUJ			
	Single Mode		Multimode	
Receiver	Minimum	Maximum	Minimum	Maximum
Bit rate	16 Mbps	2.5 Gbps	16 Mbps	622 Mbps
Receive sensitivity	–19 dBm		–25 dBm	
Receive overload		–1.5 dBm		–8 dBm
Input wavelength	1249 nm	1600 nm	1249 nm	1600 nm
Transmitter power	–5 dBm	0 dBm	–5 dBm	0 dBm
Output wavelength	1260 nm	1360 nm	1260 nm	1360 nm

Table A-10 lists the trunk side optical specifications for the 2.5-Gbps transponder module.

Table A-10 2.5-Gbps Trunk Side Optical Specifications

Description	Specification	
Fiber type	ITU-T G.652 compliant	
Connector	MUJ	
Receiver	**Minimum**	**Maximum**
OSNR [1, 2]	19 dB	
Receive sensitivity[2]	–28 dBm	
Receive overload		–8 dBm
Input wavelength	1260 nm	1580 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	4 dBm	8 dBm
Dispersion tolerance		1800 ps/nm[3]

1. OSNR = optical signal-to-noise ratio.
2. Add the proper network-level penalty to the OSNR and/or receive power based on your actual network topology characteristics, such as dispersion.
3. ps/nm = picoseconds per nanometer.

Type 2 Extended Range Transponder Module Specifications

Table A-11 lists the specifications for the Type 2 extended range transponder modules.

Table A-11 Type 2 Extended Range Transponder Module Specifications

Description	**Specification**	
Fiber	ITU-T G.652 compliant	
Receiver Specifications	**Minimum**	**Maximum**
OSNR[1]	19 db	
Receive sensitivity[1]	–28 dBm	
Receive overload		–8 dBm
Input wavelength	1430 nm	1580 nm
Transmitter Specification	**Minimum**	**Maximum**
Output power	5 dBm	10 dBm
Dispersion tolerance		3200 ps/nm

1. Add the proper network level penalty to the OSNR and/or receive power based on your actual network topology characteristics, such as dispersion.

SFP Optics Specifications

Table A-12 lists the specifications for the Cisco ONS 15540 ESP fixed rate SFP optics.

Note Only use Cisco-certified SFP optics for the Type 2 extended range transponders.

Table A-12 Fixed Rate SFP Optics Specifications

Description	**Specification**	
Part number	**15500-XVRA-01A2**	
ESCON, OC-3/STM-1 MM		
Dimensions (H x W x D)	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	155 Mbps, 200 Mbps	
Wavelength	1310 nm	
Fiber type	MM, 50/125 µm, 62.5/125 µm	
Connector type	MT-RJ	
Receiver	**Minimum**	**Maximum**
Receive sensitivity	-33 dBm	-14 dBm
Input wavelength	1280 nm	1380 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-19.5 dBm	-15 dBm
Output wavelength	1280 nm	1380 nm
Part number	**15500-XVRA-02C1**	
Gigabit Ethernet, Fibre Channel (1 Gbps), and FICON (1-Gbps) MM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	1.0625 Gbps, 1.25 Gbps	
Wavelength	850 nm	
Fiber type	MM, 50/125 µm, 62.5/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Receive sensitivity	-18 dBm	
Stressed receive sensitivity	-13.5 dBm	
Input wavelength	770 nm	860 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-9.5 dBm	-4 dBm

Table A-12 Fixed Rate SFP Optics Specifications (continued)

Description	**Specification**	
Output wavelength	830 nm	860 nm
Part number	**15500-XVRA-03B1**	
Gigabit Ethernet, Fibre Channel (1 Gbps), and FICON (1Gbps) SM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	1.0625 Gbps, 1.25 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Input power	-20.5 dBm	-3 dBm
Input wavelength	1270 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-9.5 dBm	-3 dBm
Output wavelength	1275 nm	1350 nm
Part number	**15500-XVRA-03B2**	
Fibre Channel (1 Gbps and 2 Gbps) and FICON (1 Gbps and 2 Gbps) SM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	1.0625 Gbps, 2.125 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Receive sensitivity	-20.5 dBm	
Input wavelength	1270 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-9.5 dBm	-3 dBm
Output wavelength	1275 nm	1350 nm

Table A-12 Fixed Rate SFP Optics Specifications (continued)

Description	Specification	
Part number	**15500-XVRA-02C2**	
Fibre Channel (1 Gbps and 2 Gbps) and FICON (1 Gbps and 2 Gbps) MM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	2.125 Gbps	
Wavelength	850 nm	
Fiber type	MM, 50/125 µm, 62.5/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Receive sensitivity <= 1.06 Gbps)	-18 dBm	
Receive sensitivity (> 1.06 Gbps)	-15 dBm	
Stressed receive sensitivity (<= 1.06 Gbps)	-13.5 dBm	
Stressed receive sensitivity (> 1.06 Gbps)	-12.1 dBm	-12.1 dBm
Input wavelength	770 nm	860 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-9 dBm	-4 dBm
Output wavelength	830 nm	860 nm
Part number	**15500-XVRA-06B1**	
OC-12/STM-4 SM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	622 Mbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	

Table A-12 Fixed Rate SFP Optics Specifications (continued)

Description	Specification	
Receiver	**Minimum**	**Maximum**
Receive sensitivity	-28 dBm	
Receive overload		-7 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-15 dBm	-8 dBm
Output wavelength	1260 nm	1360 nm
Part number	**15500-XVRA-07B1**	
OC-48/STM-16 SM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	2.488 Mbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Receive sensitivity	-18 dBm	
Receive overload		-3 dBm
Input wavelength	1270 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-9.5 dBm	-3 dBm
Output wavelength	1285 nm	1340 nm

Table A-13 lists the specifications for the Cisco ONS 15540 ESP variable rate SFP optics.

