E-Series Routers
Installation and User Guide

Release 5.1.x

NETWORKS

Juniper

Federal Communications Commission (FCC) Statement

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

This equipment is designed for use with properly shielded and terminated cables. Refer to the installation sections of this manual before operation.

Reference: CFR 47, Part 15J, Sect 15.105 April 18, 1989

Caution: Changes or Modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Requirements For Consumer Products

This equipment complies with FCC rules, Part 68. On the back side of this equipment is a label that contains, among other information, the FCC Registration Number and Ringer Equivalence Number (REN) for this equipment. If requested, provide this information to your telephone company.

If this equipment causes harm to the telephone network, the Telephone Company may discontinue your service temporarily. If possible, they will notify you in advance. But if advance notice isn't practical, you will be notified as soon as possible. You will be advised of your right to file a complaint with the FCC.

Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of your equipment. If they do, you will be given advance notice so as to give you an opportunity to maintain uninterrupted service.

If you experience trouble with this equipment, please contact the manufacturer for warranty/repair information. The telephone company may ask that you disconnect this equipment from the network until the problem has been corrected or until you are sure that the equipment is not malfunctioning.

Food and Drug Administration, Center for Devices and Radiological Health

This equipment complies with 21 CFR 1040.10 and 1040.11 for the safe use of lasers.

Canadian Department Of Communications Radio Interference Regulations

This Class B (or Class A, if so indicated on the registration label) digital apparatus meets the requirements of the Canadian Interference-Causing Equipment Regulations.

Réglement sur le brouillage radioélectrique du ministère des communications

Cet appareil numérique de la Classe B (ou Classe A, si ainsi indiqué sur l'étiquette d'enregistrement) respecte toutes les exigences du Reglement sur le Materiel Brouilleur du Canada.

Industry Canada Notice CS-03

The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operation and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department does not guarantee the equipment will operate to the user's satisfaction. Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using and acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be coordinated by a representative designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

Notice: The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

Avis CS-03 d'Industrie Canada

L'étiquette du ministère des Communications du Canada indique que l'appareillage est certifié, c'est-à-dire qu'il respecte certaines exigences de sécurité et de fonctionnement visant les réseaux de télécommunications. Le ministère ne garantit pas que l'appareillage fonctionnera à la satisfaction de l'utilisateur. Avant d'installer l'appareillage, s'assurer qu'il peut être branché aux installations du service de télécommunications local. L'appareillage doit aussi être raccordé selon des méthodes acceptées. Le client doit toutefois prendre note qu'une telle installation n'assure pas un service parfait en tout temps.

Les réparations de l'appareillage certifié devraient être confiées à un service d'entretien canadien désigné par lefournisseur. En cas de réparation ou de modification effectuées par l'utilisateur ou de mauvais fonctionnement del'appareillage, le service de télécommunications peut demander le débranchement de l'appareillage.

Pour leur propre sécurité, les utilisateurs devraient s'assurer que les mises à la terre des lignes de distribution d'électricité, des lignes téléphoniques et de la tuyauterie métallique interne sont raccordées ensemble. Cette mesure de sécurité est particulièrement importante en milieu rural.

Attention: Les utilisateurs ne doivent pas procéder à ces raccordements eux-mêmes mais doivent plutôt faire appel aux pouvoirs de réglementation en cause ou à un électricien, selon le cas.

Avis: Veuillez prendre note que pour tout appareillage supportant des lignes de type "loopstart," l'indice d'équivalence de la sonnerie (IES) assigné à chaque dispositif terminal indique le nombre maximal de terminaux qui peuvent être raccordés à une interface. La terminaison d'une interface téléphonique peut consister en une combinaison de quelques dispositifs, à la seule condition que la somme d'indices d'équivalence de la sonnerie de tous les dispositifs n'excède pas 5. Le REN figure sur l'étiquette "FCC Rules Part 68" située sur le support du module ou à l'arrière de l'unité.

D.O.C. Explanatory Notes: Equipment Attachment Limitations

The Canadian Department of Communications label identifies certified equipment. This certification meets certain telecommunication network protective, operational and safety requirements. The department does not guarantee the equipment will operate to the users satisfaction.

Before installing the equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above condition may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electrical inspection authority, or electrician, as appropriate.

Notes explicatives du ministère des Communications: limites visant les accessoires

L'étiquette du ministère des Communications du Canada indique que l'appareillage est certifié, c'est-à-dire qu'il respecte certaines exigences de sécurité et de fonctionnement visant les réseaux de télécommunications. Le ministère ne garantit pas que l'appareillage fonctionnera à la satisfaction de l'utilisateur.

Avant d'installer l'appareillage, s'assurer qu'il peut être branché aux installations du service de télécommunications local. L'appareillage doit aussi être raccordé selon des méthodes acceptées. Dans certains cas, le câblage interne du service de télécommunications utilisé pour une ligne individuelle peut être allongé au moyen d'un connecteur certifié (prolongateur téléphonique). Le client doit toutefois prendre note qu'une telle installation n'assure pas un service parfait en tout temps.

Les réparations de l'appareillage certifié devraient être confiées à un service d'entretien canadien désigné par le fournisseur. En cas de réparation ou de modification effectuées par l'utilisateur ou de mauvais fonctionnement de l'appareillage, le service de télécommunications peut demander le débranchment de l'appareillage.

Pour leur propre sécurité, les utilisateurs devraient s'assurer que les mises à la terre des lignes de distribution d'électricité, des lignes téléphoniques et de la tuyauterie métallique interne sont raccordées ensemble. Cette mesure de sécurité est particulièrement importante en milieu rural.

Attention: Les utilisateurs ne doivent pas procéder à ces raccordements eux-mêmes mais doivent plutôt faire appel aux pouvoirs de réglementation en cause ou à un électricien, selon le cas.

EC Declaration of Conformity

The EC Declaration of Conformity is available at the end of this manual.

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About This Guide

This *E-Series Installation and User Guide* provides the information you need to install and start the E-series router.

📄 **Note:** *If the information in the latest E-series Release Notes differs from the information in this guide, follow the E-series Release Notes.*

The E-series router is shipped with the latest system software installed. If you need to install a future release or reinstall the system software, refer to the procedures in *Appendix B, Installing JUNOSe Software.*

E-Series Routers

Five models of E-series routers are available:

- ERX-1440 router

- ERX-1410 router

- ERX-710 router

- ERX-705 router

- ERX-310 router

All models use the same software. For information about the differences between the models, see *Chapter 1, E-Series Overview*.

In the E-series documentation, the term ERX-14xx models refers to both the ERX-1440 router and the ERX-1410 router. Similarly, the term ERX-7xx models refers to both the ERX-710 router and the ERX-705 router. The terms ERX-1440 router, ERX-1410 router, ERX-710 router, ERX-705 router, and ERX-310 router refer to the specific models.

Audience

This guide is intended for experienced system and network specialists working with E-series routers in an Internet access environment.

Conventions

Table 1 defines notice icons used in this guide, and Table 2 defines text conventions used throughout the book, except for command syntax. Table 3 provides command syntax conventions used primarily in the *E-Series Command Reference Guide*. For more information about command syntax, see *E-Series System Basics Configuration Guide, Chapter 1, Planning Your Network*.

Table 1 Notice icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates that you may risk losing data or damaging your hardware.
	Warning	Alerts you to the risk of personal injury.

Table 2 Text conventions (except for command syntax)

Convention	Description	Examples
Bold typeface	Represents commands and keywords in text.	• Command example: Issue the **clock source** command. • Keyword example: Specify the keyword **exp-msg**.
Bold Courier typeface	Represents text that the user must type.	**user input**
Key name in angle brackets	Indicates the name of a key on the keyboard.	Press <Enter>.
Key names linked with a plus sign (+) in angle brackets.	Indicates that you must press two or more keys simultaneously.	Press <Ctrl+B>.
Plain Courier typeface	Represents information as displayed on your terminal's screen.	host1#**show ip ospf 2** Routing Process OSPF 2 with Router ID 5.5.0.250 Router is an Area Border Router (ABR)

Table 2 Text conventions (except for command syntax) (continued)

Convention	Description	Examples
Italics	• Emphasize words. • Identify variables. • Identify chapter, appendix, and book names.	• There are two levels of access, *user* and *privileged.* • *clusterId, ipAddress.* • *Appendix A, System Specifications.*

Table 3 Syntax conventions in *Command Reference Guide*

Convention	Description	Examples
Words in plain text	Represent keywords.	terminal length
Words in italics	Represent variables.	*mask, accessListName*
Words separated by the | symbol	Represent a choice to select one keyword or variable to the left or right of this symbol. (The keyword or variable may be either optional or required.)	diagnostic | line
Words enclosed in [brackets]	Represent optional keywords or variables.	[internal | external]
Words enclosed in [brackets]*	Represent optional keywords or variables that can be entered more than once.	[level1 | level2 | l1]*
Words enclosed in { braces }	Represent required keywords or variables.	{ permit | deny } { in | out } { *clusterId* | *ipAddress* }

Documentation

The *E-Series Installation Quick Start* poster is shipped in the box with all new routers. This poster provides the basic procedures to help you get the router up and running quickly.

With each software release, we provide the *E-Series Routers Documentation CD* (formerly *ERX Edge Routers Documentation CD*). The documentation CD contains the document set in PDF format and HTML format (with and without frames). From the HTML files, you can also access PDF files of individual chapters and appendixes.

The documentation is also available on the Web. You can order a set of printed documents from your Juniper Networks sales representative.

The document set comprises the following books:

• *E-Series Installation and User Guide* – Provides the necessary procedures for getting the router operational, including information on installing, cabling, powering up, configuring the router for

management access, and general troubleshooting. Describes SRP modules, line modules, and I/O modules available for the E-series routers, and provides information about the compatibility of line modules and I/O modules with software releases. Lists the layer 2 protocols, layer 3 protocols, and applications that line modules and their corresponding I/O modules support.

- *E-Series System Basics Configuration Guide* – Describes planning and configuring your network, managing the router, configuring passwords and security, configuring the router clock, and configuring virtual routers. Includes a list of references that provide information on the protocols and features supported by the router.

- *E-Series Physical Layer Configuration Guide* – Describes configuring physical layer interfaces.

- *E-Series Link Layer Configuration Guide* – Describes configuring link layer interfaces.

- *E-Series Routing Protocols Configuration Guide, Vol. 1* – Provides information about configuring routing policy and configuring IP, IP routing, and IP security.

- *E-Series Routing Protocols Configuration Guide, Vol. 2* – Describes BGP routing, MPLS, BGP-MPLS VPNs, and encapsulation of layer 2 services.

- *E-Series Policy and QoS Configuration Guide* – Provides information about configuring policy management and quality of service (QoS).

- *E-Series Broadband Access Configuration Guide* – Provides information about configuring remote access.

- *E-Series Command Reference Guide A to M; E-Series Command Reference Guide N to Z* – Together comprise the *E-Series Command Reference Guide*. Contain important information about commands implemented in the system software. Use to look up command descriptions, command syntax, a command's related mode, or a description of a command's parameters. Use with the E-series configuration guides.

- *E-Series Product Overview Guide* – Gives a thorough overview of the router from a software and hardware perspective. It provides illustrations and configuration examples that present the "big picture."

MIBS

Copies of the MIBs available in a software release are included on the *JUNOSe Software CD* (formerly *ERX Edge Routers Software CD*) and on the Web.

Release Notes

Release notes are included on the corresponding software CD and are available on the Web.

In the *Release Notes*, you will find the latest information about features, changes, known problems, resolved problems, and system maximum values. If the information in the *Release Notes* differs from the information found in the documentation set, follow the *Release Notes.*

Abbreviations

A complete list of abbreviations used in this document set, along with their spelled-out terms, is provided in the *E-Series System Basics Configuration Guide, Appendix A, Abbreviations and Acronyms*.

Web Access

To view the documentation on the Web, go to:

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Part 1

Installing and Using E-Series Routers

E-Series Overview

1

This chapter provides introductory information about the E-series routers.

Overview

E-series routers are modular, carrier-class networking devices that deliver performance, reliability, and service differentiation to both business and consumer Internet users. The ERX-7xx/14xx models offer high port density, low power consumption, and fully redundant Internet access routing and edge aggregation. The ERX-310 router supports the same services, but with smaller capacity and scaling capabilities. E-series routers offer the complete edge solution for IP-optimized carriers.

Where E-Series Routers Fit In

Communications with the router can take place over a variety of media. Figure 1-1 and Figure 1-2 illustrate the location of E-series routers as an edge router in an end-to-end Internet network. In Figure 1-1, the customers are businesses using T1/T3 communication lines. In Figure 1-2, the customers are using digital subscriber lines (DSLs) with a DSL access multiplexer (DSLAM).
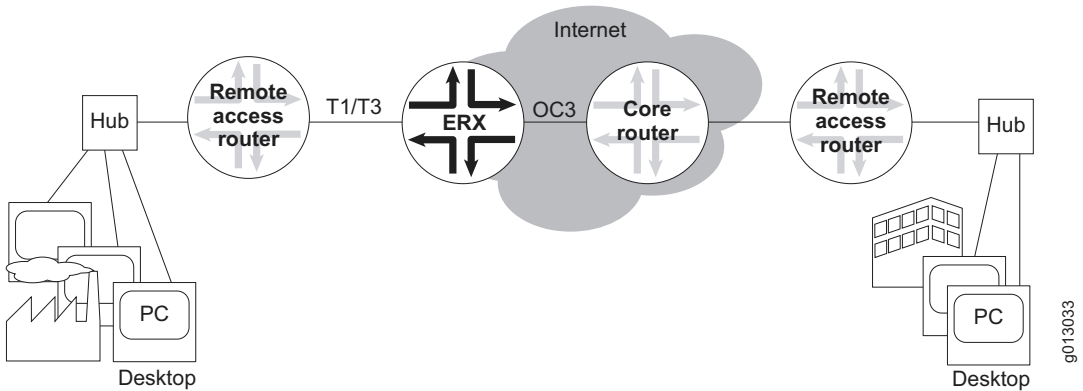
Figure 1-1 E-series router communicating over T1/T3 lines
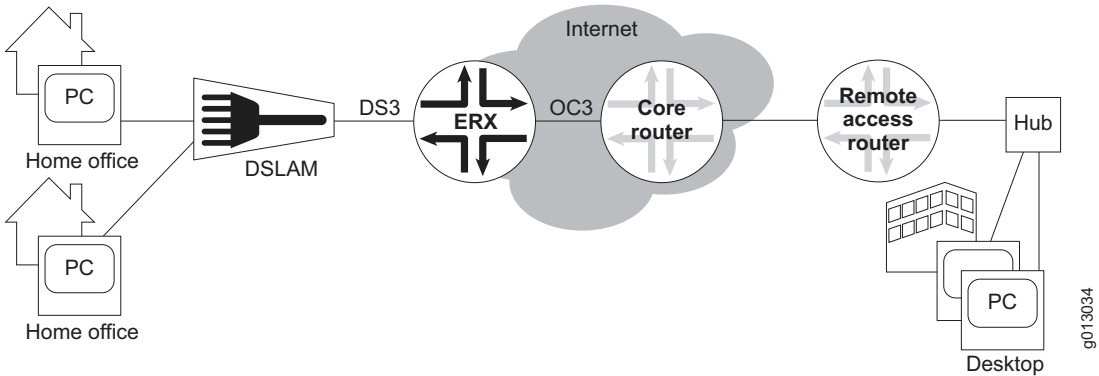
Figure 1-2 E-series router communicating over DSL lines

In Figure 1-3, the ERX-310 router is being used as an access router in a small POP location. The router is deployed by the service provider at the customer site as a CPE (customer premises equipment).
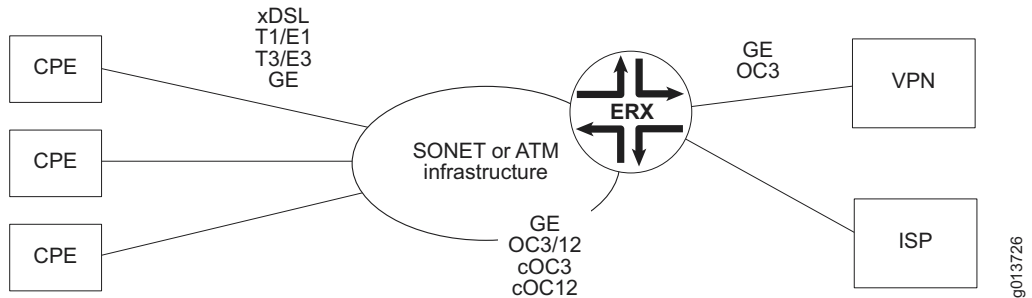
Figure 1-3 ERX-310 router deployed in a small POP

E-Series Routers

Five models of E-series routers are available:

- ERX-1440 router

- ERX-1410 router

- ERX-710 router

- ERX-705 router

- ERX-310 router

All models use the same software. However, the specific model determines the:

- Combination of line modules supported

- Conditions for line rate performance of line modules

- Type, capacity, and number of SRP modules used

ERX-14xx Models

▤ *Note: In the E-series documentation, the term ERX-14xx models refers to both the ERX-1440 router and the ERX-1410 router. The terms ERX-1440 router and ERX-1410 router refer to the specific models. See Figure 1-4 and Figure 1-5.*

The ERX-1440 router manages an extremely high volume of network traffic, and uses a 40-Gbps switch route processor (SRP) module, either the SRP-40G or SRP-40G+ module. (The SRP-40G+ module obsoletes the SRP-40G module; however, the software continues to support both modules.) In this model, all line modules operate at full wire speed simultaneously.

The ERX-1410 router manages high levels of network traffic, and uses the 10-Gbps SRP module (SRP-10G). You can configure the ERX-1410 router to enable the line modules either to operate at full line rate performance or to allow line modules to operate at a rate dependent on the resources available. The former option restricts the allowed combinations of line modules. For information on configuring performance of line modules, see *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

▤ *Note: The 10-Gbps SRP module used in the ERX-310 router is different from the 10-Gbps SRP module used in the ERX-1410 router. See section SRP Module, later in this chapter, for more information.*

Externally, the ERX-1440 chassis is the same as the ERX-1410 chassis (see Figure 1-4 and Figure 1-5). Both routers contain 14 vertical slots to accommodate modules.

Internally, the ERX-1440 chassis differs from the ERX-1410 chassis, and includes a special midplane for the 40-Gbps SRP module.

Installation procedures and operating procedures are identical for both systems. All ERX-7xx/14xx models use the same SRP I/O module, but different power input modules are used.

