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 \_\_\_\_\_ Network management \_\_\_\_\_ Other: \_\_\_\_\_
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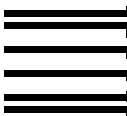
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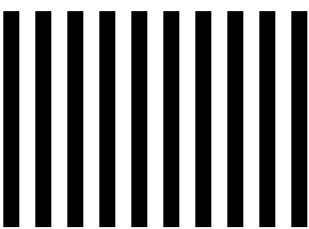
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## Preface

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This preface describes the audience, organization, and conventions of the *Cisco ONS 15540 ESPx Hardware Installation Guide*. It also provides information on 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 ESPx platform. As new hardware and Cisco IOS software releases are made available for the Cisco ONS 15540 ESPx platform, 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 ESPx.

## Audience

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

# New and Changed Information

This section lists the new and changed information for the *Cisco ONS 15540 ESPx Hardware Installation Guide* for Cisco IOS Release 12.2S and later.

Feature	Release	Description	Location
Variable rate SFP optics	12.1(12c)EV3	Two new SFP optics that support a wide range of data rates.	<a href="#">“Type 2 Extended Range Transponder Modules with SFP Optics”</a> section on page 1-22
Protection switch module (PSM)	12.1(12c)EV3	The main purpose of the protection switch module is to trigger trunk fiber protection after a trunk fiber has been cut.	<a href="#">“”</a> section on page 1-16 <a href="#">“Cabling PSMs”</a> section on page 3-10
Type 2 extended range transparent transponder module with selectable fixed rate SFP optics	12.1(10)EV	A transponder module that accepts selectable fixed-rate SFP optics supporting specific protocol rates.	<a href="#">“Type 2 Extended Range Transponder Modules with SFP Optics”</a> section on page 1-22 <a href="#">“Installing the Type 2 Extended Range Transponder Modules with SFP Optics”</a> section on page 2-25 <a href="#">“Removing SFP Optics from the Type 2 Extended Range Transponders Modules”</a> section on page 2-26

# Organization

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

Chapter	Title	Description
Chapter 1	<a href="#">Product Overview</a>	Describes the Cisco ONS 15540 ESPx chassis and its components
Chapter 2	<a href="#">Installing the Cisco ONS 15540 ESPx</a>	Describes how to install the Cisco ONS 15540 ESPx chassis and its components
Chapter 3	<a href="#">Connecting the Cisco ONS 15540 ESPx</a>	Describes how to install and route the cables in the Cisco ONS 15540 ESPx
Appendix A	<a href="#">Specifications</a>	Lists the specifications for the Cisco ONS 15540 ESPx chassis and components

# 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 ESPx:

- *[Regulatory Compliance and Safety Information for the Cisco ONS 15500 Series](#)*
- *[Cisco ONS 15540 ESPx Planning Guide](#)*
- *[Cisco ONS 15540 ESPx Optical Transport Turn-Up and Test Guide](#)*
- *[Cisco ONS 15540 ESPx Cleaning Procedures for Fiber Optic Connections](#)*
- *[Cisco ONS 15540 ESPx Configuration Guide](#)*
- *[Cisco ONS 15540 ESPx Command Reference](#)*
- *[Cisco ONS 15540 ESPx TL1 Command Reference](#)*
- *[Cisco ONS 15540 ESPx System Alarms and Error Messages](#)*
- *[Cisco ONS 15540 ESPx Troubleshooting Guide](#)*
- *[Network Management for the Cisco ONS 15540 ESPx](#)*
- *[MIB Quick Reference for the Cisco ONS 15500 Series](#)*

## Obtaining Documentation

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

## Cisco.com

You can access the most current Cisco documentation at this URL:

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

You can access the Cisco website at this URL:

<http://www.cisco.com>

You can access international Cisco websites at this URL:

[http://www.cisco.com/public/countries\\_languages.shtml](http://www.cisco.com/public/countries_languages.shtml)

## Documentation DVD

Cisco documentation and additional literature are available in a Documentation DVD package, which may have shipped with your product. The Documentation DVD is updated regularly and may be more current than printed documentation. The Documentation DVD package is available as a single unit.

Registered Cisco.com users (Cisco direct customers) can order a Cisco Documentation DVD (product number DOC-DOCDVD=) from the Ordering tool or Cisco Marketplace.

Cisco Ordering tool:

<http://www.cisco.com/en/US/partner/ordering/>

Cisco Marketplace:

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

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[http://www.cisco.com/univercd/cc/td/doc/es\\_inpk/pdi.htm](http://www.cisco.com/univercd/cc/td/doc/es_inpk/pdi.htm)

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<http://www.cisco.com/en/US/partner/ordering/>

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco Systems Corporate Headquarters (California, USA) at 408 526-7208 or, elsewhere in North America, by calling 1 800 553-NETS (6387).

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

We appreciate your comments.

## Cisco Product Security Overview

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[http://www.cisco.com/en/US/products/products\\_security\\_vulnerability\\_policy.html](http://www.cisco.com/en/US/products/products_security_vulnerability_policy.html)

From this site, you can perform these tasks:

- Report security vulnerabilities in Cisco products.
- Obtain assistance with security incidents that involve Cisco products.
- Register to receive security information from Cisco.

A current list of security advisories and notices for Cisco products is available at this URL:

<http://www.cisco.com/go/psirt>

If you prefer to see advisories and notices as they are updated in real time, you can access a Product Security Incident Response Team Really Simple Syndication (PSIRT RSS) feed from this URL:

[http://www.cisco.com/en/US/products/products\\_psirt\\_rss\\_feed.html](http://www.cisco.com/en/US/products/products_psirt_rss_feed.html)

## Reporting Security Problems in Cisco Products

Cisco is committed to delivering secure products. We test our products internally before we release them, and we strive to correct all vulnerabilities quickly. If you think that you might have identified a vulnerability in a Cisco product, contact PSIRT:

- Emergencies — [security-alert@cisco.com](mailto:security-alert@cisco.com)
- Nonemergencies — [psirt@cisco.com](mailto:psirt@cisco.com)



### Tip

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We encourage you to use Pretty Good Privacy (PGP) or a compatible product to encrypt any sensitive information that you send to Cisco. PSIRT can work from encrypted information that is compatible with PGP versions 2.x through 8.x.

Never use a revoked or an expired encryption key. The correct public key to use in your correspondence with PSIRT is the one that has the most recent creation date in this public key server list:

<http://pgp.mit.edu:11371/pks/lookup?search=psirt%40cisco.com&op=index&exact=on>

---

In an emergency, you can also reach PSIRT by telephone:

- 1 877 228-7302
- 1 408 525-6532

# Obtaining Technical Assistance

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, Cisco Technical Support provides 24-hour-a-day, award-winning technical assistance. The Cisco Technical Support Website on Cisco.com features extensive online support resources. In addition, Cisco Technical Assistance Center (TAC) engineers provide telephone support. If you do not hold a valid Cisco service contract, contact your reseller.

## Cisco Technical Support Website

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

<http://www.cisco.com/techsupport>

Access to all tools on the Cisco Technical Support Website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register at this URL:

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



### Note

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Use the Cisco Product Identification (CPI) tool to locate your product serial number before submitting a web or phone request for service. You can access the CPI tool from the Cisco Technical Support Website by clicking the **Tools & Resources** link under Documentation & Tools. Choose **Cisco Product Identification Tool** from the Alphabetical Index drop-down list, or click the **Cisco Product Identification Tool** link under Alerts & RMAs. The CPI tool offers three search options: by product ID or model name; by tree view; or for certain products, by copying and pasting **show** command output. Search results show an illustration of your product with the serial number label location highlighted. Locate the serial number label on your product and record the information before placing a service call.

---



## Submitting a Service Request

Using the online TAC Service Request Tool is the fastest way to open S3 and S4 service requests. (S3 and S4 service requests are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Service Request Tool provides recommended solutions. If your issue is not resolved using the recommended resources, your service request is assigned to a Cisco TAC engineer. The TAC Service Request Tool is located at this URL:

<http://www.cisco.com/techsupport/servicerequest>

For S1 or S2 service requests or if you do not have Internet access, contact the Cisco TAC by telephone. (S1 or S2 service requests are those in which your production network is down or severely degraded.) Cisco TAC engineers are assigned immediately to S1 and S2 service requests to help keep your business operations running smoothly.

To open a service request 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 list of Cisco TAC contacts, go to this URL:

<http://www.cisco.com/techsupport/contacts>

## Definitions of Service Request Severity

To ensure that all service requests are reported in a standard format, Cisco has established severity definitions.

**Severity 1 (S1)**—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.

**Severity 2 (S2)**—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.

Severity 3 (S3)—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.

Severity 4 (S4)—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. Visit Cisco Marketplace, the company store, at this URL:

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- *iQ Magazine* is the quarterly publication from Cisco Systems designed to help growing companies learn how they can use technology to increase revenue, streamline their business, and expand services. The publication identifies the challenges facing these companies and the technologies to help solve them, using real-world case studies and business strategies to help readers make sound technology investment decisions. You can access iQ Magazine at this URL:

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<http://www.cisco.com/ipj>

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# Product Overview

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The Cisco ONS 15540 ESPx is an optical transport platform that employs DWDM (dense wavelength division multiplexing) technology. With the Cisco ONS 15540 ESPx, users can take advantage of the availability of dark fiber to build a common infrastructure that supports data, SAN (storage area network), and TDM (time-division multiplexing) traffic. The system uses an enhanced chassis with front fiber-optic cable access for optical interconnections between transponders and optical mux/demux modules.

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

- [Cisco ONS 15540 ESPx Chassis, page 1-1](#)
- [Cisco ONS 15540 ESPx Components, page 1-7](#)



## Note

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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.

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## Cisco ONS 15540 ESPx Chassis

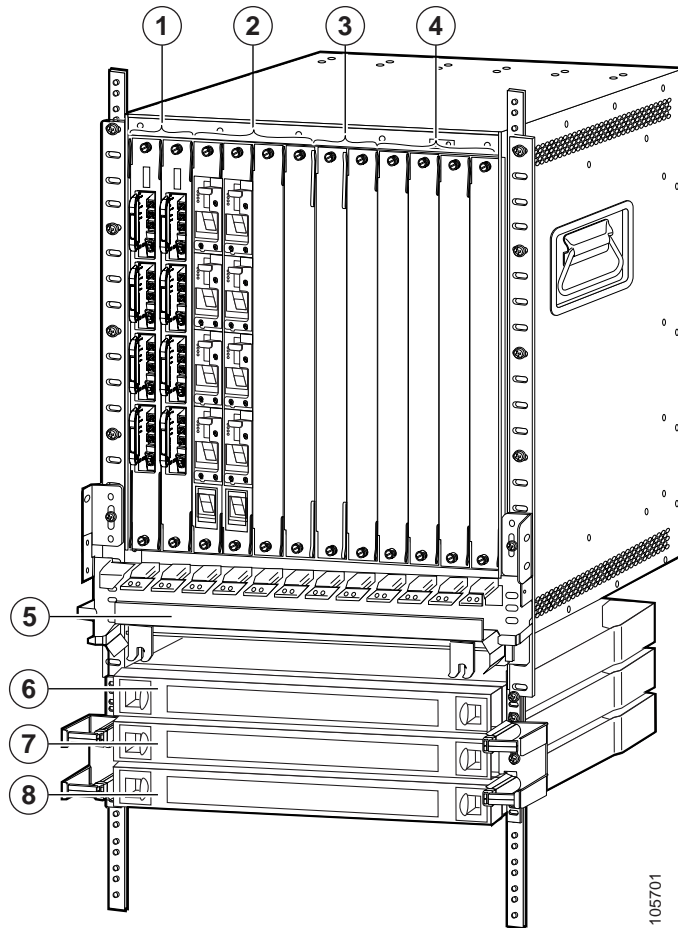
The Cisco ONS 15540 ESPx is a 12-slot modular vertical chassis. The system uses redundant -48 VDC inputs. [A redundant external AC-input power supply is available or DC-input power can be provided directly.](#) Slots 0 and 1 hold the optical mux/demux motherboards, which are populated with optical mux/demux modules. Slots 2 to 5 and 8 to 11 hold the 2.5-Gbps line card motherboards, which

are populated with 2.5-Gbps transponder modules, and 10-Gbps line card motherboards, which are populated with 10-GE transponder modules. Slots 6 to 7 hold the processor cards. (See [Figure 1-1](#).)

The air intake, fan assembly, cable management tray, cross connect drawers, and cable storage drawers are located beneath the modular slots. The system has an electrical backplane for system control.

[Figure 1-1](#) shows a populated Cisco ONS 15540 ESPx shelf with a cable storage drawer and two cross connect drawers.

Figure 1-1 Cisco ONS 15540 ESPx Populated Shelf



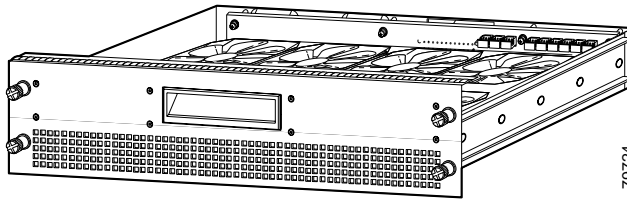
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1	Slots 0 and 1 hold the mux/demux motherboards	5	Cable management tray
2	Slots 2 to 5 hold line card motherboards	6	Cable storage drawer
3	Slots 6 and 7 hold the processor cards	7	Cross connect drawer
4	Slots 8 to 11 hold line card motherboards	8	Cross connect drawer

## Fan Assembly

The fan assembly is located at the bottom of the chassis and contains eight individual fans and a fan controller board. (See [Figure 1-2](#).) The controller board monitors the status of each fan and reports the status to the processor cards. 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.

*Figure 1-2 Fan Assembly*



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



### Note

Because the system does not know which fans have failed, all of 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.



## Power Supplies

The optional external power supply is a single-phase, AC-DC, 1050W, -48VDC 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.

See the [“Powering Up the Shelf” section on page 2-40](#) for more information about the power supplies.

## Backplane

The Cisco ONS 15540 ESPx uses an electrical backplane. The power connectors on the modules connect to the electrical backplane allowing line card motherboards to draw up to 100W of power. Optical connections between transponder modules on the client side and the mux/demux modules on the trunk side are made in the front.

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 through connectors on the backplane.

## 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 ESPx.

**Table 1-1 Alarm Card Specifications**

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

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

- [Processor Cards](#), page 1-7
- [Mux/Demux Motherboards and Mux/Demux Modules](#), page 1-14
- [PSMs](#), page 1-17
- [Line Card Motherboards](#), page 1-19
- [Transponder Modules](#), page 1-21
- [Cable Management Tray](#), page 1-29
- [Cross Connect Drawers](#), page 1-30
- [Cable Storage Drawer](#), page 1-30
- [Blank Panels](#), page 1-31

**Note**

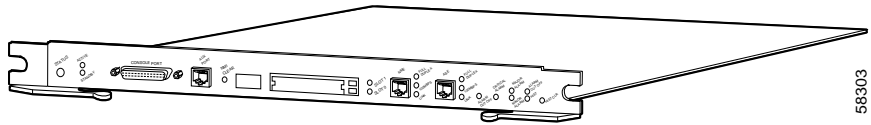
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To ensure that your hardware is supported by your release of Cisco IOS software, see the “[New and Changed Information](#)” section on [page xii](#). Also refer to the “[Hardware Supported](#)” section of the latest release notes for the Cisco ONS 15540 ESPx.

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## Processor Cards

Slots 6 and 7 of the Cisco ONS 15540 ESPx 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 1-3](#).) During a fan failure or an out-of-temperature range condition, the processor card activates an alarm. See [Table 2-2 on page 2-35](#) for fan assembly status.

**Figure 1-3 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 1-2](#) lists the LEDs on the processor card faceplate, their default conditions, and what the conditions indicate.

**Table 1-2 Processor Card LEDs**

LED	Status	Description
STATUS	Red	A board resets or initially powers 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 <sup>1</sup>		
FULL DUPLEX	Green	Full duplex is running.
	Off	Half duplex is running.
100MBPS	Green	Operating at 100 Mbps.
	Off	Operating at 10 Mbps.
LINK	Green	Link is up.
	Off	Link is down.

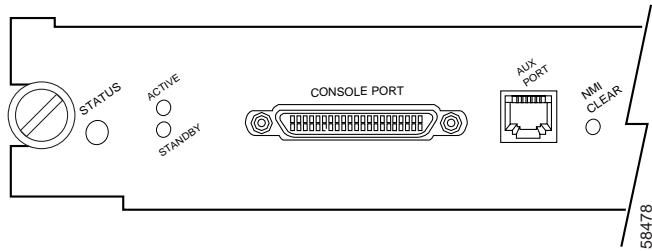
Table 1-2 Processor Card LEDs (continued)

LED	Status	Description
ASE <sup>2</sup>		
FULL DUPLEX	Green	Full duplex is running.
	Off	Half duplex is running.
100MBPS	Green	Operating at 100Mbps.
	Off	Operating at 10Mbps.
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 CUT OFF	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 <a href="#">Table 1-5</a> .
HIST	Yellow	A major or minor alarm occurred. Clears if the History Clear button is pushed and no alarm exists. See <a href="#">Table 1-5</a> .

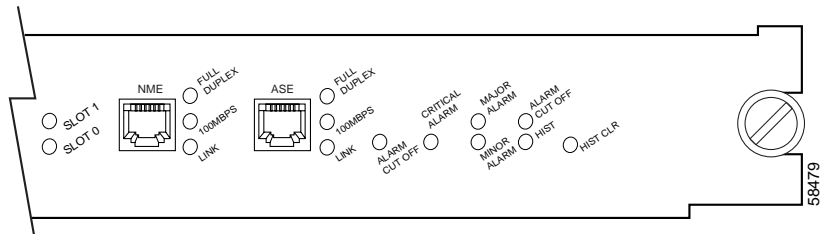
1. NME = network management Ethernet
2. ASE = aggregation shelf Ethernet

Figure 1-4 and Figure 1-5 show the processor card LEDs.

**Figure 1-4 Processor Card LEDs (Left Side)**



**Figure 1-5 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 1-3 lists the console port pinouts.

**Table 1-3 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
19	N/A	rsvd (y cable)	N/A
20	Input	DTR	N/A

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 the auxiliary port using the proper coupler. See [Table 1-4](#) for the auxiliary port pinouts on the processor card.

**Table 1-4 Auxiliary Port Pinouts for the Cisco ONS 15540 ESPx**

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

**Table 1-4 Auxiliary Port Pinouts for the Cisco ONS 15540 ESPx**

Pin Number	Direction	Circuit	Function
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 1-5](#).) These signals generate visual and audible alarm signals to the backplane, where they are connected to two DB-9 connectors that can be connected to a central telco alarm panel. 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 1-5](#).)

**Table 1-5 Alarm Cutoff and History Clear Buttons**

LED	Location	Description
ALARM CUT OFF	Recessed push-button switch	When pushed, software turns off all external alarm relay control bits until the next new alarm condition.
HISTORY CLR	Recessed push-button switch	When pushed, software turns 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 1-6](#) lists the Flash PC Card slot LEDs on the processor faceplate and what the conditions indicate.

**Table 1-6 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 (nonmaskable 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 ESPx. This Ethernet port is a management port only and cannot be configured as a routing port.

[Table 1-7](#) 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 1-7 NME LEDs**

LED	Status	Description
FULL DUPLEX	Green	Interface is operating in full duplex mode.
100MBPS	Green	Interface is operating at 100Mbps.
LINK	Green	NME interface is receiving the link integrity signal.

## Mux/Demux Motherboards and Mux/Demux Modules

The optical mux/demux motherboards occupy slots 0 and 1 of the Cisco ONS 15540 ESPx chassis. The chassis uses one optical mux/demux motherboard for unprotected operation or two per system for protected operation. The chassis supports the following mux/demux motherboards:

- Cisco ONS 15540 ESPx mux/demux motherboard with OSC
- Cisco ONS 15540 ESPx mux/demux motherboard without OSC

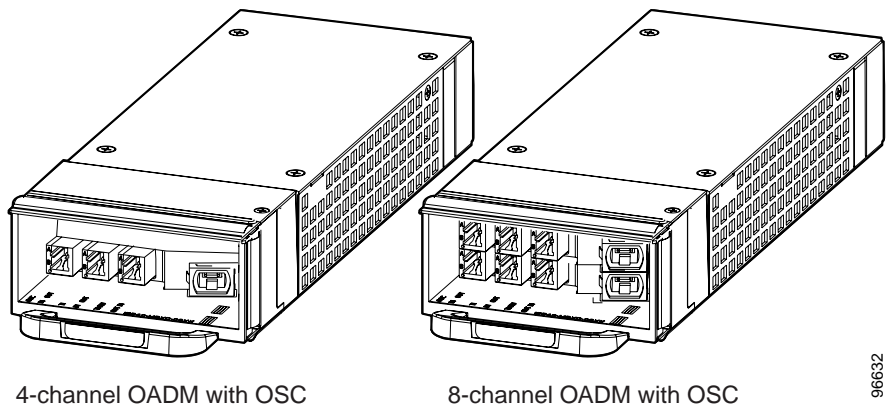
Each Cisco ONS 15540 ESPx mux/demux motherboard can accept up to four 4-channel or 8-channel mux/demux modules or one 32-channel mux/demux module. The modular mux/demux motherboards are available with or without OSC (optical supervisory channel) and can be populated according to user needs.

There are three types of mux/demux modules available:

- 4 channels
- 8 channels
- 32 channels

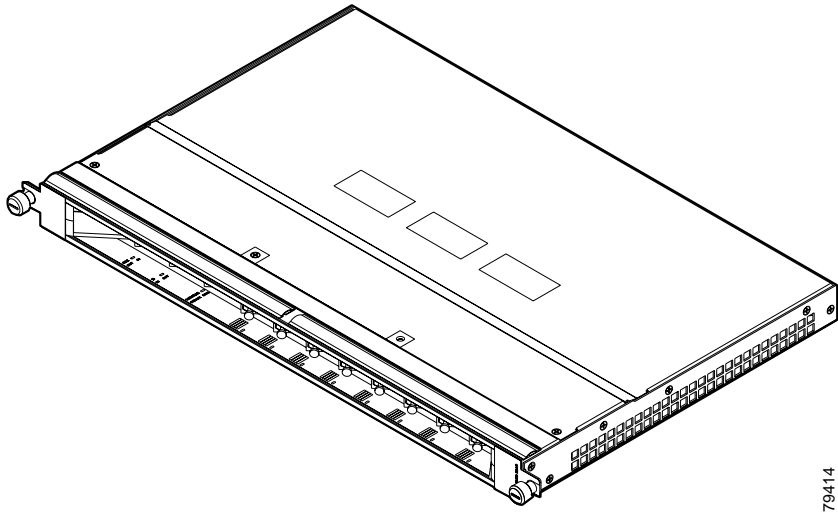
Up to four 4-channel or 8-channel optical add/drop mux/demux modules can be installed in a mux/demux motherboard. Each module can multiplex and demultiplex a band of 4 or 8 channels, for a maximum of 32 channels. Channels not filtered are passed on to the next mux/demux module. (See [Figure 1-6](#).)

**Figure 1-6 4- and 8-Channel OADM Modules with OSC**



One 32-channel terminal mux/demux module can be installed in slot 0 or 1 of the Cisco ONS 15540 ESPx chassis. The 32-channel terminal mux/demux module is equipped with OSC, input/output, and monitoring ports that use MU connectors. The remaining 8 ports that connect to the transponder modules use MTP connectors. The OSC is a dedicated, full duplex communication ITU-T DWDM channel for in-band management traffic. The input/output ports are trunk connections used to connect to the external fiber trunks. Monitoring ports use a one percent tap coupler (20 dB) for both the mux and demux sides and also allow you to non-obtrusively connect an OSA (optical spectrum analyzer) to monitor the incoming or outgoing DWDM signals. (See [Figure 1-7](#).)

Figure 1-7 32-Channel Terminal Mux/Demux Module



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## Mux/Demux Motherboard LEDs

Table 1-8 lists the LEDs on the mux/demux motherboard with OSC faceplate, their default conditions, and what the conditions indicate.



### Note

Mux/demux motherboards without OSC have no LEDs.

Table 1-8 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.

**Table 1-8 Mux/Demux Motherboard with OSC LEDs (continued)**

LED	Status	Description
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 received.
	Off	OSC is not present and the optical data stream is not received.

1	Channel 1 IN OUT ports	5	Channel 3 IN OUT ports
2	Channel 1 LED	6	Channel 3 LED
3	Channel 2 IN OUT ports	7	Channel 4 IN OUT ports
4	Channel 2 LED	8	Channel 4 LED

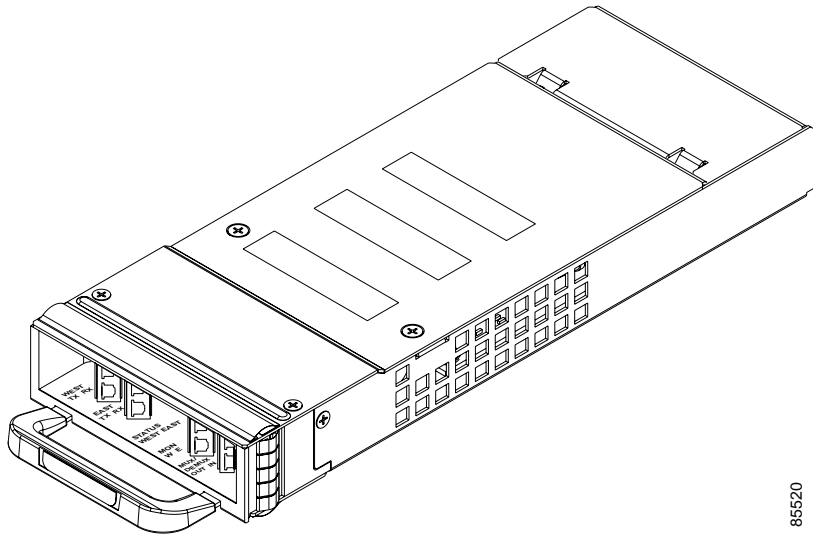
## PSMs

The PSM (protection switch module) provides trunk fiber protection for Cisco ONS 15540 ESPx systems configured in point-to-point topologies. The PSM sends the DWDM signal from the mux/demux modules to both the west and east directions. It receives both the west and east signals and sends one to the mux/demux module. When a trunk fiber cut occurs on the active path, the PSM switches the received signal to the standby path. The PSM can protect up to 32 data channels and the OSC.

The PSM also has an optical monitor port for testing the west and east receive signals. This port samples 10 percent of these signals, which can be monitored with an optical power meter.

One PSM can be installed in any slot of a mux/demux motherboard on the Cisco ONS 15540 ESPx chassis.

The PSM has the same dimensions as the OADM channels used in the Cisco ONS 15540 ESPx. The front panel has four dual MU connectors, and the module internally consists of two boards interconnected through a board-to-board right angle connector. One board (called the generic optics module) contains the optics and sensitive analog circuitry, and the other board contains the logic and system interface board. (See [Figure 1-8](#).)

**Figure 1-8 Protection Switch Module**

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## PSM LEDs

Table 1-9 lists the LEDs on the PSM, their default conditions, and what the conditions indicate

**Table 1-9 PSM LEDs**

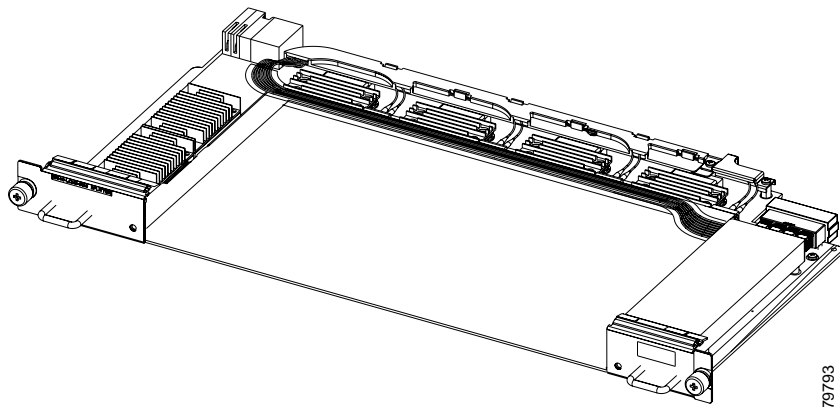
LED	Status	Description
STATUS	Solid green	Software initialization is successful.
	Off	Board failure.

## Line Card Motherboards

The Cisco ONS 15540 ESPx supports 2.5-Gbps line card motherboards and 10-Gbps line card motherboards. You can install up to eight hot-swappable line card motherboards in slots 2 to 5 and 8 to 11 of the chassis.

Each 2.5-Gbps line card motherboard can hold four 2.5-Gbps transponder modules. All modules are hot-pluggable, allowing in-service upgrades and replacement. [Figure 1-9](#) shows the 2.5-Gbps line card motherboard without inserts installed.

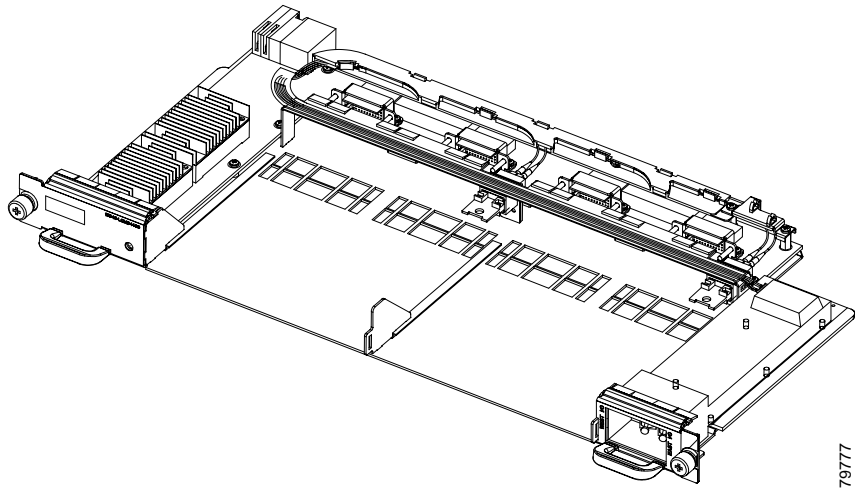
**Figure 1-9** 2.5-Gbps Line Card Motherboard



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The 10-Gbps line card motherboard holds two 10-GE transponder modules. (See [Figure 1-10](#).)

**Figure 1-10 10-Gbps Line Card Motherboard**



## Line Card Motherboard LEDs

[Table 1-10](#) lists the LEDs on the 2.5-Gbps line card motherboard faceplate, their default conditions, and what the conditions indicate.

**Table 1-10 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.



Table 1-11 lists the LEDs for the 10-Gbps line card motherboard.