Note Only use Cisco-certified SFP optics for the Type 2 extended range transponders.

Table A-13 Variable Rate SFP Optics Specifications

Description	Specification	
Part number	**15500-XVRA-10A1**	
Supported protocol encapsulations	Sysplex, Fast Ethernet, OC-3/STM-1, ESCON (MM)	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	8 to 200 Mbps	
Wavelength	1310 nm	
Fiber type	MM 50/125 µm MM 62.5/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Receive sensitivity @10^{-12} BER[1]	-32 dBm	
Receive sensitivity @10^{-15} BER	-29 dBm	
Receive overload @10^{-12} BER		-14 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-19 dBm	-14 dBm
Output wavelength	1280 nm	1380 nm
Part number	**15500-XVRA-10B1**	
Supported protocol encapsulations	Sysplex, Fast Ethernet, OC-3/STM-1, ESCON (SM)	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate range	8 Mbps to 200 Mbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	

Table A-13 Variable Rate SFP Optics Specifications (continued)

Description	Specification	
Receiver	**Minimum**	**Maximum**
Receive sensitivity @10^{-12} BER	-32 dBm	
Receive overload @10^{-12} BER		-3 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-8 dBm	-4 dBm
Output wavelength	1260 nm	1360 nm
Part number	**15500-XVRA-11A1**	
Supported protocol encapsulations	ESCON, OC-12/STM-4	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate range	200 Mbps to 622 Mbps	
Wavelength	1310 nm	
Fiber type	MM 62.5/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Receive sensitivity @10^{-10} BER	-26 dBm	
Receive sensitivity @10^{-12} BER	-25 dBm	
Maximum receive power @10^{-10} BER		-14
Input wavelength	1100 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-20 dBm	-14 dBm
Output wavelength	1270 nm	1380 nm

Table A-13 Variable Rate SFP Optics Specifications (continued)

Description	Specification	
Part number	**15500-XVRA-11B1**	
Supported protocol encapsulations	ESCON, SONET OC-12, SDH STM-4, FC, GE	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate range	200 Mbps to 1.25 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Receive sensitivity @10^{-12} BER	-20 dBm	
Maximum receive power @10^{-12} BER		-3 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-9 dBm	-3 dBm
Output wavelength	1285 nm	1345 nm
Part number	**15500-XVRA-12B1**	
Supported protocol encapsulations	Fibre Channel, FICON, GE, OC-48/STM-16	
Dimensions	0.486 x 0.522 x 2.24 in (1.23 x 1325.9 x 5.69 cm)	
Data rate range	1.062 Mbps to 2.488 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	
Receiver	**Minimum**	**Maximum**
Receive sensitivity @10^{-10} BER	-18 dBm	

Table A-13 Variable Rate SFP Optics Specifications (continued)

Description	Specification	
Maximum receive power @10^{-10} BER		-3 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	**Minimum**	**Maximum**
Transmitter power	-10 dBm	-3 dBm
Output wavelength	1266 nm	1360 nm

1. BER = bit error rate

Maintenance and Network Records

This appendix contains worksheets that you can use to record your hardware, configuration options, and network settings.

Chassis

Model number(s) of unit(s)	
Serial number(s) of unit(s)	
Installation site	
MAC address	

Line Card Motherboards and Transponder Modules

Chassis Slot/Subslot Number	Channel	Client or IP Address	Line Card Motherboard/Module Serial Numbers
2/0			
2/1			
2/2			
2/3			
3/0			
3/1			
3/2			
3/3			
4/0			
4/1			
4/2			
4/3			
5/0			
5/1			
5/2			
5/3			
8/0			
8/1			
8/2			
8/3			
9/0			
9/1			
9/2			
9/3			
10/0			
10/1			

Chassis Slot/Subslot Number	Channel	Client or IP Address	Line Card Motherboard/Module Serial Numbers
10/2			
10/3			
11/0			
11/1			
11/2			
11/3			

Mux/Demux Motherboard and Mux/Demux Modules

Chassis Slot/Subslot Number	Channel	Motherboard/Module Serial Numbers
0/0		
0/1		
0/2		
0/3		
1/0		
1/1		
1/2		
1/3		

Processor Cards

Chassis Slot Number	Serial Number

Network Details

Host name	
Domain name	
IP address	
IP netmask	
IP broadcast address	
Gateway/router address	
Domain name server address	
Modem telephone number	
PPP IP number	
IP number of PPP client	

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