▤ *Note: The router may look different from the routers shown in the figures in this chapter, depending on the line modules in the slots.*

Fan tray
behind bezel

Line module

SRP module

PCMCIA slot

Air filter (optional)
behind bezel

Bezel

Cable
management
bracket

g013727
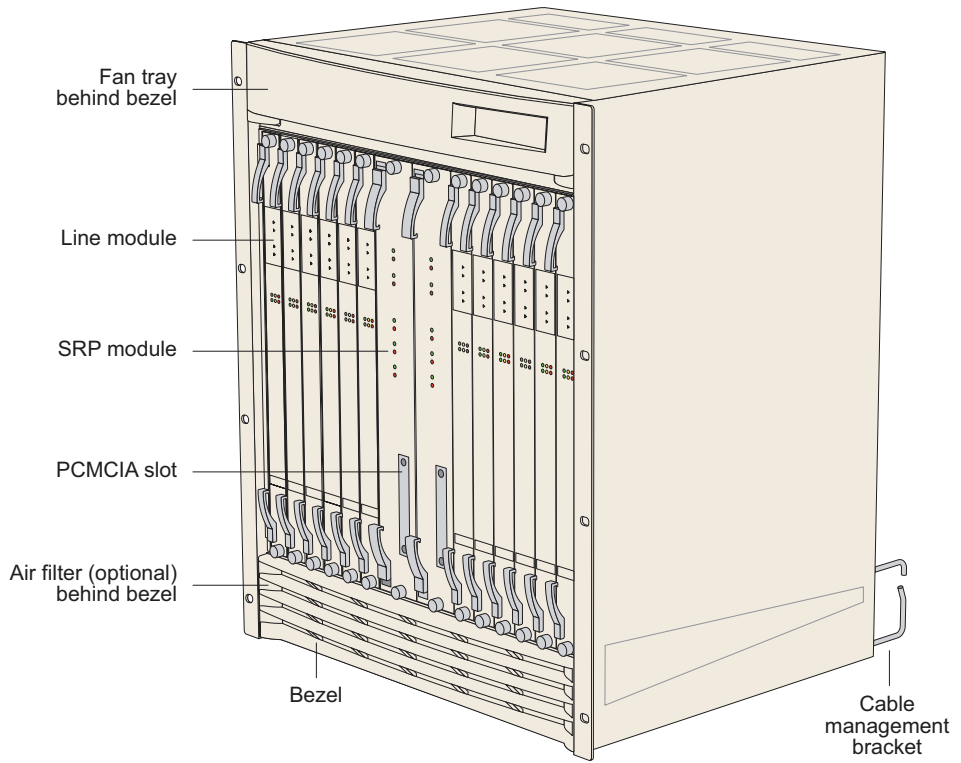
Figure 1-4 ERX-14xx model, front view
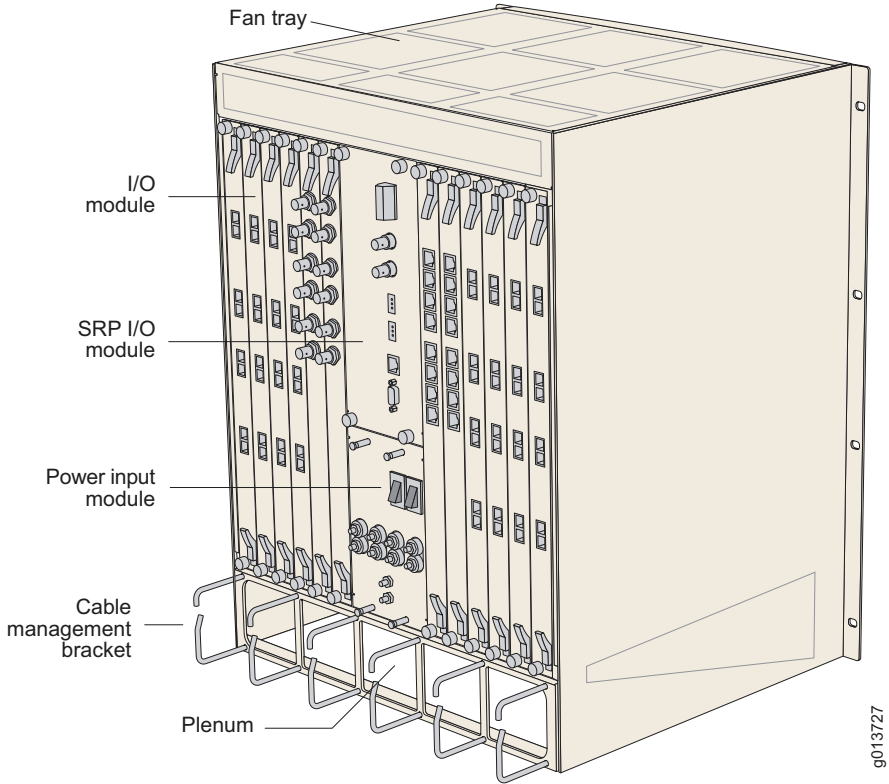
Figure 1-5 ERX-14xx model, rear view

ERX-7xx Models

📄 *Note: In the E-series documentation, the term ERX-7xx models refers to both the ERX-705 router and the ERX-710 router. The terms ERX-705 router and ERX-710 router refer to the specific models. See Figure 1-6 and Figure 1-7.*

The ERX-7xx models are robust, high-density routers with less capacity than the ERX-14xx models. The ERX-7xx models use either the SRP-10G module or the SRP-5G module.

You can configure the ERX-7xx models to enable the line modules to operate either at full line rate performance or at a rate dependent on the resources available. For information about configuring performance of line modules, see *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

📄 *Note: The 10-Gbps SRP module used in the ERX-310 router is different from the 10-Gbps SRP module used in the ERX-710 router. See section SRP Module, later in this chapter, for more information.*

The ERX-705 chassis is the same as the ERX-710 chassis (see Figure 1-6 and Figure 1-7). The chassis contains seven slots to accommodate modules. Installation procedures and operating procedures are identical for both systems. All ERX-7xx/14xx models use the same SRP I/O module, but different power input modules are used.

📄 *Note: The router may look different from the routers shown in the figures in this chapter, depending on the line modules in the slots.*
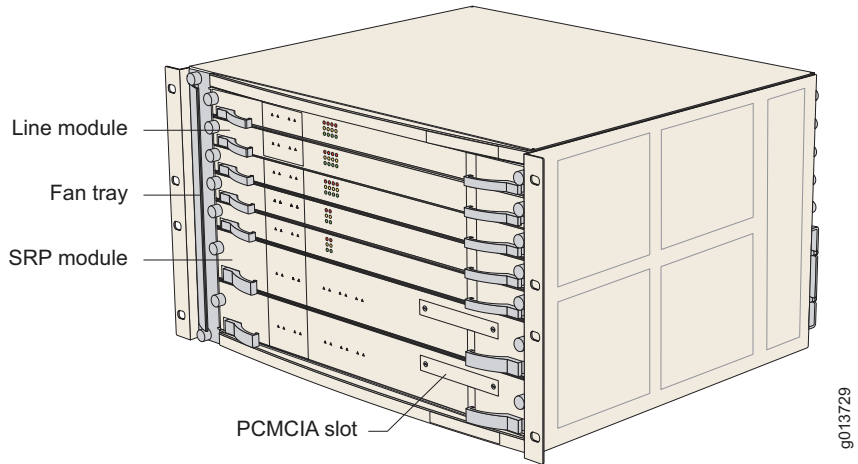
Figure 1-6 ERX-7xx model, front view
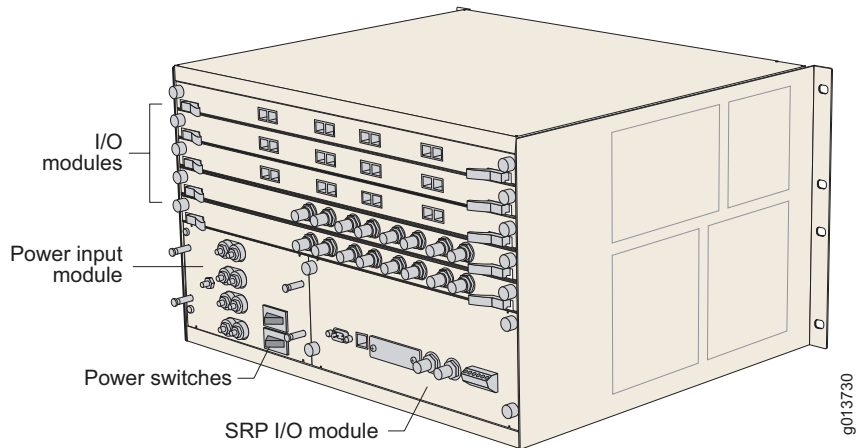
Figure 1-7 ERX-7xx model, rear view

ERX-310 Router

The ERX-310 router is a low-end platform that supports all of the same services as the ERX-7xx/14xx models, but with smaller capacity and scaling capabilities. Like the ERX-7xx/14xx models, the ERX-310 router uses the same software architecture, providing a single IP entry point into the network with the same IP-based protocols and services that are available on other E-series routers. The ERX-310 router is designed to be used as a small distributed POP router as well as a high-end CPE router.

The ERX-310 router is a three-slot chassis with a midplane architecture. One slot supports one nonredundant 10-Gbps SRP module, while the other two slots support line modules. The router supports existing E-series ASIC-based line modules (except the OC48/STM16 line module).

📄 *Note: The 10-Gbps SRP module used in the ERX-310 router is different from the 10-Gbps SRP module used in the ERX-7xx/14xx models. See section SRP Module, later in this chapter, for more information.*

The ERX-310 router is available in either redundant AC- or DC-powered models.
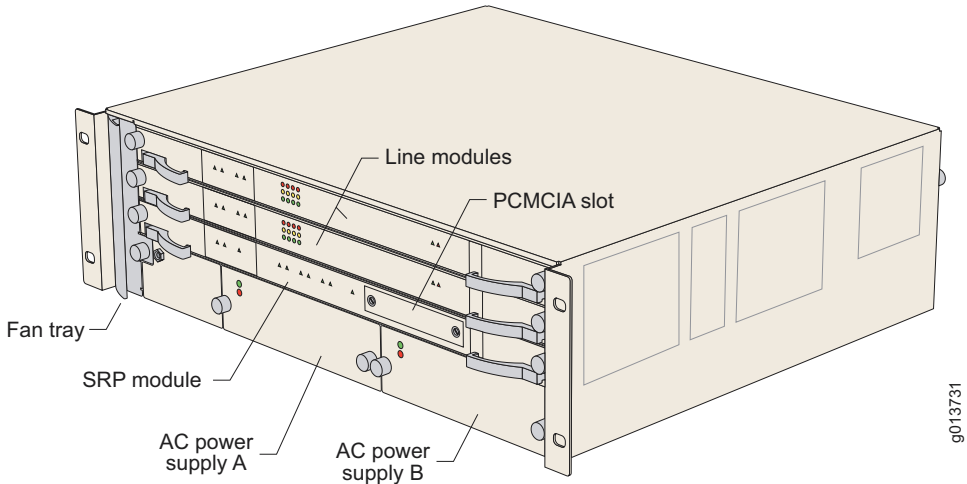
Figure 1-8 ERX-310 router, front view (AC model)

📄 *Note: DC model has blank filler panels in power supply slots.*

g013732

I/O module

SRP I/O module

ESD grounding jack

AC power inputs and switches A and B

Grounding posts
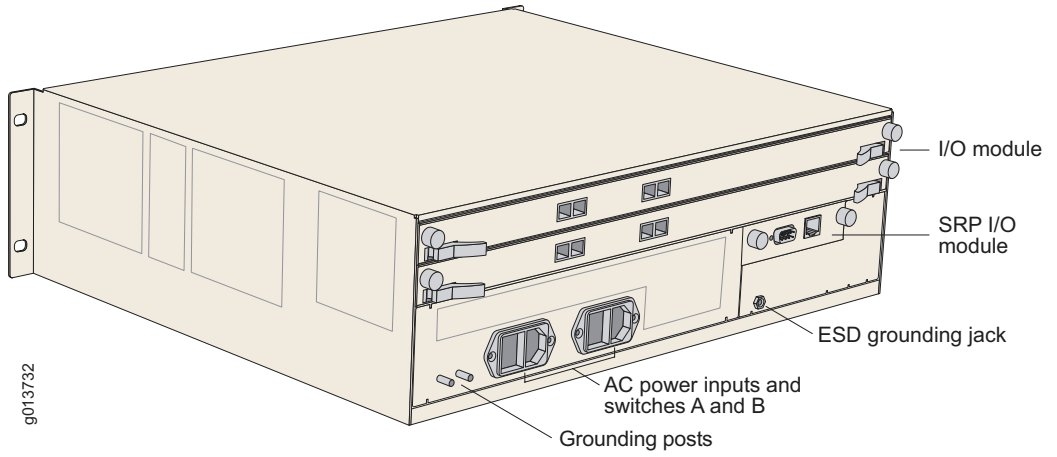
Figure 1-9 ERX-310 router, rear view (AC model)

g013733

I/O module

SRP I/O module

ESD grounding jack

DC power inputs and switches A and B

Grounding posts
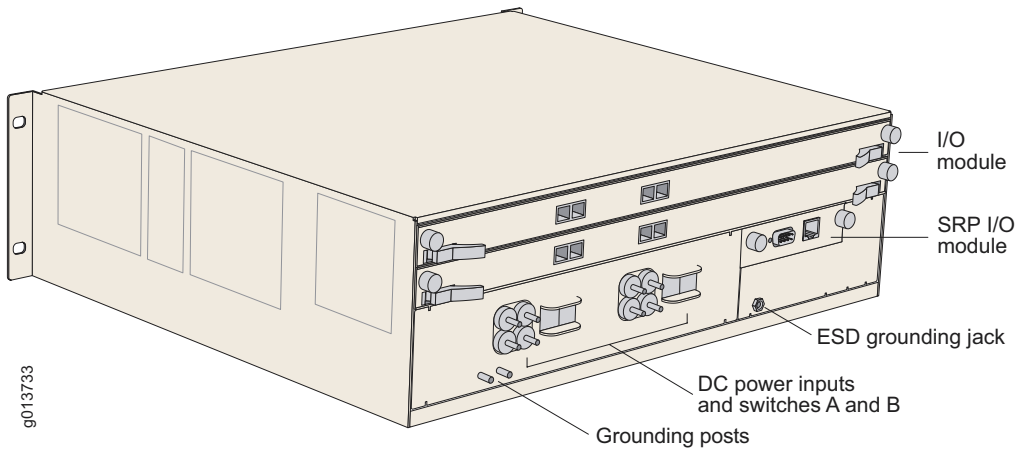
Figure 1-10 ERX-310 router, rear view (DC model)

E-Series Modules

The system supports an SRP module and a selection of line modules. You can use any line module for *access* or *uplink*. Access line modules receive traffic from low-speed circuits, and the system routes the traffic onto higher-speed uplink line modules and then to the core of the network.

Each module connects to a corresponding I/O module via a passive midplane. See Figure 1-11.

The front panel of each module contains a collection of status LEDs (light-emitting diodes). For information about how to interpret the LEDs, see *Chapter 10, Troubleshooting*.
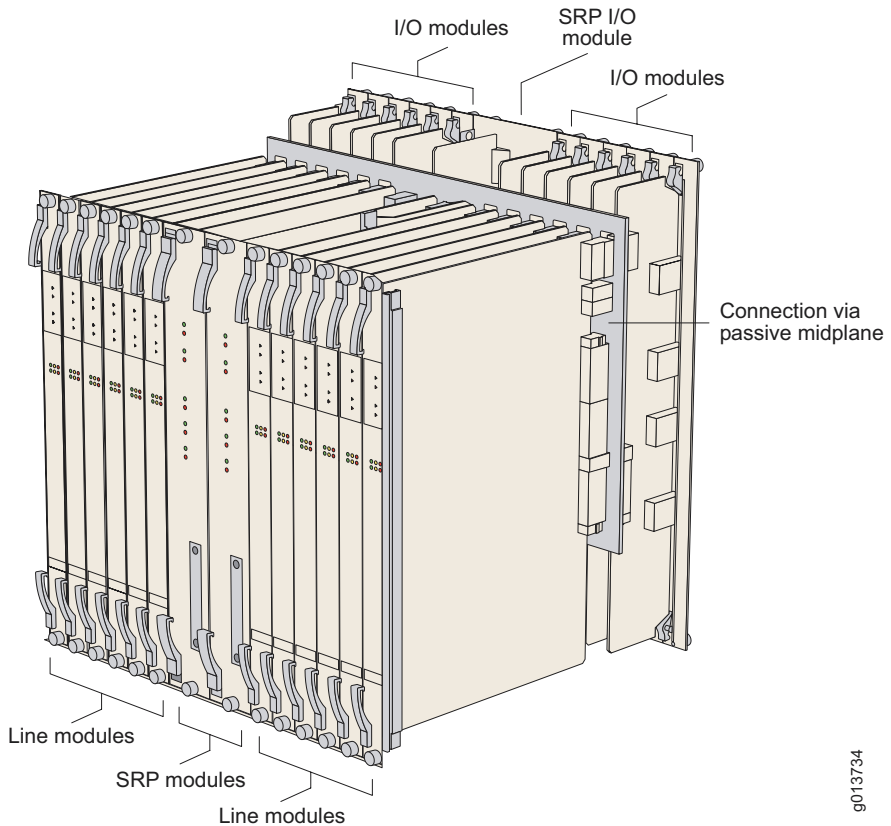
Figure 1-11 Modules in ERX-14xx model

SRP Module

Switch route processor (SRP) modules perform system management, routing table calculations and maintenance, forwarding table computations, statistics processing, configuration storage, and other control plane functions. Each SRP module is a PowerPC-based system with its own memory, nonvolatile disk storage, and power supply (see Figure 1-12 and Figure 1-13).
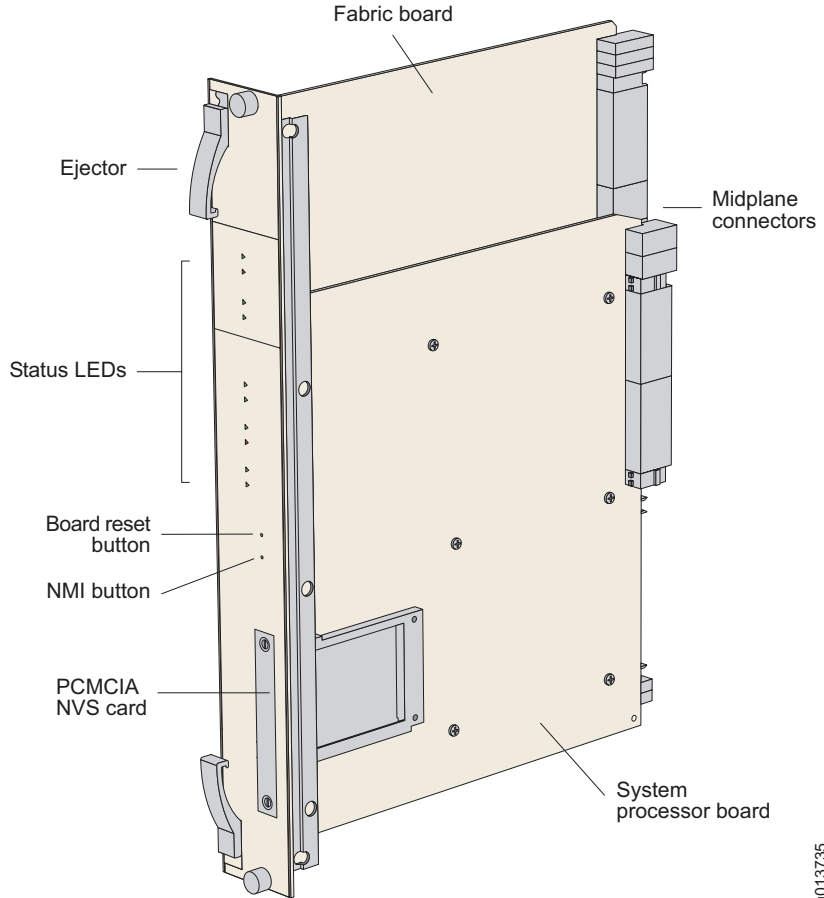
Figure 1-12 ERX-7xx/14xx SRP module
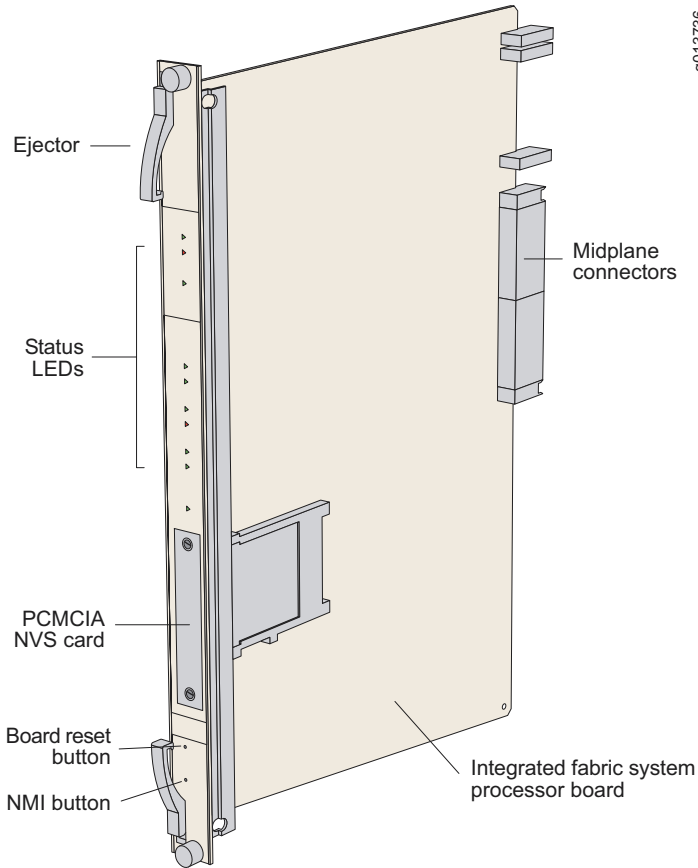
Figure 1-13 ERX-310 SRP module

Module Details

ERX-7xx/14xx models use up to two redundant SRP modules operating in an active/standby configuration. ERX-310 routers use only one SRP module. An SRP module must be present for any system to boot.