**Table 1-11 10-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.

## Transponder Modules

In the transponder module, the client signal is converted to an ITU-compliant wavelength, which is cross-connected 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 ESPx supports four types of interface transponder modules:

- SM (single-mode) transponder modules
- MM (multimode) transponder modules
- Type 2 extended range transponder modules with SFP optics
- 10-GE transponder modules

## 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.

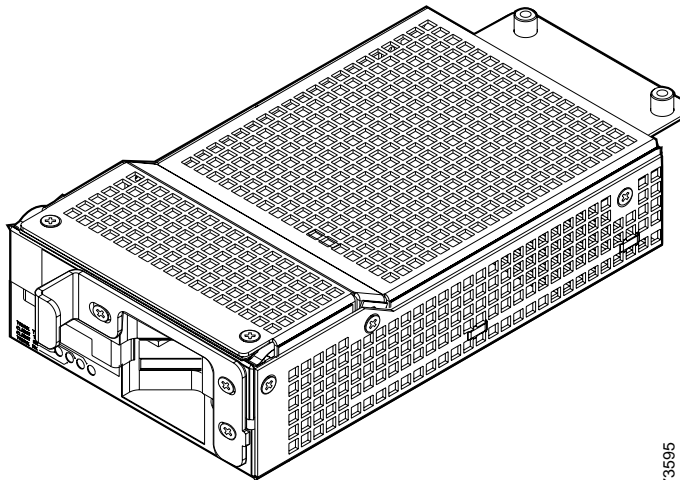
## MM Transponder Modules

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 with selectable SFP optics support different protocol rates. (See [Figure 1-11](#).)

*Figure 1-11 Type 2 Extended Range Transponder Module*



Fixed rate SFP optics modules support specific protocols. [Table 1-12](#) 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 1-12 Fixed Rate SFP Optics Features**

Model Number	Supported Protocols	Fiber Type	Wavelength	Connector Type
15500-XVRA-01A2	ESCON, OC-3/ STM-1 SR	MM 50/125 $\mu$ m MM 62.5/125 $\mu$ m	1310 nm	MT-RJ
15500-XVRA-02C1	Gigabit Ethernet <sup>1</sup> , Fibre Channel (1 Gbps) <sup>2</sup> , ISC-1 (1-Gbps)	MM 50/125 $\mu$ m MM 62.5/125 $\mu$ m	850 nm	LC
15500-XVRA-02C2	Fibre Channel (2 Gbps) <sup>3</sup> , ISC-3 (1-Gbps and 2-Gbps)	MM 50/125 $\mu$ m MM 62.5/125 $\mu$ m	850 nm	LC
15500-XVRA-03B1	Gigabit Ethernet <sup>4</sup> , Fibre Channel (1 Gbps) <sup>5</sup> , ISC-3 (2-Gbps)	SM 9/125 $\mu$ m	1310 nm	LC
15500-XVRA-03B2	Fibre Channel (2 Gbps)	SM 9/125 $\mu$ m	1310 nm	LC
15500-XVRA-06B1	OC-12/STM-4 SR <sup>6</sup>	SM 9/125 $\mu$ m	1310 nm	LC
15500-XVRA-07B1	OC-48/STM-16 SR	SM 9/125 $\mu$ m	1310 nm	LC

- 1000BASE-SX
- FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards
- FC-0-200-M5-SN-S and FC-0-200-M6-SN-S standards
- 1000BASE-LX
- FC-0-100-SM-LC-S standard
- SR = short range

Variable rate SFP optics modules support a range of clock rates. [Table 1-13](#) list the characteristics for the variable rate SFP optics supported by the Type 2 extended range transponder.

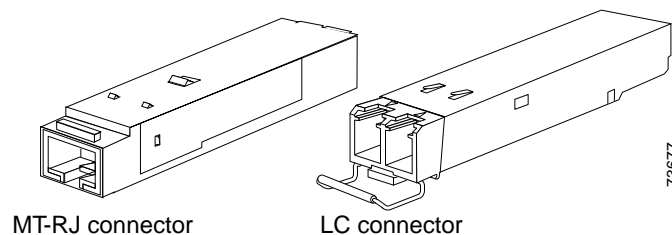
**Table 1-13 Variable Rate SFP Optics Features**

Model Number	Clock Rate Range	Fiber Type	Wavelength	Connector Type
15500-XVRA-10A1	Low-band 8 Mbps to 200 Mbps	MM 50/125 $\mu\text{m}$ MM 62.5/125 $\mu\text{m}$	1310 nm	LC
15500-XVRA-10B1	Low-band 8 Mbps to 200 Mbps	SM 9/125 $\mu\text{m}$	1310 nm	LC
15500-XVRA-11A1	Mid-band 200 Mbps to 622 Mbps	MM 62.5/125 $\mu\text{m}$	1310 nm	LC
15500-XVRA-11B1	Mid-band 200 Mbps to 1.25 Gbps, ISC-1	SM 9/125 $\mu\text{m}$	1310 nm	LC
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps, ISC-1, ISC-3	SM 9/125 $\mu\text{m}$	1310 nm	LC

Figure 1-12 shows the two types of SFP optics that the Type 2 extended range transponders support. The figure may not match your SFP exactly but it should be a close variation of the SFP.

**Note**

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

**Figure 1-12 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 2-25.

## Transponder Module LEDs

Table 1-14 lists the LEDs on the transponder module faceplate, their default conditions, and what the conditions indicate. (See Figure 1-13.)

**Table 1-14 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 1-13 SM and MM Transponder Module LEDs**

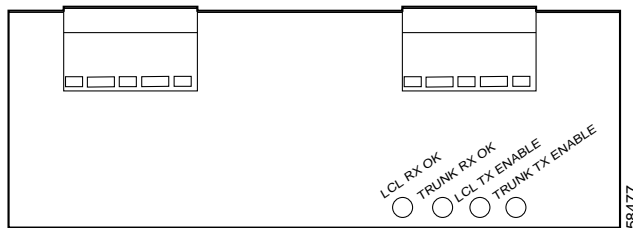
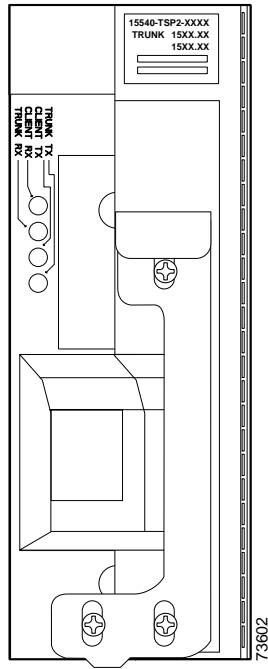


Table 1-15 lists the LEDs for the Type 2 extended range transponder module. Figure 1-14 shows the LEDs.

**Table 1-15 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 1-14 Type 2 Extended Range Transponder Module LEDs*

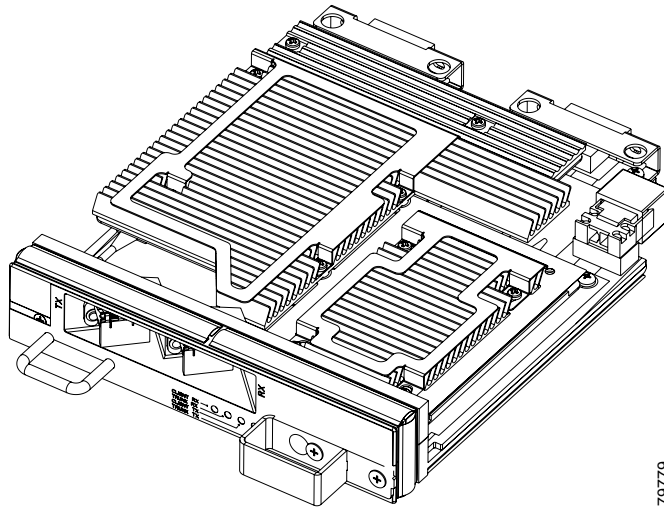


## 10-GE Transponder Module

The 10-GE transponder module is double the size of the 2.5-Gbps transponder module and requires a special 10-Gbps line card motherboard. You can install up to two 10-GE transponder modules in a 10-Gbps line card motherboard. Each transponder supports one client side and one trunk side interface. The client side is a short-reach 1310-nm interface and the trunk side interface is an ITU grid compliant 15xx-nm long-reach interface. The transmitter supports a 1260-nm to 1355-nm wavelength range. The 10-GE transponder module is available in 32 versions, one for each of the 32 ITU channels it supports.

The 10-GE transponder module is not protocol independent; it supports the 802.ae specification for 10GBASE-LR interfaces. (See [Figure 1-15](#).)

**Figure 1-15 10-GE Transponder Module**

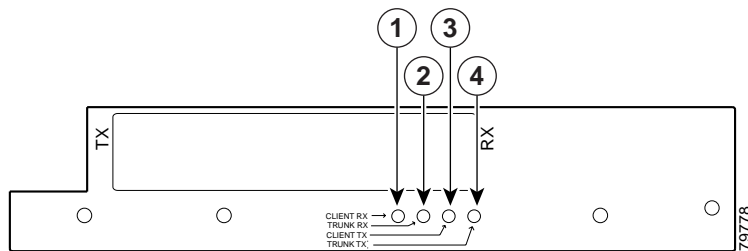


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## 10-GE Transponder Module LEDs

Figure 1-16 shows the LEDs on the 10-GE transponder module.

**Figure 1-16 10-GE Transponder Module LEDs**



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1	CLIENT RX LED	3	CLIENT TX LED
2	TRUNK RX LED	4	TRUNK TX LED

Table 1-16 lists the LEDs on the 10-GE transponder module faceplate and what the conditions indicate.

**Table 1-16 10-GE Transponder Module LEDs**

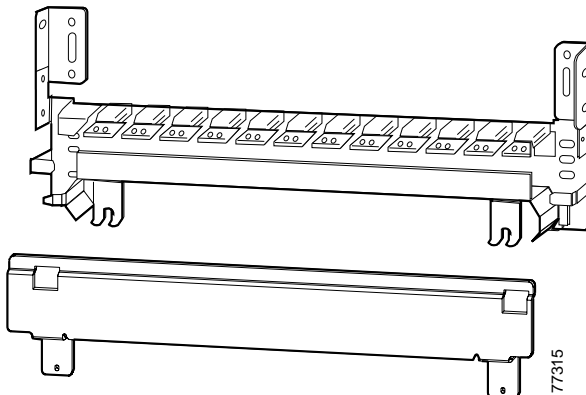
LED	Status	Description
CLIENT RX	Off	No frame lock on the PCS 64B66B decoder.
	Green	Frame lock = '1' on PCS 64B66B decoder.
TRUNK RX	Off	No frame lock on the PCS 64B66B decoder.
	Green	Frame lock = '1' on PCS 64B66B decoder.
CLIENT TX	On	Laser is transmitting optical signal.
	Off	Laser is shut and is not transmitting any optical signal.
TRUNK TX	On	Laser is transmitting optical signal.
	Off	Laser is shut and is not transmitting any optical signal.



## Cable Management Tray

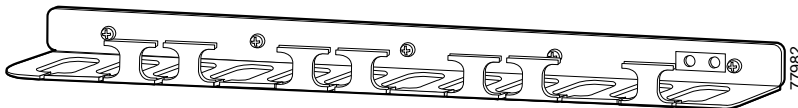
The cable management tray is a fiber optic cable management guide that is installed over the fan assembly after you rack-mount the chassis. (See [Figure 1-17](#).) The tray attaches to the rack but flips up if the fan assembly should need replacement. Cables are guided through the clips of the cable fanning tray and into and through the inside of the tray to their destination. The cable management tray ships with a cover that can be removed when you are cabling the Cisco ONS ESPx. For installation information for the cable management tray, see the “[Mounting the Chassis](#)” section on page 2-3.

**Figure 1-17 Cisco ONS 15540 ESPx Cable Management Tray and Cover**



Another cable management guide is available for the processor card cables and is installed on the upper part of the chassis above the line card slots. (See [Figure 1-18](#).)

**Figure 1-18 Top Cable Management Guide**



## Cross Connect Drawers

The cross connect drawers provide extra flexibility when provisioning channels. The cross connect drawer is a separate unit supporting 8 channels for a total of two channel bands in a protected system. The system is expandable in channels of 8. To cross connect 16 channels, use two cross connect drawers. To cross connect 32 channels, use four cross connect drawers with two cable storage drawers. See [Figure 1-1](#).

[Table 1-17](#) lists the equipment you need if you are using the cross connect drawer in a protected system using line card motherboards with splitter. [Table 1-18](#) lists the equipment needed if you are using the drawer system in an unprotected system using line card motherboards without splitter.

**Table 1-17** *Equipment Needed for a Protected System*

No. of Channels	No. of Cable Storage Drawers	No. of Cross Connect Drawers
1 to 8	1	1
9 to 16	1	2
17 to 24	2	3
25 to 32	2	4

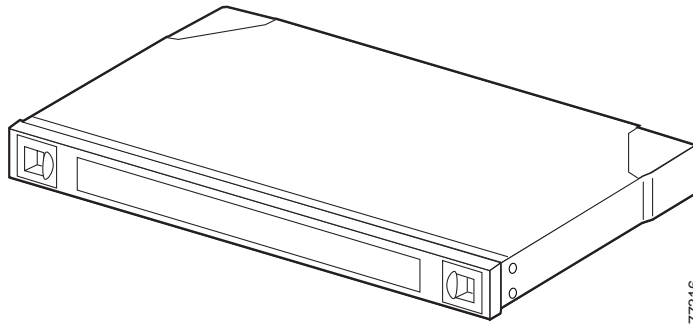
**Table 1-18** *Equipment Needed for an Unprotected System*

No. of Channels	No. of Cable Storage Drawers	No. of Cross Connect Drawers
1 to 16	1	1
17 to 32	1	2

## Cable Storage Drawer

The cable storage drawer should be installed immediately beneath the chassis. (See [Figure 1-19](#).) Cables connect the MTP connectors on the motherboards are routed in, through, and out the other side of the cable storage drawer.

*Figure 1-19 Cisco ONS 15540 ESPx Cable Storage Drawer*



More than one cable storage drawer may be required depending on your configuration needs.

## Blank Panels

You can install blank panels in any of the 12 slots of the Cisco ONS 15540 ESPx 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 complement of transponder modules)





# Installing the Cisco ONS 15540 ESPx

---

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

- [Before Installing, page 2-2](#)
- [Rack-Mounting the Chassis, page 2-4](#)
- [Installing the Chassis, page 2-6](#)
- [Installing the Drawers, page 2-10](#)
- [Installing the Adapters in the Cross Connect Panels, page 2-12](#)
- [Installing the Vertical Cable Guides, page 2-16](#)
- [Grounding the Chassis, page 2-18](#)
- [Installing and Removing Motherboards and Processor Cards, page 2-21](#)
- [Installing and Removing Modules, page 2-23](#)
- [Installing and Removing the Fan Assembly, page 2-35](#)
- [Powering Up the Shelf, page 2-40](#)
- [Using Y-Cable, page 2-61](#)



## 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 ESPx.

---

**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 chassis, you must complete the following tasks:

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

**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 or dust covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

---

## Unpacking and Inspecting the Cisco ONS 15540 ESPx

The Cisco ONS 15540 ESPx ships with 19-inch mounting brackets. The chassis 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

Keep a record of all of your hardware, configuration options, and network settings.

---

## Mounting the Chassis

The unit is designed for mounting in a 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.

# Rack-Mounting the Chassis

You can install the Cisco ONS 15540 ESPx 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**

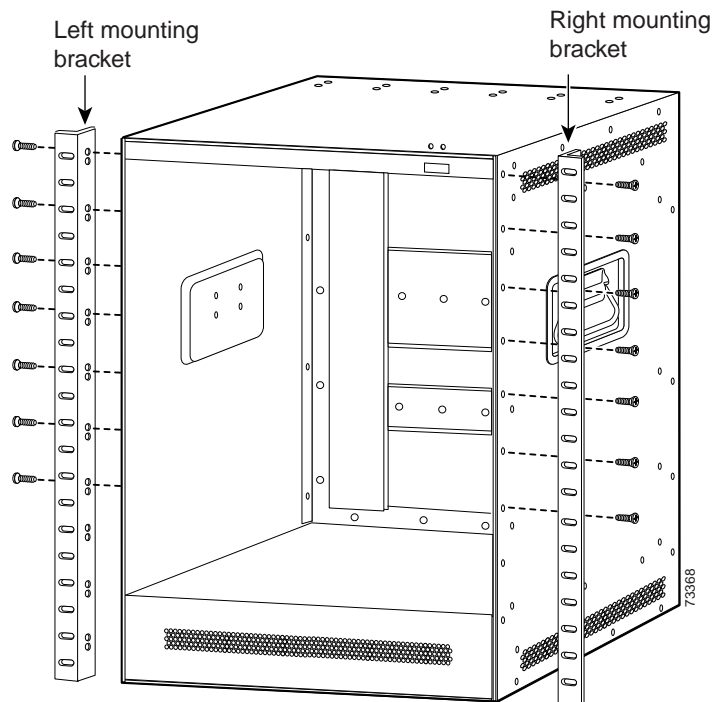
Rack	L Bracket Part Number
19-inch	700-15196-01
21-inch	700-15176-01
23-inch	700-18074-01



To rack-mount the chassis, 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 number 12-24 screws provided in the rack-mount kit. (See [Figure 2-1](#).) Use seven screws on each L bracket on the sides of the chassis. Start with the first screw at the top of the chassis and use a screw every 2 RU to equally space the screws out and safely secure the chassis in the rack.

**Figure 2-1 Attaching L Brackets**



# Installing the Chassis

**Warning**

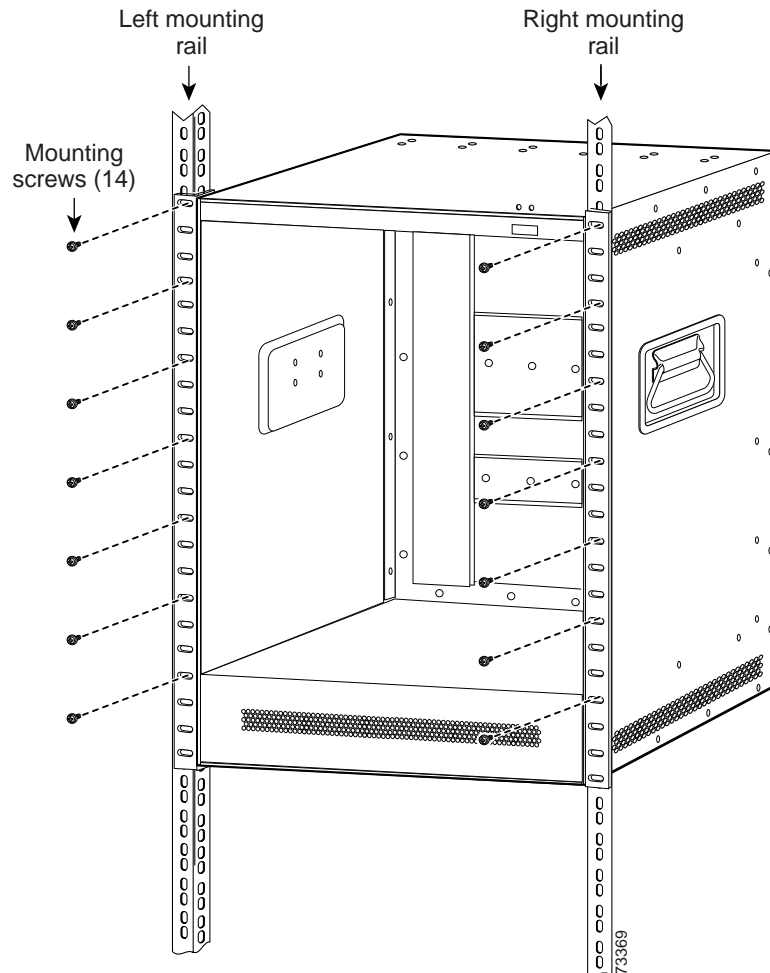
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**Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

---

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 on the handles. With one person at each side of the chassis, use the handles on the chassis to slowly lift the chassis in unison.
  - Step 2** Position the chassis in the rack.
  - Step 3** Align the mounting holes in the L bracket with the mounting holes in the equipment rack. (See [Figure 2-2](#).)

**Figure 2-2** *Installing the Chassis in the Rack*

- Step 4** Use the number 12-24 screws shipped with the chassis to mount the chassis in the rack. (See [Figure 2-2](#).) Use seven screws on each L bracket on the sides of the chassis. Start with the first screw at the top of the chassis and use a screw every 2 RU to equally space the screws out and safely secure the chassis in the rack.
- Step 5** Place the cable management tray over the fan assembly, ensuring that the tray is just under the chassis slots.

- Step 6** Secure the cable management tray to the rack with four number 12-24 screws, two on each side. To ensure correct placement of the tray, install the second of the two screws in the sixth slot from the bottom of the chassis rack up on each side of the cable management tray. (See [Figure 2-3](#).)



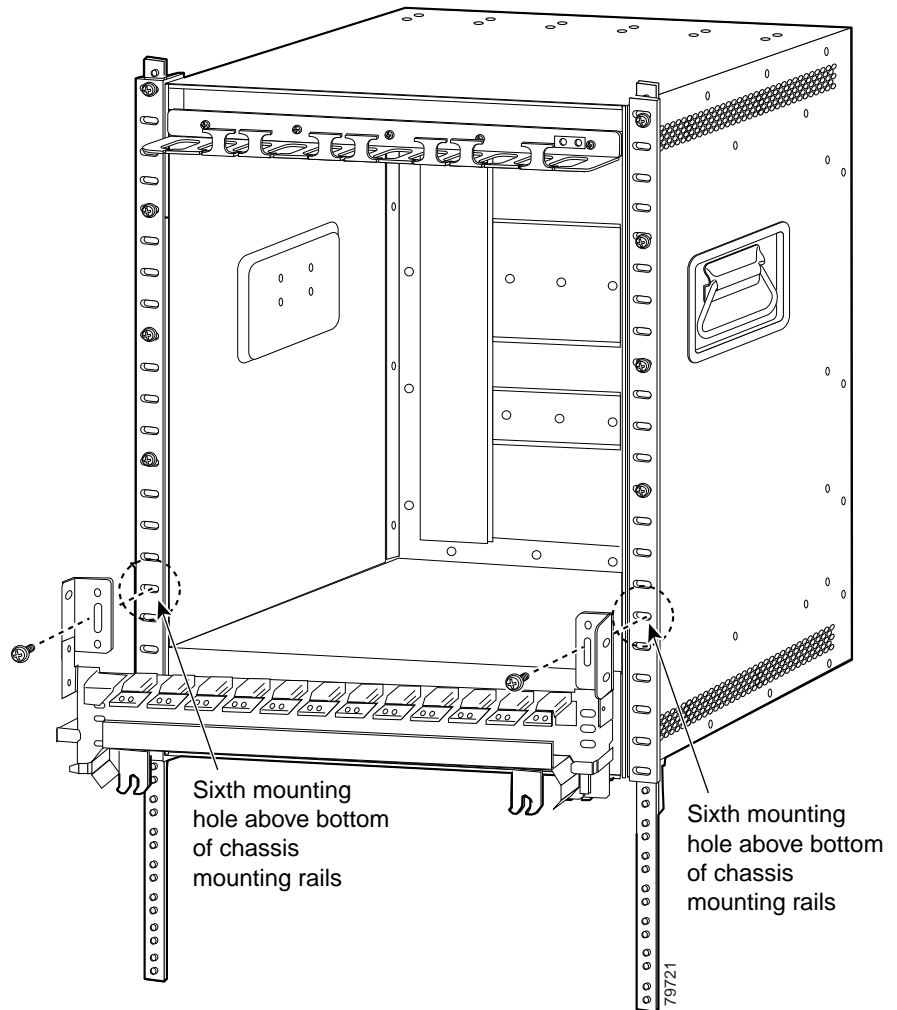
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**Note** Test the cable management tray placement before cabling up the system.

---

- Step 7** Attach the top cable management guide to the chassis just above the slots using the number 12-24 screws. Make sure the grounding holes are visible through the top cable management guide.

Figure 2-3 Installing the Cable Management Tray



# Installing the Drawers

The process for installing the cable storage and cross connect drawers is the same. The order of placement beneath the chassis is important and should be installed in the following order from top to bottom:

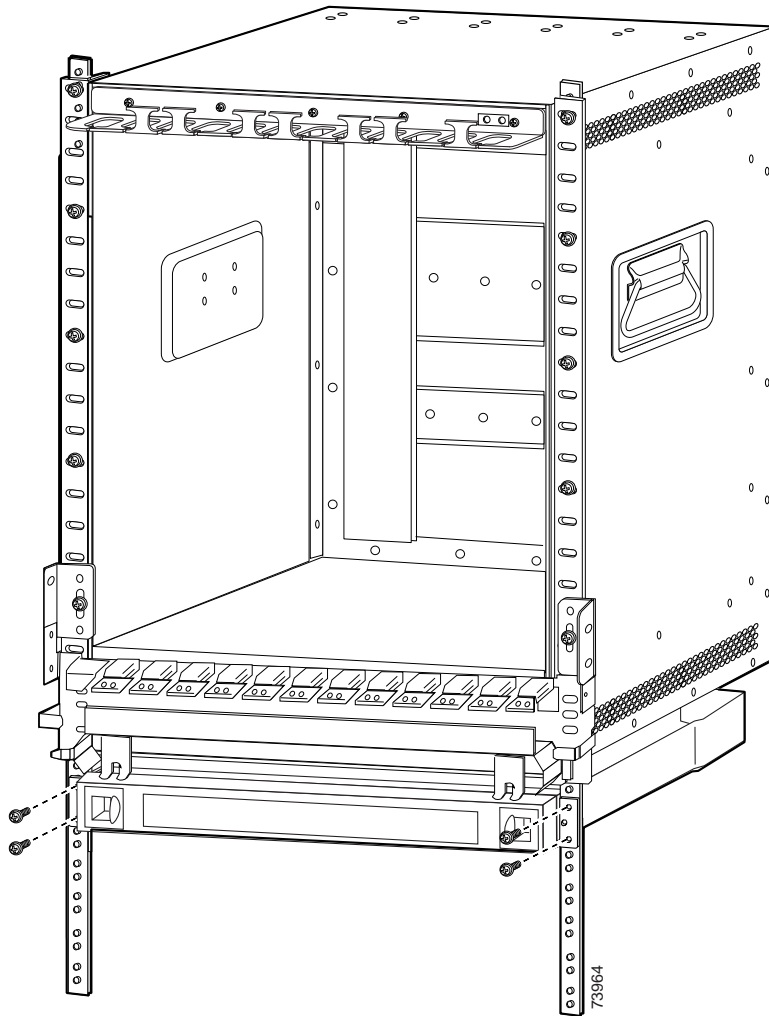
1. Cable storage drawer
2. Cross connect drawer
3. Cross connect drawer
4. Cable storage drawer
5. Cross connect drawer
6. Cross connect drawer

The first cable storage drawer can be used for direct connections and storage for connections made using the first and second cross connect drawers. Each cable storage drawer stores cables for two cross connect drawers.

The cross connect and cable storage drawers ship with the rack mount ears already installed. To install the cross connect and cable storage drawers into the rack, follow these steps:

- 
- Step 1** Hold the drawer with both hands and position the drawer in the rack beneath the chassis. (See [Figure 2-4.](#)) All drawers following this first one can be stacked directly underneath each other.

**Figure 2-4** *Installing the Cable Storage Drawer in the Rack*

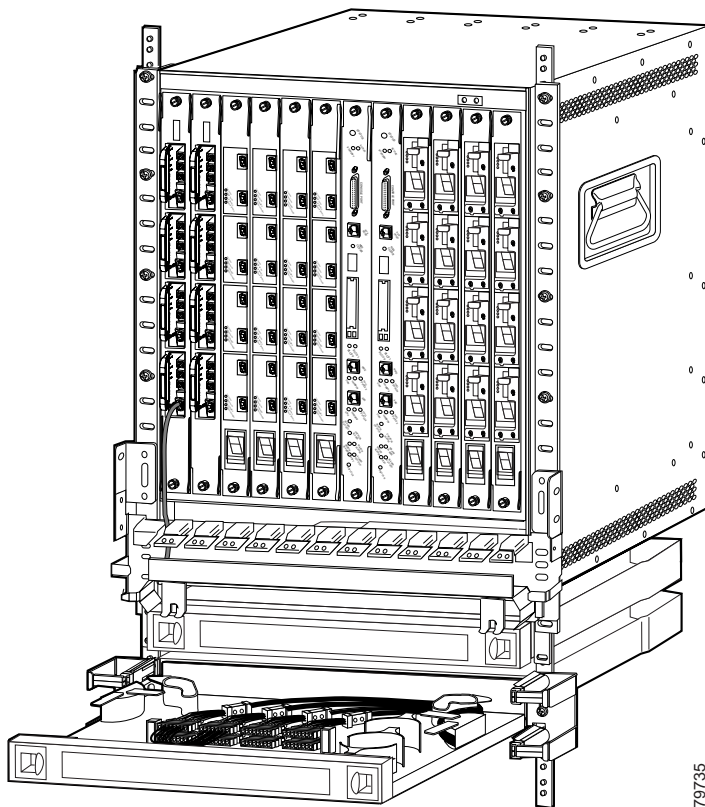


- Step 2** Align the mounting holes on the bracket with the mounting holes in the equipment rack.
- Step 3** Install the 12-24 or 10-32 screws through the elongated holes in the brackets and into the threaded holes in the mounting post. Repeat this step for the other side.

# Installing the Adapters in the Cross Connect Panels

Your cross connect drawers ship bare and require installation of the adapters into your cross connect panels. (See [Figure 2-5](#).) These adapters are required for cross connecting cables for your system.

*Figure 2-5 Pulling out the Cross Connect Drawer*



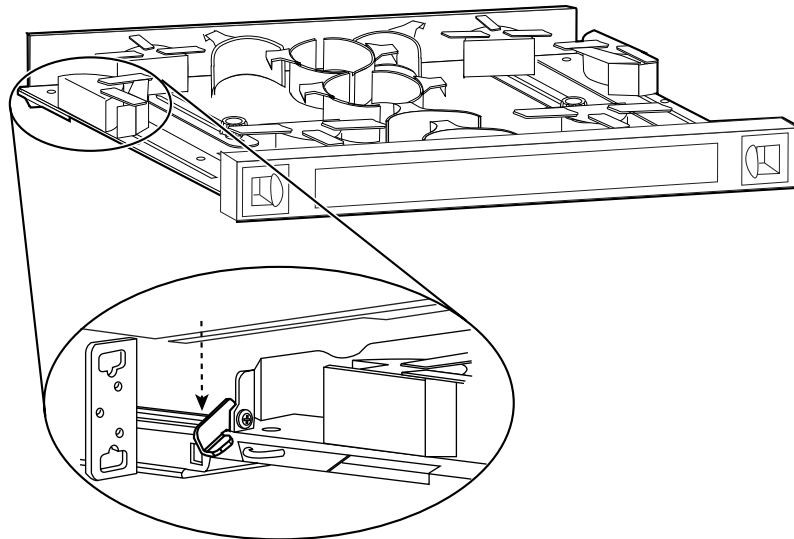
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To install adapters into the cross connect panels, follow these steps:

- 
- Step 1** Open the cross connect drawer.
- Step 2** Lock the drawer in the open position by pushing the lever at the back left of the drawer down in the lock position. (See [Figure 2-6](#).)