SRP modules ranging from 5 Gbps to 40 Gbps can be used in ERX-7xx/14xx models. Only a 10-Gbps SRP module (SRP-SE10G) can be used in ERX-310 routers. See *Chapter 12, Module Specifications* for complete information.

Note: Because of different physical dimensions and switch fabric capabilities, SRP modules are not interchangeable between systems. For example, the 10-Gbps SRP module used in ERX-7xx/14xx models cannot be used in the ERX-310 router, and vice versa.

⚠️ *Caution: Do not remove the SRP module while the system is running.*

For details about installing SRP modules, see *Chapter 5, Installing Modules*.

SRP Module Redundancy

SRP module redundancy is available only for ERX-7xx/14xx models. See *Redundancy Features*, later in this chapter, for more information.

Nonvolatile Storage

The PCMCIA slot on the front of the SRP module holds a Type II PCMCIA nonvolatile storage (NVS) card (see Figure 1-12 and Figure 1-13). This card is loaded with the system's software and configuration files. The PCMCIA card is factory installed.

SRP I/O Module

The SRP I/O module is a single corresponding input/output module that interfaces with the SRP module(s) through the system's midplane. The same SRP I/O module works with all SRP modules, but is router specific. The I/O module used in ERX-7xx/14x models cannot be used in the ERX-310 router, and vice versa. See Figure 1-5, Figure 1-7, and Figure 1-9 for locations.

Module Details

The SRP module provides standard craft management interfaces, including:

- 10/100Base-T – Enables access to the E-series router for Ethernet management functions via CLI or SNMP, for example.

- RS-232 – Provides a serial connection for monitoring the system's hardware configuration through a PC (running terminal emulation software) or ASCII terminal. Allows direct CLI access.

- Alarm contacts – Provide for remote indication of critical, major, and minor E-series router alarms (ERX-7xx/14xx models only; currently not implemented)

- External timing inputs – Provide a method of ensuring that the clock timing used by the E-series router remains synchronized with the network's system clock. BNC connectors and wire wraps are available for ERX-7xx/14xx models only.

For details about installing the SRP I/O module, see *Chapter 5, Installing Modules*.

Line Modules

Line modules process data from different types of network connections. For information about available line modules and which SRP modules support specific line modules, see *Chapter 12, Module Specifications*.

Figure 1-14 shows a representative line module. For details about installing line modules, see *Chapter 5, Installing Modules*.

Ejector

Status LEDs

Midplane connectors

Board reset button

NMI button

g013737
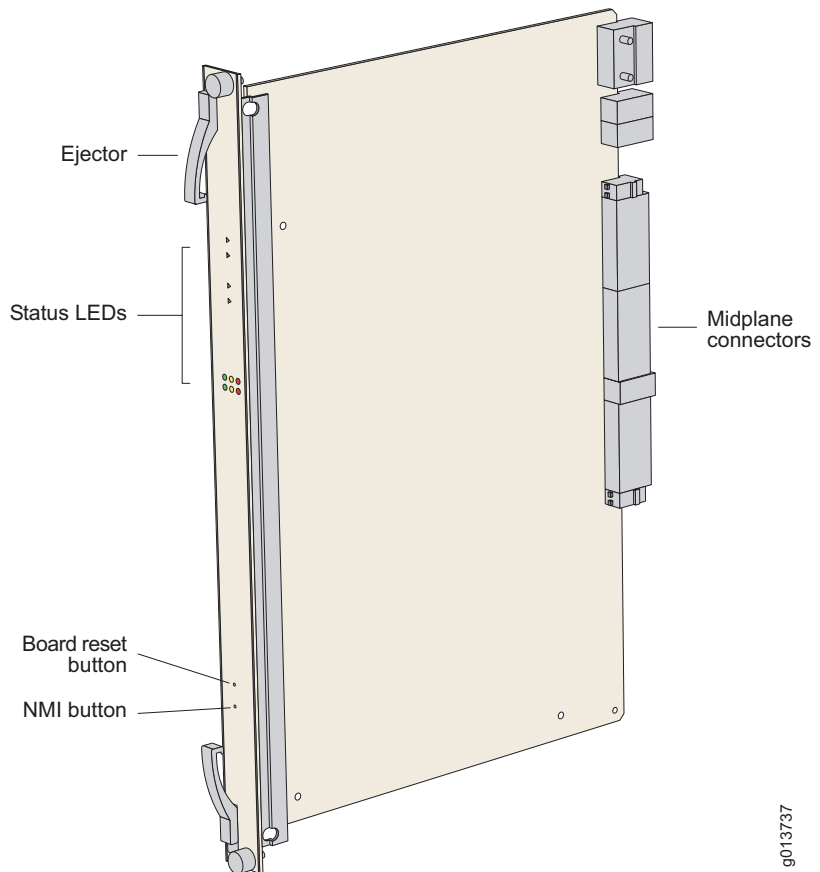
Figure 1-14 Representative line module

Packet Classification

Most line modules support packet classification on ingress (some non-ASIC line modules do not). A classification engine on the line module matches specific fields (such as source and destination IP address, source and destination port, and protocol), the ingress IP interface, layer 2 fields, or some combination of these against user-configured filters at wire speed.

I/O Modules

Most line modules have a corresponding input/output (I/O) module that provides the physical interconnection to the network. Insert each I/O module into the back of the system, directly behind its corresponding line module.

For information about which line modules pair with which I/O modules, see *Chapter 12, Module Specifications*. See Figure 1-5, Figure 1-7, and Figure 1-9 for locations. For details about installing I/O modules, see *Chapter 5, Installing Modules*.

Network Management Tools

You can use different management tools to configure the system to meet the specific networking requirements.

CLI Management

The CLI provides fully developed and automated configuration and status functionality through a local RS-232 port, Telnet, or SSH via any reachable network. For a full discussion of the CLI, see the *E-Series System Basics Configuration Guide, Chapter 2, Command Line Interface*.

SNMP MIB Management

The system offers a complete SNMP interface for configuration, status, and alarm reporting. The system supports both Standard and Enterprise MIBs (Management Information Bases). The Juniper Networks E-Series Enterprise MIB is ASN.1 notated for easy importing into third-party SNMP management applications. For more information, see *E-Series System Basics Configuration Guide, Chapter 3, Configuring SNMP.*

NMC-RX Device Management System

The NMX-RX application provides a global method of managing all routers, line modules, and ports through a graphical user interface.

Redundancy Features

The system has the following redundancy features:

SRP Modules

Note: This section applies to ERX-7xx/14xx models only. ERX-310 routers contain one SRP module and therefore do not offer SRP module redundancy.

ERX-7xx/14xx models use a 1:1 redundancy scheme for the SRP module. When two SRP modules of the same type are installed in the chassis, one acts as a primary and the second as a standby. Both SRP modules share a single SRP I/O module located in the rear of the chassis. If the primary SRP fails, the redundant SRP module assumes control without rebooting or initializing. (As a consequence, if you upgrade software, you must copy the software to the redundant SRP and reboot it.) For information about configuring and managing SRP module redundancy, see the *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

After you install two SRP modules, the modules negotiate for the primary role. A number of factors determine which module becomes the primary; however, preference is given to the module in the lower-numbered slot. The SRP modules record their latest roles and retain them the next time you switch on the system. For information about installing SRP modules, see *Chapter 5, Installing Modules*.

NVS Cards

If you have two SRP modules installed in a system, you can use NVS cards of different capacities on the SRP modules. The effective capacity of the higher-capacity NVS card will equal that of the lower-capacity NVS card. For information about installing NVS cards, see *Chapter 5, Installing Modules*.

When you install new NVS cards or SRP modules, you must issue the **synchronize** command to match the file system of the NVS card on the redundant SRP module with the file system of the NVS card on the primary SRP module. (The NVS card on the redundant SRP module will hereafter be referred to as the redundant NVS card; the NVS card on the

primary SRP module will hereafter be referred to as the primary NVS card.)

If the capacity of the primary NVS card is equal to or smaller than that of the redundant NVS card, the system copies all the files from the primary NVS card to the redundant NVS card. However, if the capacity of the primary NVS card exceeds that of the redundant NVS card, the system creates an invisible synchronization reserve file on the primary NVS card, provided that there is enough space for the file.

The purpose of the synchronization file is to prevent the creation of data that will not fit on the redundant NVS card. The file contains no useful data, and is not visible when you view the files in NVS. The size of the file is equal to the difference in capacities of the two NVS cards. For example, if the primary NVS card has a capacity of 224 MB and the redundant NVS card has a capacity of 220 MB, the size of the synchronization file is 4 MB, and only 220 MB of space is available on the primary NVS card.

If there is not enough space on the primary NVS card to create the synchronization reserve file, the **synchronize** command fails, and a warning message is displayed on the console. To resolve this issue, either delete unwanted files from the primary NVS card or replace the redundant NVS card with a higher-capacity NVS card.

Line Modules

📄 *Note: This section applies to ERX-7xx/14xx models only. ERX-310 routers do not offer line module redundancy.*

ERX-7xx/14xx models support line module redundancy for several line modules. For details about which line modules support redundancy, see *Chapter 12, Module Specifications*. In this scheme, an extra line module in a group of identical line modules provides redundancy in case of line module failure. To use this feature, you need a:

- Spare line module
- Redundancy midplane
- Redundancy I/O module

A redundancy midplane may cover 3–6 slots. It provides additional connectivity that enables the spare line module to assume control of the I/O module associated with any failed line module in the redundancy group. The spare I/O module provides connectivity from the spare line module to the redundancy midplane.

The process by which the system switches to the spare line module is called *switchover*. When switchover occurs, the system:

1   Breaks the connection between the primary I/O module and the primary line module.

2   Connects the primary I/O module to the spare line module via the redundancy midplane and redundancy I/O module.

Protocol processing then takes place on the spare line module.

Figure 1-15 shows the data flow when a spare line module becomes active.

1. A packet arrives at the primary I/O module.
2. The packet passes along the redundancy midplane from the primary I/O module to the redundancy I/O module.
3. The packet passes from the redundancy I/O module to the spare line module.
4. The spare line module processes the packet.
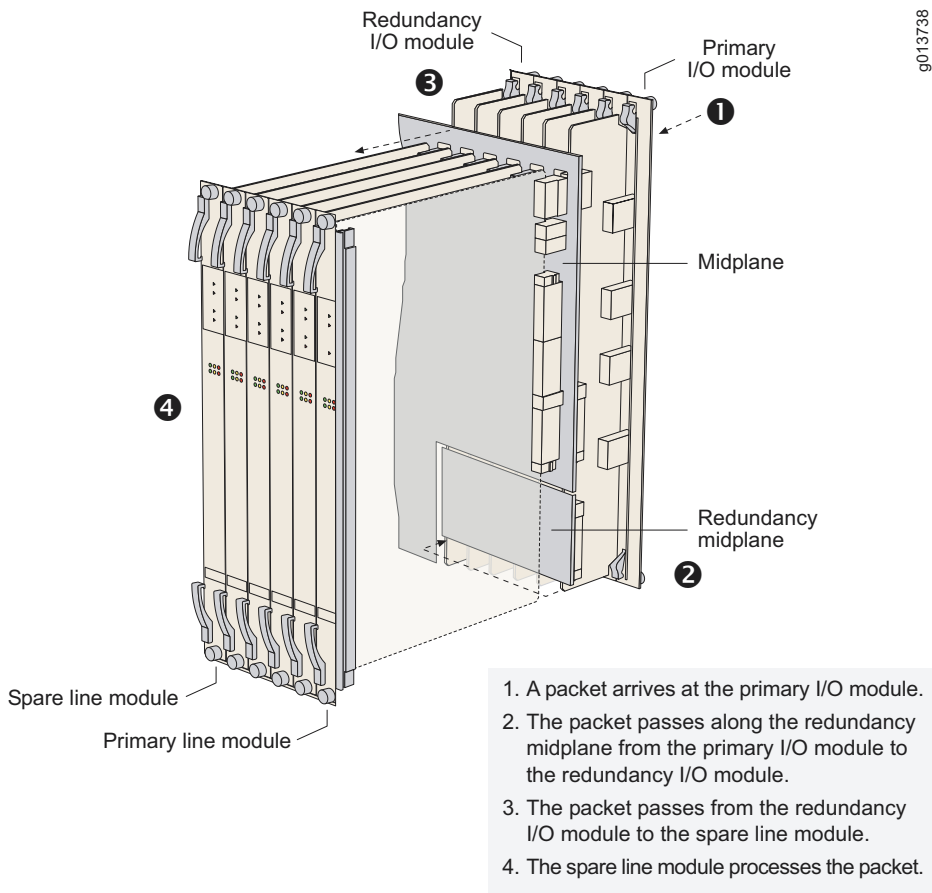
Figure 1-15 Data flow when a spare line module is active

For information about installing modules for line module redundancy, see *Chapter 5, Installing Modules*. For information about configuring and managing SRP module redundancy, see *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

Power

All E-series routers provide a power architecture that distributes redundant –48 VDC feeds through the router to each line module, SRP module, and fan module where DC-to-DC converters provide local conversion to the required secondary voltages.

The ERX-310 router is available with either DC or AC power inputs. The AC-powered version can be configured with one or two hot-swappable power supplies for optional redundancy (see Figure 1-8 and Figure 1-9). The power supplies convert AC power to internal –48 V redundant DC feeds that are then distributed through the router.

Fans

Forced air-cooling keeps the temperature of the E-series modules and components within normal operating limits. In ERX-14xx models, six cooling fans are located in a tray at the top of the router (see Figure 1-4). In ERX-7xx models, four cooling fans are located in a tray on one side of the router (see Figure 1-6). In the ERX-310 router, two cooling fans are located in a tray on one side of the router (see Figure 1-8).

The system monitors the temperature of each module. If the temperature of a module exceeds the maximum limit, the system immediately goes into thermal protection mode. In this mode, the modules consume extremely low levels of power. For information about troubleshooting high operating temperatures, see *Chapter 10, Troubleshooting*.

In ERX-7xx/14xx models, the fan tray has two redundant converters that power the fans (for the ERX-14xx models, a –24 V, 50 W converter; for the ERX-7xx models, a –12 V, 15 W converter). If one converter fails, the other takes over. The ERX-310 router does not have redundant converters.

For all E-series routers, the system software reports an alarm if any of the fans or converters fail.

2

Unpacking and Inspecting E-Series Routers

This chapter reviews shipping contents and unpacking procedures for E-series routers.

Topic	Page
Before You Begin	2-1
Unpacking ERX-14xx Models	2-2
Unpacking ERX-7xx Models and ERX-310 Routers	2-3
Inspecting E-Series Router Components and Accessories	2-3
If You Detect or Suspect Damage	2-3
Contacting Juniper Networks	2-3
The Next Step	2-4

Before You Begin

Before you begin unpacking the router, be sure you have the following tools:

- A No. 2 Phillips screwdriver

- A utility knife

- A mechanical lift, or at least two people to assist in lifting

Unpacking ERX-14xx Models

ERX-14xx models come boxed, bolted, and strapped to a skid. For your convenience, Juniper Networks recommends that you unpack the E-series router in the location where you want to install it.

⚠️ *Heavy-Equipment Warning: Three people are required to install the E-series router in a rack: two to lift the system into position and one to screw it to the rack.*

To unpack ERX-14xx models:

1 Cut the two straps that secure the carton to the skid, open the carton from the top, and remove the box of accessories that sits on top of the router.

2 Unlock the four plastic clips that hold the box to the skid by squeezing them in their center and pulling out, and then lift the carton off the router.

3 Remove the three screws that attach each of the two L-brackets to the router.

4 To avoid scratching the router when removing it from the skid, detach one of the L-brackets from the skid by removing the three screws. See Figure 2-1.

L-bracket

g013739
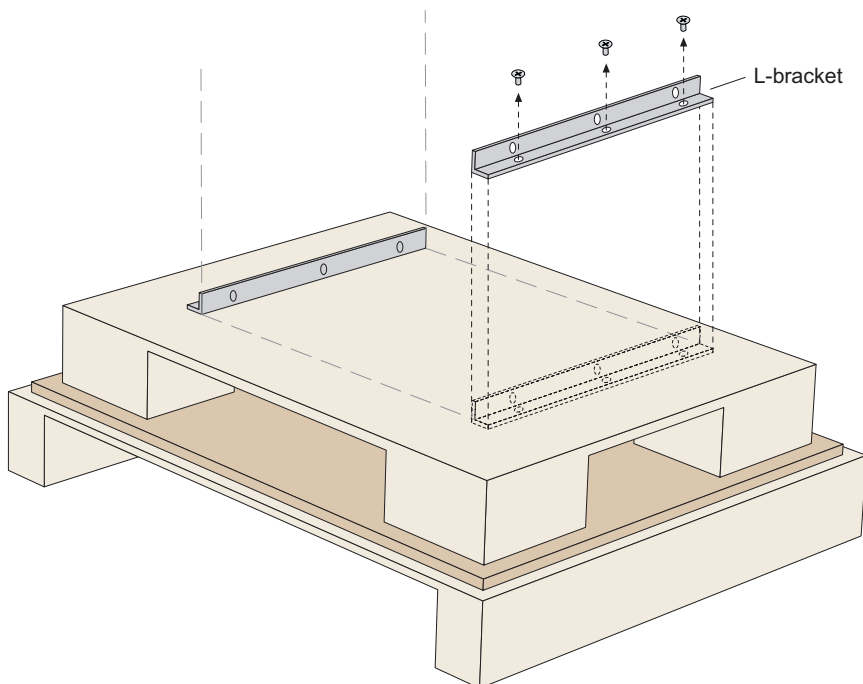
Figure 2-1 Removing an L-bracket

Unpacking ERX-7xx Models and ERX-310 Routers

ERX-7xx models and ERX-310 routers are shipped boxed, but not attached to a skid. For your convenience, Juniper Networks recommends that you unpack the E-series router in the location where you want to install it.

To unpack an ERX-7xx model or an ERX-310 router:

1   Open the carton from the top.

2   Remove the box of accessories that sits on top of the system.

3   Remove the router from the box.

Heavy-Equipment Warning: Three people are required to install the E-series router in a rack: two to lift the system into position and one to screw it to the rack.

Inspecting E-Series Router Components and Accessories

After you remove the equipment from the shipping containers:

• Confirm the contents of each container.

• Inspect all external surfaces and external connectors for visible signs of damage.

• Inspect all accessories shipped with each unit.

• Document any damage noted during your inspection.

• Confirm that the router has the correct number and type of modules for your ordered configuration.

If You Detect or Suspect Damage

If you detect or suspect damage to any equipment:

• Contact the shipper responsible for delivery, and formally report the damage.

• Contact your Juniper Networks sales representative or reseller.

Contacting Juniper Networks

Please contact Juniper Networks at 1-888-314-JTAC (within the United States) or 408-745-9500 (from outside the United States), or contact your sales representative if you have any questions or concerns. See *Appendix C, Customer Support*, for complete contact information.

The Next Step

- To familiarize yourself with the electrical, environmental, and other guidelines and requirements for installing E-series routers, turn to *Chapter 3, Installation Guidelines and Requirements*.

- If you are familiar with these guidelines and requirements, turn to *Chapter 4, Installing E-Series Routers*.

Installation Guidelines and Requirements

3

This chapter reviews preinstallation considerations such as electrical, environmental, and safety compliances for E-series routers. For complete system specifications, refer to *Chapter 11, System Specifications*.

Your Preinstallation Responsibilities

Complete the following tasks before installing the system:

- Verify that the electrical supply meets all AC and DC power requirements. See *Chapter 11, System Specifications*.

- Verify that the site meets all environment specifications. See *Environmental Requirements* later in this chapter and *Chapter 11, System Specifications*.

- Verify that the cables you plan to use meet the specifications, and review the cabling recommendations. See *Cabling Recommendations* later in this chapter.

- Verify the operation of all telephone circuits, digital services, and T1 facilities required for installation.

- Ensure that all IP environment requirements are met, such as autonomous system (AS) number, port IP address and mask, management Ethernet port IP address and mask, and broadcast address.

Environmental Requirements

Refer to *Chapter 11, System Specifications* for complete environmental specifications.

Choose a location for the router that is dry, relatively dust free, well ventilated, and air conditioned. If you install equipment in a rack, be sure that the floor is capable of supporting the combined weight of the rack and the installed equipment. Place the router in a location with sufficient access to power and network cables.

Like other network devices, the router generates a significant amount of heat. It is important to provide a balanced environment so that the router performs properly and safely. See *Chapter 11, System Specifications* for acceptable ranges of temperature and humidity.

Be sure to allow enough space around the router for adequate ventilation. Inadequate ventilation can cause the system to overheat.

Caution: Do not block the air vents on E-series routers. Otherwise, the router may overheat.

Regulatory Compliances

Refer to *Chapter 11, System Specifications*, for a complete list of regulatory compliance requirements, including safety, EMC, and telecommunications.

Safety Guidelines

For your safety, before installing the system, review all safety warnings in this section.

Temperature Warning: *The recommended maximum ambient temperature is 50° C (122° F). The internal temperature of the rack should be considered for safe operation.*

Rack Installation Warning: *Install equipment in the rack from the bottom upward. This will maintain the stability of the rack and reduce the chance of the rack's tipping over.*

Heavy-Equipment Warning: *Two people are required to lift an E-series router. Three people are required to install an E-series router in a rack. The equipment is extremely heavy.*

Ground (Earth) Warning: *Connect the E-series router or rack to ground (earth), and ensure that a reliable grounding path is maintained in the rack.*

Lightning Activity Warning: *Do not work on the system or connect or disconnect cables during lightning activity.*

DC Power Disconnection Warning: *Before powering on the E-series router, remove power from the DC circuit by deactivating the circuit breaker on the panel board that services the DC circuit.*

Power Connection Warning: *Before servicing the E-series router, turn off the power.*

Jewelry Removal Warning: *Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. Metal objects heat up when connected to power and ground and can cause serious burns or become welded to the terminals.*

Metal Objects Warning: *Do not insert any metal object, such as a screwdriver, into an open slot or the backplane. Doing so may cause electric shock and serious burns.*

Branch Circuit Caution: *Evaluate the overall loading of the branch circuit before you install any equipment into a rack.*

ERX-310 Power Cord Warnings (AC Model)

This unit has more than one power-supply cord. Disconnect 2 power cords BEFORE servicing to avoid electric shock.

Denne enhed har mere end een strømfordelingsledning. Fjern ledning(er) nummer 2 FØR eftersyn for at undgå elektrisk stød.
Waarschuwing! Dit apparaat heeft meerdere netsnoeren. Vermijd elektrische schok! Verwijder 2 netsnoeren ALVORENS onderhoud te verrichten.
Tässä laitteessa on useampi kuin yksi verkkojohto. Irrottakaa 2 verkkojohtoa ENNEN huoltoa sähköiskujen välttämiseksi.
Attention: Cet appareil comporte plus d'un cordon d'alimentation. Afin de prévenir les chocs électriques, débrancher les 2 (donner le nombre de cordons) cordons d'alimentation AVANT le dépannage.
Dieses Gerät hat mehrere Stromversorgungskabel. Klemmen Sie 2 Stromkabel VOR der Wartung ab, um einen elektrischen Schlag zu vermeiden.
L'unità ha più di un cavo di alimentazione. Scollegare 2 cavi di alimentazione PRIMA di usarla, onde evitare scosse elettriche.
Denne enheten har mer enn en nett-tilkobling. 2 nettkabler må frakobles FØR service for å unngå elektrisk støt.
Este equipamento tem mais do que um cabo de alimentação. Para que se evitem choques, desligar 2 cabos, ANTES de servir o equipamento.
Esta unidad tiene más de un cable de toma de corriente. Desconecte 2 cables ANTES de darle mantenimiento a la unidad, para evitar descargas eléctricas.
Denna enhet har fler än en nätanslutningskabel. Koppla bort 2 nätanslutingskablar INNAN du påbörjar service.

Equipment Rack Requirements

When allocating equipment rack space, consider the following:

- Type of equipment racks recommended for E-series routers

- Number of equipment racks required to hold your current E-series router configuration

- Future expansion

Your distribution rack should meet basic mechanical and space requirements and comply with conventional standards. In the United States, use *EIA-310-D Cabinets, Racks, Panels, and Associated Equipment, September 1992.*

ERX-310 router

ERX-7xx model

Plenum

ERX-14xx model

g013740
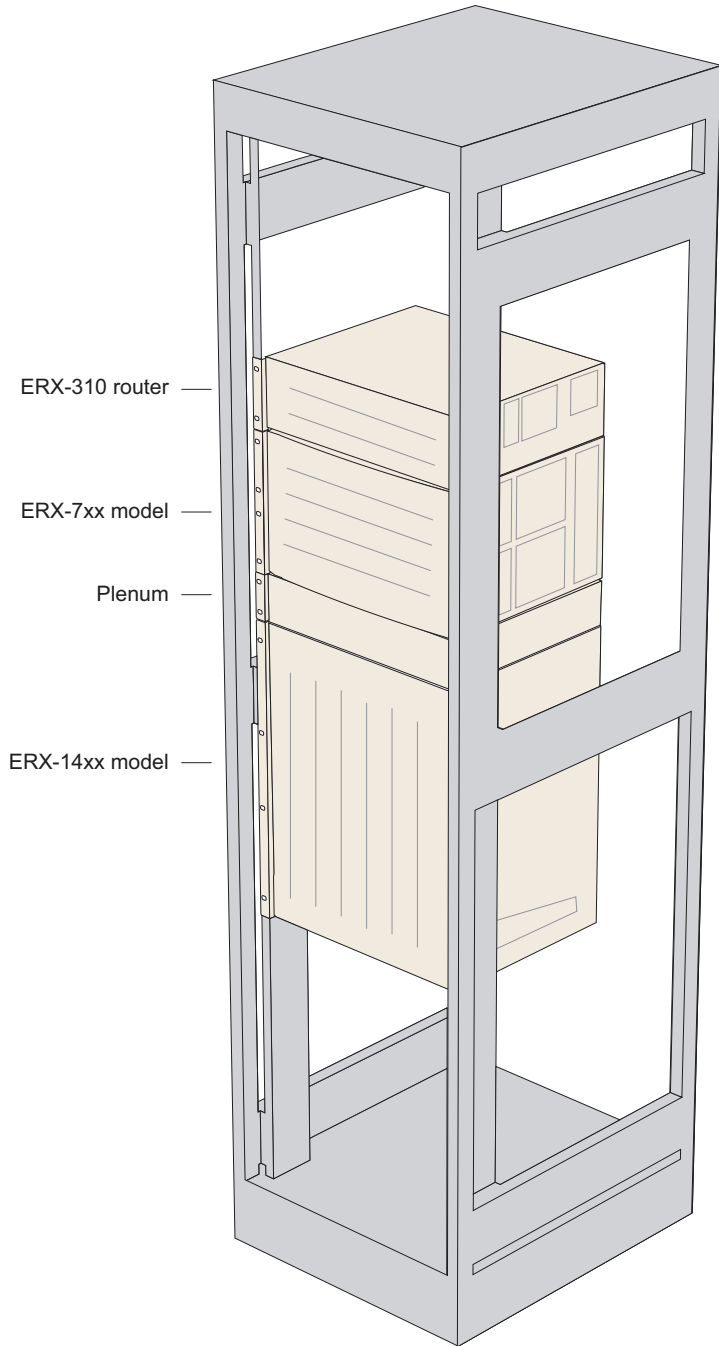
Figure 3-1 E-series routers installed in a rack

Mechanical Requirements

Follow these mechanical requirements for your rack:

- Select from the following rack options:

  > Two-post rack – a freestanding enclosed cabinet with two mounting posts in the front

  > Telco-type rack – two adjacent mounting posts that you must secure to the floor or an overhead structure

  > Four-post rack – a freestanding open rack, either open or closed

- The rack must have at least two mounting posts.

- The distance between the mounting holes in the two posts must be 18.31 inches ±.063 inch, as specified in the EIA-310-D.

- Do not use an enclosed rack for ERX-7xx models or the ERX-310 router. It does not provide adequate ventilation.

- A fully loaded rack with three ERX-14xx models must structurally support 300 pounds (136 kilograms).

- Optional mounting kits are available for 19-inch and 23-inch rack mounting (mid- and front-chassis mounting). Contact your Juniper Networks sales representative for more information.

Space Requirements

If you use an enclosed rack for an ERX-14xx model, ensure that there is a minimum of 3 inches of clearance between the inner side wall and the router. This clearance space will allow adequate air flow.

Proper Rack Installation

To confirm proper equipment rack installation, check the following:

- Racks are installed and electrically grounded according to manufacturer instructions.

- Equipment racks are anchored to the floor and, when possible, anchored to the ceiling as well.

- Equipment rack installations comply with applicable local, state, and national codes.

Warning: To maintain airflow requirements, a plenum must be installed above ERX-14xx models before any other piece of equipment is installed above the router.

Air output
ERX-310 router and
ERX-7xx model

Air intake ERX-310 router
and ERX-7xx model

Air output ERX-14xx model
via plenum

Air intake
ERX-14xx model

3- to 4-ft.
(0.9- to 1.2-m)
access space

7-ft. (2.1-m) rack

g013741
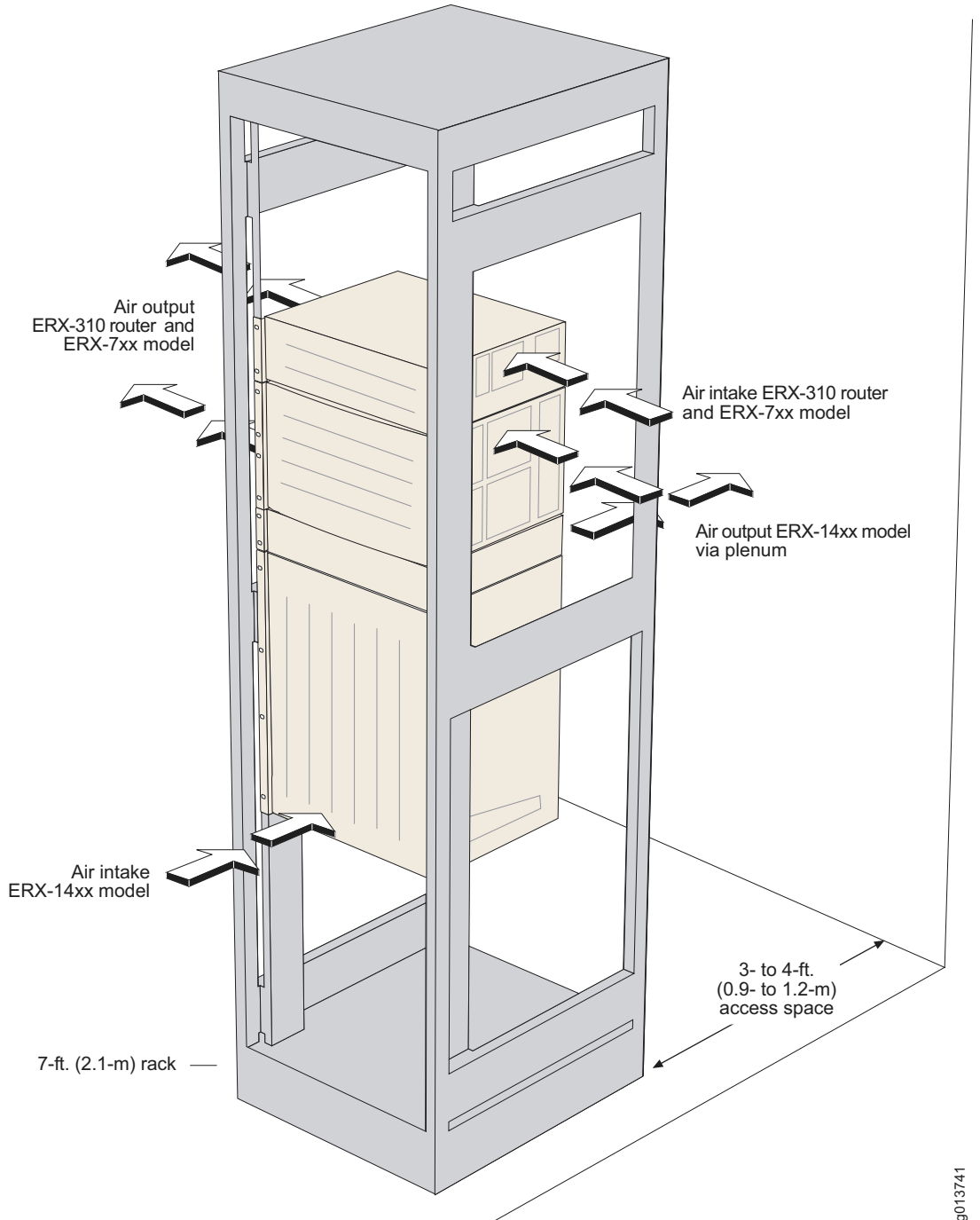
Figure 3-2 Airflow for E-series routers

Cabling Recommendations

You may want to consult the document *GR-63 (LSSGR, FD-15): Network Equipment Building System (NEBS) Requirements: Physical Protection, Issue 1, October 1995* for additional cable recommendations.

Comply with the following recommendations:

• Use only shielded cables.

• Ensure that cable distance and rate limits meet IEEE-recommended maximum speeds and distances for signaling purposes. For information about attenuation and power loss in optical fiber cables see:

> ANSI T1.646a-1997 Telecommunications – Broadband ISDN - Physical Layer Specification for User-Network Interfaces Including DS1/ATM (1997)

> ANSI T1.646-1995 Telecommunications – Broadband ISDN - Physical Layer Specification for User-Network Interfaces Including DS1/ATM (1995)

> AT&T (Lucent) Technical Note Power Margin Analysis (November 1995)

• Ensure that power cables deliver sufficient power to the system.

• Attach laser fiber connectors only to Class 1 laser devices in accordance with IEC 825-1, Safety of Laser Products - Part 1.

• Route cables so that they do not restrict ventilation or airflow.

• Route cables so that modules and field-replaceable units are easily accessible.

• Route cables in a logical direction to prevent loss of connectivity to other equipment in the rack, associated equipment in adjacent racks, or to the backbone network.

• Consider using cable-management brackets to keep network cables untangled and orderly and to prevent cables from hindering access to other slots.

• For specifications on cables for line modules, see *Chapter 12, Module Specifications*.

4

Installing E-Series Routers

This chapter describes how to install E-series routers in a rack.

Before You Begin

Before installing E-series routers, be sure you:

- Have a plan for installing E-series routers. This plan should consider future expansion of your system.

- Have the tools and accessories needed to complete the installation.

- Read and understand the clearance requirements for the front and back of the chassis for cable routing and other unit access. See *Environmental Requirements* on page 3-2 for more information.

- Prepare the equipment racks by measuring and marking space for each E-series router and plenum you will install.

Freestanding Installation

When installing the system on a table top or in any other freestanding mode, be sure to leave enough space around the system for adequate ventilation. Position the router with easy access to the connections that it needs for power, local communications, and remote communications.

See *Chapter 3, Installation Guidelines and Requirements*, and *Chapter 11, System Specifications*, for more information.

⚠️ *Warning: Two people are required to lift an E-series router.*

📄 *Note: All persons handling an E-series router should wear an antistatic device.*

Connectors are located on the I/O modules and the power input module and are installed from the rear of the router (see Figure 4-1). See *Chapter 6, Cabling E-Series Routers*, for cabling installation procedures.
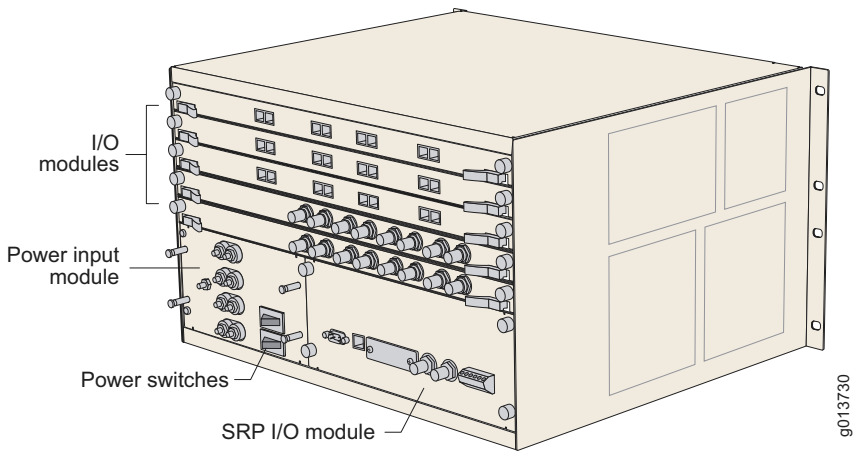
Figure 4-1 ERX-7xx model, rear view

Rack-Mounted Installation

Juniper Networks recommends that you use a standard EIA distribution rack. Refer to *Equipment Rack Requirements* in *Chapter 3, Installation Guidelines and Requirements*, for detailed rack information.

Installation Guidelines

Before installing the systems in a rack, consider the following guidelines and refer to Figure 4-2:

- You can install up to three ERX-14xx models, six ERX-7xx models, or fourteen ERX-310 routers in a single 7-ft. (2.1 m) rack.

  Installing multiple systems in a single rack allows you to maximize your available space.

- You can install an ERX-14xx model, an ERX-7xx model, and an ERX-310 router together in the same rack (see Figure 4-2).

  If you install an ERX-7xx model or ERX-310 router directly above an ERX-14xx model in the same rack, you must install a plenum between the ERX-7xx model or ERX-310 router and the ERX-14xx model so that the air can circulate between the systems (see Figure 3-2). This plenum is available from Juniper Networks.

  If you install an ERX-14xx model above an ERX-7xx model or ERX-310 router, there is no need to install a plenum between the units because the ERX-7xx models and ERX-310 routers vent air out the side of the chassis.

Warning: To maintain airflow requirements, a plenum must be installed above an ERX-14xx model before any other piece of equipment is installed above the router.