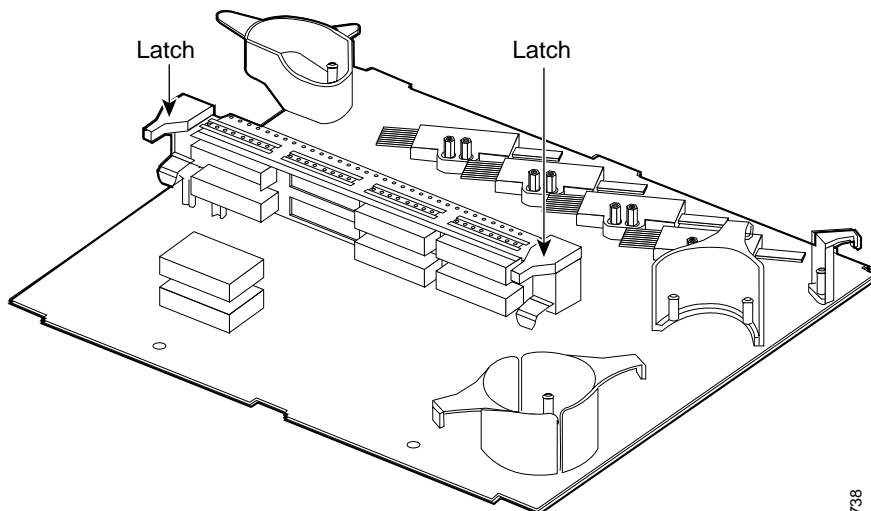
**Figure 2-6** Locking the Drawer



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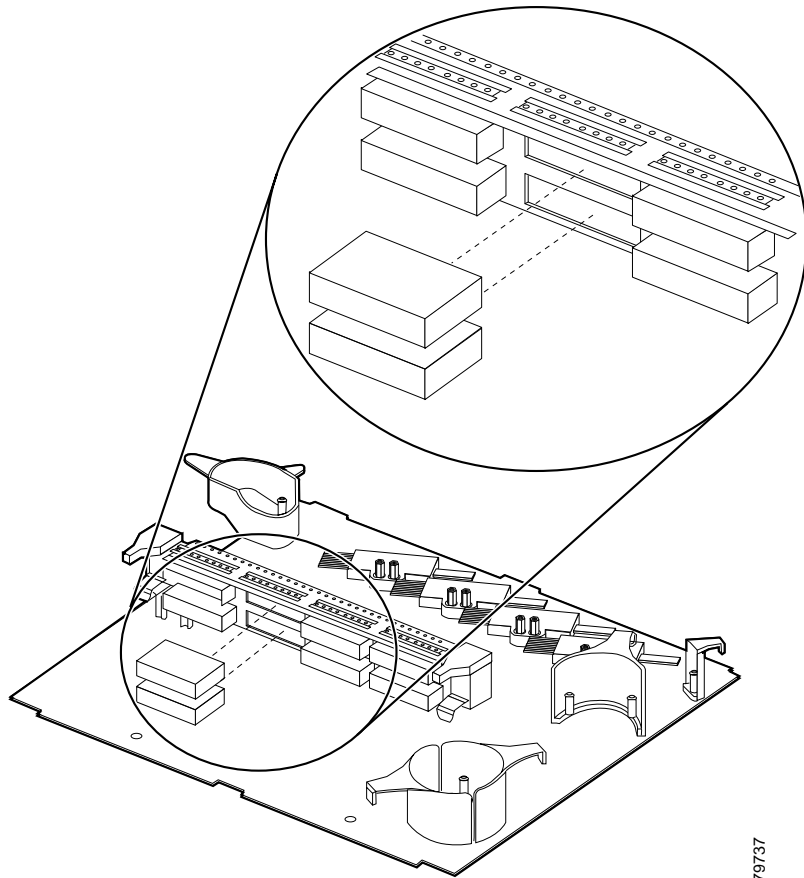
- Step 3** Pull the cross connect panel up by flipping the latches up and using them to pull the panel up simultaneously. (See [Figure 2-7](#).)

**Figure 2-7** Pulling up the Cross Connect Panel



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- Step 4** Remove the adapter from its packaging.
- Step 5** Insert the adapter into the panel from the front as shown in [Figure 2-8](#).

**Figure 2-8** Inserting the Adapter

- Step 6** Flip the latches down and push the panel down when all desired adapters have been installed.

To cable the drawer using the cross connect panel, see the [“Mux/Demux Module and Line Card Motherboard Cabling with Cross Connect Drawers”](#) section on page 3-21.

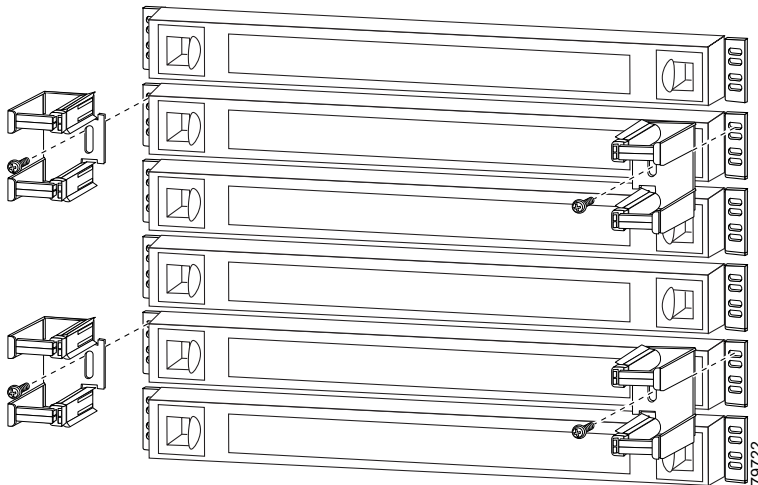
# Installing the Vertical Cable Guides

Vertical cable guides are installed onto the rack next to the cross connect drawers. They are used to guide and hold the cables down from the line card motherboards into the cross connect drawers.

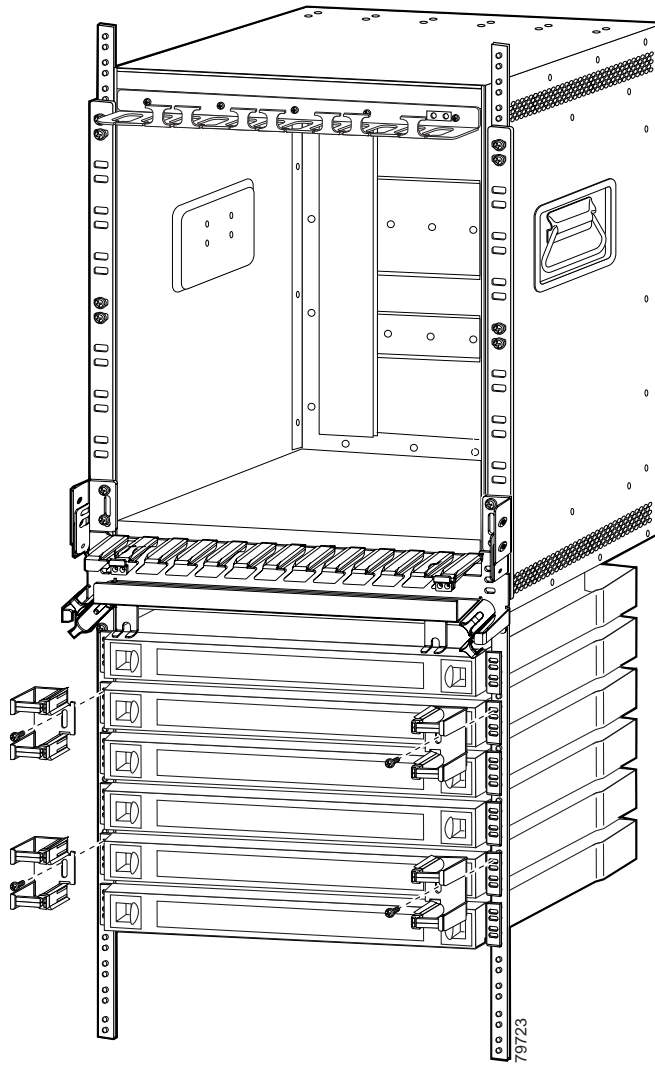
To install the vertical cable guides onto the chassis, follow these steps:

- 
- Step 1** Make sure you have the correct vertical cable guide for the side of the rack you are installing on.
  - Step 2** Hold the vertical cable guide over the rack next to the correct storage or cross connect drawer. See [Figure 2-9](#) for placement guidelines.

**Figure 2-9** Vertical Cable Guide Placement



- Step 3** Align the mounting holes on the vertical cable guide with the mounting holes in the equipment rack.
- Step 4** Secure the vertical cable guides with number 12-24 or 10-32 screws. (See [Figure 2-10](#).)

*Figure 2-10 Installing the Vertical Cable Guides*

# Grounding the Chassis

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. We recommend 6 AWG. The length of the grounding wires depends on the location of your Cisco ONS 15540 ESPx 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, lug mounting adapter, 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 ESPx to earth ground. You must complete this procedure before connecting system power or powering up your shelf.

**Tip**

---

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 2-11.](#))
  - Step 5** Remove the label that covers the grounding receptacle.
  - Step 6** Place the lug mounting adapter against the grounding receptacle at the top of the chassis, then the grounding lug on top of the adapter.



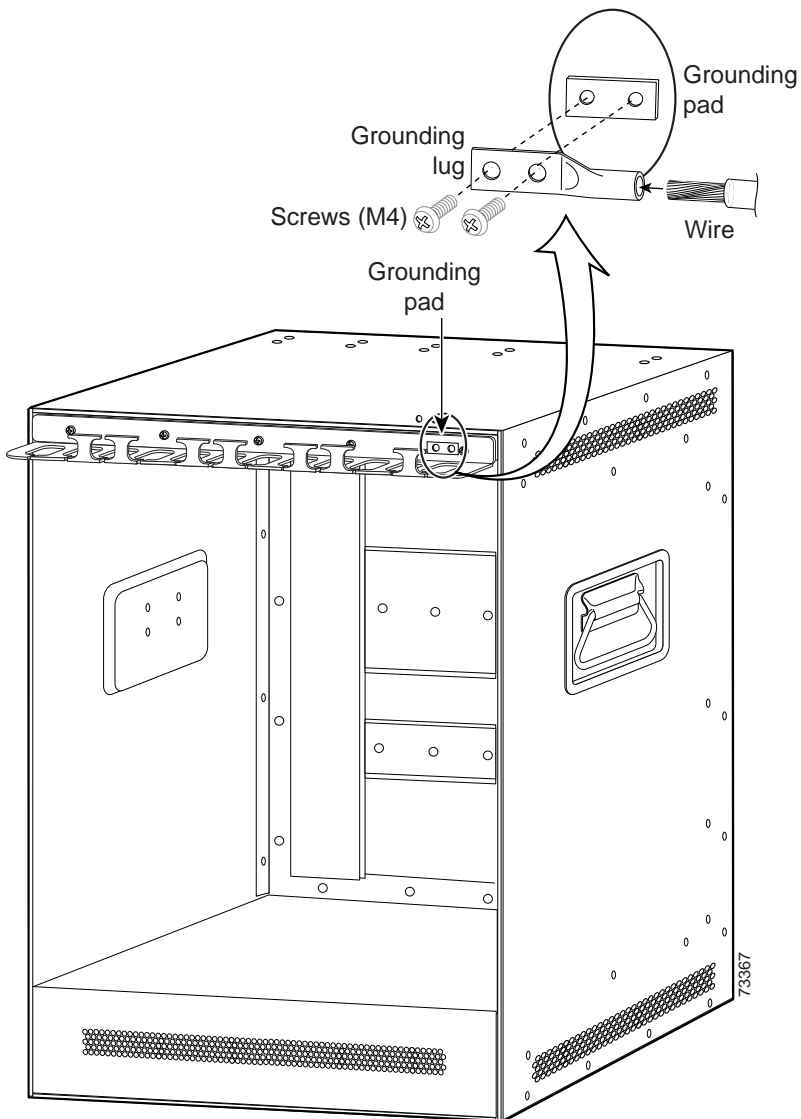
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**Note** The lug mounting adapter is an optional adapter.

---

- Step 7** 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 2-11.](#))
- Step 8** Install the locking washers and nuts; tighten them to secure the grounding lug to the grounding receptacle.
- Step 9** 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 ESPx.

Figure 2-11 Grounding Receptacle





# Installing and Removing Motherboards and Processor Cards

The mux/demux motherboards, line card motherboards, and processor cards are hot-swappable. We recommend installing the processor cards first and then filling the chassis from slots 0 to 11, left to right. 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. See the [“Removing Mux/Demux Motherboards and Processor Cards” section on page 2-22](#).
  - Step 2** Take the new motherboard or processor card from the shipping container.
  - Step 3** Insert the motherboard or processor card 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.
  - 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.
- 

After the system is powered up, you can check the LEDs to ensure proper installation. See [Table 1-8 on page 1-16](#) for mux/demux motherboard LED descriptions and [Table 1-2 on page 1-8](#) 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 2-21.

## Installing Line Card Motherboards

To install a line card motherboard, follow these steps:

- 
- Step 1** Remove the failed line card motherboard from the shelf. See the [“Removing Line Card Motherboards”](#) section on page 2-23.
  - Step 2** Take the new line card motherboard from the shipping container.
  - Step 3** Remove the dust covers from the back of the motherboard.



---

**Note** Failure to remove these dust covers may cause damage to the system.

---

- Step 4** Insert the motherboard carefully into the chassis slot while guiding the upper and lower edges of the motherboard in the tracks until its connectors come into contact with the backplane.

- Step 5** Use the handles to push the line card motherboard in until it is fully seated in the backplane connector.
  - Step 6** Use a 3/16-inch flat-blade screwdriver to tighten the captive installation screws.
  - Step 7** Check the LED to ensure proper installation. See [Table 1-10 on page 1-20](#) 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 2-22.

## Installing and Removing Modules

The mux/demux modules, PSMs, 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 Mux/Demux Modules

To install the mux/demux 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.
  - Step 5** Check the LEDs to ensure proper installation. See [Table 1-8 on page 1-16](#) for mux/demux motherboard LED descriptions.
- 

Save the filler modules with the packaging material.

## Installing 2.5-Gbps Type 1 Transponder Modules

To install the 2.5-Gbps Type 1 transponder module, follow these steps:

- 
- Step 1** Remove the failed module or the filler module from the 2.5-Gbps line card 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.
  - Step 5** Check the LEDs to ensure proper installation. See [Table 1-14 on page 1-25](#) for 2.5-Gbps Type 1 transponder module LED descriptions.
  - Step 6** Save the filler modules with the packaging material.
-

## Installing PSMs

To install the PSM, 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.
  - Step 5** Check the LEDs to ensure proper installation. See [Table 1-9 on page 1-18](#) for PSM LED descriptions.
- 

## 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 modules with SFP optics, follow these steps:

- 
- Step 1** Take the desired SFP optics from the shipping container.
  - Step 2** Install the SFP by inserting it into the Type 2 extended range transponder module. Push the SFP until you hear a click. The click indicates that it is securely set in the module.
  - Step 3** Insert the Type 2 extended range 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.
- Step 6** Check the LEDs to ensure proper installation. See [Table 1-15 on page 1-25](#) for Type 2 extended range transponder module LED descriptions.
- 

## Removing SFP Optics from the Type 2 Extended Range Transponders Modules

There are two types of SFP optics that can be installed in the Type 2 extended range 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 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.

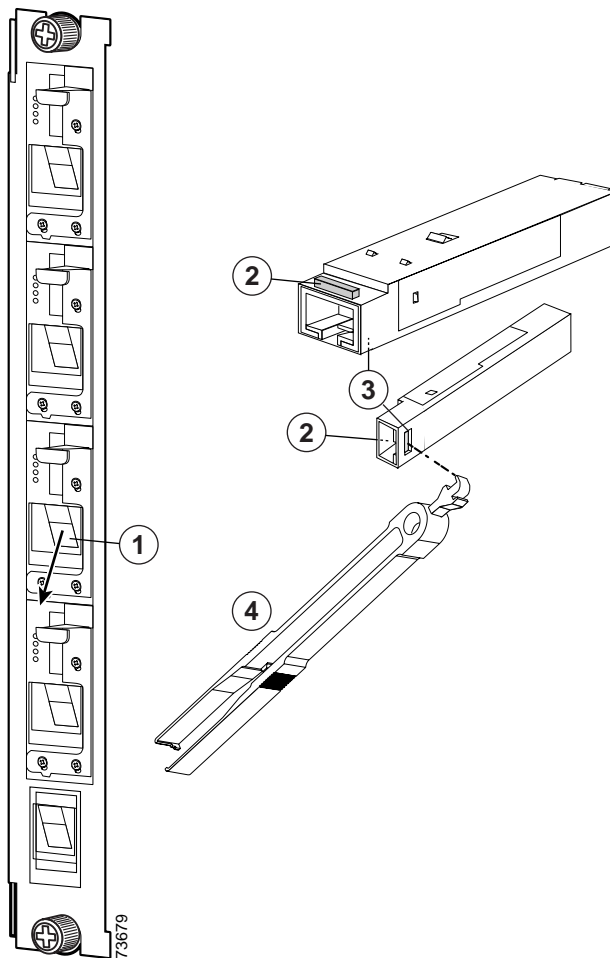
---

To remove an SFP with an MT-RJ connector from the Type 2 extended range 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 2-12.](#))

Figure 2-12 Removing the SFP with MT-RJ Connector



1	SFP placement in the module	3	SFP extraction tool insertion hole
2	Lever on the SFP (two views)	4	SFP extraction and cable installation and removal tool



- Step 3** Use the tool to remove the SFP by inserting the tool into the side of the module and pulling it out. (See [Figure 2-12](#).)
- Step 4** Place the removed SFP in a container appropriate for shipping and storage.
- 

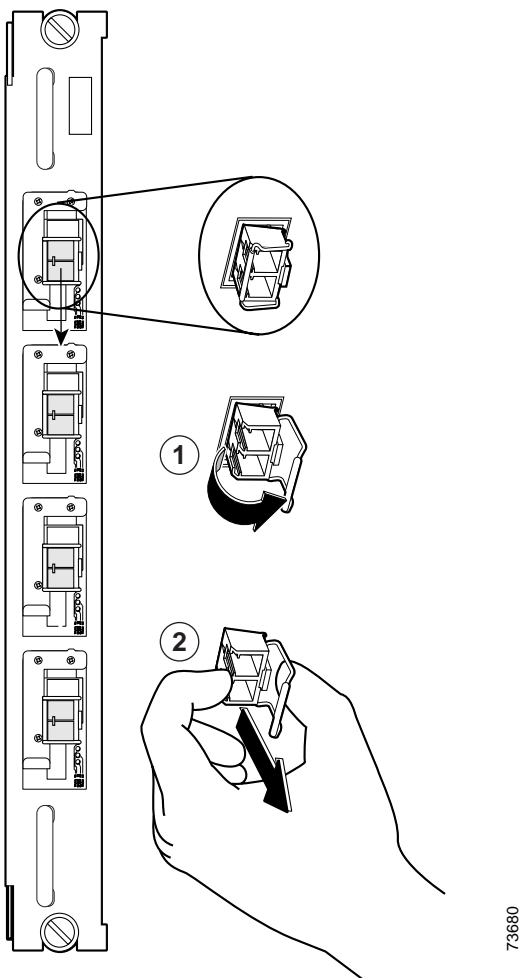
## Removing SFP Optics with LC Connectors

To remove an SFP with an LC connector from the Type 2 extended range 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 2-13](#).)

Figure 2-13 Removing the Transceiver with the LC Connector



1	Release latch	2	SFP removal
---	---------------	---	-------------

73680

- Step 3** Continue to pull the latch down and use the latch to pull the SFP out of the module. (See [Figure 2-13.](#))
  - Step 4** Place the removed SFP in a container appropriate for shipping and storage.
- 

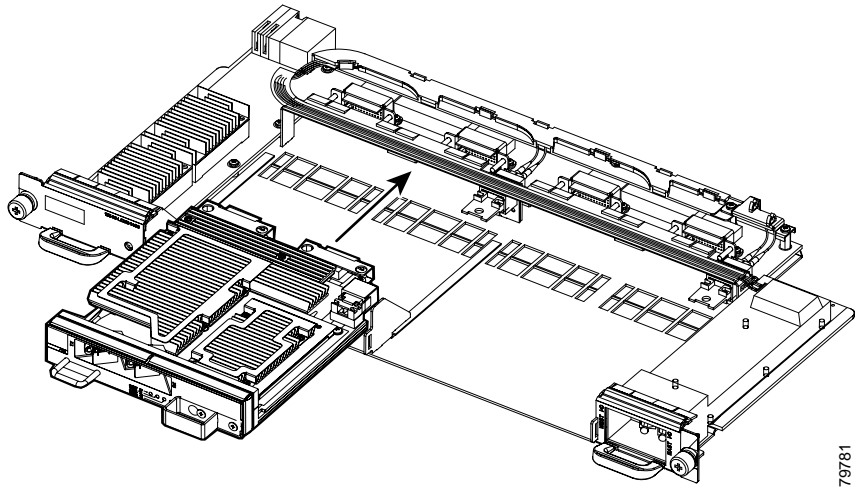
## Installing 10-GE Transponder Modules

You must install a 10-GE transponder module in a 10-GE line card motherboard for proper operation in a Cisco ONS 15540 ESPx. The 10-GE line card motherboards support up to two half-width 10-GE transponder modules.

To install 10-GE transponder modules, follow these steps:

- Step 1** Remove the failed or blank module from the 10-GE line card 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. (See [Figure 2-14.](#))

*Figure 2-14 Installing the 10-GE Transponder Module*



- Step 4** Attach the appropriate cables.
- Step 5** Check the LEDs to ensure proper installation. See [Table 1-15 on page 1-25](#) for Type 2 extended range transponder module LED descriptions.



**Note** Allow two minutes for the 10-Gbps laser on the 10-GE transponder module to warm up before it transmits traffic.

## Using CLI Prior to 2.5-Gbps Transponder Module Removal

Removing a 2.5-Gbps transponder module from the Cisco ONS 15540 ESPx causes bit rate errors on other 2.5-Gbps 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
<b>hw-module subslot <i>slot/subslot</i> power off</b>	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
<b>show hardware linecard slot</b>	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.

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

- 
- Step 1** Remove all cables from the desired module using the cable installation and Remove the module by carefully pulling it out of the slot in the motherboard.
  - Step 2** Reinstall the blank filler module.
  - Step 3** 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. To remove the fan assembly, you must first loosen the cables that are cabled through the storage drawers and the cable management tray. Failure to do this can result in possible damage to your fiber optic cables.



### 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.

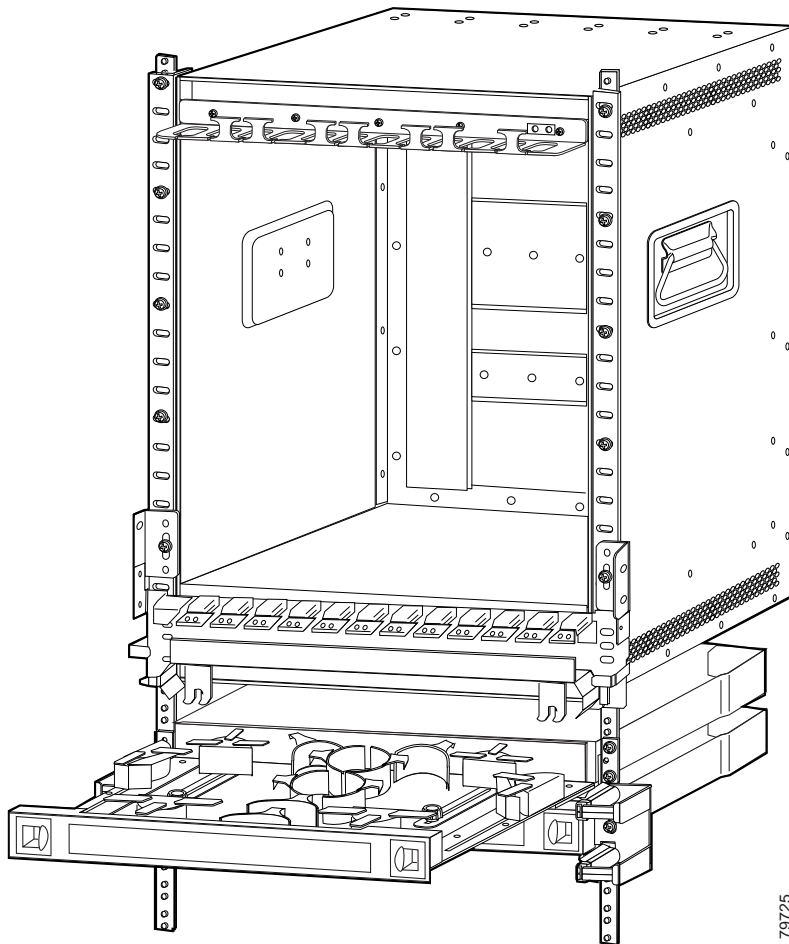
**Table 2-2** Fan Assembly Status

Fan Failure	Status
None	Normal
One	Minor
Two or more	Major

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

- Step 1** Open and pull out the cable storage drawer installed immediately beneath the chassis that holds the system fiber optic cables. (See [Figure 2-15](#).)

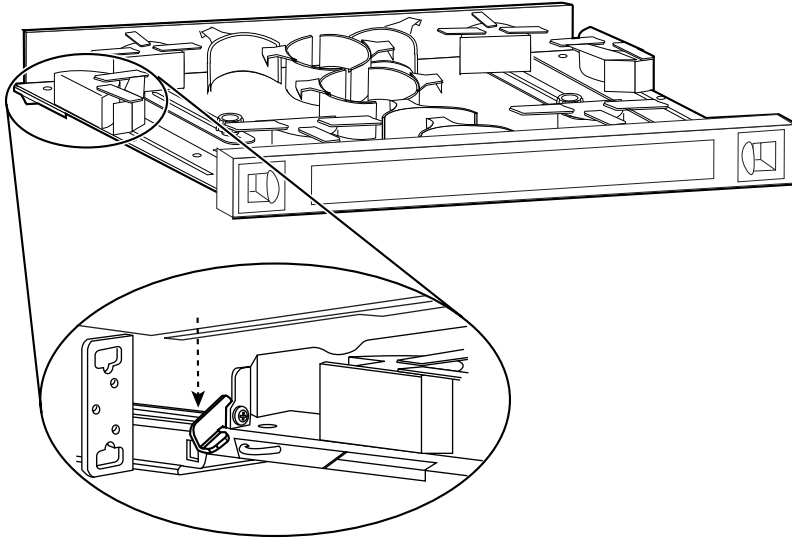
*Figure 2-15 Cable Storage Drawer*





- Step 2** Lock the drawer by pushing the lever down at the back left side of the drawer. (See [Figure 2-16](#).)

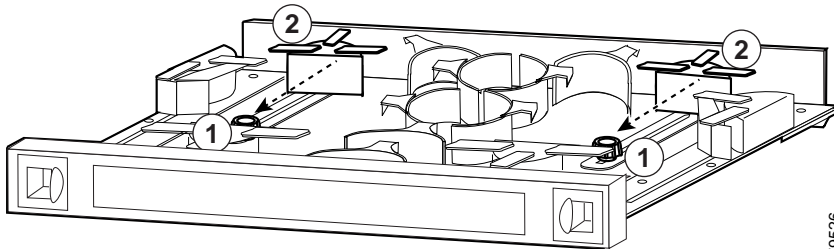
**Figure 2-16** *Drawer Lock*



105784

- Step 3** Untwist the black fasteners in the drawers to loosen the cable guide spoils. (See [Figure 2-17](#).)

**Figure 2-17** *Preparing to Loosen the Cables*

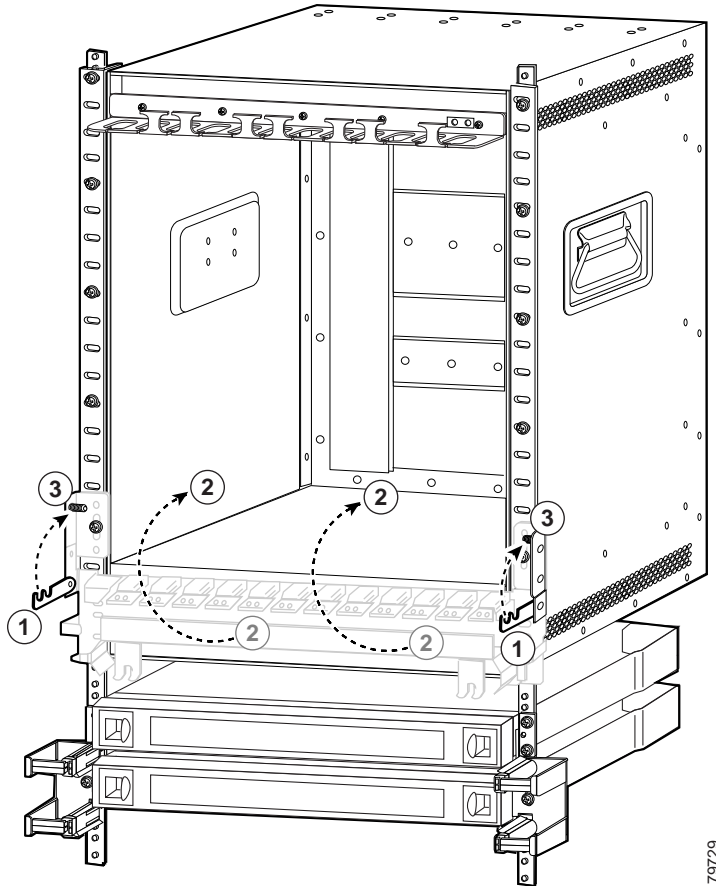


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1	Black fastener	2	Cable spool
---	----------------	---	-------------

- Step 4** Push the spools down towards the black fasteners. Carefully pull out the cables from the spools towards the outside of the drawers. (See [Figure 2-17](#).)
- Step 5** Flip the cable management tray up so that it no longer covers the fan tray. (See [Figure 2-18](#).)