- Install heavier systems, such as an ERX-14xx model, on the bottom of the rack. Lighter systems, such as the ERX-310 router, should be mounted higher in the rack.

ERX-310 router

ERX-7xx model

Plenum

ERX-14xx model

g013740
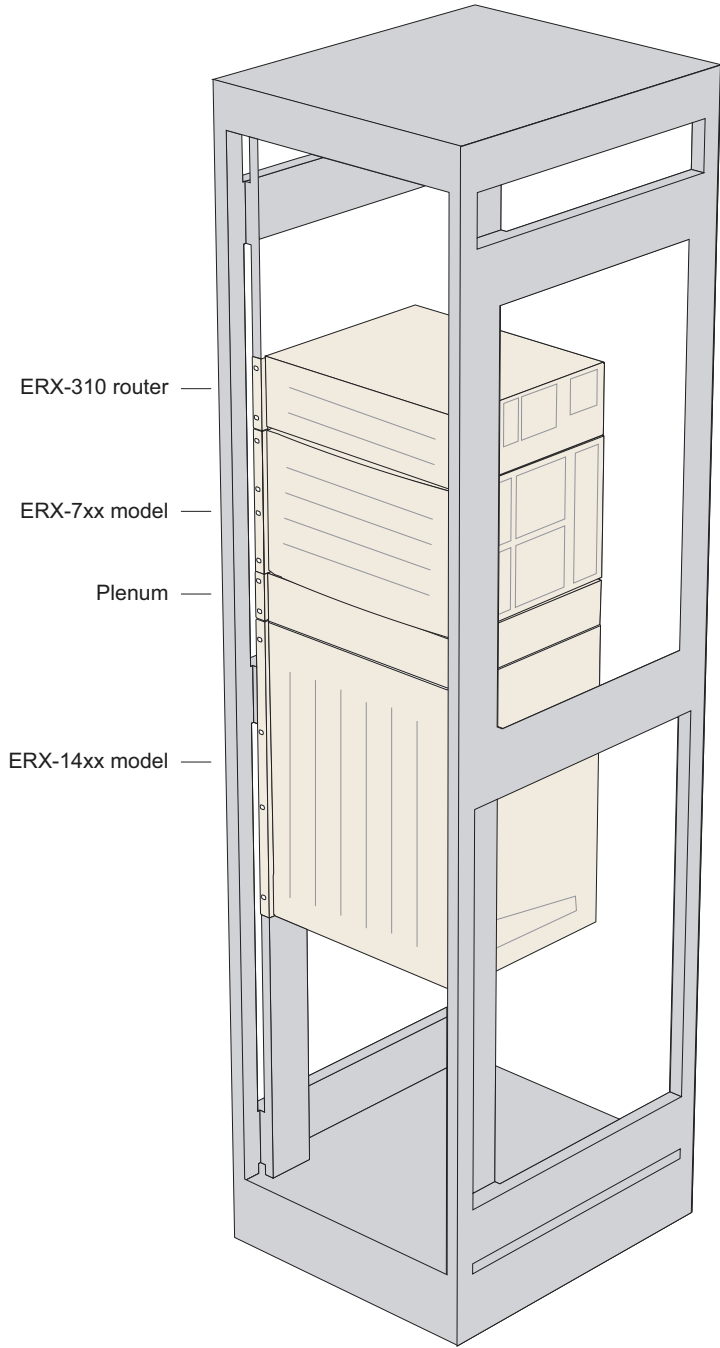
Figure 4-2 E-series routers installed in recommended order

Safety Guidelines

Observe the following safety guidelines when mounting the router in a rack.

Rack Installation Warning: *Install equipment in the rack from the bottom upward. This will maintain the stability of the rack and reduce the chance of the rack's tipping over.*

Heavy-Equipment Warning: *Three people are required to install the E-series router in a rack: two to lift the system into position and one to screw it to the rack.*

Branch Circuit Warning: *Evaluate the overall loading of the branch circuit before you install any equipment into a rack.*

Ground (Earth) Warning: *Connect the E-series router or rack to ground (earth), and ensure that a reliable grounding path is maintained in the rack.*

Lightning Activity Warning: *Do not work on the system or connect or disconnect cables during lightning activity.*

DC Power Disconnection Warning: *Before powering on the E-series router, remove power from the DC circuit by deactivating the circuit breaker on the panel board that services the DC circuit.*

Servicing Unit Warning: *Before servicing the E-series router, turn off the power.*

Jewelry Removal Warning: *Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. Metal objects heat up when connected to power and ground and can cause serious burns or become welded to the terminals.*

Metal Objects Warning: *Do not insert any metal object, such as a screwdriver, into an open slot or the backplane. Doing so may cause electric shock and serious burns.*

ERX-310 Router Power Cord Warning: *The ERX-310 router AC model has more than one power-supply cord. Disconnect 2 power cords BEFORE servicing to avoid electric shock.*

Preparing the Equipment Racks

Following your installation plan, use a tape measure and marking pen to measure and mark space on each equipment rack for each E-series router component. Horizontal spacing should follow NEBS requirements. If you choose not to install a plenum, be sure to include 2 U of space between the each chassis to allow for proper exhaust. A plenum, however, is highly recommended.

Installing the Router

To complete the installation of the router in a rack, you need:

- A Phillips screwdriver

- Depending on the router, up to eight 10-32 x 3/8 Phillips screws (provided with the router) for each router to be installed

Warning: Three people are required to install the E-series router in a rack: two to lift the system into position and one to screw it to the rack.

Note: All persons handling an E-series router should wear an antistatic device.

To install the router in the rack:

1 Position the router in its designated location in the equipment rack. Make sure the holes of the mounting brackets align evenly with the holes of the equipment rack on both sides.

Note: One person should stand on the left side of the router, and another should stand on the right side when lifting.

2 Starting at the bottom, secure the router in the equipment rack by using the 10-32 x 3/8 Phillips screws.

3 Connect the necessary cables (see *Chapter 6, Cabling E-Series Routers*, for instructions on installing the cables).

Figure 4-2 illustrates a distribution rack with one ERX-310 router, one ERX-7xx model, and one ERX-14xx model installed.

The Next Step

After you finish installing the router:

- If you need to install any modules, turn to *Chapter 5, Installing Modules*.
- If the router was delivered with the modules already installed, turn to *Chapter 6, Cabling E-Series Routers,* for instructions on connecting cables.

Installing Modules

5

This chapter describes how to install and remove E-series modules.

For information about managing installed modules, see *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

Overview

Line module slots are located in the front of each E-series chassis, while I/O module slots are located in the rear. See *Chapter 1, E-Series Overview*, for front and rear views of E-series routers.

In ERX-14xx models, modules mount vertically in a chassis with 14 slots. In ERX-7xx models and ERX-310 routers, modules mount horizontally in a chassis with 7 slots and 3 slots, respectively. See Figure 5-1.

g013742

ERX-7xx model

ERX-14xx model

ERX-310 router
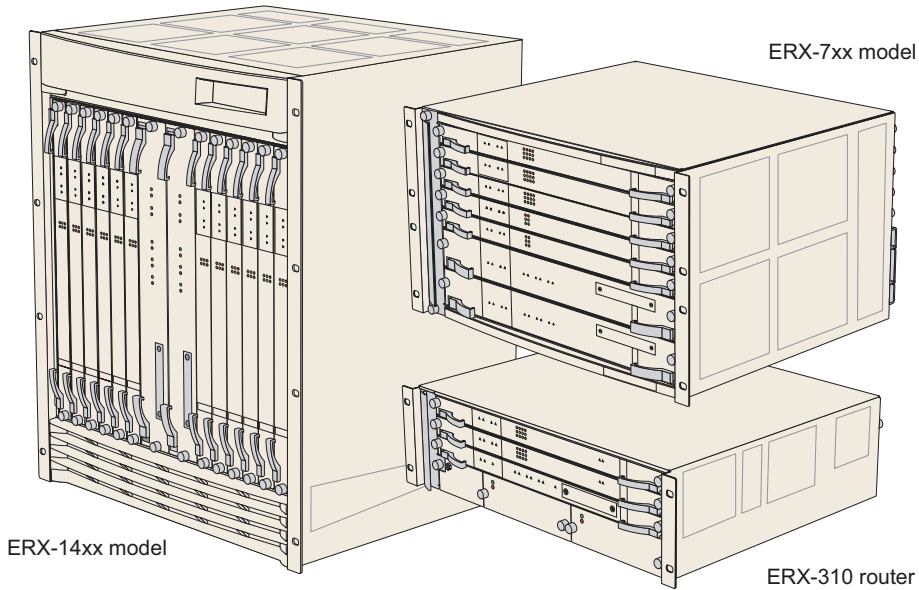
Figure 5-1 Orientation of line modules in E-series routers

For details about available line modules, see *Chapter 12, Module Specifications*. For information about compatibility between lines modules and SRP modules, see Table 12-2 in *Chapter 12, Module Specifications*.

Slot Groups

The slots in the ERX-1410 router and the ERX-7xx models are divided into groups. The number of groups and number of slots per group depend on the system.

There are no slot groups in the ERX-1440 router or the ERX-310 router. In the ERX-310 router, slot 0 contains the SRP module and slots 1 and 2 contain a line module.

Slot Groups for the ERX-1410 Router

A slot group in the ERX-1410 router comprises three adjacent chassis slots. The groups for the ERX-1410 router consist of the following slots (Figure 5-2):

- Slot group 1 – slots 0 through 2

- Slot group 2 – slots 3 through 5

- Slot group 3 – slots 8 through 10

- Slot group 4 – slots 11 through 13

Slots 6 and 7 are reserved for the SRP modules.
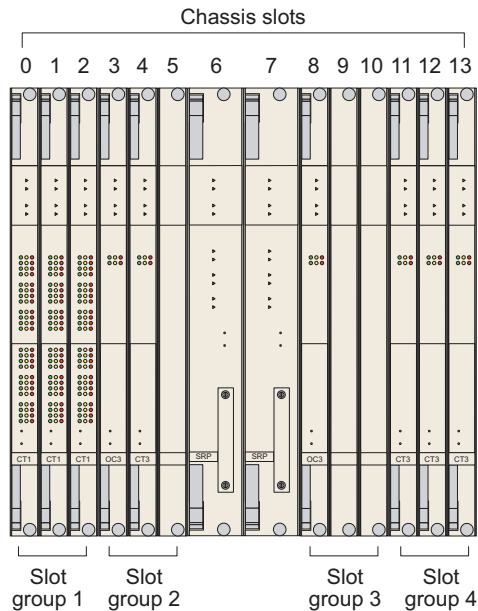
Figure 5-2 ERX-1410 slot groups

Slot Groups for the ERX-7xx Models

A slot group in an ERX-7xx model comprises one slot or two adjacent slots. The groups for an ERX-7xx model consist of the following slots (Figure 5-3):

- Slot group 1 – slots 2 and 3
- Slot group 2 – slot 4
- Slot group 3 – slot 5
- Slot group 4 – slot 6

Slots 0 and 1 are reserved for the SRP modules.
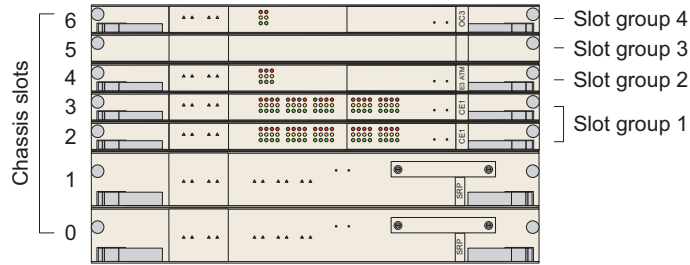
Figure 5-3 ERX-7xx model slot groups

Combinations of Line Modules

For information about allowed combinations of line modules, see *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

OC48 Line Modules

The ERX-1440 router with the SRP-40G+ SRP module supports OC48 line modules. Other E-series routers do not support OC48 line modules.

An OC48 line module spans two slots in an ERX-1440 router. You can install this line module only in slots 2–3 and slots 4–5. Other slots in the system do not support this line module.

The corresponding OC48 Frame APS I/O module spans only one slot. Install the I/O module in the lower of the slots (either slot 2 or slot 4) that the line module spans.

Replacing and Managing Modules Using the Software

For information about software procedures associated with replacing and managing modules, see *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

Hot-Swapping Modules

All E-series routers support hot-swapping of modules. Hot-swapping allows you to add or remove a module without powering down the system.

Protecting Modules and Slots

Each E-series chassis has an ESD (electrostatic discharge) grounding jack. See Table 5-1 for locations. To prevent damage from electrostatic discharge, connect an antistatic wrist strap to the jack when handling components.
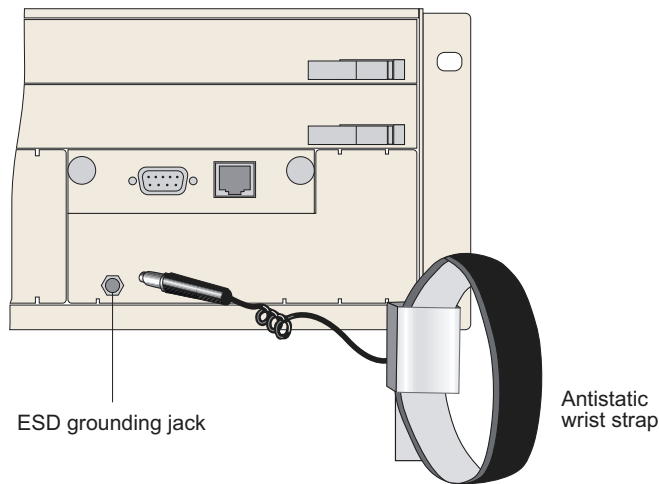
Figure 5-4 Connecting the wrist strap to the ERX-310 router (rear)

Table 5-1 Grounding jack locations

E-Series Router	Location
ERX-14xx model	Front: inside front bezel in lower-left corner
	Rear: upper-right corner
ERX-7xx model	Rear: lower-right corner
ERX-310 router	Front: lower-left corner
	Rear: lower-right corner

To protect the modules and slots when installing modules, observe the following guidelines:

⚠ *Caution: When handling modules, use an antistatic wrist strap connected to the E-series router's ESD grounding jack. This action helps to protect the module from damage by electrostatic discharge.*

⚠ *Caution: Always handle the module by its edges. Do not touch the components, pins, leads, or solder connections.*

⚠ *Caution: If you meet strong resistance when attempting to seat the module using the ejectors, remove it from the chassis and confirm that the slot is one designed to hold the module. Also, be sure that you have aligned the top and bottom edges in the correct matching tracks.*

⚠ *Caution: Be sure to cover every empty slot with a blank faceplate to protect the system from dust or other foreign substances and to ensure proper system cooling.*

⚠ *Caution: Do not discard the antistatic bag. When a module is not in use, store it in an antistatic bag.*

Order of Installation

Before you attempt to install or replace a module (inserted in the front of the chassis), the corresponding I/O module (inserted in the rear of the chassis) should already be in place. The system diagnostics run when a module is installed in a chassis slot. If the corresponding I/O module is not present, the diagnostics fail, and you need to remove and reinsert the module.

Required Tools and Safety Items

You need the following tools to install a line module:

• A Phillips screwdriver

• An ESD wrist strap

Safety Guidelines

Before and during the installation process, observe the following precautions:

Lightning Activity Warning: Do not work on the system or connect or disconnect cables during lightning activity.

DC Power Disconnection Warning: Before powering on the E-series router, remove power from the DC circuit by deactivating the circuit breaker on the panel board that services the DC circuit.

Jewelry Removal Warning: Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. Metal objects heat up when connected to power and ground and can cause serious burns or become welded to the terminals.

Metal Objects Warning: Do not insert any metal object, such as a screwdriver, into an open slot or the backplane. Doing so may cause electric shock and serious burns.

Repair Warning: Never attempt to repair parts of modules yourself. Only trained customer service personnel are authorized to service parts. Call Juniper Networks Customer Service to make arrangements to return defective modules for repair.

Installing SRP I/O and SRP Modules

SRP modules should be installed in specific slots in each router. See Table 5-2 for SRP module slot assignments.

Table 5-2 SRP module slot assignments

E-Series Router	Slot
ERX-14xx model	6 and 7
ERX-7xx model	0 and 1
ERX-310 router	0

Note: Because of different physical dimensions and switch fabric capabilities, SRP modules are not interchangeable between systems. For example, the 10-Gbps SRP module used in ERX-7xx/14xx models cannot be used in an ERX-310 router, and vice versa.

Note: Install the SRP I/O module before you install the SRP module; otherwise, the system diagnostics will fail.

Installing an SRP I/O Module

To install an SRP I/O module:

1 Ground yourself by using an antistatic wrist strap or other device.

2 With a Phillips screwdriver, loosen the captive screws that secure the blank faceplate covering the empty chassis slot, if present, and remove the faceplate.

3 Remove the SRP I/O module from its antistatic bag.

4 Slide the module into the chassis by placing it between the guides of the selected slot and pushing the module until it stops.

Note: See figures in Chapter 1, E-Series Overview, for module locations.

5 Tighten the module's captive screws using a Phillips screwdriver. Turn both screws several times before tightening them completely to allow the module to sit correctly.

Installing an SRP Module

To install an SRP module:

1 Ground yourself by using an antistatic wrist strap or other device.

Note: See figures in Chapter 1, E-Series Overview, for module locations.

2 Choose the slot in which you want to install the module.

- ERX-14xx models – slot 6 or 7

- ERX-7xx models – slot 0 or 1

- ERX-310 router – slot 0

3 With a Phillips screwdriver, loosen the captive screws that secure the blank faceplate covering the empty chassis slot, if present, and remove the faceplate.

4 Remove the SRP module from its antistatic bag.

5 Verify that the ejectors are in the open position, as shown in Figure 5-5.
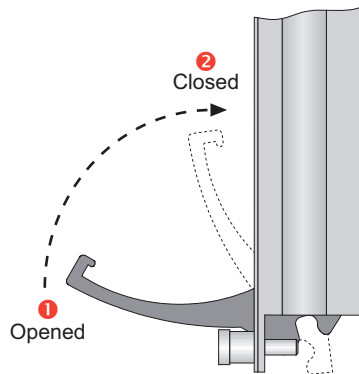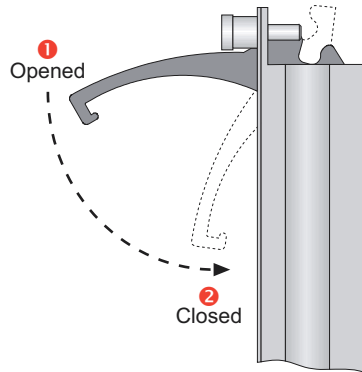
Figure 5-5 Ejectors in the open position

6 Slide the module into the chassis by placing it between the guides of the selected slot and pushing the module until it stops.

The module stops sliding when the ejectors make contact with the front of the chassis.

⚠ *Caution: If you meet strong resistance when attempting to seat the module using the ejectors, remove it from the chassis and confirm that the slot is one designed to hold the module. Also, be sure that you have aligned the top and bottom edges in the correct matching tracks.*

7 Insert the module into the backplane by simultaneously depressing both ejectors (as shown in Figure 5-5) and exerting forward pressure on the module.

8 Tighten the module's captive screws using a Phillips screwdriver. Alternately turn each screw several times before tightening them completely to allow the module to sit correctly.

Installing Line and I/O Modules

This section describes the procedures for installing line and I/O modules.

Note: Install the I/O module before you install the corresponding line module; otherwise, the system diagnostics fail, and after the line module has tried to reboot, its status will be "inactive" when you issue the **show version** *command.*

Installing a Line Module or an I/O Module

To install a module:

1 Ground yourself by using an antistatic wrist strap or other device.

2 Choose the slot where you want to insert the module.

Note: Line modules are in the front of the system, and I/O modules are in the back of the system.

Table 5-3 Module slot assignments

E-Series Router	Module Slot
ERX-1440 router	• Install modules other than the OC48 modules in slots 0–5 and slots 8–13 • Install the OC48 line module in slots 2–3 and slots 4–5 › Install the corresponding I/O module only in the lower of the two slots (either slot 2 or slot 4) that the line module spans
ERX-1410 router	Install modules in slots 0–5 and slots 8–13
ERX-7xx model	Install modules in slots 2–6
ERX-310 router	Install modules in slots 1–2

3 With a Phillips screwdriver, loosen the screws that secure the blank faceplate covering the empty chassis slot, if present, and remove the faceplate.

4 Remove the module from its antistatic bag.

5 Verify that the ejectors are in the open position, as shown in Figure 5-5.

6 Guide the module into the chassis by placing it between the guides of the selected slot and pushing the module until it stops.

The module stops sliding when the ejectors make contact with the front of the chassis.

⚠ *Caution: If you meet strong resistance when attempting to seat the module using the ejectors, remove it from the chassis and confirm that the slot is one designed to hold the module. Also, be sure that you have aligned the top and bottom edges in the correct matching tracks.*

7 Insert the module into the midplane by simultaneously depressing both ejectors (as shown in Figure 5-5) and exerting forward pressure on the module.

8 Tighten the module's captive screws using a Phillips screwdriver. Alternately turn each screw several times before tightening them completely to allow the module to sit correctly.

Removing a Module

📄 *Note: Although not required, it is recommended that you issue the **slot disable** command from the CLI before removing a module.*

⚠ *Caution: If you do not use the **halt** command before removing or powering down an SRP, the system's NVS card may become corrupted.*

To remove a module:

1 Enter the **halt** command.

See *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules* for information about the **halt** command.

2 Ground yourself by using an antistatic wrist strap or other device.

3 Use a screwdriver to loosen the thumb screws located at the top and bottom of the module panel.

4 Pull the ejector handles located at the top and bottom of the module so that they are in position 2, as shown in Figure 5-6.
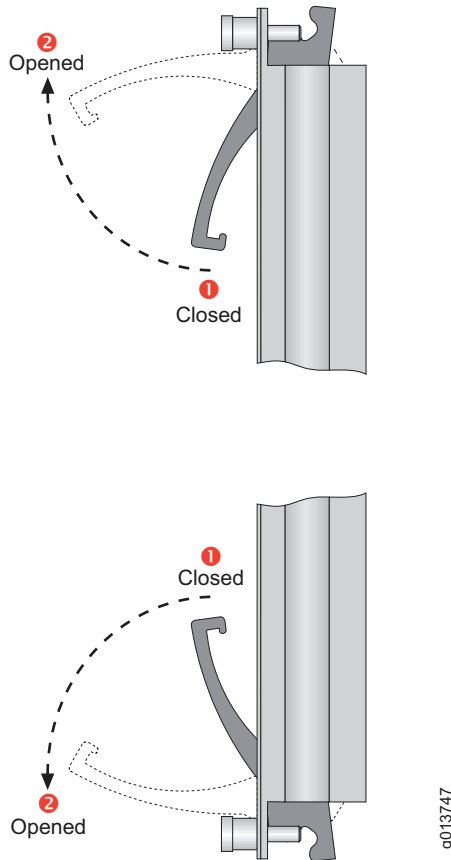
Figure 5-6 Ejectors in the closed position

5 Carefully slide the module out of the chassis.

6 Place the module in its antistatic bag.

7 Cover the empty chassis slot with a blank faceplate, and tighten the faceplate's captive screws using a Phillips screwdriver. Turn both screws several times before tightening them completely.

If you remove an I/O module and not the corresponding line module, the line module reboots. Its status becomes "inactive" when you issue the **show version** command.

If you remove a line module and do not delete the corresponding configuration, the status of the line module will be "not present" when you issue the **show version** command.

Installing Components for Line Module Redundancy

A spare line module provides redundancy for a group of identical line modules for ERX-7xx/14xx models only.

📄 *Note: The ERX-310 router does not support line module redundancy.*

For line module redundancy to operate, you must install:

- The line modules, including the spare line module

- The redundancy midplane

- The I/O modules, including the spare I/O module

For more information, see *Redundancy Features* in *Chapter 1, E-Series Overview*.

⚡ *Warning: Do not insert any metal object, such as a screwdriver, or place your hand into an open slot or the backplane when the E-series router is on. Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. These actions prevent electric shock and serious burns.*

⚠ *Caution: When handling modules, use an antistatic wrist strap connected to the E-series router's ESD grounding jack, and hold modules by their edges. Do not touch the components, pins, leads, or solder connections. These actions help to protect modules from damage by electrostatic discharge.*

Installing the Line Modules

To install the line modules in a redundancy group:

1 Install the spare line module in the lowest-numbered slot of the redundancy group.

2 Install the other line modules in the remaining slots. (See *Installing Line and I/O Modules* earlier in this chapter).

Installing the Redundancy Midplane

To install the redundancy midplane in a redundancy group:

⚠ *Caution: If you do not use the **halt** command before removing or powering down an SRP, the system's NVS card may become corrupted.*

1 Enter the **halt** command.

See *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules* for information about the **halt** command.

Warning: Turn off the E-series router before you install the redundancy midplane. Working inside the router when it is on can lead to electric shock and serious burns.

2 Turn off the power switches located on the power input module in the rear of the system (see Figure 5-7).

3 Remove the I/O modules from the slots that the redundancy midplane will span.

4 Place the redundancy midplane in the chassis so that it rests against the guides below the chassis midplane (see Figure 5-7).

5 Align the screw holes in the redundancy midplane with the screw holes in the guides so that the midplane covers the slots for the redundancy group.

6 Using a Phillips screwdriver and the screws provided, loosely attach, but do not tighten, the redundancy midplane to the guides.

7 Carefully insert an I/O module in one slot to ensure that the redundancy midplane is aligned correctly; then tighten the screws.

Caution: A misaligned redundancy midplane can result in bent pins on the backplane and midplane and poor contact between the I/O modules and the redundancy midplane.

Redundancy
midplane
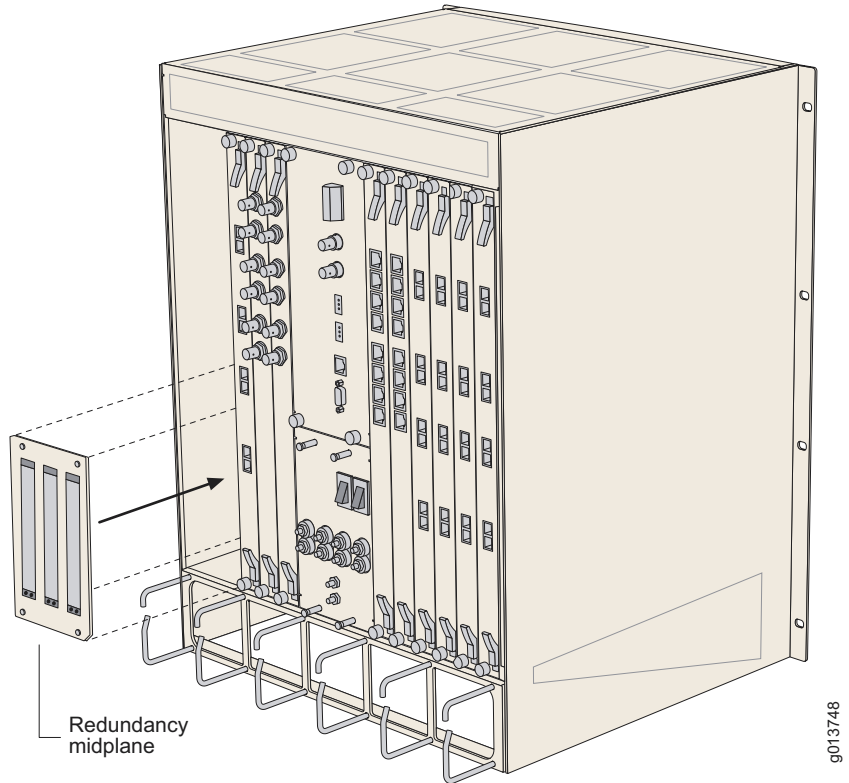
Figure 5-7 Installing a redundancy midplane

Installing the I/O Modules

To install the I/O modules in a redundancy group:

1   Install the redundancy I/O module in the lowest-numbered slot of the redundancy group.

⚠ *Caution: When setting up a redundancy group with line modules, be sure to install the redundancy I/O module in the lowest-numbered slot of the redundancy group. It is possible to install the redundancy I/O module in other slots; however, doing so may damage other I/O modules connected to the redundancy midplane.*

2   Install the corresponding I/O module for the line module of each slot in the redundancy group. (See *Installing a Line Module or an I/O Module*, earlier in this chapter.)

3   Cable each module to provide a path to the remote interface (see *Chapter 6, Cabling E-Series Routers*).

Verifying the Installation

To verify that the installation is complete:

1 After you have cabled the system for power (see *Chapter 6, Cabling E-Series Routers*), turn on the power switches.

The system reboots.

2 Issue the **show redundancy** command, and verify that the display shows the redundancy hardware.

Configuring Line Module Redundancy

For information about configuring line module redundancy, refer to *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

The Next Step

After you install the modules, you can connect cables to the system. Turn to *Chapter 6, Cabling E-Series Routers*.

Cabling E-Series Routers

6

This chapter describes how to cable an E-series router. Before you cable the router, ensure that you have completed all installation instructions identified in previous chapters.

Cabling Overview

Cabling an E-series router requires the following main tasks:

1 Familiarize yourself with the module ports, and ensure that you have the cables and wires needed to complete each cabling procedure (see Figure 6-1).

2 Read and understand all safety warnings. (See *Chapter 3, Installation Guidelines and Requirements*.)

3 *(Optional)* Connect timing ports.

4 Connect the SRP I/O module to the network and to a management console.

5 Connect grounding wires to the E-series chassis.

6 Connect the power cables from the power source to the power input module.

7 Connect the line I/O modules to their appropriate network interface.

Note: *Juniper Networks recommends that you use shielded cables where appropriate.*

Alarm leads

External timing ports (Europe)

External timing ports (North America)

SRP I/O module
(slot positions 6 and 7)

FE-8 I/O module
(slot 5)

OC3-4
I/O module
(slot 12)

CT3
I/O module
(slot 9)

Port 0 — RX
        TX

OC3
I/O module
(slot 13)

Port 1 — RX
        TX

Blank
faceplate

Ejector

OC3 I/O

OC3-4 I/O SINGLE MODE

OC3-4 I/O SINGLE MODE

CT3 I/O

CT3 I/O

FE-8 I/O

ALARMS

MINOR
MAJOR
CRITICAL

EXTERNAL TIMING

E1 75 OHM
CLOCK IN

T1 100 OHM
CLOCK IN

A
B

CONSOLE

10/100
BASE T

RS-232

Port 0

Port 1

Port 2

Port 3

10/100 BASE T port

RS-232 terminal port

Power input module

THIS PRODUCT IS EQUIPPED WITH
TWO POWER FEEDS. DISCONNECT
BOTH FEEDS PRIOR TO SERVICE.

POWER A   POWER B

POWER A   POWER B
-48VDC RTN -48VDC RTN

-48VDC RTN -48VDC RTN

WARNING!
NO OPERATOR ACCESSIBLE
COMPONENTS. AUTHORIZED
SERVICE PERSONNEL ONLY.

Power A and Power B
on/off switches

Power A and Power B
input connectors

Ground terminals

g013749

Figure 6-1 E-series ports and connectors (ERX-14xx model shown)

Required Tools, Wires, and Cables

Cabling your system should take only a few minutes. You will need the items listed below and in Table 6-1 for proper installation.

- 1/8" flathead screwdriver

- 3/8" wrench or 3/8" nut-driver

- No. 2 Phillips screwdriver

- Ground wires – We recommend a minimum of 10-AWG ground wire.

- #10 (ERX-7xx/14xx models) or #8 (ERX-310 router) kep nut to connect the ground (earth) wire to the ground terminal.

- Power input module wiring – We recommend a minimum of 10-AWG (ERX-7xx/14xx model) or 14-AWG (ERX-310 router DC model) wire with a dual stud terminal lug with 3/8" spacing. For the ERX-310 router AC model, use a standard IEC power cord.

Table 6-1 Required cables

Connection	Port and Cable Used
Management connection between SRP I/O module and the LAN	One 10/100Base-T Ethernet management port with an RJ-45 connector
Management connection between SRP I/O module and a management console	One RS-232 port with a DB-9 connector for VT100 management access
Direct connections to I/O modules	See Table 12-3 in *Chapter 12, Module Specifications* for specific I/O module connector information

📄 *Note: If you plan on using a cable-management bracket (ERX-7xx/14xx models only), install it before you begin cabling your E-series router. Cable-management brackets are helpful to keep network interface cables untangled and orderly and to prevent cables from hindering access to other slots. See Installing a Cable-Management Bracket on ERX-7xx Models in Chapter 9, Maintaining E-Series Routers.*

Cabling the SRP I/O Module

Before powering up the E-series router, you must set up a management console. The console enables you to communicate with your system during the power-up process and to manage your system using the command line interface (CLI).

When connecting a console directly to the SRP I/O module, use a cable appropriate for your terminal connector. The cable must have a female DB-9 connector to attach to the RS-232 port on the SRP I/O module. See Figure 6-2 and Figure 6-3.

The console port is considered a data terminal equipment interface (DTE). Direct connection to a terminal or PC (which also have DTE interfaces) requires a crossover cable.

Note: The alarm function on the SRP I/O module is currently not implemented.

Only ERX-7xx/14xx models have external timing ports and alarm leads located on the SRP I/O module. All E-series routers have console ports located on the SRP I/O module. See Table 6-2 for details on each component.

Table 6-2 SRP I/O ports

Port	Description
Alarm leads *(ERX-7xx/14xx models only)*	Six terminal blocks for external alarm contacts; use a minimum 26-AWG for each (currently not implemented)
External timing ports *(ERX-7xx/14xx models only)*	• Two 3-pin wire-wrap posts for US external clock sources; primary (A) and secondary (B) • Two BNC connectors for E1 clock sources; primary (A) and secondary (B)
Console ports	• One 10/100Base-T Ethernet management port with an RJ-45 connector • One RS-232 port with a DB-9 connector for VT100 management access

External Timing Ports

Note: This section applies to ERX-7xx/14xx models only. The ERX-310 router does not support external timing.

There are two input ports on the SRP I/O module for external clock sources. These ports provide a way to ensure that the E-series router system clock remains synchronized with the network's system clock. The primary clock is labeled A; the secondary, redundant clock is labeled B.

Use the connectors appropriate for your locale (European or North American standard):

- European – Two 75-ohm E1 2.048-Mbps inputs with BNC connectors

- North American – Two 100-ohm T1 inputs with three pin wire-wrap connectors. Pins are labeled T (tip), G (ground), and R (ring). We recommend using 26-AWG wire minimum.

📄 *Note: Use shielded cables to connect the external clock sources to the clock source input ports.*
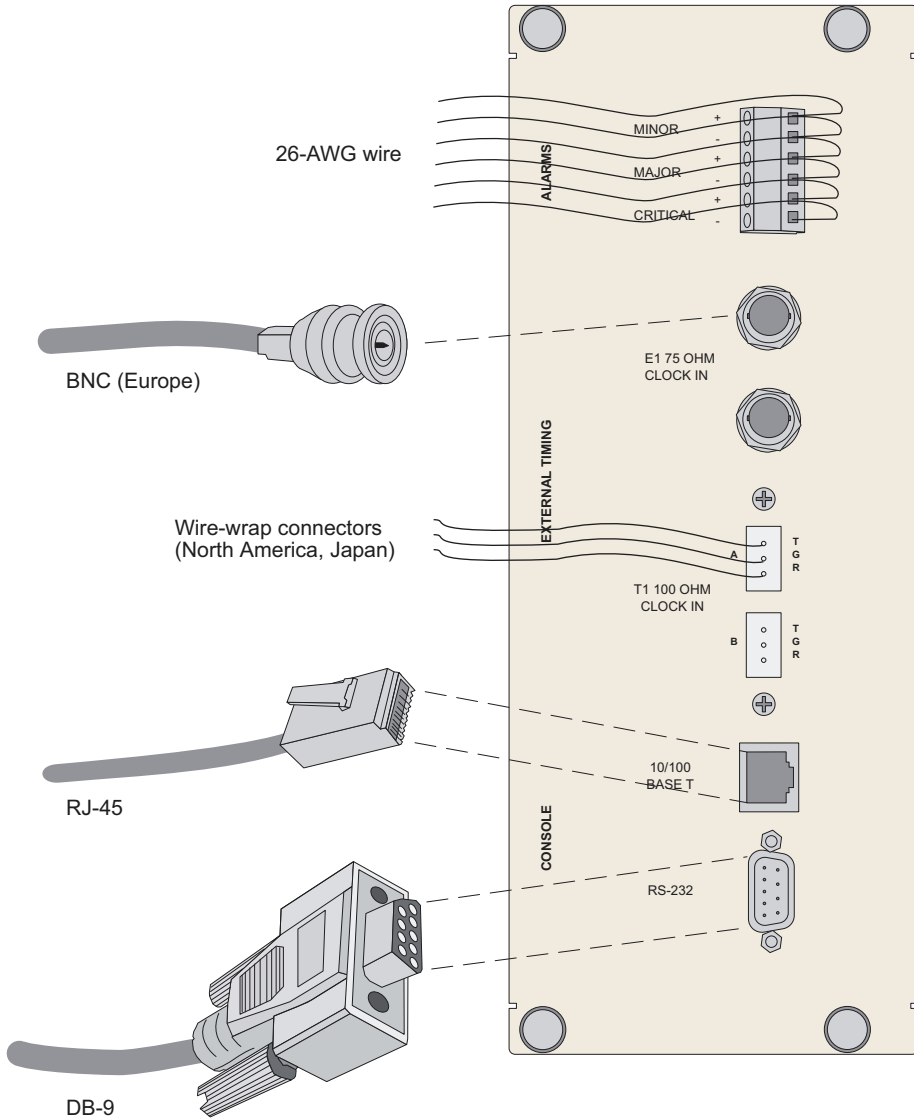
Figure 6-2 ERX-14xx model SRP I/O module

To connect the clock source input ports:

1   Depending on the connector type, complete one of the following tasks:

- E1: Attach the BNC connector to Clock A's external timing port.

- T1: Wrap the tip wire on pin marked T of Clock A's external timing port, the ground wire on G pin, and the ring wire on R pin.

📝 *Note: You can use a wire-wrap gun to attach wires to pins.*

2   Attach the opposite end of the external timing cable or wires to your network's clock source A.

3   Repeat steps 1 and 2 for the Clock B connections.

Console Ports

📝 *Note: This section applies to all E-series routers.*

There are two ports located in the Console section of the SRP I/O module (see Figure 6-2 and Figure 6-3) that allow management access.

- The 10/100Base-T Ethernet port accepts an RJ-45 (male) connector, providing an out-of-band connection for LAN access through a Telnet session or SNMP.

- The RS-232 port accepts a DB-9 (female) connector, allowing direct CLI access from a console terminal.

  The console port is considered a data terminal equipment interface (DTE). Direct connection to a terminal or PC (which also have DTE interfaces) requires a crossover cable.
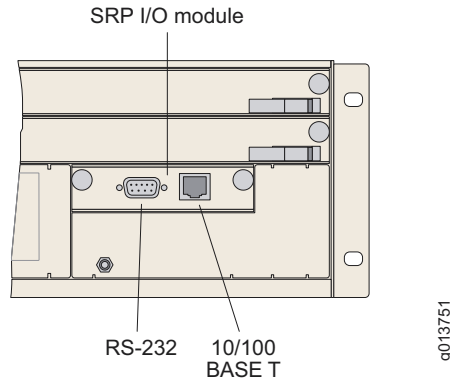
Figure 6-3 ERX-310 router SRP I/O module

See *Chapter 8, Accessing E-Series Routers*, for more information about management access.