**Figure 2-18** Hooked Cable Management Tray

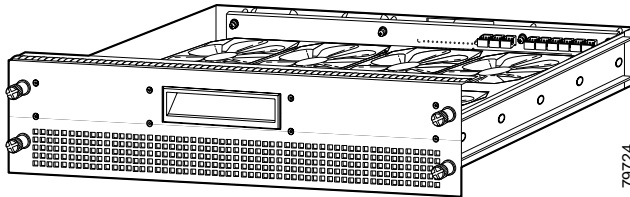


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1	Cable management tray hook	3	Rack mount latch
2	Cable management tray		

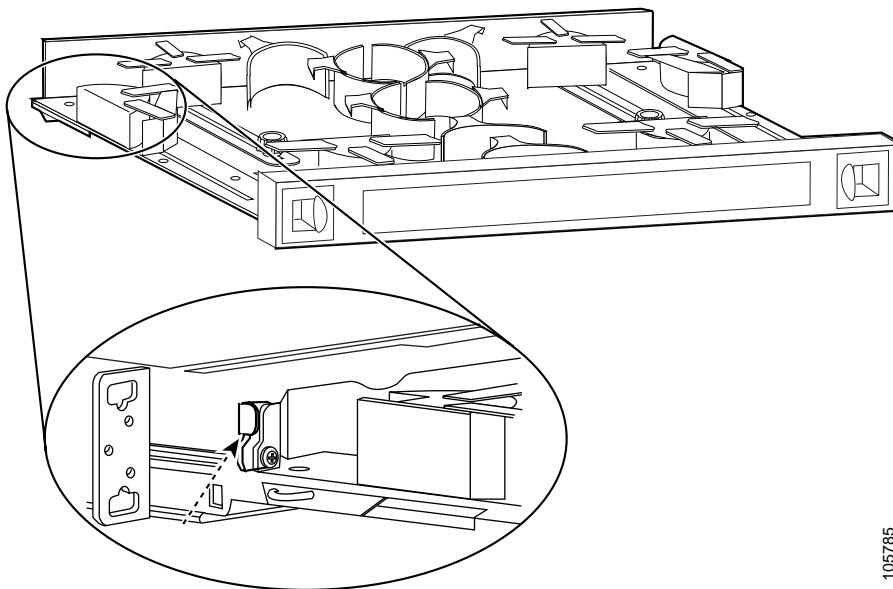
- Step 6** Attach the hook on the tray to the rack mount part of the tray on the rack so that it stays in the up position.
- Step 7** Unscrew the captive installation screws on the fan assembly. (See [Figure 2-19](#).)

**Figure 2-19 Fan Assembly**



- Step 8** Pull the fan assembly out of the bay and put it aside.
- Step 9** 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 10** Push the fan assembly into the chassis until the captive installation screws meet the chassis.
- Step 11** Tighten each of the captive installation screws.
- Step 12** Release the hook on the cable management tray and lower the tray so that it again covers the fan assembly.
- Step 13** Restore the fiber optic cable slack using the spools in the cable management drawer. Push the spools loosened in [Step 2](#) back up to its original place.
- Step 14** Pull the cable down and around the spools so that they are back to their original places before the fan assembly removal.
- Step 15** Tighten the black fasteners in the drawers to secure the spools and cables in place.
- Step 16** Unlock the drawer and close it. (See [Figure 2-20](#).)

Figure 2-20 Unlocking the Drawer



105785

- Step 17** 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 2-48.

## 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 2-51 for the other model.

**Note**

---

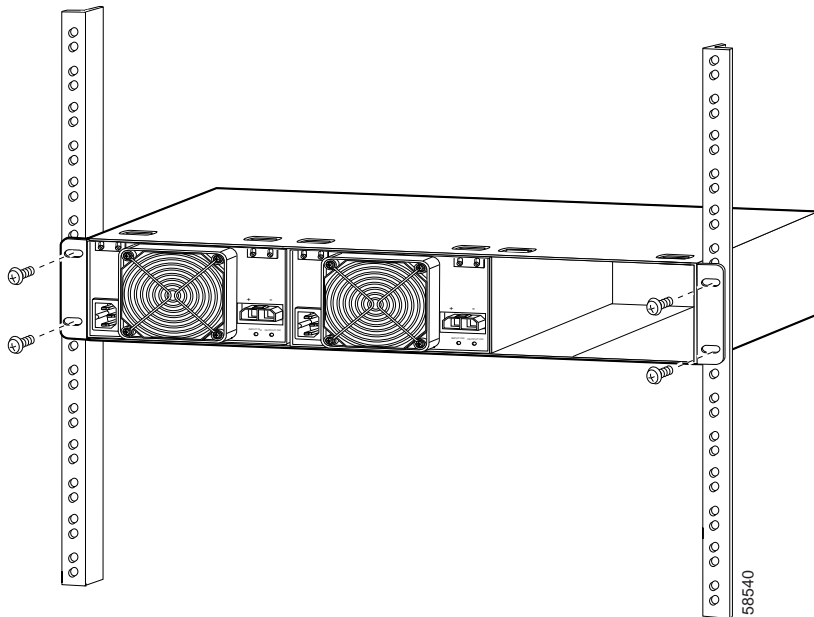
Make sure you install the 15540-PWR-AC external power shelf close enough to your chassis so that you can connect all power cords to the chassis and to the power outlet. We recommend that you install the 15540-PWR-AC external power shelf directly above your Cisco ONS 15540 chassis, leaving one half inch 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 2-21](#).)

**Figure 2-21** *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.
-

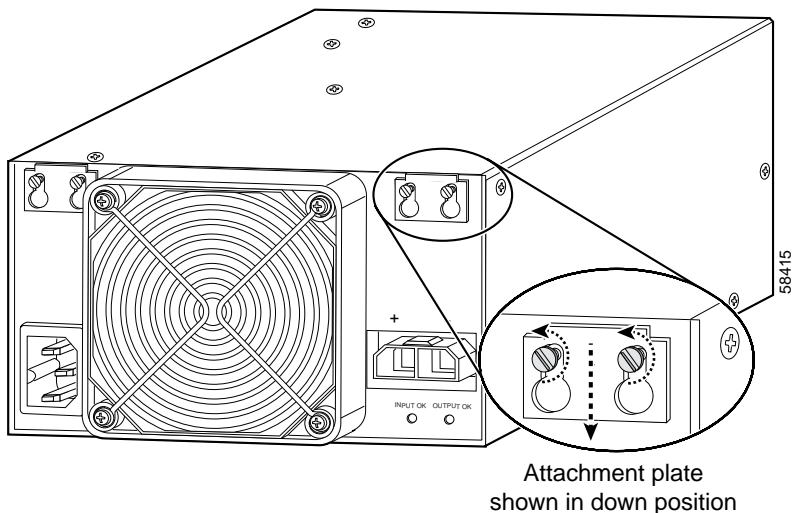
## Installing and Connecting the 15540-PWR-AC External Power Supply

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 2-41.

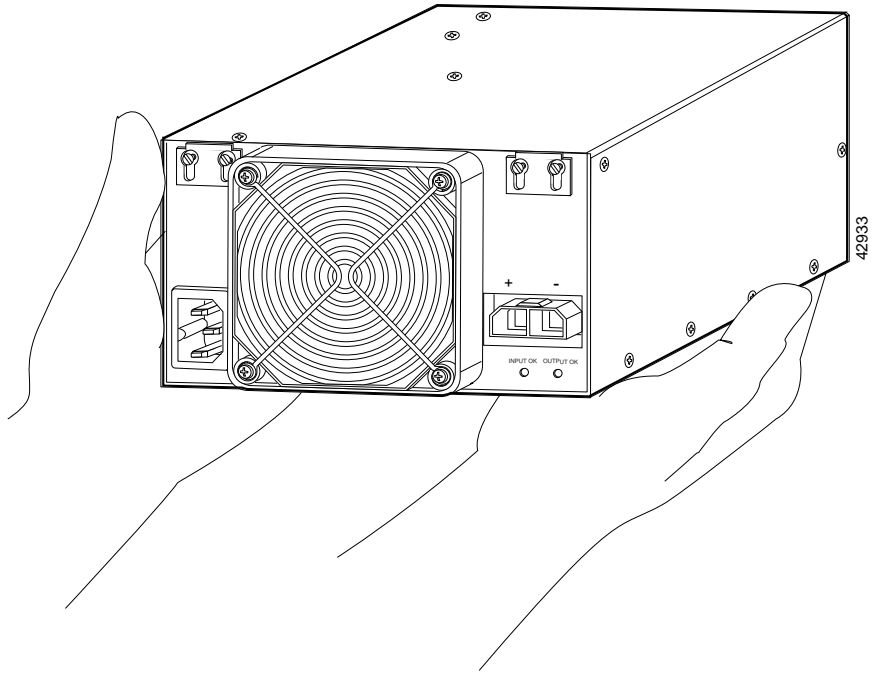
To install a 15540-PWR-AC power supply, follow these steps:

- 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 2-22](#).)

*Figure 2-22 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 2-23](#).)

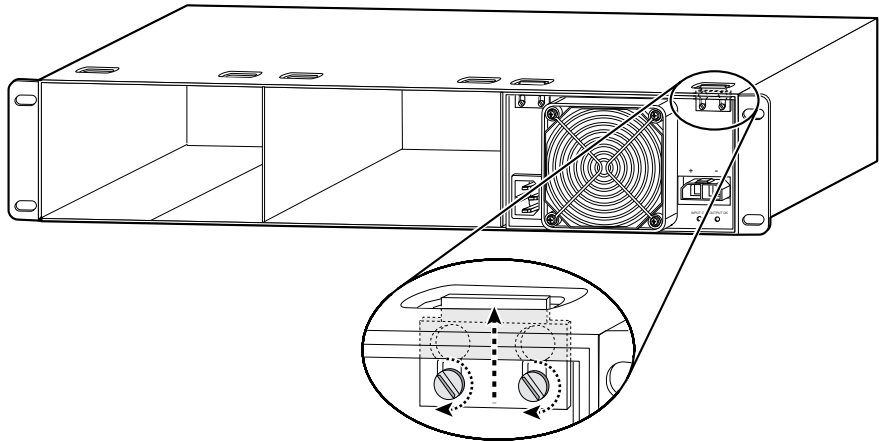
*Figure 2-23 Handling the 15540-PWR-AC Power Supply***Caution**

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 2-24](#).)



**Figure 2-24** Tightening the Attachment Plates

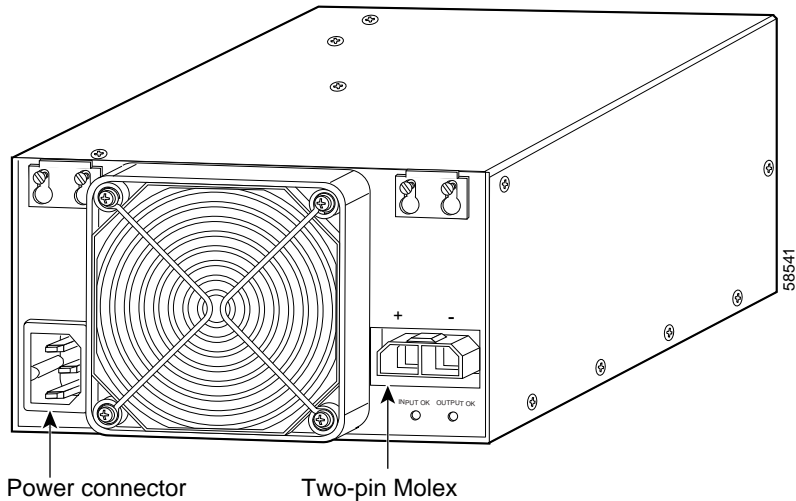


Attachment plate  
shown in up position

43146

- 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 2-25](#).)

Figure 2-25 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 2-26](#).)

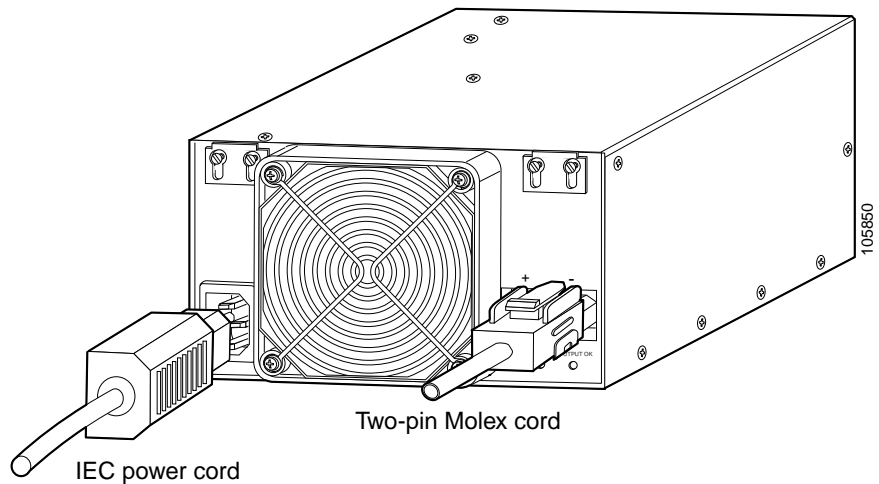
**Caution**


---

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.

---

Figure 2-26 Connecting the 15540-PWR-AC Power Supply to the Chassis



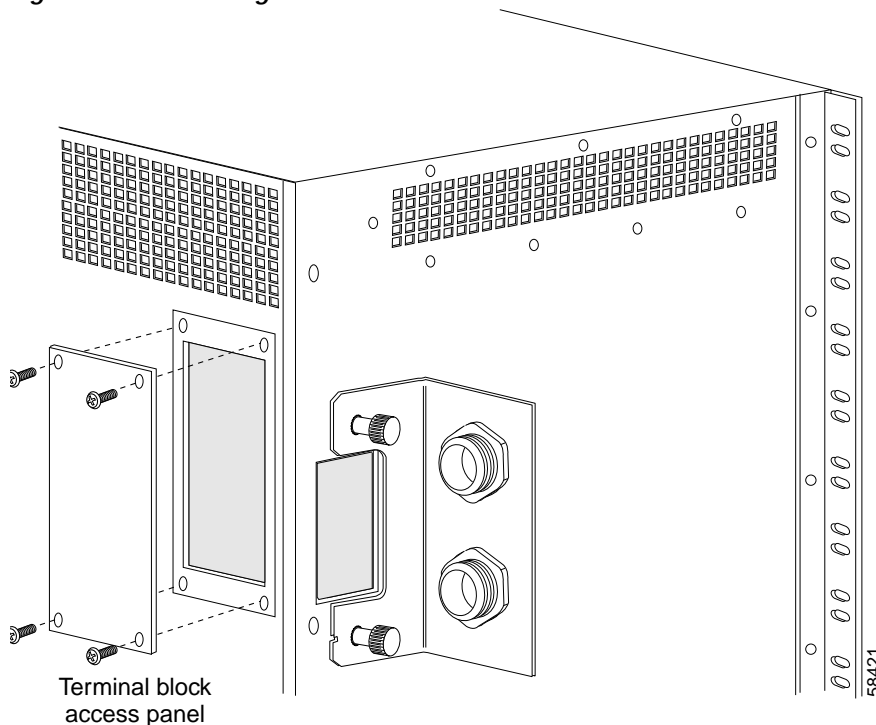
- Step 10** Verify 15540-PWR-AC power supply operation by checking the power supply front panel LEDs:
- INPUT OK LED is on.
  - OUTPUT OK LED is on.
- Step 11** Check the external power supply status from the system console by entering the **show hardware** command. For more information on commands, refer to the [Cisco ONS 15540 ESPx Configuration Guide](#) and the [Cisco ONS 15540 ESPx 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:

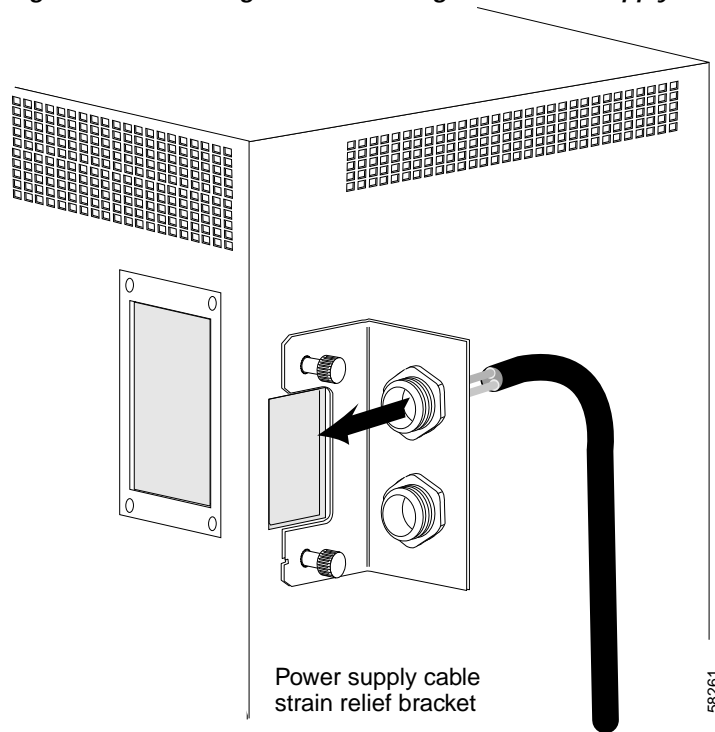
- Step 1** Remove the four screws from the terminal block access panel on the back panel of the chassis. (See [Figure 2-27](#).)

**Figure 2-27 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 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 2-28](#).)

**Figure 2-28** Inserting the Cord Through the Power Supply Cable Strain Relief



**Step 4** Connect the wires of the cables to the terminal blocks. (See [Figure 2-29](#).) Wire the cables in the following sequence:

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

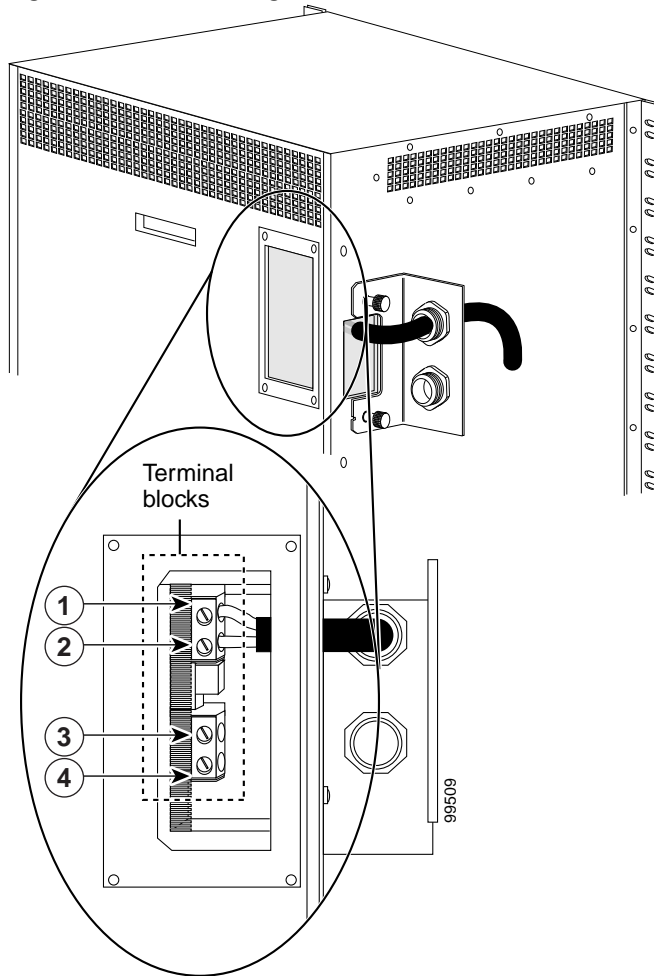


**Note** The ground connections should always be connected first and disconnected last.



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

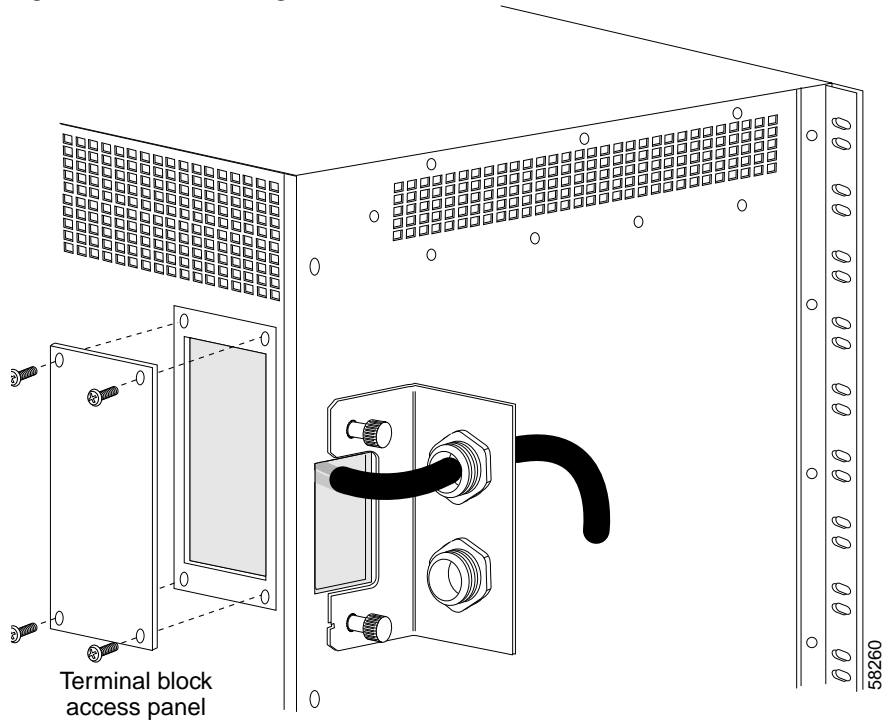
Figure 2-29 Connecting Cable Wires to the Terminal Blocks



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 2-30](#).)

*Figure 2-30 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

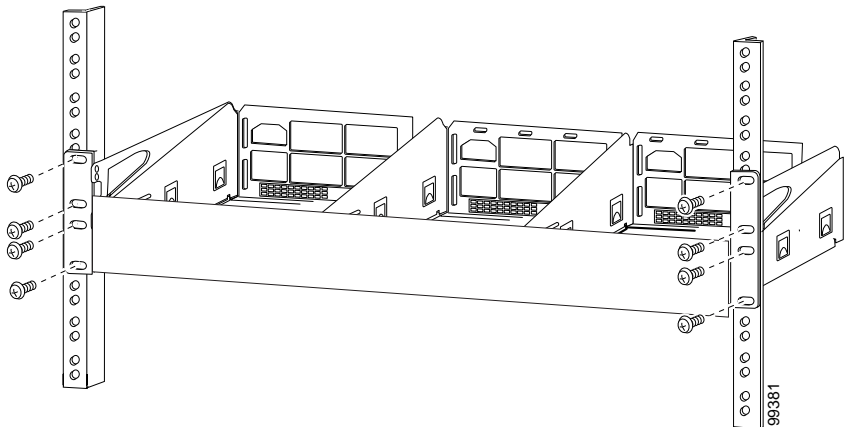
Make sure you install the 15540-ACPS-N-E external power shelf close enough to your chassis so that you can connect all power cords to the chassis and to the power outlet. We recommend that you install the 15540-ACPS-N-E external power shelf directly above your Cisco ONS 15540 chassis, leaving one-half 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 2-31](#).)

**Figure 2-31** *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.
-

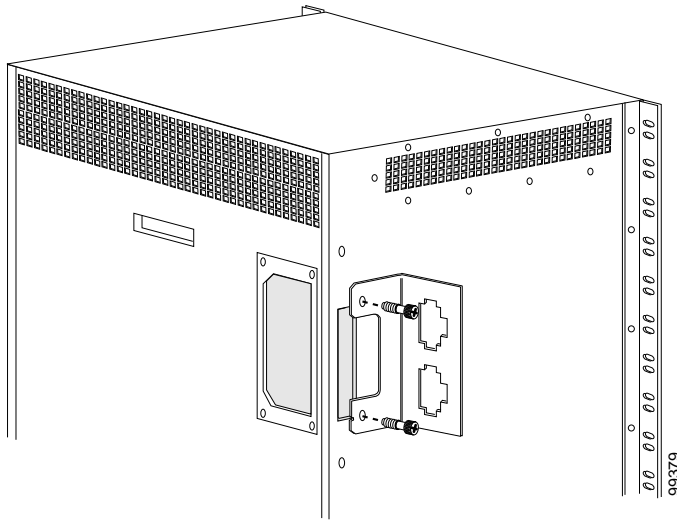


## Connecting DC-Input Power from the 15540-ACPS-N-E External Power Shelf

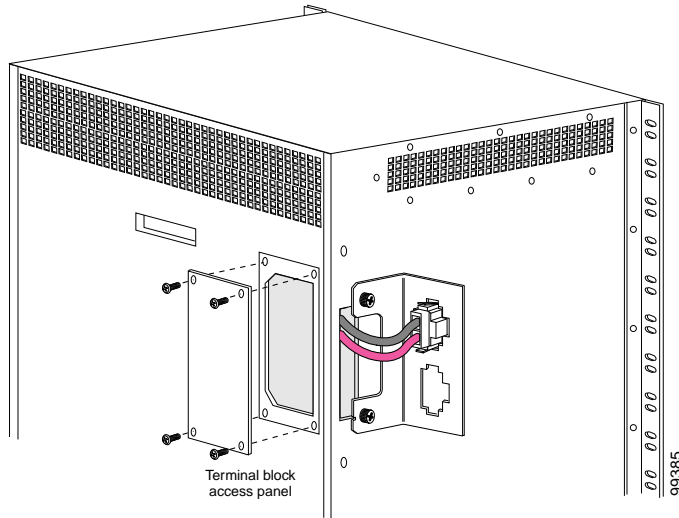
To apply DC-input power to your Cisco ONS 15540 shelf, you must install a cable strain relief bracket and two DC power cables. The two DC power cables are connected to each other at the cable strain relief bracket. To complete the connections, follow these steps:

- Step 1** Attach the cable strain relief bracket to the side of the Cisco 15540 chassis. (See [Figure 2-32](#).)

**Figure 2-32** *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 2-33](#).)

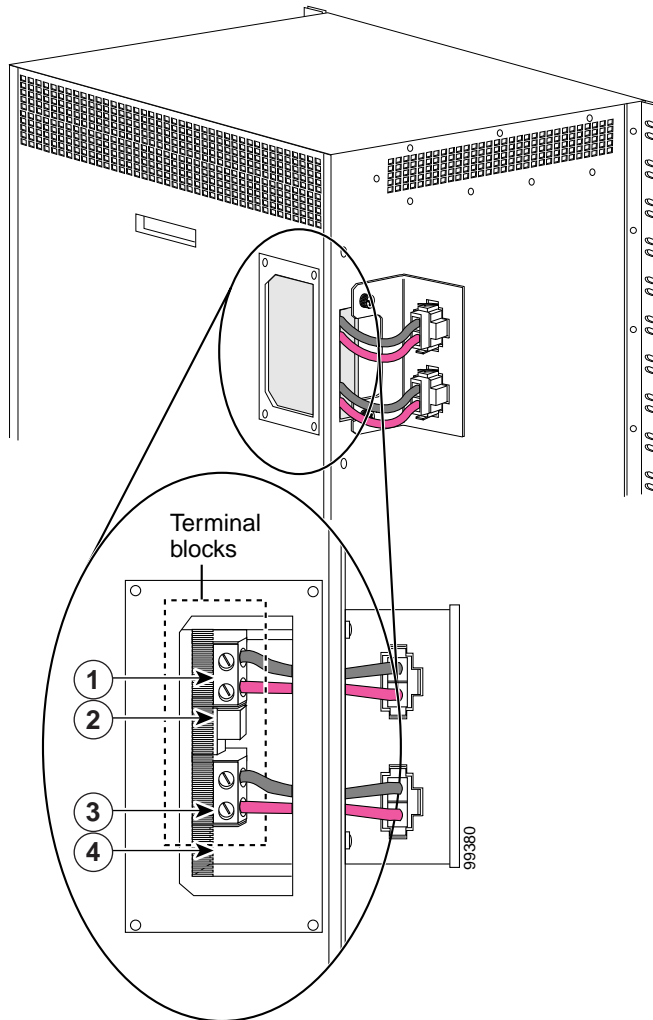
**Figure 2-33 Removing the Terminal Block Access Panel**

- Step 3** Snap the cable connector of the short DC power cable into the cable strain relief bracket. (See [Figure 2-33](#).)
- Step 4** Insert the cable through the left rear of the chassis and connect the leads to the terminal blocks (see [Figure 2-34](#)) in the following sequence:
- Black lead to RTNA.
  - Red lead to -48A.



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

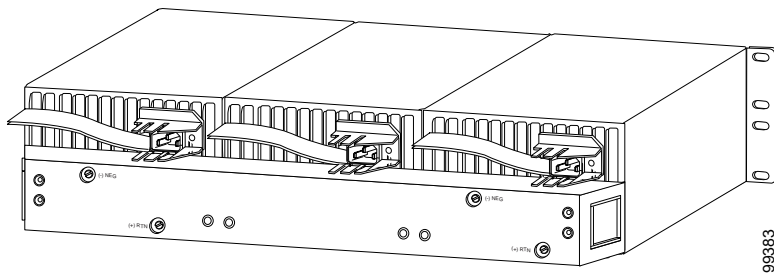
Figure 2-34 Connecting Cable Wires to the Terminal Blocks



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 2-33](#).)
- 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 2-35](#).)

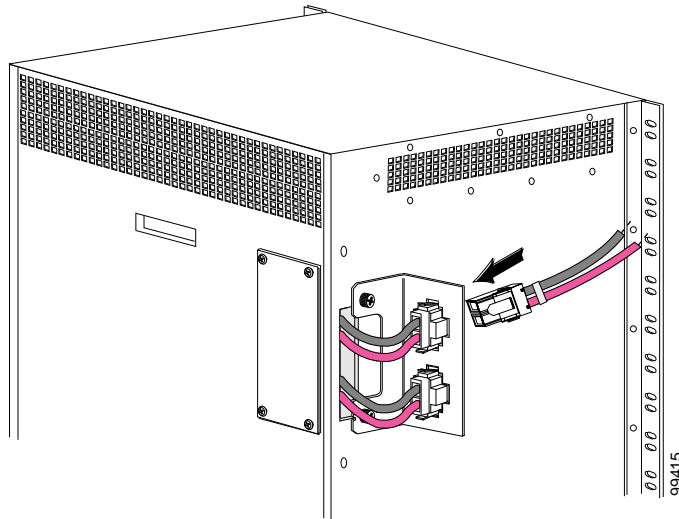
**Figure 2-35 Connecting to Earth Ground**



<b>1</b>	Side B	<b>2</b>	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 2-36](#).)

*Figure 2-36 Connecting the DC Power Cables*



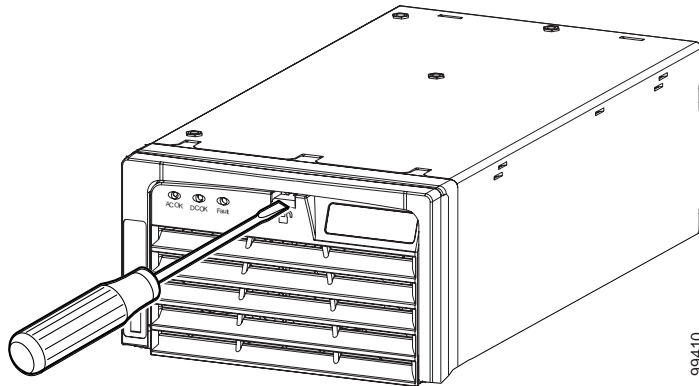
## Installing and Connecting the 15540-ACPS-N-E External Power Supply

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 2-51.