Connecting to the Network

To connect the E-series router to the network:

1 Insert an Ethernet cable (RJ-45) connector into the 10/100Base-T (RJ-45) port on the SRP I/O module until it clicks into place.

2 Connect the other end of the cable to the appropriate Ethernet network for an out-of-band connection.

Connecting to a Console Terminal

When you connect a console directly to the E-series router SRP I/O module, use a cable appropriate for your terminal connector. The cable must have a female DB-9 connector to attach to the RS-232 port on the SRP I/O module.

To connect the console to the SRP I/O module:

1 Insert the female DB-9 connector into the RS-232 port, and tighten the screws.

2 Connect the other end of the cable to your terminal's serial port (VT100/ANSI).

Cabling the E-Series Router for Power

After you have correctly cabled the modules and I/O modules, you must attach grounding and electrical wires before you attempt system power-up. There are three main tasks involved:

1   Switch all E-series router power switches to OFF.

⚠ *Caution: Switches may have inadvertently flipped to ON during shipping and installation.*

2   Connect the grounding wires to the chassis.

⚡ *Warning: Always connect the grounding wires first (before connecting the power cables) and disconnect them last when installing or servicing the E-series router.*

3   Connect the power cables (AC or DC) to the power input modules.

See *Chapter 11, System Specifications* for the power requirements for the E-series router. Table 6-3 identifies the power input module cabling requirements, and Figure 6-4 shows the main components of a power input module.

Table 6-3 Power input module cables/wires needed

Cable/Wire	From	To
ERX-7xx/14xx models		
One 10-AWG ground wire	Power input module ground terminal	Termination ground
Two 10-AWG wire leads	Power input module Power A –48 VDC and RTN leads	Appropriate leads on power source No. 1
Two 10-AWG wire leads	Power input module Power B –48 VDC and RTN leads	Appropriate leads on power source No. 2
ERX-310 router		
One 10-AWG ground wire	Power input module ground terminal	Termination ground
Two 14-AWG wire leads[a]	Power input module Power A –48 VDC and RTN leads	Appropriate leads on power source No. 1
Two 14-AWG wire leads[a]	Power input module Power B –48 VDC and RTN leads	Appropriate leads on power source No. 2
One AC power cord[b]	Power input module AC power IEC receptacle	Appropriate AC power supply

a. DC model only
b. AC model only
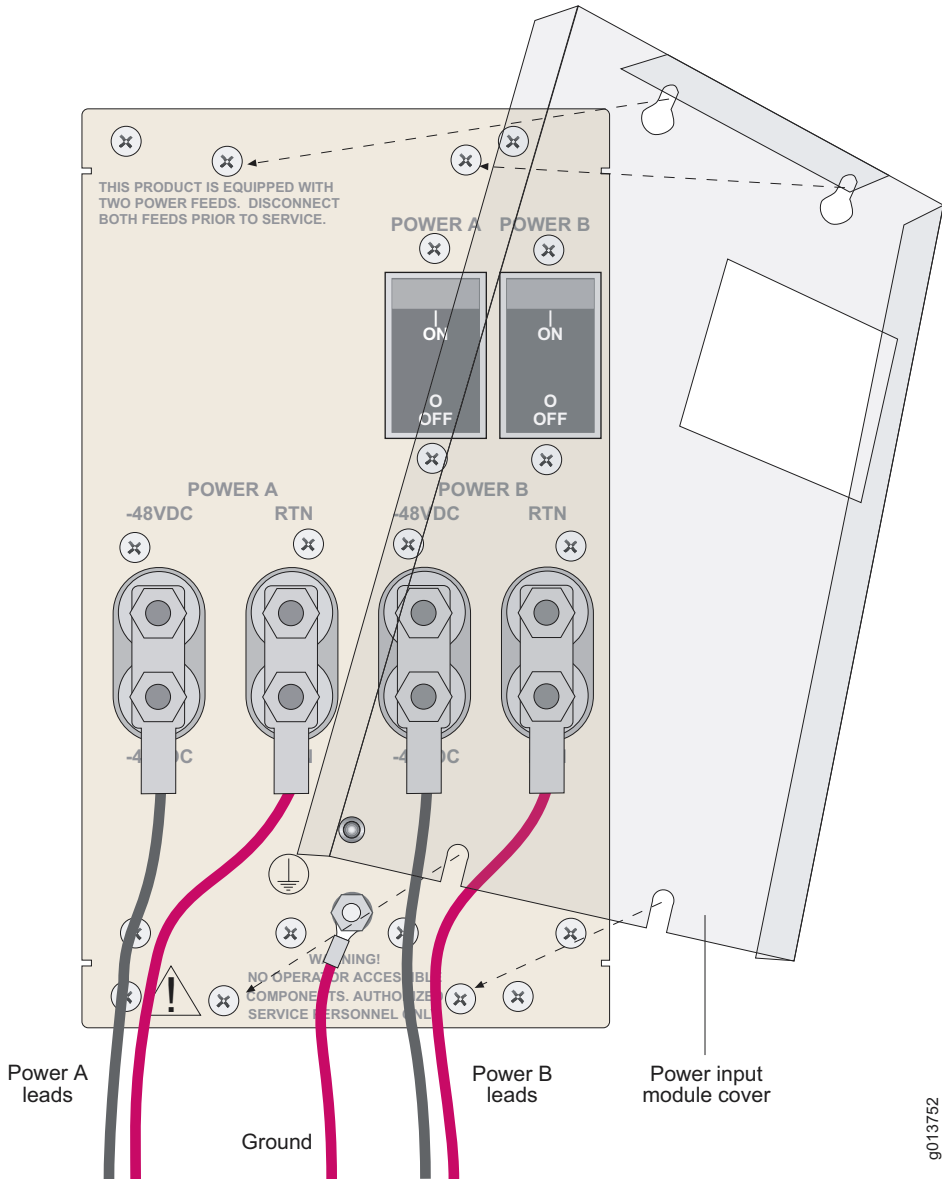
Figure 6-4 ERX-14xx model, power input module

Task 1: Turn Off All E-Series Router Power

Before starting, you must switch all E-series router power switches to OFF.

• To turn off the router, push each power switch to the OFF position.

Task 2: Connect the Grounding Cables

All E-series routers have two grounding studs located in the rear of the chassis, near the power inputs. Each stud provides grounding for a single power unit.

To ground each power unit:

1 Locate the grounding studs on the E-series router (see Figure 6-4 and Figure 6-5).

2 Remove the nuts and locking washers from the grounding studs.

📄 *Note: We recommend a minimum of 10-AWG ground wire with a ring style terminal.*

3 Place the grounding cable lead on one of the grounding studs and tighten the nuts to secure the connection.

4 Connect the other end of the ground cable to the appropriate ground termination lead.

5 Repeat steps 3–4 for the remaining grounding stud.

📄 *Note: When grounding an E-series router, leave a service loop in the grounding cable to ensure that the grounding cable is the last cable to disconnect from the shelf if strain is placed on the electrical cables.*

Task 3: Connect the Power Cables

To connect power cables to an E-series router, follow these steps. Refer to Figure 6-4, Figure 6-5, and Figure 6-6 as needed.

ERX-7xx models, ERX-14xx models, ERX-310 router (DC model)

⚠️ *Caution: Before you begin this procedure, ensure that all power switches are in the OFF position.*

1 Be sure you have completed Task 1 and Task 2 in the previous sections.

2 If applicable, loosen the screws from the clear power input module cover and remove it.

⚡ *Warning: Be sure the power source is turned off, the E-series router is turned off, and proper grounding wires are attached before continuing with this procedure.*

> ⚠️ *Warning: The wiring color code of the power cables depends on the color coding of the DC power source installed at your site. Color code standards for DC wiring do not exist. To ensure that the correct polarity is connected to the E-series router power units, confirm the connection of the power cables to the + (positive) and – (negative) leads at the power source.*

3 Remove the nuts and locking washers from the posts for the power input (A or B) using a small insulated adjustable wrench.

4 Place one negative (neutral) cable lead on the post labeled –48 VDC.

5 Replace the locking washers and nuts, and tighten the nuts to secure the connection.

6 Place the other cable lead on the post labeled RTN.

7 Replace the locking washer and nut, and tighten the nut to secure the connection.

8 Attach the opposite end of Power A's wire leads to the appropriate leads on your power source.

> 📄 *Note: To provide redundancy, Power A and Power B leads should not terminate at the same power source.*

9 Place the clear plastic guard over the terminal posts, and secure it in place by tightening the four screws.

10 Repeat steps 1–9 for each power input module in your configuration.
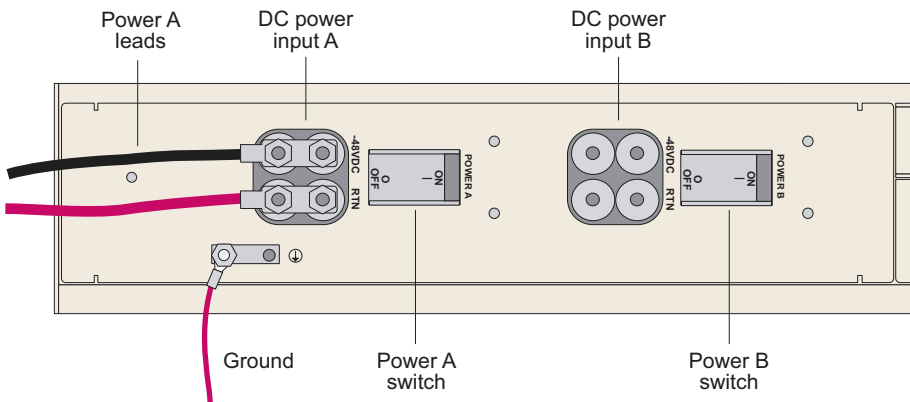
Figure 6-5 ERX-310 router, rear view (DC model)

ERX-310 router (AC model)

1 Insert the power cord into the AC power IEC receptacle (see Figure 6-6).

2 Insert the other end of the power cord into an appropriate AC power source.

📄 *Note: To provide redundancy, Power A and Power B leads should not terminate at the same power source.*

3 Repeat steps 1–2 for the other power input module, if needed.
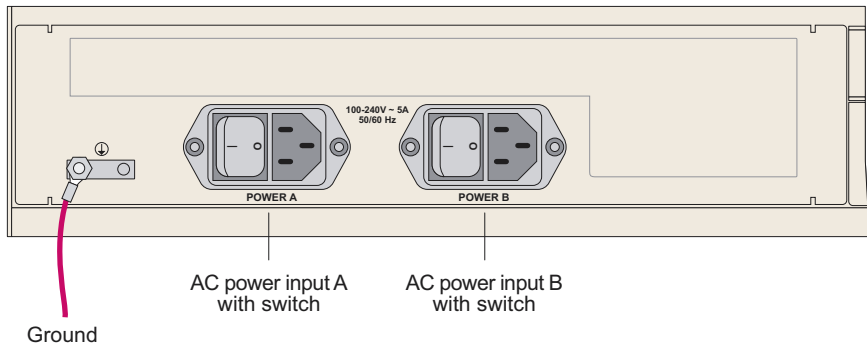
Figure 6-6 ERX-310 router, rear view (AC model)

Cabling I/O Modules

The following section illustrates the common connector types used with E-series I/O modules. For information about the connectors on the different line modules, see *Chapter 12, Module Specifications*.

BNC Connectors
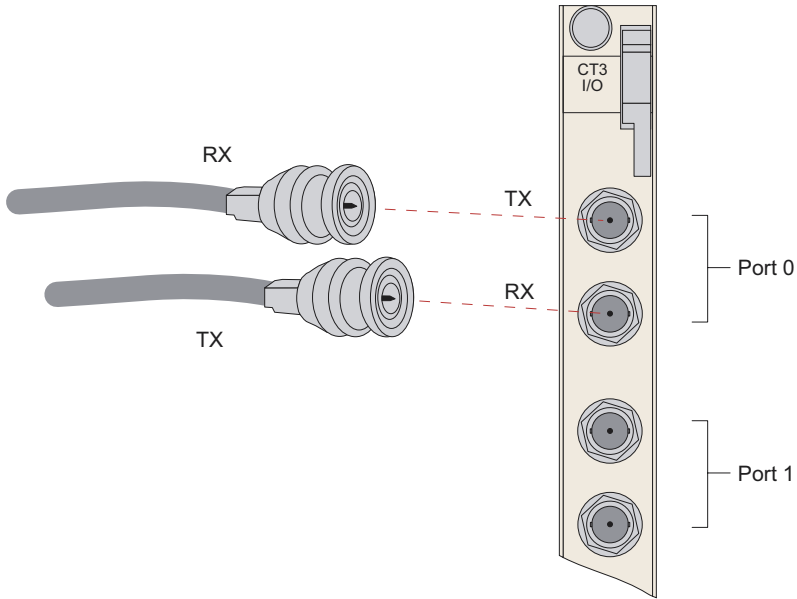
Figure 6-7 I/O module with BNCs

HSSI Connectors

The HSSI I/O module uses a standard 50-pin HSSI connector.

⚠ *Caution:* *Do not terminate HSSI connections with SCSI connectors. Although SCSI connectors look very similar to HSSI connectors, using SCSI connectors on HSSI connections may lead to data loss.*
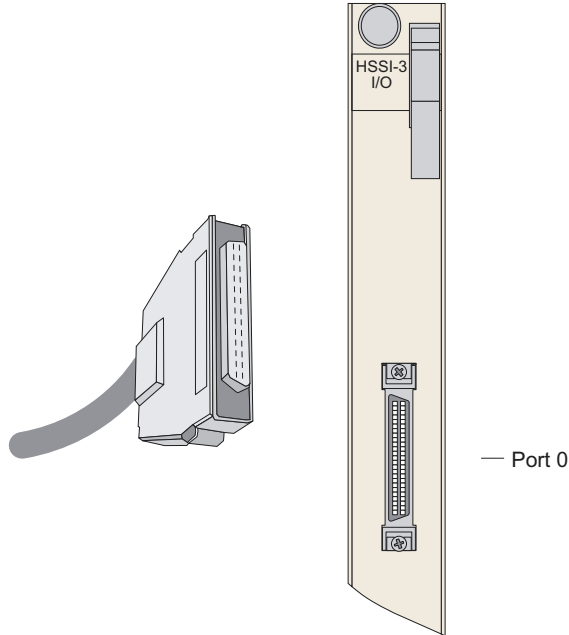
Figure 6-8 HSSI I/O module with 50-pin HSSI connector

RJ-45 Connectors

When inserting an RJ-45 connector, be sure it clicks into the port.
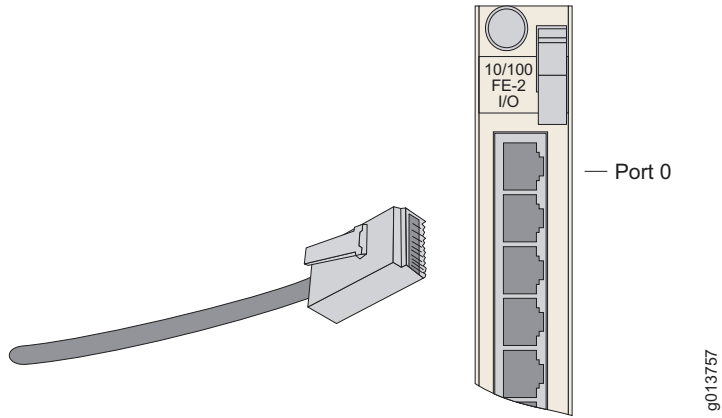
Figure 6-9 I/O module with RJ-45 connector

RJ-48C Connectors

When inserting an RJ-48C connector, be sure it clicks into the port.
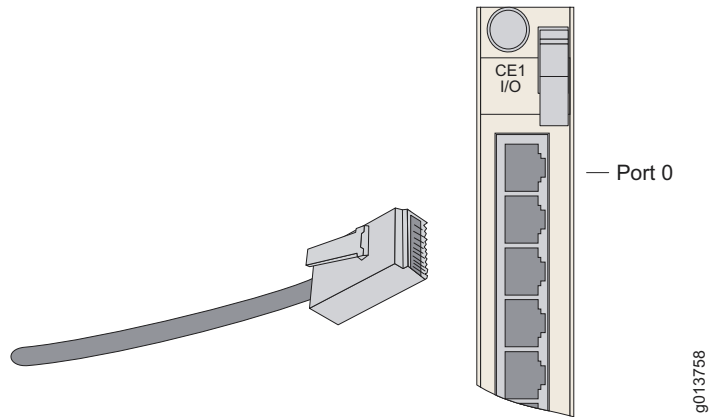
Figure 6-10 I/O module with RJ-48C connectors

LC Duplex Connectors

In accordance with EN60825-1, Safety of Laser Products - Part 1: Equipment Class, Requirements, and User's Guide (2001), multimode I/O modules with LC connectors are defined as follows:

CLASS 1 LED PRODUCT.

In accordance with EN60825-1, Safety of Laser Products - Part 1: Equipment Class, Requirements, and User's Guide (2001), single-mode I/O modules with LC connectors are defined as follows:

CLASS 1 LASER PRODUCT.

Warning: Do not look directly into LC-style fiber connectors. The fiber-optic laser used in single-mode fiber (SMF) meets the regulatory requirements for casual exposure to the eye; however, looking directly into a laser can cause eye damage.

Warning: IEC 825, Class 1 laser fiber connectors are for connection only to Class 1 laser devices.
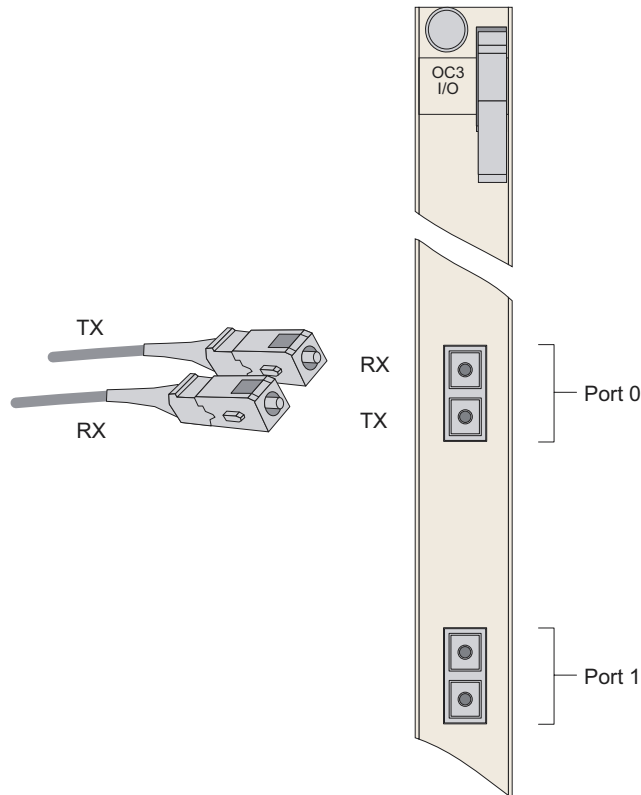
Figure 6-11 I/O module with LC full duplex connectors

SC Duplex Connectors

In accordance with EN60825-1, Safety of Laser Products - Part 1: Equipment Class, Requirements, and User's Guide (2001), multimode I/O modules with SC connectors are defined as follows:

CLASS 1 LED PRODUCT.

In accordance with EN60825-1, Safety of Laser Products - Part 1: Equipment Class, Requirements, and User's Guide (2001), single-mode I/O modules with SC connectors are defined as follows:

CLASS 1 LASER PRODUCT.