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

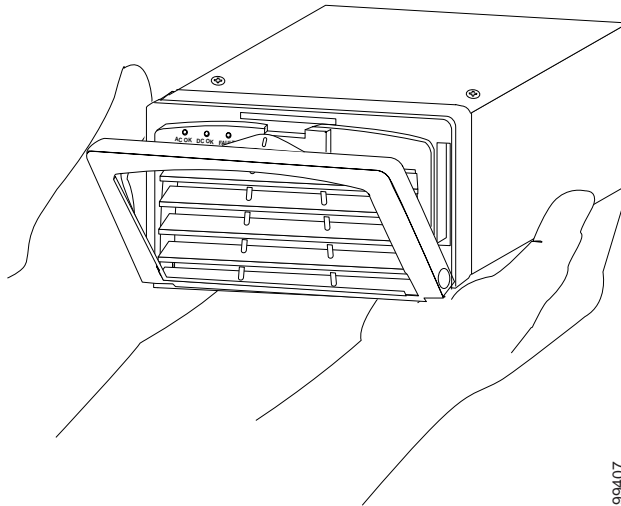
- Step 1** Use a flat blade screwdriver to push in on the release handle latch until the release handle opens. (See [Figure 2-37](#).)

**Figure 2-37** *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 2-38](#).)

**Figure 2-38 Handling the 15540-ACPS-N-E Power Supply**

**Caution**

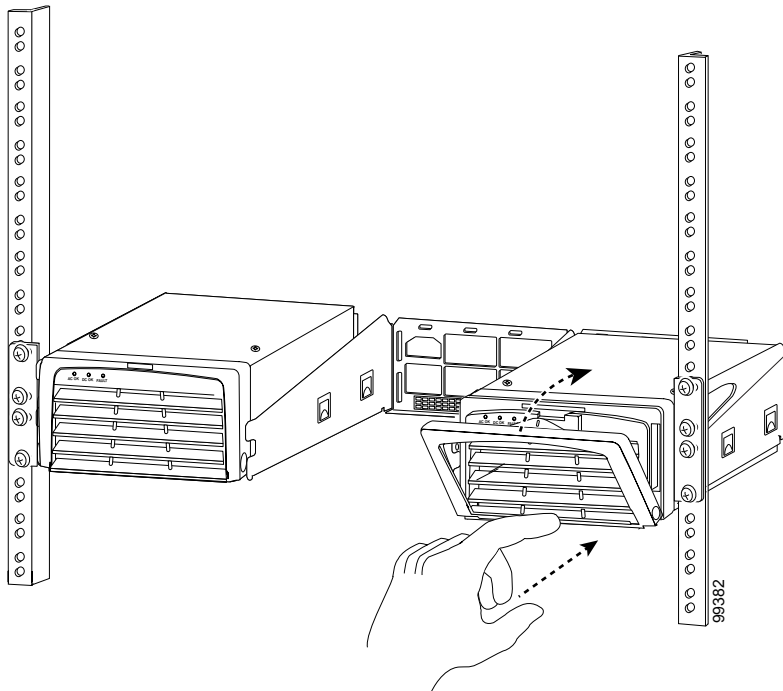
Use both hands to install and remove the 15540-ACPS-N-E power supply.

- 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 2-39](#).)

**Note**

The 15540-ACPS-N-E power supply does 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 2-39** 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.



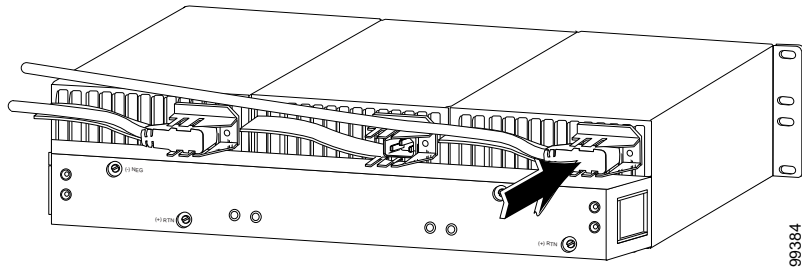
**Caution**

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 2-40](#).)



Figure 2-40 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 ESPx Configuration Guide](#) and the [Cisco ONS 15540 ESPx 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 ESPx 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 ESPx Configuration Guide* and the *Cisco ONS 15540 ESPx Command Reference*.
  - Step 2** Choose the 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 ESPx

---

Fiber optic cables are routed to the cable management tray at the bottom of the shelf. The Cisco ONS 15540 ESPx is powered using  $-48$  VDC power. Positive and negative power terminals are accessible on the backplane. You can mount the Cisco ONS 15540 ESPx in a 19-inch or 23-inch rack.

This chapter describes how to connect the Cisco ONS 15540 ESPx 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 3-4](#)
- [Connecting Mux/Demux Modules, page 3-6](#)
- [Connecting PSMs, page 3-9](#)
- [Connecting Transponder Modules, page 3-13](#)
- [Connecting the Cables, page 3-16](#)
- [Connecting the 2.5-Gbps Transponder Module, page 3-30](#)
- [Connecting the 10-GE Transponder Module, page 3-45](#)



### Note

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For power supply cable and alarm cable connecting information, see the [“Powering Up the Shelf”](#) section on page 2-40.

---

**Note**

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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 ESPx.

---

## Preparing for Network Connections

When preparing your site for network connections to the Cisco ONS 15540 ESPx 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

This document contains general cleaning tips and practices not specific to the kit mentioned above.

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**

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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, refer to *Cisco ONS 15540 ESPx Cleaning Procedures for Fiber Optic Connections* or go to: <http://www.cisco.com/univercd/cc/td/doc/product/mels/15540x/15467kit.htm>.

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.

---

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:

- 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 (network management Ethernet) port

**Note**

---

The ASE (aggregation shelf Ethernet) 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 fiber cables down through the cutout holes on the cable management tray out of the right side of the shelf assembly.
- 

## 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 ESPx.

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

- 
- Step 1** Place the auxiliary 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 fiber cables down through the cutout holes on the cable management tray out of the right side of the shelf assembly.
-

## 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 fiber cables down through the cutout holes on the cable management tray out of the right side of the shelf assembly.
- 

## Connecting Mux/Demux Modules

The Cisco ONS 15540 ESPx fiber optic mux/demux modules use MU connectors. To install fiber optic cables in the Cisco ONS 15540 ESPx, a fiber cable with the corresponding connector type must be connected to the transmit and receive ports on the modules. We recommend that you label the transmit, receive, and the working and protection fibers at each end of the fiber span to avoid confusion with cables that are similar in appearance. Labels are shipped with the system that you can use to do this.

The Cisco ONS 15540 ESPx supports mux/demux modules with front panel optical filter connectors. Each mux/demux module supports a specific band of channels. Every 4-channel band on the mux/demux module has its own MTP connector. A 4-channel mux/demux module has one MTP connector, an 8-channel has two, and a 32-channel mux/demux module has eight.

**Caution**

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

---



**Note**

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

---

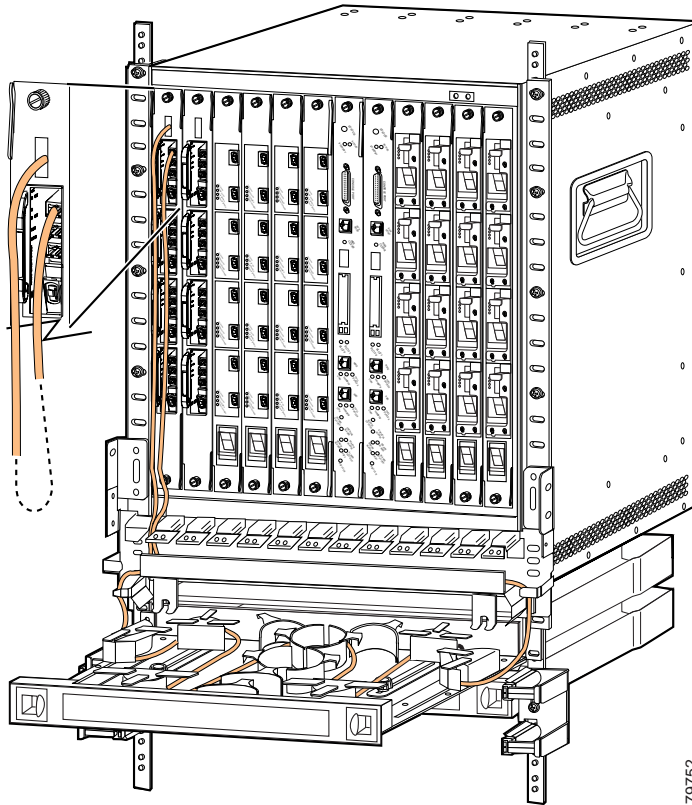
## Cabling Mux/Demux Modules with OSC

There are three different cables you can use to cable the mux/demux modules. This section describes how to attach and route fiber optic cables between mux/demux modules.

For OSC connections on the motherboard and pass through OSC connections, follow these steps:

- 
- Step 1** Route the fiber cable from the top OSC connector on the motherboard down through the cable management tray.
  - Step 2** Route the cable out of the left side of the tray, down the vertical cable guides and in through the left side of the cable storage drawer.
  - Step 3** Route the cable through the cable storage drawer and out the right side. Bring the cable up and into the right side of the cable management tray and continue to route the cable through until you come to the bottom of the desired mux/demux module. (See [Figure 3-1](#).)

Figure 3-1 OSC Cabling



- Step 4** Bring the cable up to the desired connection point on the module and insert the connector.

## Interconnecting Mux/Demux Modules

For mux/demux interconnections, use jumper cables to daisy chain the modules together and follow these steps:

- 
- Step 1** Insert one end of the cable in the third from the top connector on the module.
  - Step 2** Install the other end of the cable to the top connector of the mux/demux module installed directly below that module.
- 

## Connecting PSMs

The PSM (protection switch module) is a shelf replaceable unit, that plugs into any subslot in the mux/demux module. The unit has a front panel set of MU connectors that interface with the trunk fiber in a 1+1 protection scheme. The backside of the module provides an edge connector card, which interfaces with the mux/demux motherboard. The PSM can be connected to the mux/demux module or using a cross-connect drawer direct connections can be made from the ITU trunk cards, the 2.5-Gbps transponder module, or the 10-Gbps uplink card.

To install fiber optic cables in the Cisco ONS 15540 ESPx, a fiber cable with the corresponding connector type must be connected to the transmit and receive ports on the modules. We recommend that you label the transmit, receive, and the working and protection fibers at each end of the fiber span to avoid confusion with cables that are similar in appearance. Labels are shipped with the system.



### 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.**

---



### Note

---

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

---

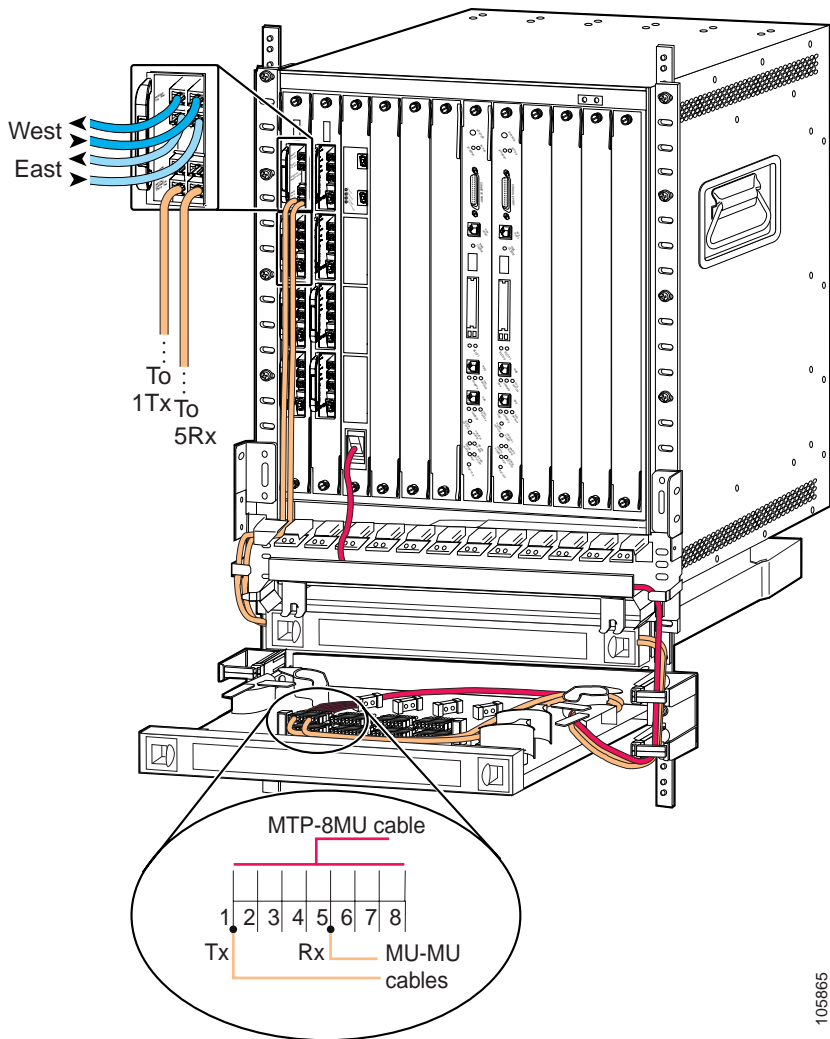
## Cabling PSMs

To attach and route MU fiber optic cables for PSMs connected to mux/demux modules, follow these steps:

- 
- Step 1** Use MU connectors to make your east and west connections from the PSM to the equipment appropriate for your configuration.
  - Step 2** Attach MU connectors to the mux/demux OUT/IN connections on the PSM.
  - Step 3** Route the cables down through the vertical cable guides and in through the left side of the cable storage drawer.
  - Step 4** Continue to route the cable through the drawer around the round cable retainers to the right side.
  - Step 5** Pull the cable up out of the right side of the drawer and back up through the cable management tray.
  - Step 6** Insert the other end of the MU connectors into the trunk IN/OUT ports on the desired mux/demux module. [Figure 3-2](#) shows the connections described in these steps with the PSM in slot 0, subslot 0 and an 8-channel mux/demux module in slot 0, subslot 1.



Figure 3-3 PSM Directly Connected to the 2.5-Gbps Transponder Module



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To cable the PSM, follow these steps:

- 
- Step 1** Use MU cables to connect the west TX/RX ports from the PSM to the west side equipment appropriate for your configuration.
  - Step 2** Use MU cables to connect the east TX/RX ports from the PSM to the east side equipment appropriate for your configuration.
  - Step 3** Use an MTP cable to connect the 2.5-Gbps line card motherboard containing the transponder module to the cross-connect panel in the cross-connect drawer.
  - Step 4** Use an MU cable to connect the mux/demux OUT port from the PSM to pin 5 of the cross-connect panel.
  - Step 5** Use an MU cable to connect the mux/demux IN port from the PSM to pin 1 of the cross-connect panel.
- 

## Connecting Transponder Modules

The Cisco ONS 15540 ESPx fiber optic transponder modules use MU connectors. To install fiber optic cables in the Cisco ONS 15540 ESPx, a fiber cable with the corresponding connector type must be connected to the transmit and receive ports on the modules. We recommend that you label the transmit, receive and the working and protection fibers at each end of the fiber span to avoid confusion with cables that are similar in appearance. Labels are shipped with the system that you can use to do this.

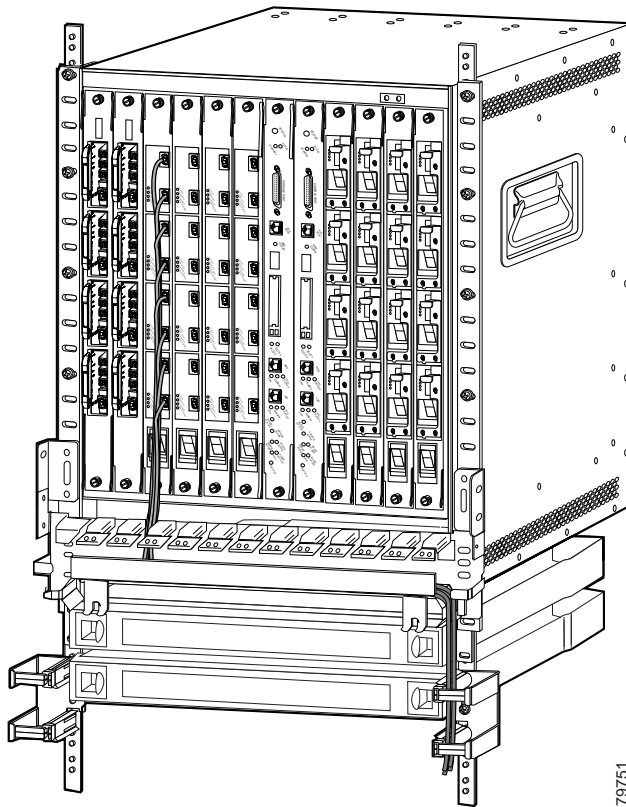
The line card motherboards and the mux/demux motherboards on the Cisco ONS 15540 ESPx connect to each other through the cross connect drawers using the MTP-to-MU breakout cables. The cable has one MTP connector at one end which is plugged either onto the MTP connector at the base of the line card motherboard or onto the MTP connectors on the mux/demux modules.

The motherboards can be installed in any of slots 2 to 5 and 8 to 11; however, the transponder modules in the motherboards, or the channels within the band, must be in increasing order from top to bottom.

To cable the SM and MM transponder module client equipment, follow these steps:

- 
- Step 1** Place the cable 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 the fiber cables down through the cable management tray and out of the right side of the shelf assembly. (See [Figure 3-4](#).)



**Figure 3-4** Cabling Transponder Modules

**Step 5** Connect the cables to your equipment according to your configuration.

To cable the 2.5-Gbps transponder modules, see the [“Connecting the 2.5-Gbps Transponder Module”](#) section on page 3-30

To cable the 10-GE transponder modules, see the [“Connecting the 10-GE Transponder Module”](#) section on page 3-45.

# Connecting the Cables

Optical components on the Cisco ONS 15540 ESPx can be cabled together in two different ways:

- Direct connections with an MTP cable storage drawer
- With cross connect drawers

MTP cables directly connect line card motherboards to optical mux/demux motherboards. One end of each MTP cable connector plugs into a line card motherboard MTP adapter. The other end of the cable plugs into a mux/demux motherboard MTP adapter.

When using the cross connect drawers, the line card motherboards and the mux/demux modules are separately connected to the cross connect panel. One end of a cable plugs into a line card motherboard or a mux/demux motherboard. The connections to the cross connect drawers are made using breakout cables. The cables break out to single fiber cables, which then plug into one end of a high density (octal-MU) adapter. The connections between line card motherboards and mux/demux modules are then made using single fiber cables (terminated in MU connectors at both ends). One end of each of these single fiber cables plugs into an adapter connected to a line card motherboard and the other end into another adapter connected to a mux/demux module.

Final connection between the line card motherboard and the mux/demux module is made using up to sixteen single fiber MU-to-MU cables. The MU connector on one end of the cable plugs into an octal-MU adapter connected to the line card motherboard. The other end of the connector plugs into an adapter connected to the mux/demux module.

**Note**

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The cable storage drawer can accommodate attenuators that are available from optical component distributors.

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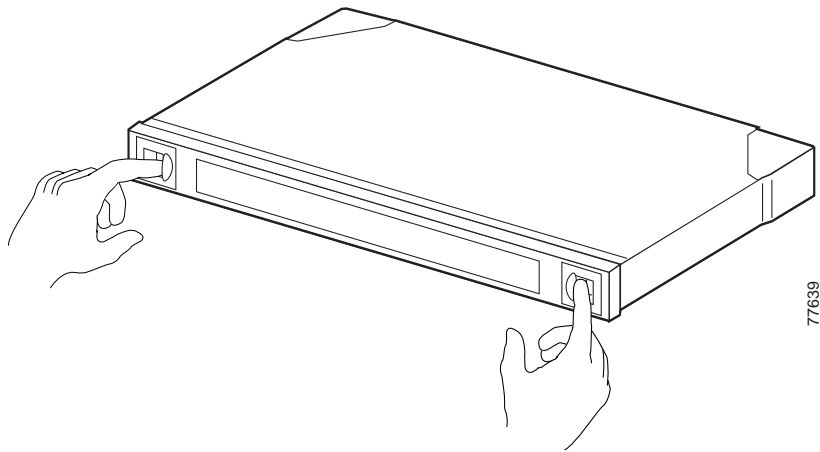
## Direct Connections with Cable Storage Drawers

When you make direct connections in the Cisco ONS 15540 ESPx, you connect the line card motherboard MTP connections directly to the MTP connections on the mux/demux modules or mux/demux motherboards. This connection requires just one MTP cable storage drawer.

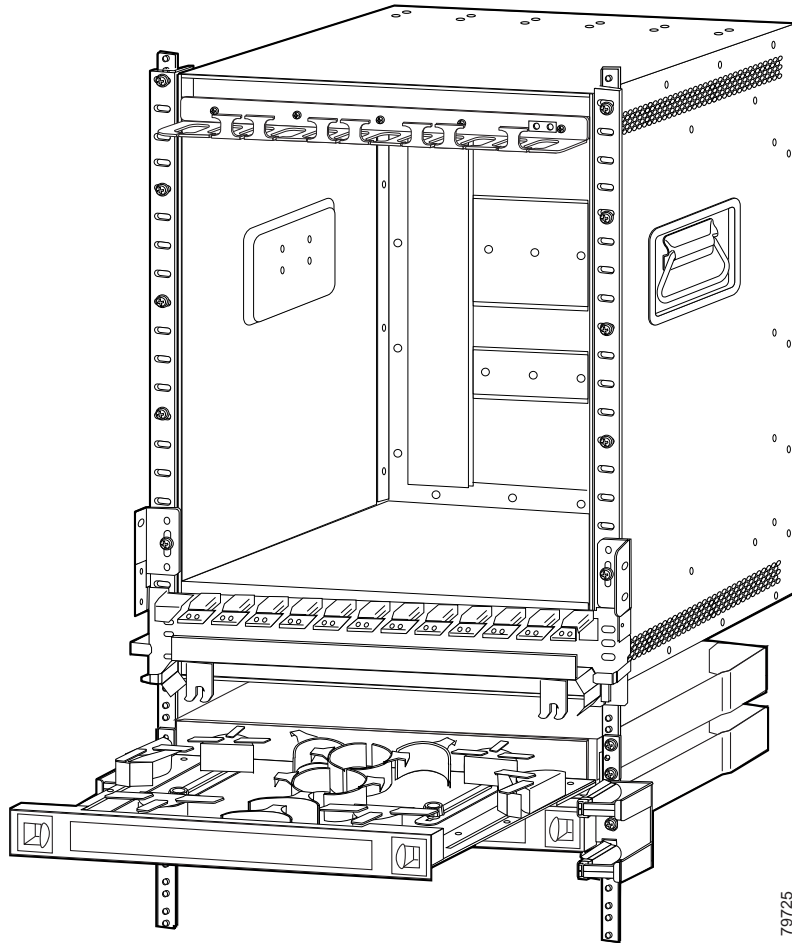
To connect the mux/demux motherboard and line card motherboards directly, follow these steps:

- 
- Step 1** Open the cable storage drawer by pushing the tabs in to release the lock on the drawer. (See [Figure 3-5](#).)

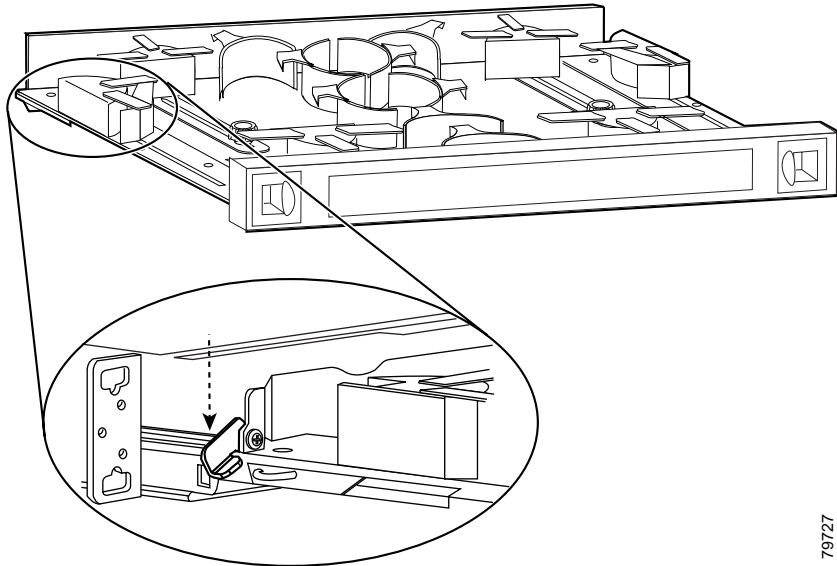
**Figure 3-5** *Opening the Cable Storage Drawer*



- Step 2** Pull out the cable storage drawer. (See [Figure 3-6](#).)

**Figure 3-6** Pulling out the Cable Storage Drawer

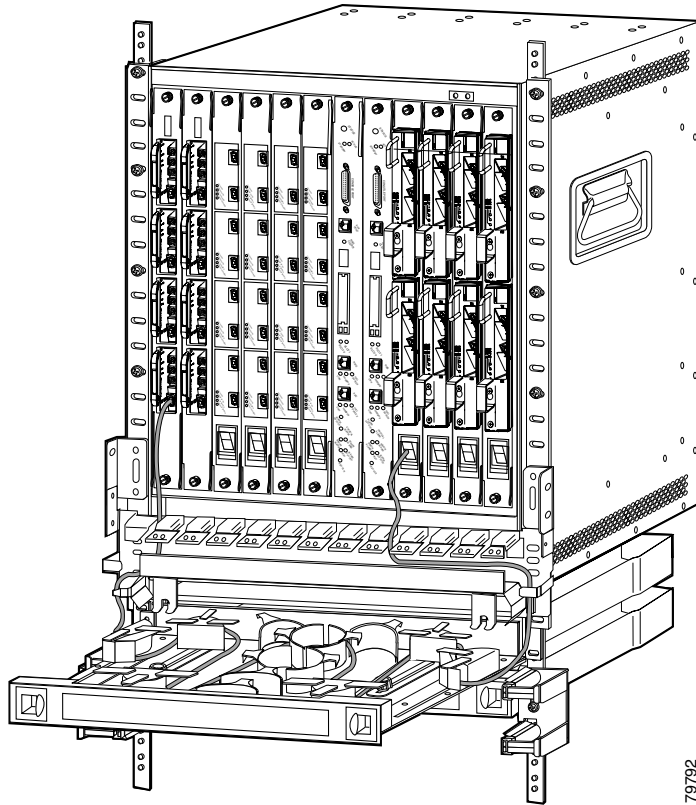
- Step 3** Lock the drawer in the open position by pushing the latch at the back left of the drawer down into the lock position. (See [Figure 3-7](#).)

**Figure 3-7 Locking the Drawer**

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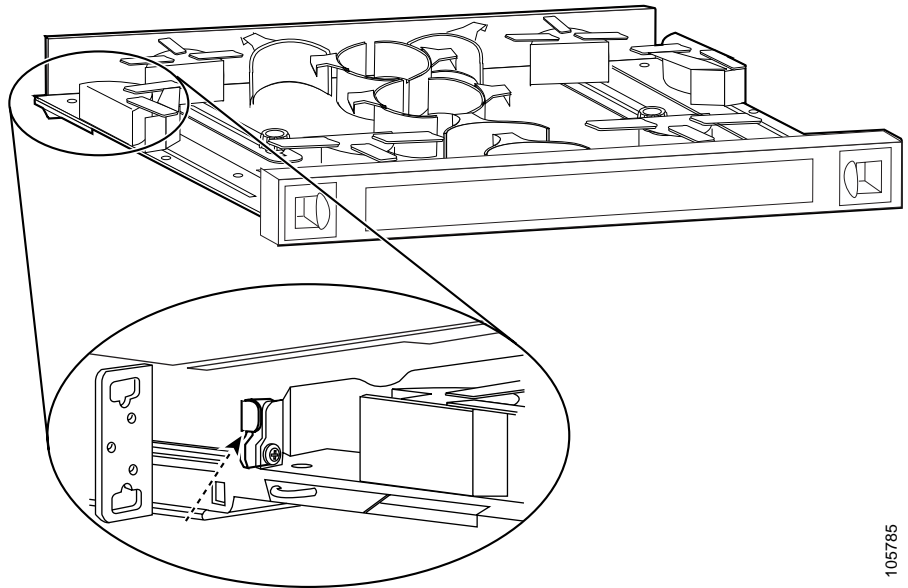
- Step 4** Use the MTP cable installation tool to push the MTP connector of the cable into the adapter on the line card motherboard until the connector snaps into place.
- Step 5** Route the MTP cable down through the cable management tray. Pull the cable out the left side of the tray.
- Step 6** Route the cable down the left side of the chassis and into the drawer.
- Step 7** Continue to route the cable through the drawer around the round cable retainers to the right side.
- Step 8** Pull the cable up out of the right side of the drawer and the back up through the cable management tray.
- Step 9** Insert the MTP connector into the MTP adapter on the desired line card motherboard. (See [Figure 3-8](#).)

Figure 3-8 Routing the Cable Storage Drawer



Repeat Steps 1 through 4 to continue cabling the system without the cross connect panel.

- Step 10** Unlock the drawer by moving the latch back into an upright position and close the drawer. (See [Figure 3-9](#).)

**Figure 3-9** *Unlocking the Drawer*

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**Note**

You can use the client clips shipped with the chassis to clip together cables for easy handling and organization.

## Mux/Demux Module and Line Card Motherboard Cabling with Cross Connect Drawers

The line card motherboards and the mux/demux modules on the Cisco ONS 15540 ESPx connect to each other through the cross connect drawers using MTP-to-MU breakout cables. Each breakout cable has an MTP connector on one end and eight individual MU connectors on the other end called breakout cables.

Each cross connect drawer is an 8-channel drawer. To configure a 32-channel system you need four drawers and two cable storage drawers. All MTP and MTP-to-MU breakout cables are pulled out to the left of the chassis and enter the

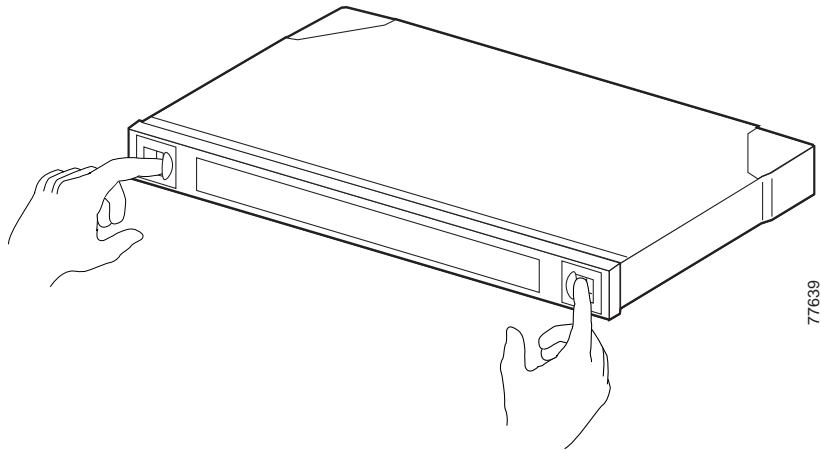
drawers on the left side of the cable storage drawers. They then route out of the right side of the cable storage drawer, enter the cross connect drawers through the right side, and connect to their destination connector. The breakout cables are color coded and should be matched to its corresponding color on the cross connect panel inside the drawer.

The cabling route inside the drawers described in this document is suggested cabling only. Use your own judgement as to how to best route your cable in the drawer according to your configuration and cable length.

To connect cables on the Cisco ONS 15540 ESPx mux/demux modules and line card motherboards using the cross connect drawer, follow these steps:

- 
- Step 1** Open the cable storage drawer by pushing the tabs in to release the lock on the drawer. (See [Figure 3-10](#).)

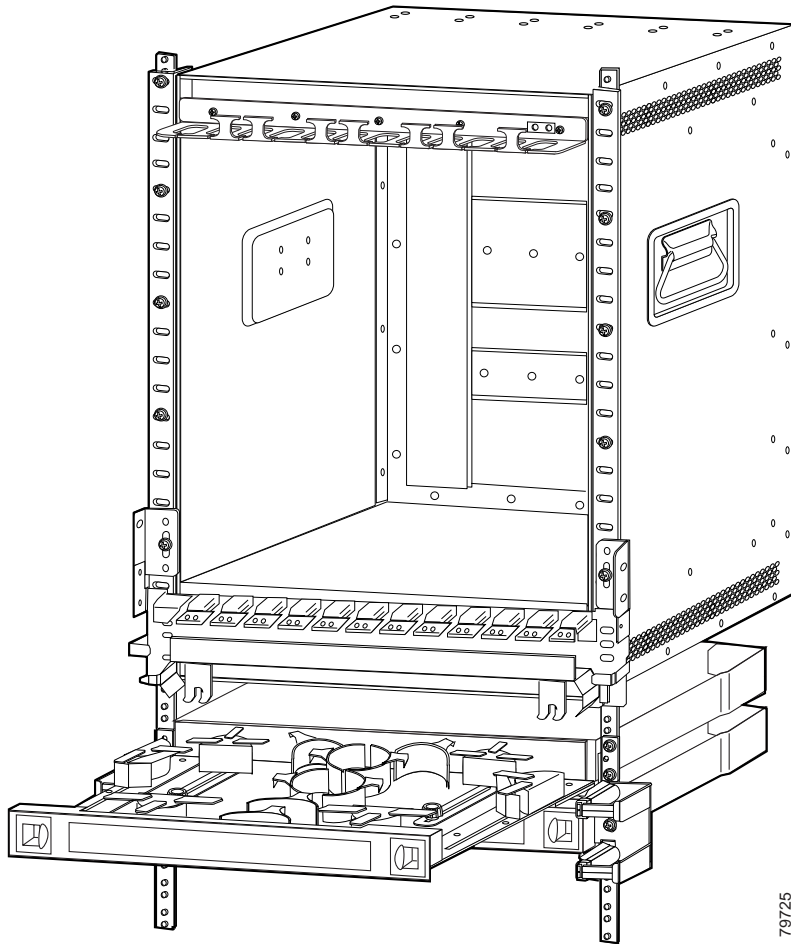
**Figure 3-10** *Opening the Cable Storage Drawer*



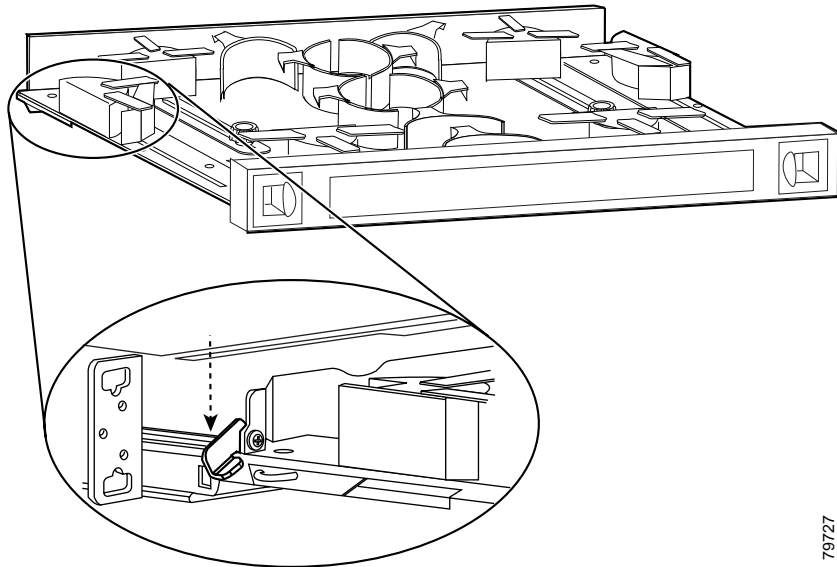
- Step 2** Pull out the cable storage drawer. (See [Figure 3-11](#).)



**Figure 3-11** Pulling out the Cable Storage Drawer



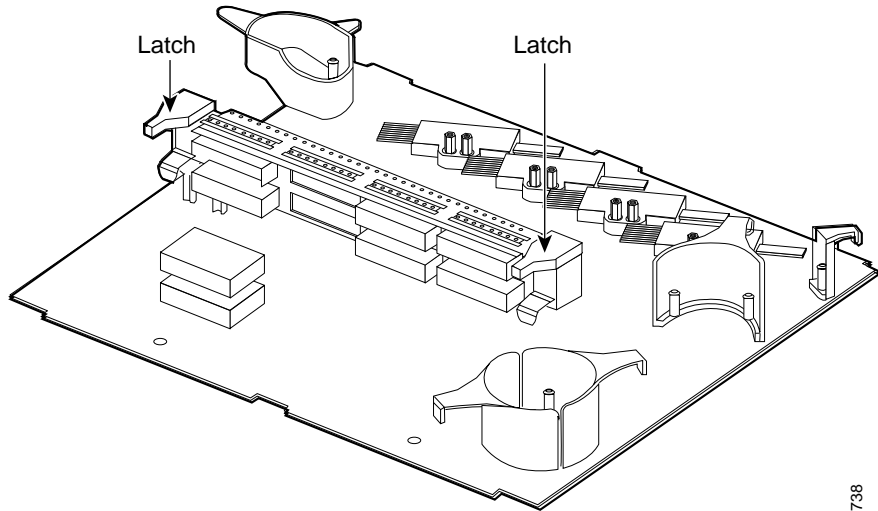
- Step 3** Lock the drawer in the open position by pushing the lever at the back left of the drawer down in the lock position. (See [Figure 3-12](#).)

**Figure 3-12 Locking the Drawer**

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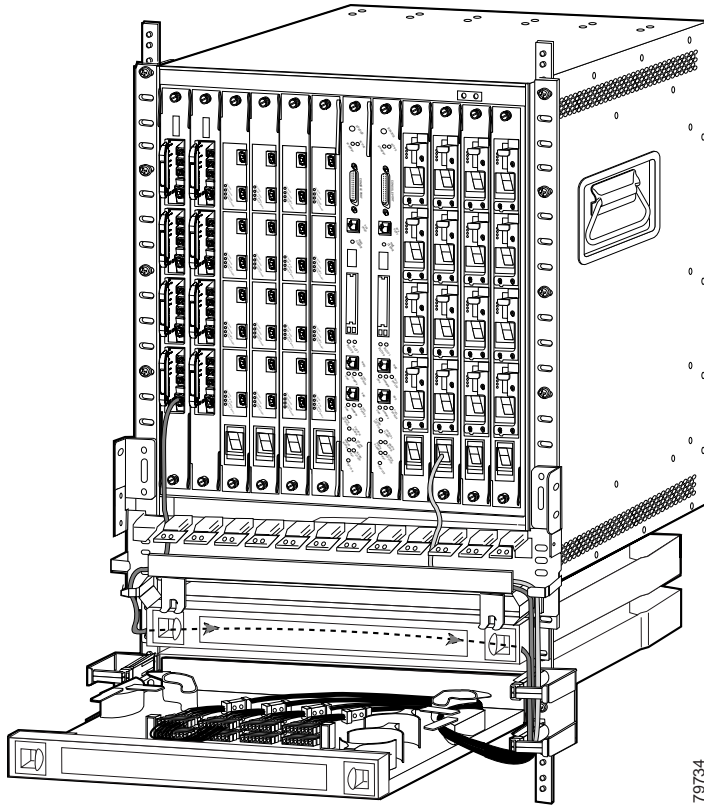
- Step 4** Use the MTP cable installation tool to push the MTP connector of the cable into the adapter on the mux/demux module until the connector snaps into place.
- Step 5** Route the MTP cable down through the cable management tray. Pull the cable out the left side of the tray.
- Step 6** Route the cable down the left side of the chassis and into the drawer.
- Step 7** Pull the cable through the vertical cable guides on the side of the cable storage drawer.
- Step 8** Route the cables through the storage drawer as directed in Step 5 to Step 7 in the [“Direct Connections with Cable Storage Drawers”](#) section.
- Step 9** Close the cable storage drawer once the cables are routed out of the right side and you unlock the drawer.
- Step 10** Open the cross connect drawer appropriate for your system configuration. See Step 1 to Step 3 above for drawer opening details.
- Step 11** Flip the latches on the cross connect panel up and use them to pull the panel up. (See [Figure 3-13.](#))

**Figure 3-13** Pulling Up the Cross Connect Panel



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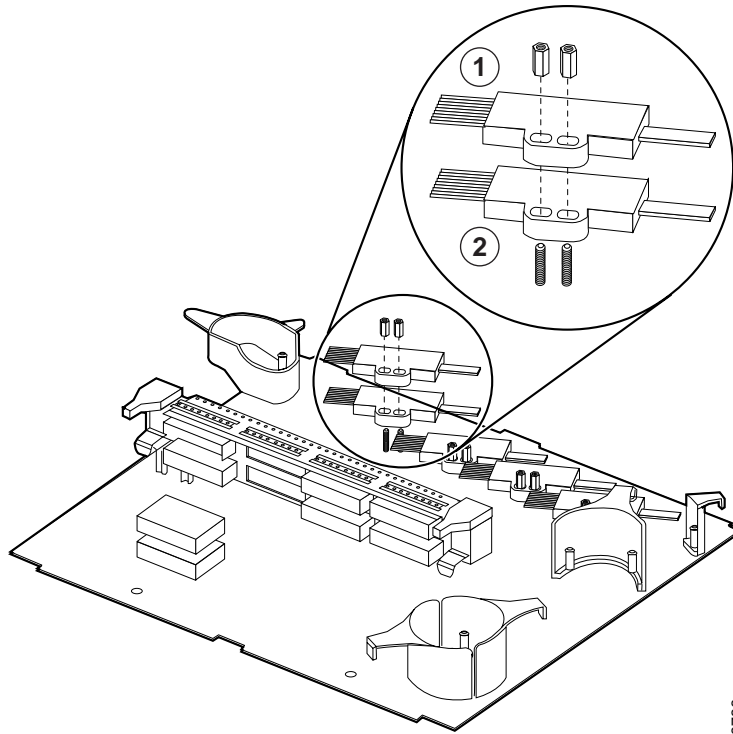
- Step 12** Route the MU breakout end of the cable in through the left side of the drawer. (See [Figure 3-14](#).)

*Figure 3-14 Routing the Cross Connect Cables*

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**Step 13** Mount the transition box as shown in [Figure 3-15](#).

Figure 3-15 Mounting the Transition Box

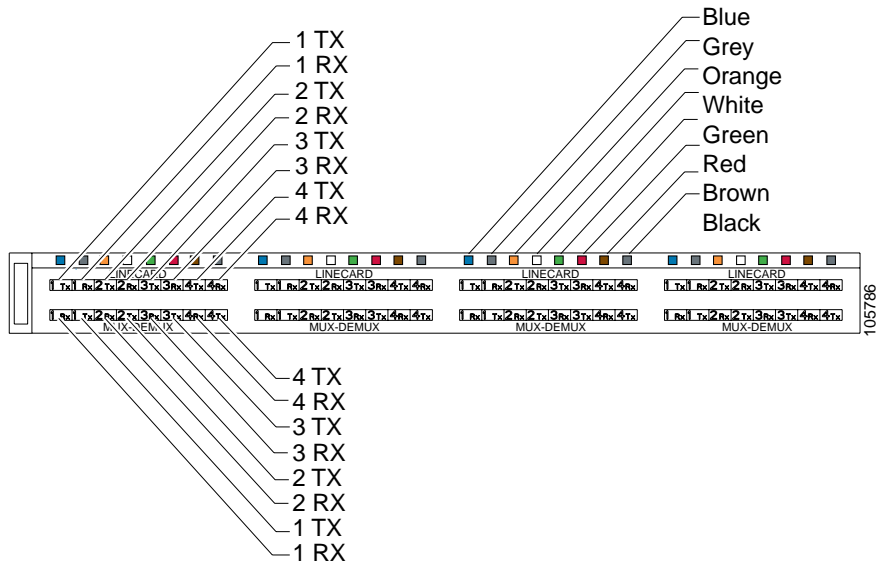


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1	Line card motherboard connections	2	Mux/demux motherboard connections
---	-----------------------------------	---	-----------------------------------

- Step 14** Connect the cables to the bottom half of the desired adapter mux/demux connections on the inner side of the cross connect panel. These are color coded and should be connected by matching the color on the panel to the colored wires out of the transition box. (See [Figure 3-16](#).)

Figure 3-16 Cross Connect Panel



## Connecting Mux/Demux Motherboards Land Line Card Motherboards with Cross Connect Drawers

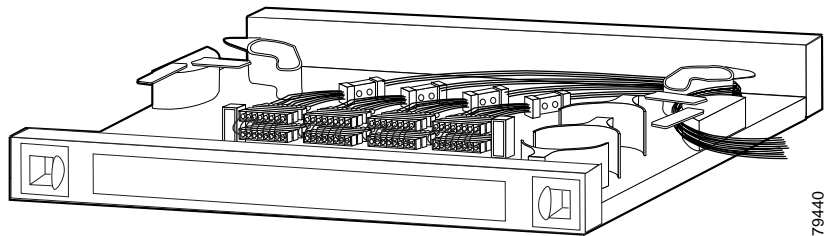
The mux/demux motherboards and the line card motherboards and the on the Cisco ONS 15540 ESPx connect to each other through the cross connect drawers using MTP-to-MU breakout cables. Each breakout cable has an MTP connector on one end and eight individual MU connectors on the other end.

Each cross connect drawer is an 8-channel drawer. To configure a 32-channel system you need four drawers and two cable storage drawers. All MTP and MTP-to-MU breakout cables are pulled out to the left of the chassis and enter the drawers on the left side of the cable storage drawers. They then route out of the right side of the cable storage drawer, enter the cross connect drawers through the right side, and connect to their destination connector.

To connect the mux/demux and transponders in the Cisco ONS 15540 ESPx, use the MU to MU cables and follow these steps:

- 
- Step 1** Make the mux/demux motherboard and line card motherboard connections. See the [“Mux/Demux Module and Line Card Motherboard Cabling with Cross Connect Drawers”](#) section.
- Step 2** Connect one end of the MU to MU cable to the top half of the desired mux/demux motherboard connections on the outside of the cross connect panel.
- Step 3** Connect the other end of the same MU to MU cable to the bottom half of the desired line card motherboard connection on the outside of the cross connect panel. (See [Figure 3-17](#).)

**Figure 3-17** Cross Connect Panel Connections



- Step 4** Push the panel down and lock it by pushing the tabs down.
- Step 5** Push the drawer in when you are done making all of your connections.

---

For more information about different configurations, see the *Cisco ONS 15540 ESPx Planning Guide*.

# Connecting the 2.5-Gbps Transponder Module

The 2.5-Gbps transponder module requires the following cables:

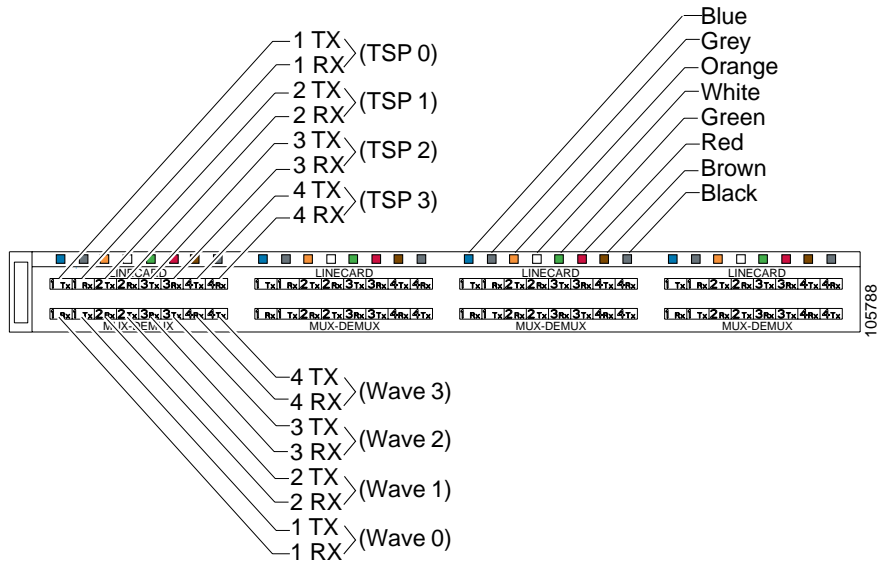
- MTP to MTP connectors used for direct connections (blue)
- MTP to 8 MU connectors used on OADM modules (gray)
- MTP to 8 MU connectors used on line card motherboards (green)
- MU to MU connectors (yellow)

When you make direct connections in the Cisco ONS 15540 ESPx, you connect the line card motherboard MTP connections directly to the MTP connections on the mux/demux modules or mux/demux motherboards. This connection requires just one MTP cable storage drawer.

The line card motherboards and the mux/demux modules on the Cisco ONS 15540 ESPx connect to each other through the cross connect drawers using the MTP-to-8 MU breakout cables. The cable has one MTP connector at one end that is plugged either onto the MTP connector at the base of the line card motherboard or onto the MTP connectors on the mux/demux modules. The cable then runs down into the cross connect drawer and connects to the cross connect panel with the 8 MU cables. The motherboards can be installed in any of slots 2 to 5 and 8 to 11; however, the transponder modules in the line card motherboards, or the channels within the band, must be in increasing order from top to bottom. [Figure 3-18](#) shows an example of the transponder modules (TSP) to wavelength connection through the cross connect panel.

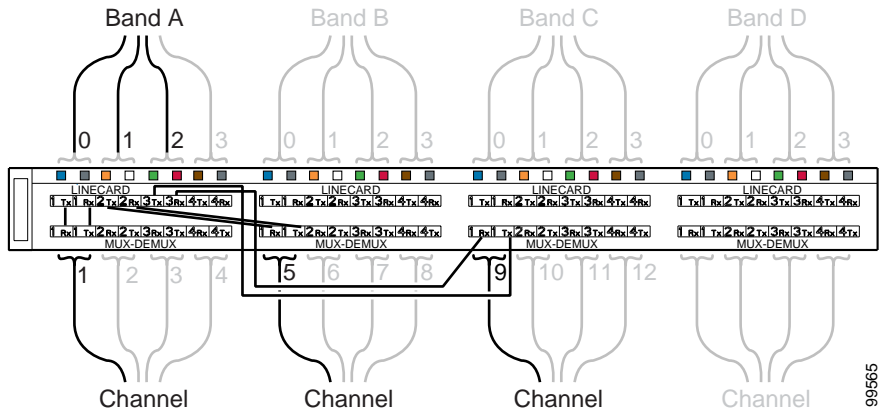


Figure 3-18 Transponder Module to Wavelength Connection



The Cisco ONS 15540 ESPx allows channels from different bands in the same slot. With the cross connect drawer, the system allows for use of an application where it is possible to use only certain channels in a given node. [Figure 3-19](#) shows the connections you would make if you wanted to use only channels 1, 5, and 9.

Figure 3-19 Channels from Different Bands



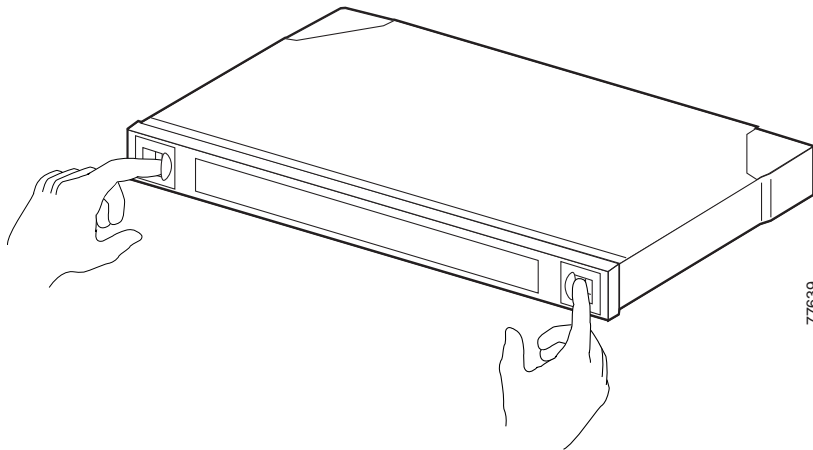
Band A 0 to 2 would extend from your mux/demux module. Using your cross connect drawer, channels 1, 5, and 9 would extend to your transponder modules. Use the MU-to-MU connectors to connect from band A to channels 1, 5, and 9.

## Using MTP Cables for Direct Connections

To connect the mux/demux motherboards and line card motherboards directly using an MTP-to-MTP cable, follow these steps:

- 
- Step 1** Open the cable storage drawer by pushing the tabs in to release the lock on the drawer. (See [Figure 3-20](#).)

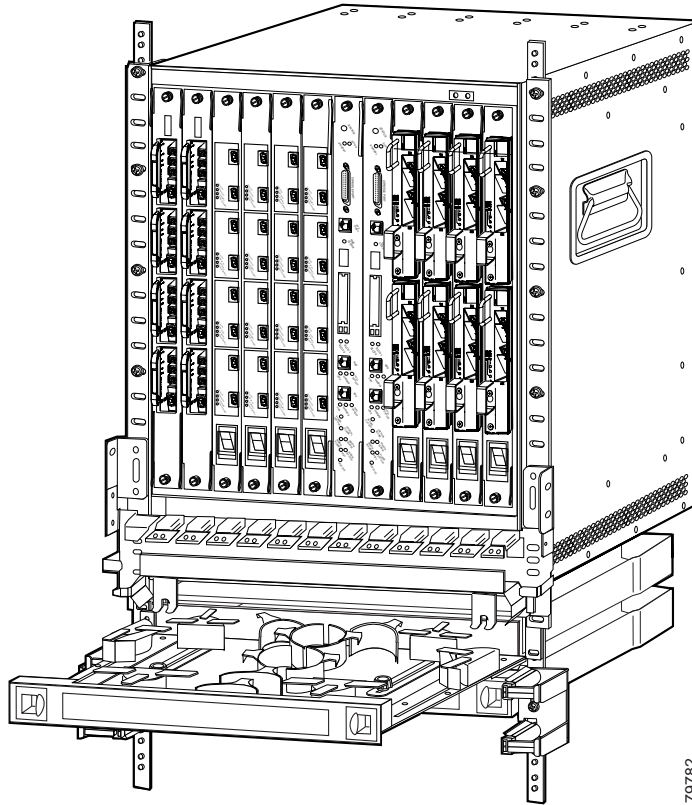
*Figure 3-20 Opening the Cable Storage Drawer*



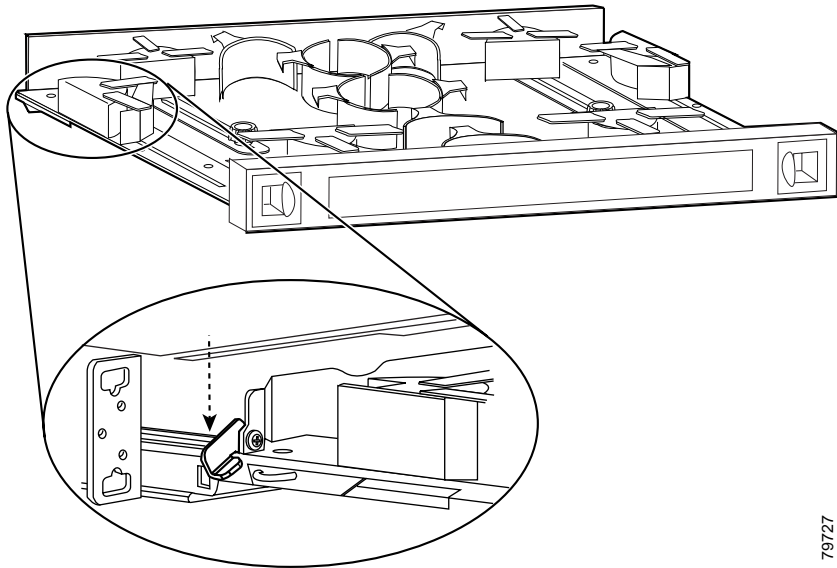
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- Step 2** Pull out the cable storage drawer. (See [Figure 3-21](#).)

**Figure 3-21** Pulling Out the Cable Storage Drawer



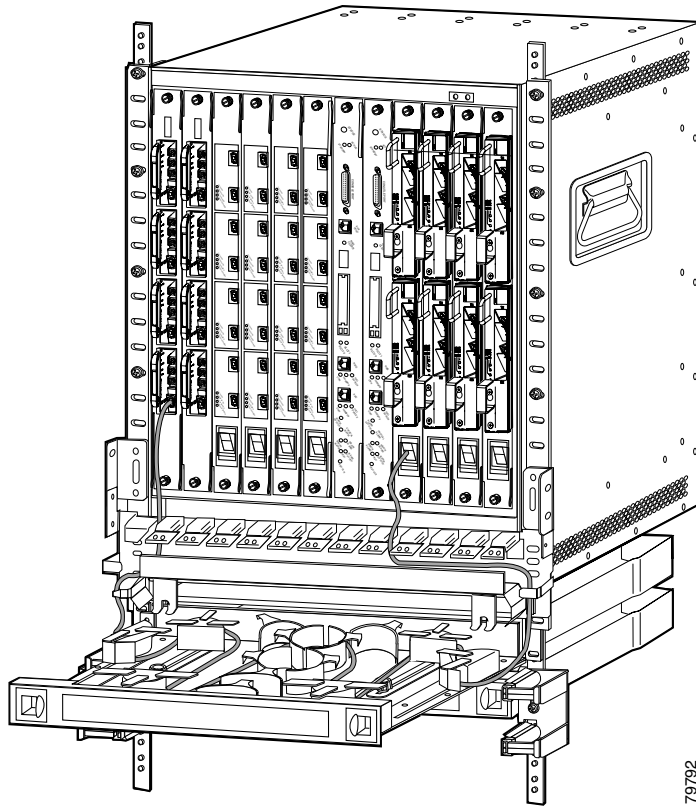
- Step 3** Lock the drawer in the open position by pushing the latch at the back left of the drawer down into the lock position. (See [Figure 3-22](#).)

**Figure 3-22 Locking the Drawer**

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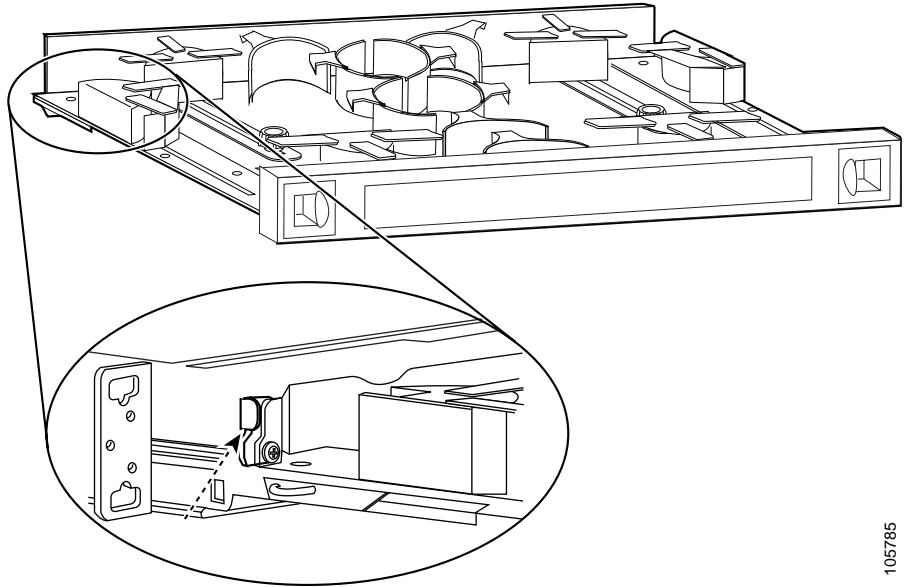
- Step 4** Use the MTP cable installation tool to push the MTP connector of the cable into the adapter on the line card motherboard until the connector snaps into place.
- Step 5** Route the MTP cable down through the cable management tray. Pull the cable out the left side of the tray.
- Step 6** Route the cable down the left side of the chassis and into the drawer.
- Step 7** Continue to route the cable through the drawer around the round cable retainers to the right side.
- Step 8** Pull the cable up out of the right side of the drawer and back up through the cable management tray.
- Step 9** Insert the MTP connector into the MTP adapter on the desired line card motherboard. (See [Figure 3-23](#).)

Figure 3-23 Routing the Cable Storage Drawer



Repeat Steps 1 through 4 to continue cabling the system without the cross connect panel.

- Step 10** Unlock the drawer by moving the latch back into an upright position and close the drawer. (See [Figure 3-24](#).)

**Figure 3-24** *Unlocking the Drawer*

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**Note**

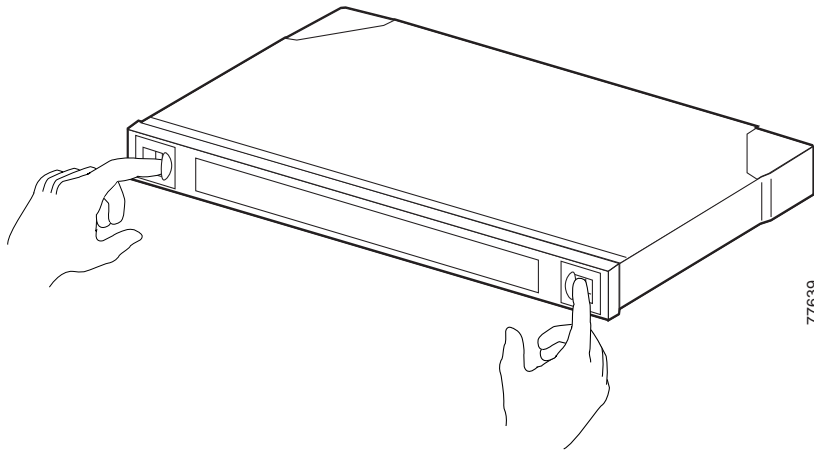
You can use the client clips shipped with the chassis to clip together cables for easy handling and organization.

## Cabling 2.5-Gbps Transponder Modules with Cross Connect Drawers

To connect cables on the Cisco ONS 15540 ESPx 2.5-Gbps transponder modules using the cross connect drawer, follow these steps:

- Step 1** Open the cable storage drawer by pushing the tabs in to release the lock on the drawer. (See [Figure 3-25](#).)

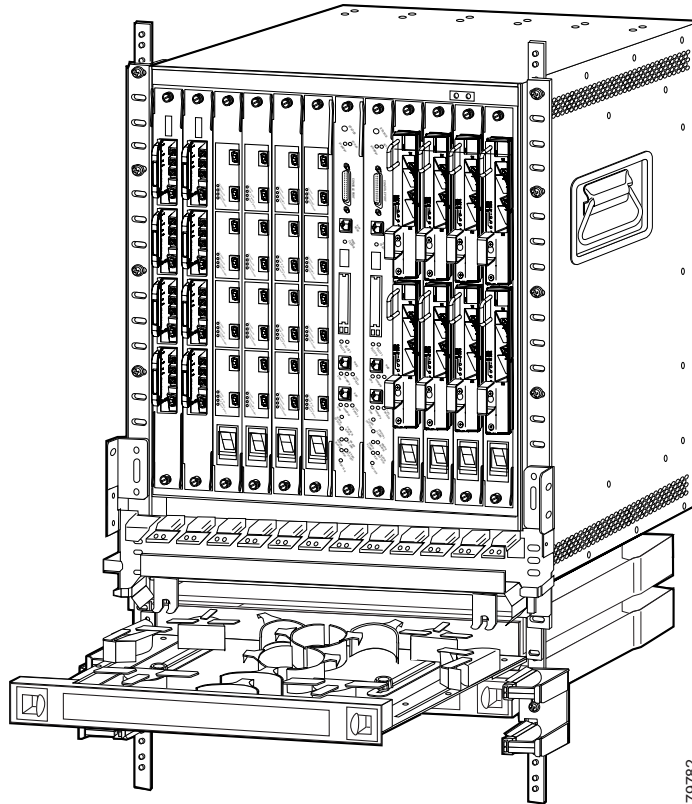
*Figure 3-25 Opening the Cable Storage Drawer*



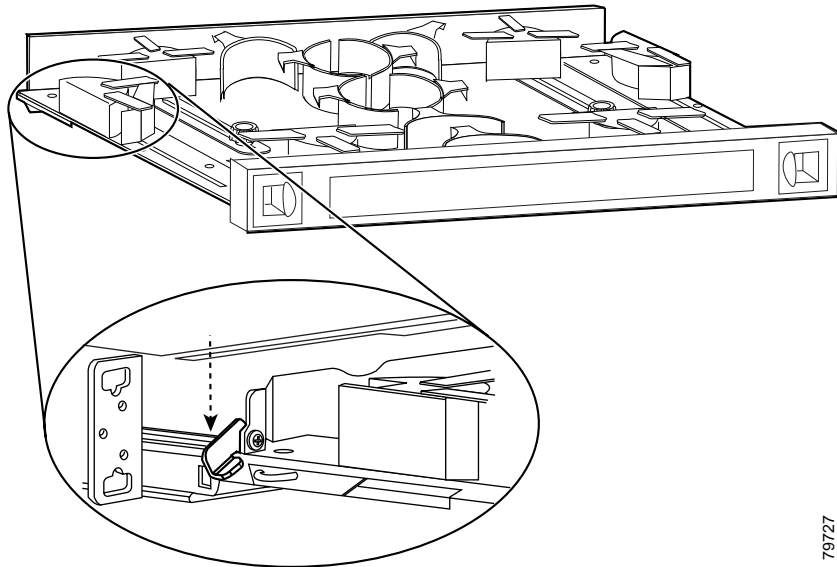
- Step 2** Pull out the cable storage drawer. (See [Figure 3-26](#).)



*Figure 3-26 Pulling out the Cable Storage Drawer*



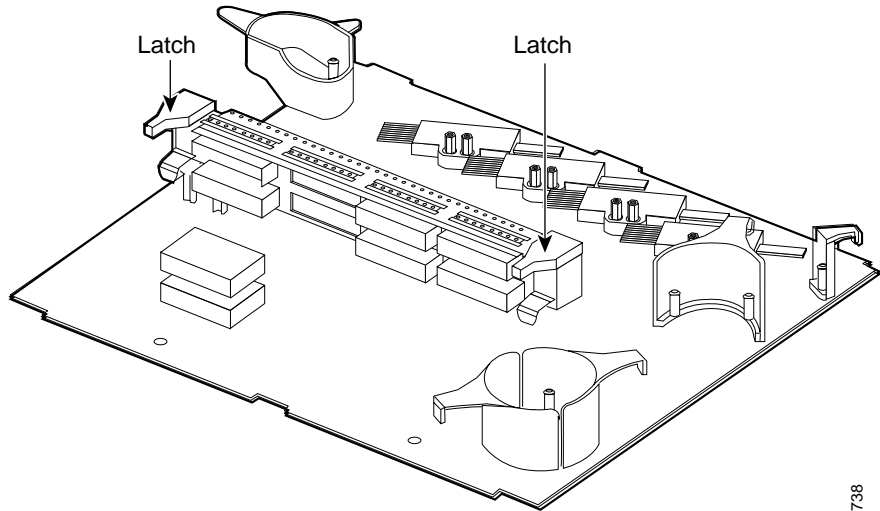
- Step 3** Lock the drawer in the open position by pushing the lever at the back left of the drawer down in the lock position. (See [Figure 3-27](#).)

**Figure 3-27 Locking the Drawer**

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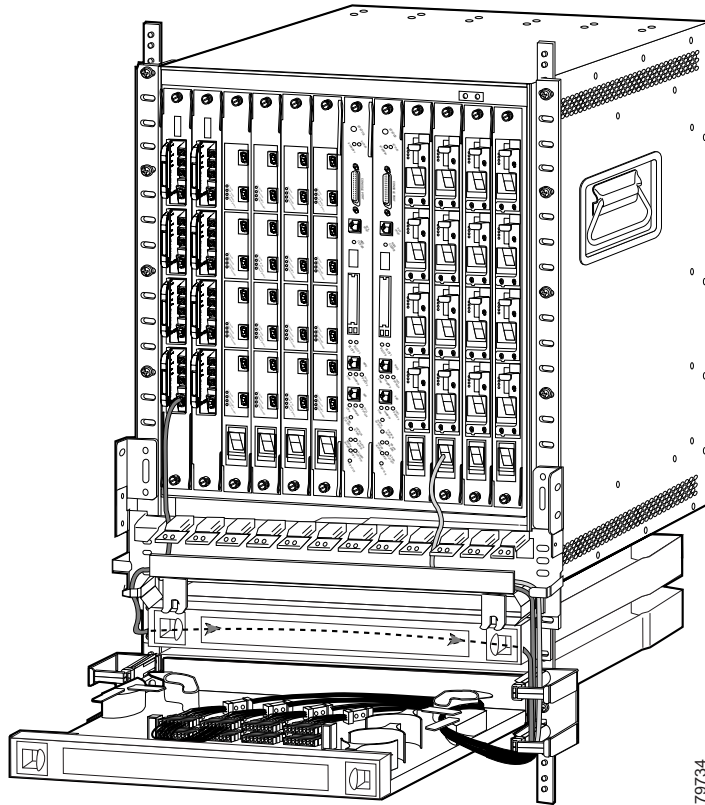
- Step 4** Use the MTP cable installation tool to push the MTP connector on the cable into the adapter on the 2.5-Gbps transponder module until the connector snaps into place.
- Step 5** Route the MTP cable down through the cable management tray. Pull the cable out the left side of the tray.
- Step 6** Route the cable down the left side of the chassis and into the drawer.
- Step 7** Pull the cable through the vertical cable guides on the side of the cable storage drawer.
- Step 8** Route the cables through the storage drawer as directed in Steps 5 to 7 in the [“Direct Connections with Cable Storage Drawers”](#) section on page 3-16.
- Step 9** Close the cable storage drawer once the cables are routed out of the right side and you unlock the drawer.
- Step 10** Open the cross connect drawer appropriate for your system configuration. See Step 1 to Step 3 above for drawer opening details.
- Step 11** Flip the latches on the cross connect panel up and use them to pull the panel up. (See [Figure 3-28](#).)

**Figure 3-28** Pulling Up the Cross Connect Panel



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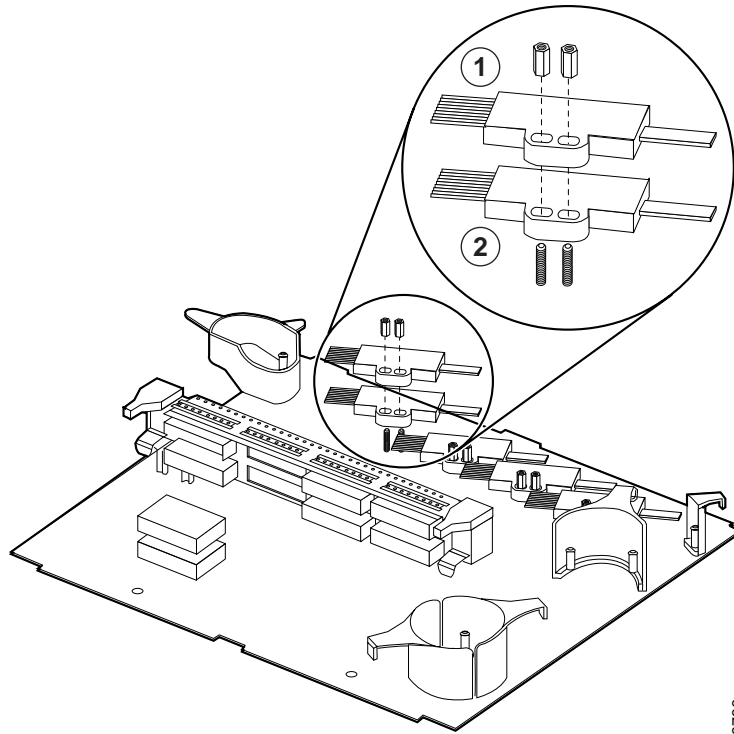
- Step 12** Route the MU breakout end of the cable in through the right side of the drawer. (See [Figure 3-29](#).)

*Figure 3-29 Routing the Cross Connect Cables*

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**Step 13** Mount the transition box as shown in [Figure 3-30](#).

Figure 3-30 Mounting the Transition Box

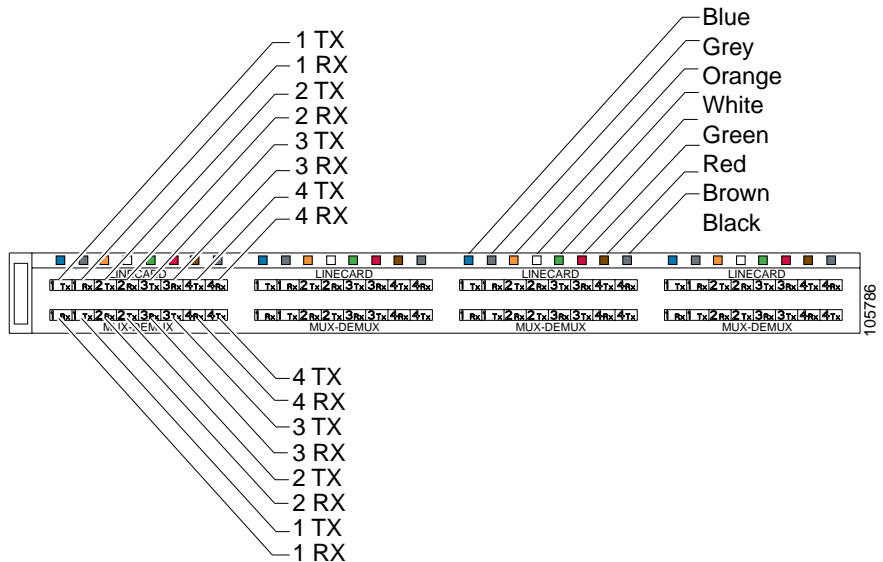


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1	2.5-Gbps line card motherboard connections	2	Mux/demux motherboard connections
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- Step 14** Connect the cables to the bottom half of the desired adapter mux/demux connections on the inner side of the cross connect panel. These are color coded and should be connected by matching the color on the panel to the colored wires out of the transition box. (See [Figure 3-31](#).)

Figure 3-31 Cross Connect Panel



- Step 15** Connect the MU connectors on the outer side of the panel. Connect the Tx from the line card motherboard to the Tx on the mux/demux motherboard side. Connect the Rx line card side to the Rx on the mux/demux motherboard side.

To connect the mux/demux motherboards to the line card motherboards, see the [“Connecting Mux/Demux Motherboards Land Line Card Motherboards with Cross Connect Drawers”](#) section on page 3-28.

# Connecting the 10-GE Transponder Module

The 10-GE transponder module requires the following cables:

- MTP to 4 MU (aqua)
- MTP to 4 MU (rose)
- Y cable (blue)
- MTP to MTP

When you make direct connections in the Cisco ONS 15540 ESPx, you connect the line card motherboard MTP connections directly to the MTP connections on the mux/demux modules or mux/demux motherboards. This connection requires just one MTP cable storage drawer. There are two different cables you can use for direct connections depending on your configuration:

- MTP to MTP
- MTP to 2x MTP (y cable)

The line card motherboards and the mux/demux motherboards on the Cisco ONS 15540 ESPx connect to each other through the cross connect drawers using the MTP-to-MU breakout cables. The cable has one MTP connector at one end that usually is plugged either onto the MTP connector at the base of the line card motherboard or onto the MTP connectors on the mux/demux modules.

The motherboards can be installed in any of slots 2 to 5 and 8 to 11; however, the transponder modules in the line card motherboards, or the channels within the band, must be in increasing order from top to bottom.

**Note**

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Allow two minutes for the 10-Gbps laser on the 10-GE transponder module to warm up before it transmits traffic.

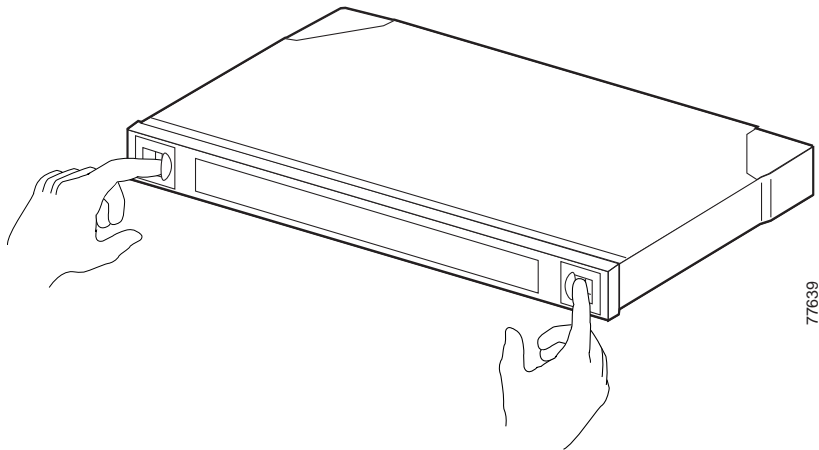
---

## Using MTP Cables for Direct Connections

To connect the mux/demux motherboards and line card motherboards directly using an MTP-to-MTP cable, follow these steps:

- 
- Step 1** Open the cable storage drawer by pushing the tabs in to release the lock on the drawer. (See [Figure 3-32](#).)

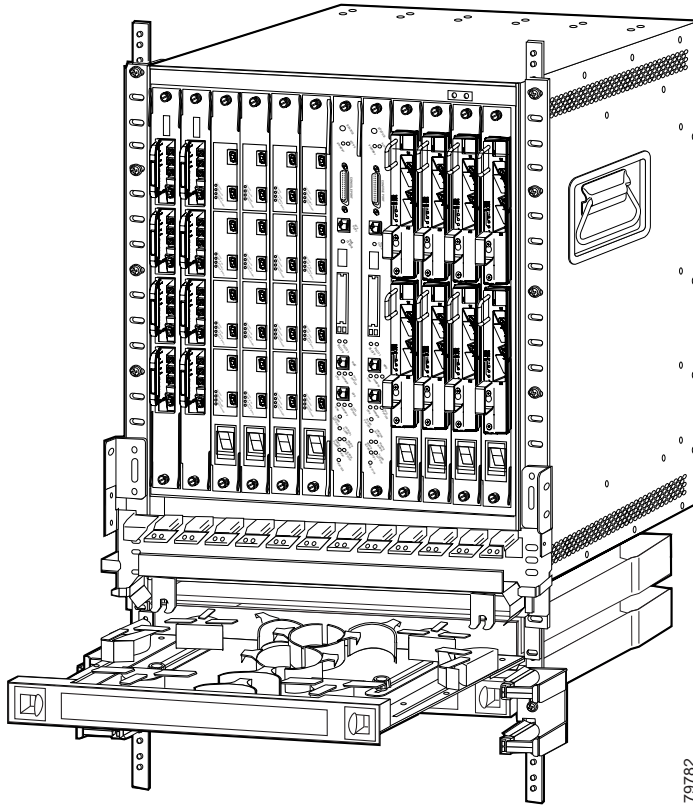
*Figure 3-32 Opening the Cable Storage Drawer*



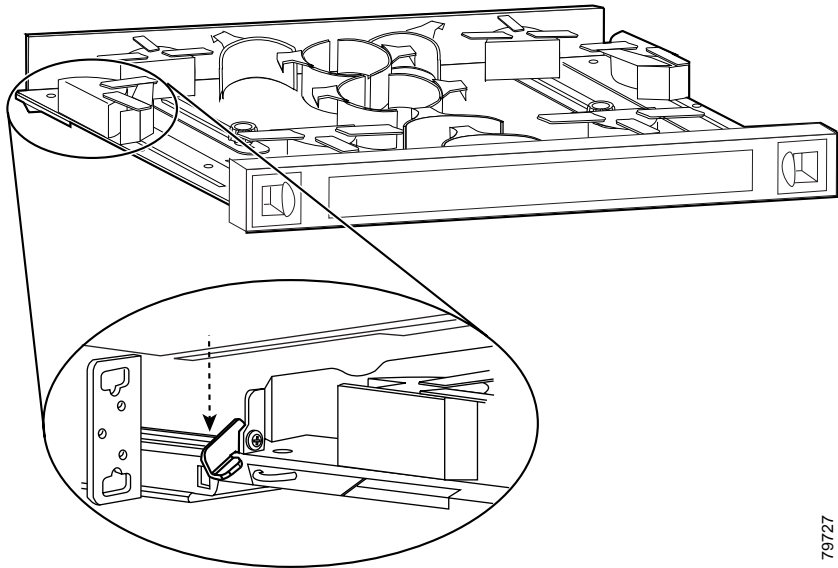


- Step 2** Pull out the cable storage drawer. (See [Figure 3-33](#).)

**Figure 3-33** Pulling out the Cable Storage Drawer



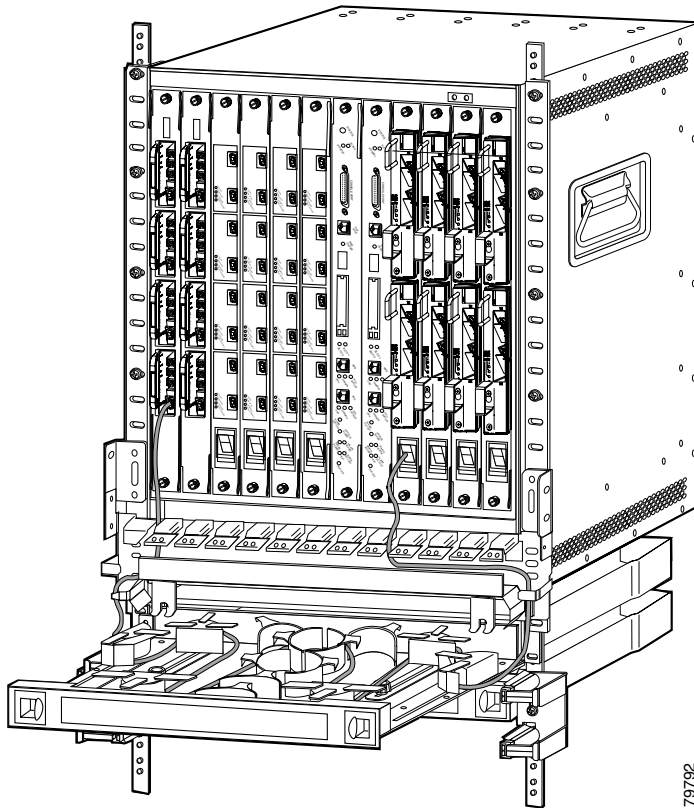
- Step 3** Lock the drawer in the open position by pushing the latch at the back left of the drawer down into the lock position. (See [Figure 3-34](#).)

**Figure 3-34 Locking the Drawer**

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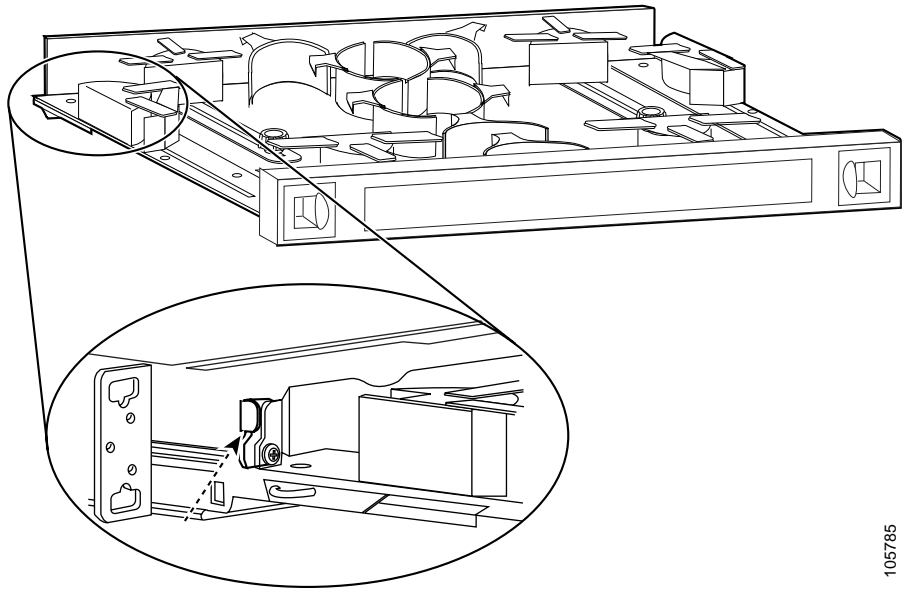
- Step 4** Use the MTP cable installation tool to push the MTP connector of the cable into the adapter on the line card motherboard until the connector snaps into place.
- Step 5** Route the MTP cable down through the cable management tray. Pull the cable out the left side of the tray.
- Step 6** Route the cable down the left side of the chassis and into the drawer.
- Step 7** Continue to route the cable through the drawer around the round cable retainers to the right side.
- Step 8** Pull the cable up out of the right side of the drawer and back up through the cable management tray.
- Step 9** Insert the MTP connector into the MTP adapter on the desired line card motherboard. (See [Figure 3-35](#).)

*Figure 3-35 Routing the Cable Storage Drawer*



Repeat Steps 1 through 4 to continue cabling the system without the cross connect panel.

- Step 10** Unlock the drawer by moving the latch back into an upright position and close the drawer. (See [Figure 3-36](#).)

**Figure 3-36** *Unlocking the Drawer*

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**Note**

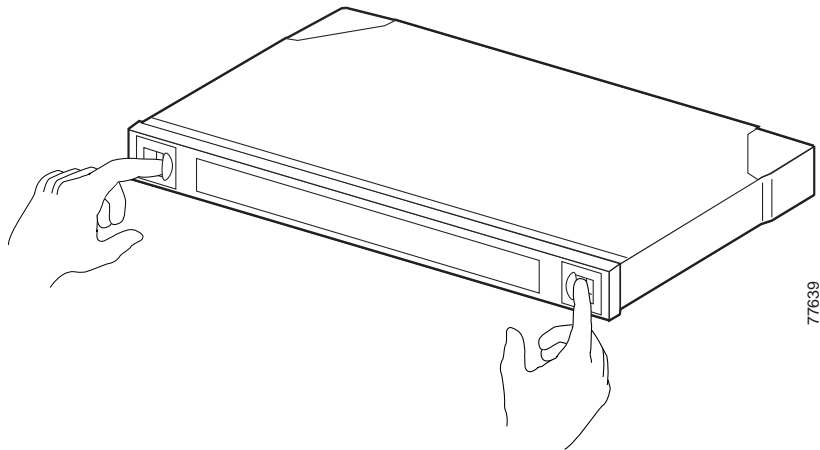
You can use the client clips shipped with the chassis to clip together cables for easy handling and organization.

## Using Y Cables for 10-GE Direct Connections

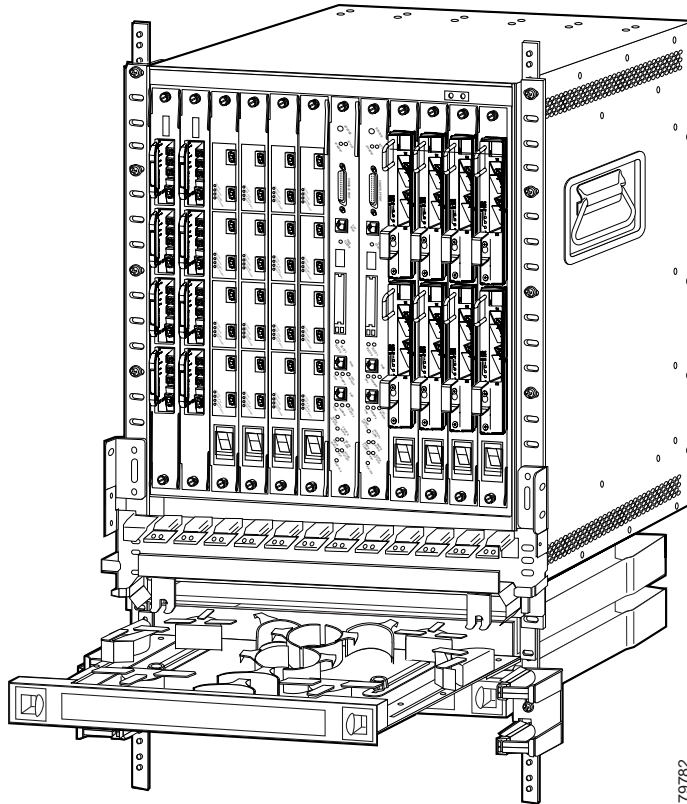
To connect the mux/demux motherboards and line card motherboards directly using a y cable, follow these steps:

- 
- Step 1** Open the cable storage drawer by pushing the tabs in to release the lock on the drawer. (See [Figure 3-37](#).)

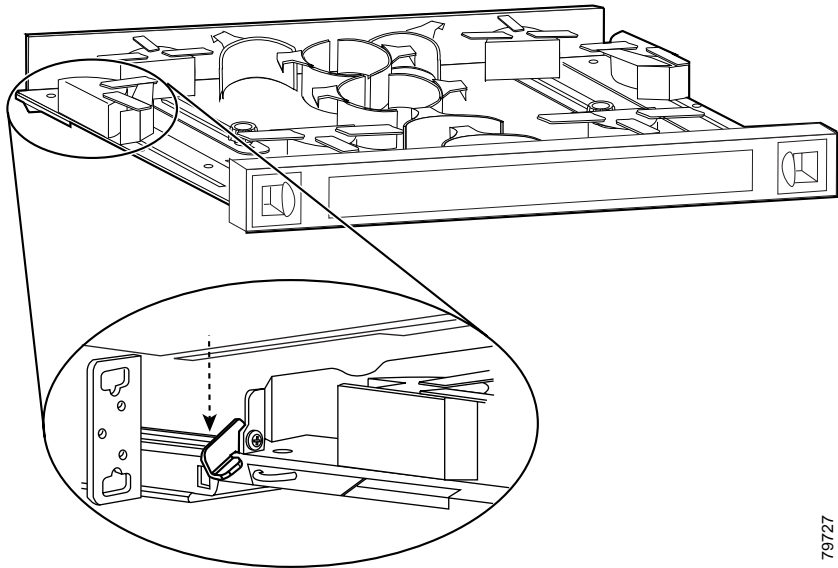
*Figure 3-37 Opening the Cable Storage Drawer*



- Step 2** Pull out the cable storage drawer. (See [Figure 3-38](#).)

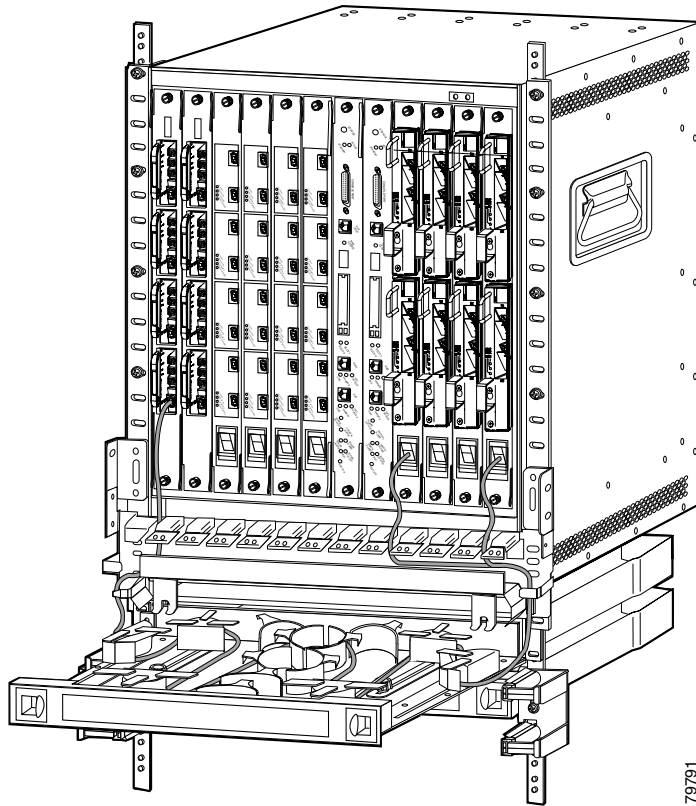
*Figure 3-38 Pulling out the Cable Storage Drawer*

- Step 3** Lock the drawer in the open position by pushing the latch at the back left of the drawer down into the lock position. (See [Figure 3-39](#).)

**Figure 3-39 Locking the Drawer**

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- Step 4** Use the MTP cable installation tool to push the MTP connector of the cable into the adapter on the mux/demux module until the connector snaps into place.
- Step 5** Route the MTP cable down through the cable management tray. Pull the cable out the left side of the tray.
- Step 6** Route the cable down the left side of the chassis and into the drawer.
- Step 7** Continue to route the cable through the drawer around the round cable retainers to the right side.
- Step 8** Pull the cable up out of the right side of the drawer and the back up through the cable management tray.
- Step 9** Insert the MTP connectors into two different MTP adapters on the desired line card motherboards. (See [Figure 3-40](#).)

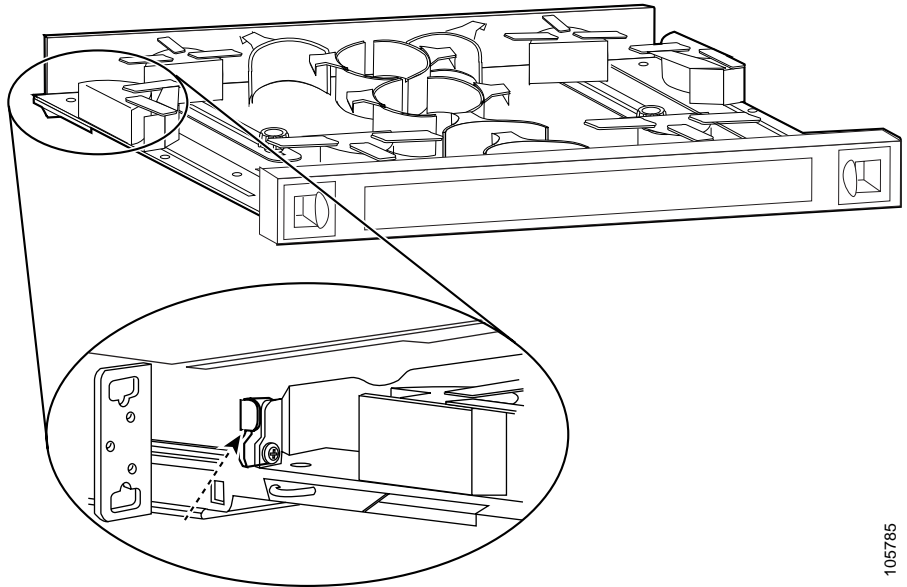
*Figure 3-40 Routing the Cable Storage Drawer*

Repeat Steps 1 through 4 to continue cabling the system without the cross connect panel.

- Step 10** Unlock the drawer by moving the latch back into an upright position and close the drawer. (See [Figure 3-41](#).)



**Figure 3-41** *Unlocking the Drawer*



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**Note**

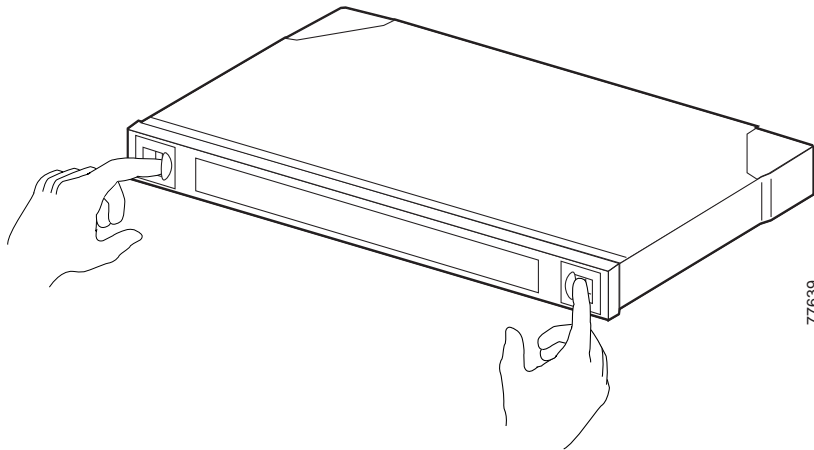
You can use the client clips shipped with the chassis to clip together cables for easy handling and organization.

## Cabling 10-GE Transponder Modules with Cross Connect Drawers

To connect cables on the Cisco ONS 15540 ESPx 10-GE transponder modules using the cross connect drawer, follow these steps:

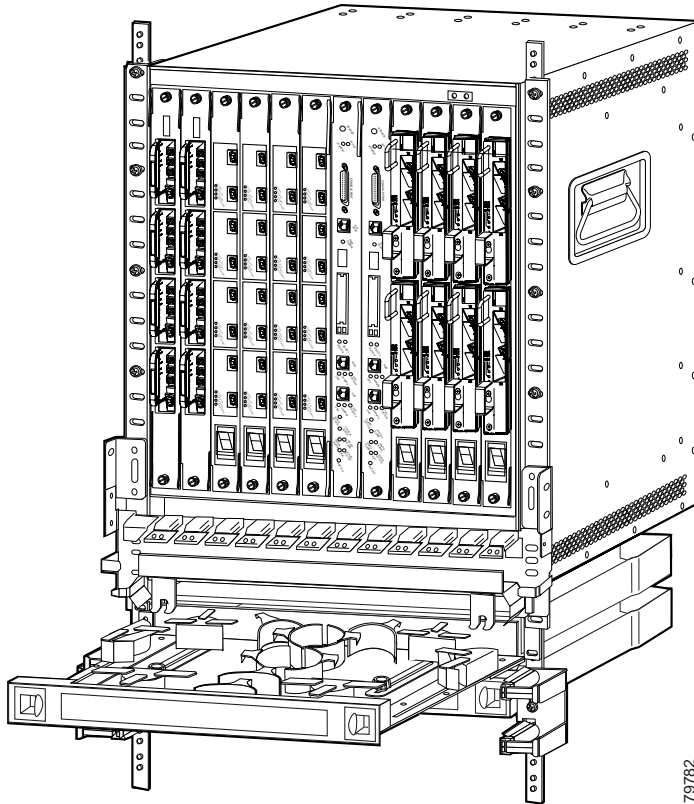
- 
- Step 1** Open the cable storage drawer by pushing the tabs in to release the lock on the drawer. (See [Figure 3-42](#).)

*Figure 3-42 Opening the Cable Storage Drawer*

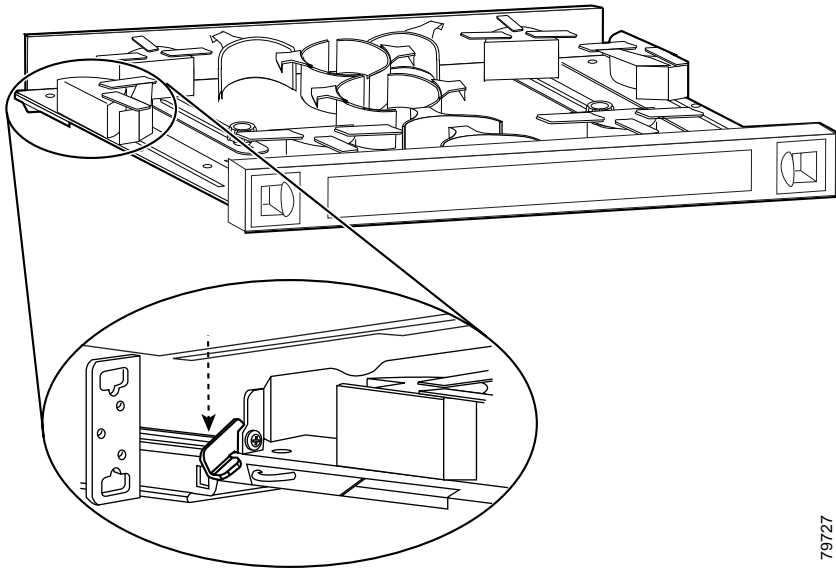


- Step 2** Pull out the cable storage drawer. (See [Figure 3-43](#).)

**Figure 3-43** Pulling out the Cable Storage Drawer



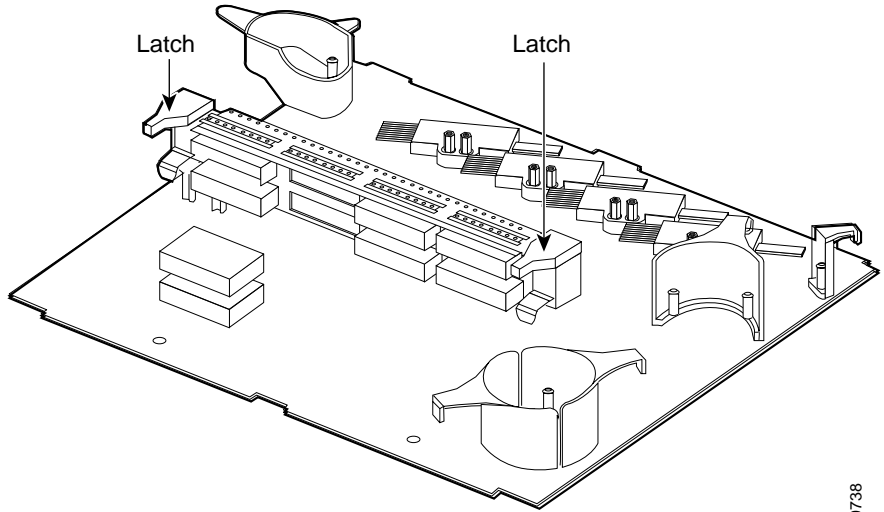
- Step 3** Lock the drawer in the open position by pushing the lever at the back left of the drawer down in the lock position. (See [Figure 3-44](#).)

**Figure 3-44 Locking the Drawer**

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- Step 4** Use the MTP cable installation tool to push the MTP connector on the cable into the adapter on the 10-GE transponder module until the connector snaps into place.
- Step 5** Route the MTP cable down through the cable management tray. Pull the cable out the left side of the tray.
- Step 6** Route the cable down the left side of the chassis and into the drawer.
- Step 7** Pull the cable through the vertical cable guides on the side of the cable storage drawer.
- Step 8** Route the cables through the storage drawer as directed in Steps 5 to 7 in the [“Direct Connections with Cable Storage Drawers”](#) section on page 3-16.
- Step 9** Close the cable storage drawer once the cables are routed out of the right side and you unlock the drawer.
- Step 10** Open the cross connect drawer appropriate for your system configuration. See Step 1 to Step 3 above for drawer opening details.
- Step 11** Flip the latches on the cross connect panel up and use them to pull the panel up. (See [Figure 3-45](#).)

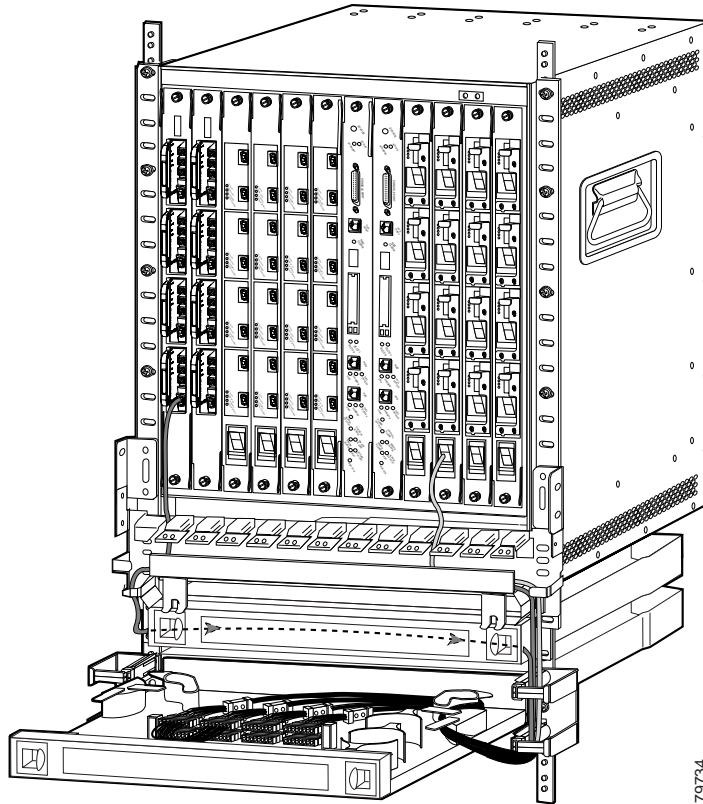
*Figure 3-45 Pulling up the Cross Connect Panel*



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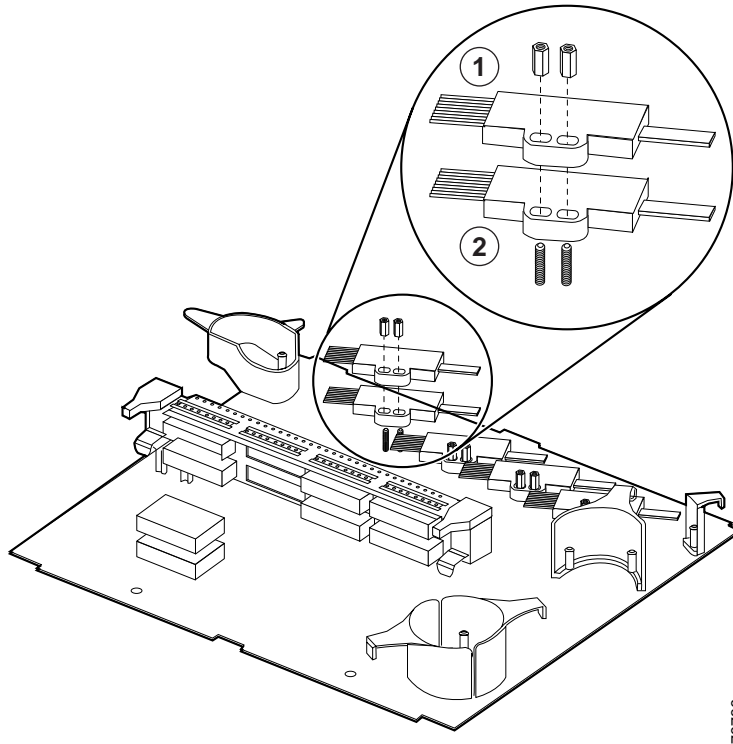
- Step 12 Route the MU breakout end of the cable in through the right side of the drawer. (See [Figure 3-46](#).)

*Figure 3-46 Routing the Cross Connect Cables*



**Step 13** Mount the transition box as shown in [Figure 3-47](#).

**Figure 3-47** Mounting the Transition Box

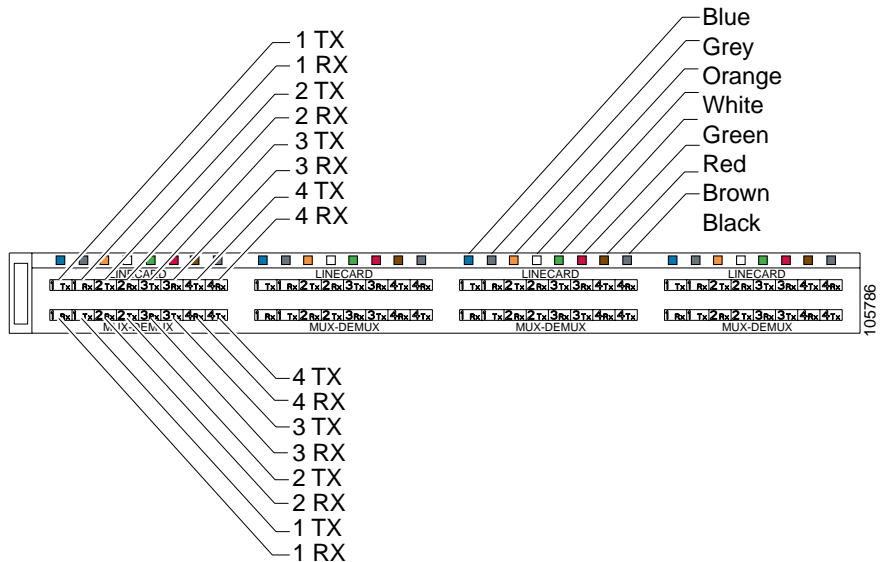


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1	10-Gbps line card motherboard connections	2	Mux/demux motherboard connections
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**Step 14** Connect the cables to the bottom half of the desired adapter mux/demux connections on the inner side of the cross connect panel. (See [Figure 3-48](#).)

Figure 3-48 Cross Connect Panel



- Step 15** Connect the MU connectors on the outer side of the panel. Connect the Tx from the line card motherboard to the Tx on the mux/demux motherboard side. Connect the Rx line card side to the Rx on the mux/demux motherboard side.

The mux/demux expects the channels within the band boundary in a certain order, lowest to highest. Since the 10-Gbps line card motherboard holds only two 10-GE transponder modules, the module in subslot 0 always uses the first channel and the module in subslot 1 uses the second channel within the four possible channels.

When you connect the MU connectors from the mux/demux motherboard to the 10-Gbps line card motherboard on the cross connect panel, you must know what channel the 10-GE transponder module represents and cross connect to the appropriate location.

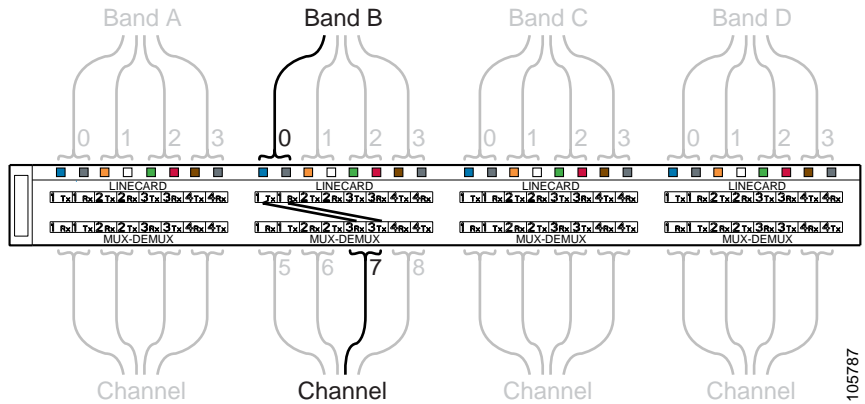
For example, (see [Figure 3-49](#)) if the 10-GE transponder module installed in subslot 0 represents channel seven, then it corresponds with the third channel within band B (5, 6, 7, 8). You would use the MU connectors to connect the Tx and Rx of the subslot 0 line card motherboard port to the Tx and Rx of the third channel on the mux/demux motherboard port on the cross connect panel. If the



10-GE transponder module were installed in subslot 1, you would connect the Tx and Rx of the subslot 1 line card motherboard port to the Tx and Rx of the third channel on the mux/demux motherboard port on the cross connect panel.

**Figure 3-49 10-GE Transponder to Channel Connection**

Subslot 0, Channel 7



To connect the mux/demux motherboards to the line card motherboards, see the [“Connecting Mux/Demux Motherboards Land Line Card Motherboards with Cross Connect Drawers”](#) section on page 3-28.





# Specifications

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This appendix describes the specifications for the chassis and components used in the Cisco ONS 15540 ESPx 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](#)
- [32-Channel Terminal Mux/Demux Module Specifications, page A-8](#)
- [PSM Optical Specifications, page A-9](#)
- [Line Card Motherboard Specifications, page A-10](#)
- [2.5-Gbps Transponder Module Specifications, page A-11](#)
- [Type 2 Extended Range Transponder Module Specifications, page A-13](#)
- [10-GE Transponder Module Specifications, page A-22](#)



## Note

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

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# Chassis Specifications

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

**Table A-1 Cisco ONS 15540 ESPx Specifications**

Description	Specification
<b>Environmental</b>	
Temperature, ambient operating	32 to 104°F (0 to +40°C)
Relative humidity, ambient (noncondensing) operating	90 to 95%
<b>Physical Characteristics</b>	
Dimensions (H x W x D)	24 x 17.3 x 12 in. (60.1 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-type connectors MU connectors MT-RJ LC
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)
<b>AC-Input Power</b>	
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
<b>DC-Input Power</b>	
DC-input voltage	-48 to -60 VDC (nominal) -40.5 to -72 VDC (full range)
Power consumption maximum	1125W
Heat dissipation	3840 BTU/hr

# 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 ESPx Band	Cisco ONS 15540 ESPx Channel	ITU Channels	ITU Wavelength <sup>1</sup>	ITU Frequency <sup>2</sup>
OSC <sup>3</sup>		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 ESPx Band	Cisco ONS 15540 ESPx Channel	ITU Channels	ITU Wavelength <sup>1</sup>	ITU Frequency <sup>2</sup>
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 <sup>1</sup> 9 μm	
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)	
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>
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	
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>
Transmitter power	4 dBm	8 dBm
Output wavelength	1530.33 nm	1560.61 nm
Dispersion tolerance		1800 ps/nm <sup>2, 3</sup>

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 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	0.5 lbs (.23 kg)
Fiber	ITU-T G.652 compliant
OSC <sup>1</sup>	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 <sup>2</sup>
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 <sup>1</sup>	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 <sup>2</sup>
Maximum relative humidity	90 to 95%

1. OSC = optical supervisory channel.
2. See [Table A-2](#) for band A to H wavelengths.

# 32-Channel Terminal Mux/Demux Module Specifications

Table A-6 lists the specifications for the 32-channel with OSC terminal mux/demux module.



## Warning

If the chassis loses CPU power, traffic on the 32-channel module will be lost or seriously degraded. The 32-channel module uses arrayed wavelength grating (AWG) filters, which require temperature control. A power failure significantly reduces the power at the receiver because the passband of the filter is temperature sensitive.

**Table A-6 32-Channel with OSC Terminal Mux/Demux Specifications**

Description	Specification
Dimensions	13.8 x 8.6 in. (33 x 22 cm)
Weight	3.5 lbs (1.59 kg)
Operating temperature	32 to 149°F (0~to 65°C)
Storage temperature	-40 to 185°F (-40 to 85°C)
Channel mapping	Bands A to H <sup>1</sup>
Fiber	SMF-28 or equivalent
Monitor, OSC, and common ports	Low loss tuned MU/UPC
Add/drop channel connectors	Low loss MTP female /APC
Tap ratio	-20 ± 1 dB (with connectors)

1. See Table A-2 for band A to H wavelengths.

# PSM Optical Specifications

[Table A-7](#) lists the PSM specifications for the Cisco ONS 15540 ESPx.

**Table A-7 PSM Specifications**

Description	Specification
Dimensions	3.7 x 9 in. (9.4 x 22.9 cm)
Weight	3.5 lbs (1.59 kg)
Connector type	MU/UPC
Operation wavelength	1525 nm minimum, 1565 nm maximum
Measurement range	0 to -31dBm
Receive overload	17 dBm
Power monitor accuracy	± 1.9 dB

[Table A-8](#) lists the PSM optical specifications for the Cisco ONS 15540 ESPx.

**Table A-8 Optical PSM Specifications**

Port	Insertion Loss	
	Min	Max
Rx_West to monitor	19	20
Rx_East to monitor	19	20
Tx_Common to Tx_West	2.7	3.7
Tx_Common to Tx_East	2.7	3.7

# Line Card Motherboard Specifications

Table A-9 lists the specifications for the Cisco ONS 15540 ESPx line card motherboards.

**Table A-9** *Line Card Motherboard Specifications*

Description	Specification
Dimensions	18 x 9 in. (45.7 x 22.9 cm)
Connector	MTP

## 2.5-Gbps Transponder Module Specifications

[Table A-10](#) lists the client side optical specifications for the 2.5-Gbps SM and MM transponder module.



### Note

Error-free transmission of some D1 video signals (defined by the SMPTE 259M standard) and test patterns (such as Matrix SDI) cannot be guaranteed by the Cisco 15500 Series because of the pathological pattern in D1 video. This well-known limitation is usually overcome by the D1 video equipment vendor, who uses a proprietary, second level of scrambling. No standards exist at this time for the second level of scrambling.

**Table A-10 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	Minimum	Maximum	Minimum	Maximum
Transmitter power	-5 dBm	0 dBm	-5 dBm	0 dBm
Output wavelength	1260 nm	1360 nm	1260 nm	1360 nm

Table A-11 lists the trunk side optical specifications for the 2.5-Gbps transponder module.

**Table A-11 2.5-Gbps Transponder Module Trunk Side Optical Specifications**

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

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-12 lists the trunk side optical specifications for the Type 2 extended range transponder module.



## Note

Error-free transmission of some D1 video signals (defined by the SMPTE 259M standard) and test patterns (such as Matrix SDI) cannot be guaranteed by the Cisco 15500 Series because of the pathological pattern in D1 video. This well-known limitation is usually overcome by the D1 video equipment vendor, who uses a proprietary, second level of scrambling. No standards exist at this time for the second level of scrambling.

**Table A-12** *Type 2 Extended Range Transponder Module Trunk Side Optical Specifications*

Description	Specification	
Fiber	ITU-T G.652 compliant	
Receiver	Minimum	Maximum
OSNR <sup>1</sup>	19 dB	
Receive sensitivity <sup>1</sup>	-28 dBm	
Receive overload		-8 dBm
Input wavelength	1430 nm	1580 nm
Transmitter	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-13 lists the specifications for the Cisco ONS 15540 ESPx fixed rate SFP optics.



Note

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

**Table A-13 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 $\mu$ m, 62.5/125 $\mu$ m	
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 and Fibre Channel (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 $\mu$ m, 62.5/125 $\mu$ m	



**Table A-13 Fixed Rate SFP Optics Specifications (continued)**

Description	Specification	
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
Output wavelength	830 nm	860 nm
<b>Part number</b>	<b>15500-XVRA-03B1</b>	
Gigabit Ethernet and Fibre Channel (1 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, 1.25 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 $\mu$ m	
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
<b>Part number</b>	<b>15500-XVRA-03B2</b>	
Fibre Channel (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	

**Table A-13 Fixed Rate SFP Optics Specifications (continued)**

Description	Specification	
Fiber type	SM, 9/125 $\mu$ m	
Connector type	LC	
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>
Receive sensitivity	-20.5 dBm	
Input wavelength	1270 nm	1600 nm
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>
Transmitter power	-9.5 dBm	-3 dBm
Output wavelength	1275 nm	1350 nm
<b>Part number</b>	<b>15500-XVRA-02C2</b>	
<b>Fibre Channel (1 Gbps and 2 Gbps) MM</b>		
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 $\mu$ m, 62.5/125 $\mu$ m	
Connector type	LC	
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>
Receive sensitivity ( $\leq$ 1.06 Gbps)	-18 dBm	
Receive sensitivity ( $>$ 1.06 Gbps)	-15 dBm	
Stressed receive sensitivity ( $\leq$ 1.06 Gbps)	-13.5 dBm	
Stressed receive sensitivity ( $>$ 1.06 Gbps)	-12.1 dBm	-12.1 dBm
Input wavelength	770 nm	860 nm
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>
Transmitter power	-9 dBm	-4 dBm

**Table A-13 Fixed Rate SFP Optics Specifications (continued)**

Description		Specification	
Output wavelength	830 nm	860 nm	
<b>Part number</b>	<b>15500-XVRA-06B1</b>		
SONET OC-12 SM and SDH STM-4			
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 $\mu$ m		
Connector type	LC		
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>	
Receive sensitivity	-28 dBm		
Receive overload		-7 dBm	
Input wavelength	1100 nm	1600 nm	
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>	
Transmitter power	-15 dBm	-8 dBm	
Output wavelength	1260 nm	1360 nm	
<b>Part number</b>	<b>15500-XVRA-07B1</b>		
SONET OC-48 SM and SDH STM-16			
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 $\mu$ m		
Connector type	LC		
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>	
Receive sensitivity	-18 dBm		
Receive overload		-3 dBm	
Input wavelength	1270 nm	1600 nm	

**Table A-13 Fixed Rate SFP Optics Specifications (continued)**

Description	Specification	
	Minimum	Maximum
Transmitter		
Transmitter power	-9.5 dBm	-3 dBm
Output wavelength	1285 nm	1340 nm

Table A-14 lists the specifications for the Cisco ONS 15540 ESPx variable rate SFP optics.



**Note**

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

**Table A-14 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 $\mu$ m MM 62.5/125 $\mu$ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @ $10^{-12}$ BER <sup>1</sup>	-32 dBm	
Receive sensitivity @ $10^{-15}$ BER	-29 dBm	
Receive overload @ $10^{-12}$ BER		-14 dBm
Input wavelength	1100 nm	1600 nm

**Table A-14 Variable Rate SFP Optics Specifications (continued)**

<b>Description</b>	<b>Specification</b>	
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>
Transmitter power	-19 dBm	-14 dBm
Output wavelength	1280 nm	1380 nm
<b>Part number</b>	<b>15500-XVRA-10B1</b>	
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 $\mu$ m	
Connector type	LC	
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>
Receive sensitivity @ $10^{-12}$ BER	-32 dBm	
Receive overload @ $10^{-12}$ BER		-3 dBm
Input wavelength	1100 nm	1600 nm
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>
Transmitter power	-8 dBm	-4 dBm
Output wavelength	1260 nm	1360 nm
<b>Part number</b>	<b>15500-XVRA-11A1</b>	
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 $\mu$ m	
Connector type	LC	

**Table A-14 Variable Rate SFP Optics Specifications (continued)**

Description	Specification	
	Minimum	Maximum
Receiver		
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
<b>Part number</b>	<b>15500-XVRA-11B1</b>	
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 $\mu$ m	
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
<b>Part number</b>	<b>15500-XVRA-12B1</b>	

**Table A-14 Variable Rate SFP Optics Specifications (continued)**

Description	Specification	
Supported protocol encapsulations	Fibre Channel, 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 $\mu$ m	
Connector type	LC	
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>
Receive sensitivity @ $10^{-10}$ BER	-18 dBm	
Maximum receive power @ $10^{-10}$ BER		-3 dBm
Input wavelength	1100 nm	1600 nm
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>
Transmitter power	-10 dBm	-3 dBm
Output wavelength	1266 nm	1360 nm

1. BER = bit error rate

# 10-GE Transponder Module Specifications

**Table A-15** specifies the client side transmit and receive characteristics for the 10-GE transponders.



## Note

Error-free transmission of some D1 video signals (defined by the SMPTE 259M standard) and test patterns (such as Matrix SDI) cannot be guaranteed by the Cisco 15500 Series because of the pathological pattern in D1 video. This well-known limitation is usually overcome by the D1 video equipment vendor, who uses a proprietary, second level of scrambling. No standards exist at this time for the second level of scrambling.

**Table A-15** 10-GE Transponder Module Client Side Optical Specifications

Description	Specification	
Fiber type	SM 1310 nm	
Connector	SC	
Dimensions	10.4 x 1.105 x 8.797 in. (264.2 x 28.1 x 223.4 mm)	
Bit rate	10 GE LAN-PHY	
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>
Receive sensitivity	-13.23 dBm	
Receive overload		0.5 dBm
Stressed receive sensitivity	-10.3 dBm	
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>
Transmit power	-5.2 dBm	0.5 dBm
Wavelength range	1260 nm	1355 nm



Table A-16 specifies the trunk side transmit and receive characteristics for the 10-GE transponders.

**Table A-16 10-GE Transponder Module Trunk Side Optical Specifications**

Description	Specification	
Fiber type	ITU-T G.652	
Connector	SC	
<b>Receiver</b>	<b>Minimum</b>	<b>Maximum</b>
OSNR <sup>1, 2</sup>	26 dB	
Receive sensitivity <sup>2</sup>	-22 dBm	
Receive overload		-8 dBm
Input wavelength	1430 nm	1580 nm
<b>Transmitter</b>	<b>Minimum</b>	<b>Maximum</b>
Output power	1 dBm	6 dBm
Dispersion tolerance		$\pm 1000$ ps/nm <sup>3</sup>

1. OSNR = optical signal-to-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 = picosecond per nanometer.





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