Warning: *Do not look directly into SC-style fiber connectors. The fiber-optic laser used in single-mode fiber (SMF) meets the regulatory requirements for casual exposure to the eye; however, looking directly into a laser can cause eye damage.*

Warning: *IEC 825, Class 1 laser fiber connectors are for connection only to Class 1 laser devices.*

SC duplex connectors have the same basic shape as LC duplex connectors, but are slightly larger. See Figure 6-11.

SMB Connectors

To cable I/O modules with SMB connectors, pull back the metal sheath on the connector, insert the connector into the selected port, and release the metal sheath.
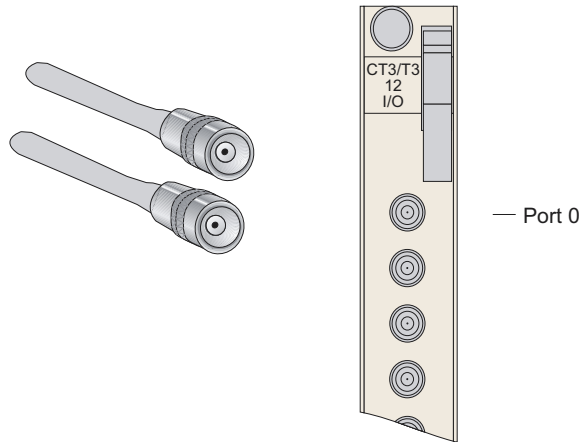
Figure 6-12 I/O module with SMB connectors

Cabling X.21/V.35 Connectors

Four cables are available for the X.21/V.35 I/O modules:

- X.21 DCE cable (terminated with 8 female X.21 connectors)

- X.21 DTE cable (terminated with 8 male X.21 connectors)

- V.35 DCE cable (terminated with 8 female V.35 connectors)

- V.35 DTE cable (terminated with 8 male V.35 connectors)

Each 200-pin proprietary socket on the I/O module provides connections to 8 V.35 or X.21 ports. The remote end of the cable is terminated with either 8 X.21 connectors or 8 V.35 connectors. The cable you attach to the port on the I/O module determines whether the connection is X.21 or V.35 and DCE or DTE.
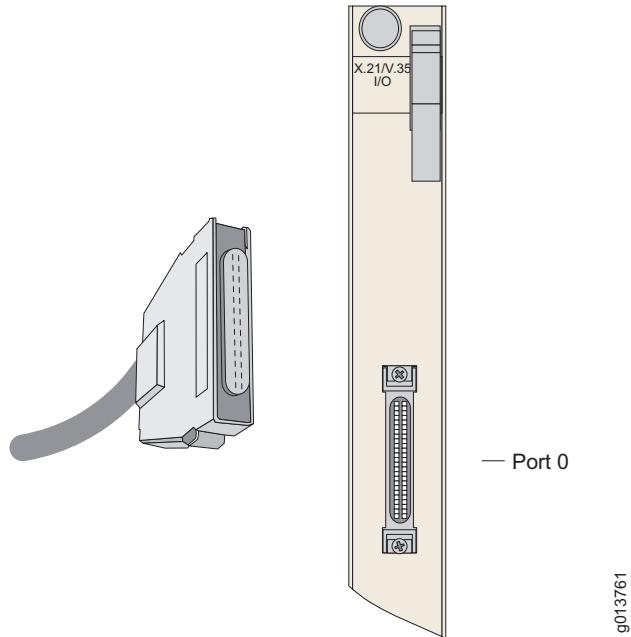
Figure 6-13 X.21/V.35 module with 50-pin X.21/V.35 connector

Redundant Ports

Some modules have redundant ports. See *Chapter 12, Module Specifications* for specifications. Cabling both ports provides a redundant path to the E-series module.

⚠ **Caution:** *For port redundancy to operate correctly on a GE I/O module that supports SFPs, both the primary and redundant ports on an E-series GE I/O module must use the same type of SFP.*

The Next Step

Turn to *Chapter 7, Powering Up E-Series Routers*.

7

Powering Up E-Series Routers

This chapter describes how to power up an E-series router and determine if it has booted properly.

Before You Power Up the System

Before powering up the system, you should complete the tasks shown in Table 7-1. Refer to the appropriate chapters in this guide for information about these tasks.

⚡ **Warning:** *Be sure the power source is turned off and the system is turned off before you perform the installation tasks.*

Table 7-1 Installation tasks

Installation Task	Page
Install an SRP module and SRP I/O module	5-7
Install line modules and their corresponding I/O modules.	5-10
Cable all SRP I/O modules.	6-5
Connect a management console to the system.	6-7
(Optional) Connect the 10/100Base-T port to the network.	6-7

Table 7-1 Installation tasks (continued)

Installation Task	Page
Warning: Be sure the power source is turned off and the system is turned off before performing the following task.	
Connect DC power or AC power to your E-series router. (depending on model)	6-9
Cable all line modules.	6-14

Powering Up

Note: This procedure assumes that the system is already connected to a power source. See Chapter 6, Cabling the E-Series Router for Power.

For specifications on the electrical requirements for the system, see *Chapter 11, System Specifications*. For details on the power consumed by the different E-series modules, see *Chapter 12, Module Specifications*.

Branch Circuit Caution: Evaluate the overall loading of the branch circuit before you install any equipment into a rack.

To power up the system:

1   Verify that the power source is operational and turned on.

2   Inspect all grounding and power connections to the E-series chassis.

3   Confirm that all connections are secure.

4   Switch the power switches to ON.

5   Monitor the LEDs on the front of the SRP modules to verify that the system is booting properly. See Table 10-2 in *Chapter 10, Troubleshooting*. for LED status explanations.

When the prompt appears on the system console, the system is in User Exec mode and is ready to be configured:

```
host1>
```

6   Enter the **enable** command to access Privileged Exec mode:

```
host1>enable
host1#
```

In Privileged Exec mode you can begin to configure the system. See the *E-Series System Basics Configuration Guide, Chapter 2, Command Line Interface* for more information.

Initialization Sequence

Each E-series line module is initialized independently. As a result, the CLI on the SRP module may become available before the line modules have completed initialization. Commands relating to a line module may fail if the module has not completed initialization. The **show version** command can be used to display line module status. Do not enter commands for a line module until its state is "online".

Status LEDs

Upon initial powerup, the components of the E-series router run boot code, go through a series of self diagnostic tests, and synchronize with each other.

When the tests are complete, use the LEDs on each module to determine the status of the router. Observe the line module and SRP module LEDs in the front, and the I/O line module and SRP I/O module LEDs in the rear.

Refer to *Chapter 10, Troubleshooting*, for information on the system's LEDs.

Powering Down

If you need to power down or remove the SRP module, first enter the **halt** command to temporarily suspend the system's operation. See *E-Series System Basics Configuration Guide, Chapter 4, Managing the System* for more information.

⚠ *Caution: If you do not use the **halt** command before removing or powering down an SRP module, the system's NVS card may become corrupted.*

If you shut down the system improperly, it will run an investigation of the file allocation table (FAT) the next time it reboots.

The Next Step

If you have problems powering up the system, turn to *Chapter 10, Troubleshooting*, for help.

If the system boots properly, turn to *Chapter 8, Accessing E-Series Routers.*

Accessing E-Series Routers

8

This chapter discusses how to access the system to manage it. Managing your router includes both configuring and monitoring it. For basic information on the management of the system, see *E-Series System Basics Configuration Guide, Chapter 4, Managing the System*.

Setting Up Management Access

Before you power up the system, you must set up a management console (see *Connecting to a Console Terminal* in *Chapter 6, Cabling E-Series Routers*. The console allows you to communicate with the system during the power-up process, set an IP address, and manage the system using the command line interface (CLI).

The E-series router can be managed and monitored through a:

- Console terminal: Connect a console (PC, Macintosh, or UNIX workstation) directly to the system's RS-232 serial port.

- Remote console: Connect 10/100Base-T port on the SRP I/O module to an Ethernet network, and run Telnet from a remote console.

For initial access to the system, you need to physically connect your console directly to the system's RS-232 port. This connection allows you

to use the CLI to set an IP address on the system. Once you configure the IP address, you can access the system remotely (for example, via Telnet).

Console Port Setup

A console terminal (PC, Macintosh, or UNIX workstation) can be connected directly to the SRP I/O module via the RS-232 terminal port. When you connect a console directly to the system, you can configure the system without an IP address.

To communicate with the system, you must have a terminal emulation program running on your PC or Macintosh. You can use any terminal emulation program, such as HyperTerminal. A UNIX workstation can use the emulator TIP.

Using HyperTerminal

If your console uses a version of Microsoft Windows (such as Windows 95 or Windows NT 4.0) that supports the HyperTerminal application, you can access the system via HyperTerminal.

1   Click the Start button and select Programs, Accessories, and HyperTerminal.

2   In the HyperTerminal window, select HyperTerminal.

3   In the Connection Description window, enter a name for your router (for example, erx1400) in the Name field.

4   Select any icon to represent your terminal emulation, and click OK.

5   In the Connect To dialog box, in the Connect using field, select the appropriate COM port to use (for example, COM1), and click OK.

6   In the COM1 Properties window, select the following settings:

   • Bits per second: 9600

   • Data bits: 8

   • Parity: None

   • Stop bits: 1

   • Flow control: Xon/Xoff

7   Click OK.

Connecting Directly to the E-Series Router

When you connect a console directly to the system, use a cable appropriate for your terminal connector. The cable must have a female DB-9 connector to attach to the RS-232 port on the system.

The console port is considered a data terminal equipment interface (DTE). Direct connection to a terminal or PC (which also have DTE interfaces) requires a crossover cable.

To connect a console directly to the system:

1   Connect the female DB-9 connector to the RS-232 port on the system's SRP I/O module. See Figure 8-1.

ERX-310 Router
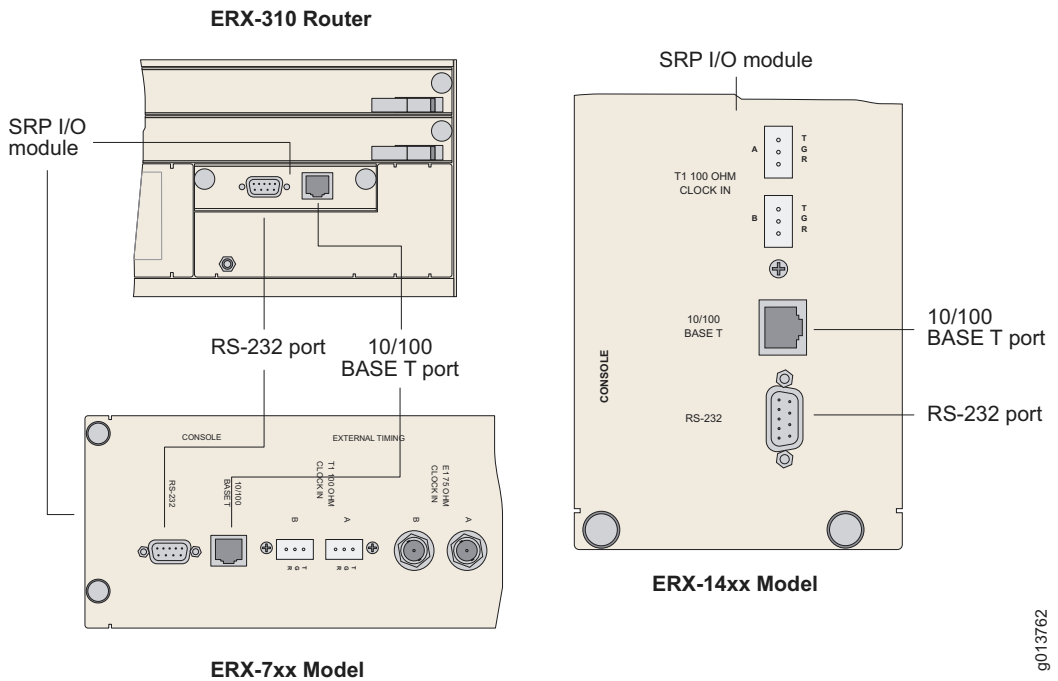
Figure 8-1 E-series routers management ports

2   Connect the crossover adapter connector to your PC's serial port.

3   Power up the system.

When you power up the system, the CLI appears on your console's screen. The system is now in User Exec mode, and you can begin configuration. For more information on using the CLI and configuring the system, see the *E-Series System Basics Configuration Guide*.

📄 *Note: Direct access through the RS-232 serial port allows you to monitor the system as it boots.*

Assigning an IP Address

When your console is ready to communicate with the system, power up the system (see *Chapter 7, Powering Up E-Series Routers*), and set an IP address for the system. The system powers up in User Exec mode. To assign an IP address:

1 Enter the **enable** command at the User Exec prompt.

```
host1>enable
host1#
```

The system is now in Privileged Exec mode.

2 Set an IP address on the Ethernet interface:

- Substitute the slot number where the SRP module is located for the *slotnumber* variable.

- Use an IP address valid for the system.

```
host1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#interface FastEthernet slotnumber/0
host1(config-if)#ip address 10.10.7.3 255.255.255.0
```

3 Continue to configure the system's parameters as needed.

After you have assigned an IP address to the system, you can communicate remotely by running Telnet over an Ethernet network. See the next section, *Telnet Setup*.

Telnet Setup

When you have configured an IP address for the system, you can run Telnet from a host to access the system through its Ethernet port. To connect the Ethernet port to the network:

1 Connect an Ethernet cable (RJ-45) to the system's 10/100Base-T (RJ-45) port on the SRP I/O module.

2 Connect the other end of the cable to the appropriate Ethernet network for an out-of-band connection.

Before you can access the system with Telnet, you must either configure a password for Telnet access or disable the password requirement from the management console. In the following example, you disable the password.

1 Enter the **enable** command.

```
host1>enable
host1#
```

The system is now in Privileged Exec mode.

2 Enter the **configure** command.

```
host1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#
```

The system is now in Global Configuration mode.

3 Enter the **line** command.

```
host1(config)#line vty 0 4
host1(config-line)#
```

The system is now in Line Configuration mode.

4 Disable the password.

```
host1(config-line)#no login
```

📄 *Note: In this example, you disabled the password requirement, but you can choose to set a password instead. See the E-Series System Basics Configuration Guide, Chapter 6, Passwords and Security for information on setting a password.*

5 Run Telnet from a host on the same Ethernet network as the system.

6 Enter the IP address of the system to open the Telnet session.

The User Exec prompt appears when the Telnet session to the system is established.

```
host1>
```

7 Enter the **enable** command.

```
host1>enable
host1#
```

The system is now in Privileged Exec mode.

8 Enter the **configure** command.

```
host1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#
```

The system is now in Global Configuration mode, from which you can configure the system. See *E-Series System Basics Configuration Guide, Chapter 2, Command Line Interface.*

⚠ *Caution:* Do not change the IP address for the Ethernet interface that you are using to communicate with the system. If you change the address, you will lose the Telnet session.

SNMP

The system supports Simple Network Management Protocol (SNMP), a standard management protocol for IP networks. You can configure the system as an SNMP agent.

As an SNMP agent, the system provides access to management information that it maintains. See *E-Series System Basics Configuration Guide, Chapter 3, Configuring SNMP* for information on SNMP. See *E-Series Command Reference Guide A to M* and *E-Series Command Reference Guide N to Z* for the commands that are available for configuring the system as an SNMP agent.

The Next Step

Turn to *Chapter 9, Maintaining E-Series Routers*.

Maintaining E-Series Routers

9

This chapter lists the tools, items, and steps needed for installing and uninstalling E-series components. Other maintenance procedures must be performed by an authorized Juniper Networks technician.

Required Tools and Items

You will need the following tools and other items to replace E-series components.

- Flathead and Phillips screwdrivers

- Insulated adjustable wrench

- Antistatic wrist strap

- Antistatic bags (or other protective packaging to hold components)

- Plastic boots or other protective cover for fiber-optic SC and LC connectors

Storing Modules and Components

⚠ *Caution: Failure to store electronic modules and components correctly may lead to damage of these items.*

Retain the packaging in which a module or component was shipped, and use this packaging to store the item. Modules are shipped in antistatic bags and protective packaging. Components, such as transceivers and NVS cards, are shipped in antistatic plastic containers within an antistatic padded box.

Follow these guidelines for storing modules and components:

- Store each module in a separate antistatic bag.

- Store components in an antistatic plastic container. Some of these containers can accommodate several components in separate compartments.

- Do not store multiple modules or components in an antistatic bag or container where they can touch other items.

- (Optional) Store the item in its antistatic bag or container within the protective packaging or padded box that the item was shipped in.

Cleaning the System

⚡ *Warning: Do not insert any metal object, such as a screwdriver, or place your hand into an open slot or the backplane when the E-series router is on. Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. These actions prevent electric shock and serious burns.*

⚠ *Caution: When cleaning the system, wear an antistatic wrist strap connected to the system's ESD grounding jack. This action helps to protect modules from damage by electrostatic discharge.*

Dust is attracted to the side of the system on which the air intake vent is situated. Clean this side of the system with a dry cloth every few weeks to prevent excessive accumulation of dust. This cleaning will maintain the efficiency of the cooling system and prevent damage to electronic components.

Upgrading NVS Cards on SRP Modules

This section describes how to install higher-capacity NVS cards on SRP modules. The procedure you use depends on the number of SRP modules in the system. A new NVS card will contain the software release you ordered.

📄 *Note: The new NVS card must contain the same software release that you are running on the system.*

Upgrading a System That Contains One SRP Module

If the system contains only one SRP module, you must power down the system before you upgrade the NVS card. To upgrade the NVS card on a system that contains one SRP module:

⚠ *Caution: If you do not use the **halt** command before removing or powering down an SRP module, the system's NVS card may become corrupted.*

1 Enter the **halt** command.

See *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules* for information about the **halt** command.

⚡ *Warning: Do not insert any metal object, such as a screwdriver, or place your hand into an open slot or the backplane when the E-series router is on. Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. These actions prevent electric shock and serious burns.*

⚠ *Caution: When handling modules, use an antistatic wrist strap connected to the E-series router's ESD grounding jack. This action helps to protect the module from damage by electrostatic discharge.*

2 Connect the antistatic wrist strap to the ESD grounding jack on the E-series router.

3 Power down the system.

4 Remove the SRP module.

5 Replace the NVS card on the SRP module (see *Replacing an NVS Card*, later in this chapter).

6 Power up the system (see *Chapter 7, Powering Up E-Series Routers*).

Upgrading a System That Contains Two SRP Modules

In a system that contains two SRP modules, you can upgrade the NVS cards on the SRP modules without powering down the system.

⚡ *Warning: Do not insert any metal object, such as a screwdriver, or place your hand into an open slot or the backplane when the E-series router is on. Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. These actions prevent electric shock and serious burns.*

⚠ *Caution: When handling modules, use an antistatic wrist strap connected to the E-series router's ESD grounding jack. This action helps to protect the module from damage by electrostatic discharge.*

To upgrade the NVS cards on the SRP modules in a system that contains two SRP modules:

1 Connect the antistatic wrist strap to the ESD grounding jack on your E-series router.

2 Halt the redundant SRP module.

```
host1#halt standby
```

3 Remove the redundant SRP module from the chassis.

4 Replace the NVS card on this SRP module (see *Replacing an NVS Card*, later in this chapter).

5 Reinsert the SRP module into the chassis.

6 When this SRP module is available, synchronize the SRP modules.

```
host1#synchronize
```

7 When the SRP modules are synchronized, reboot the SRP module that you upgraded.

```
host1#reload slot 7
```

8 When this SRP module is available, synchronize the SRP modules.

```
host1#synchronize
```

9 When the SRP modules are synchronized, force the redundant SRP module to take over from the primary SRP module.

```
host1#srp switch
```

10 Immediately remove the former primary SRP module.

11 Repeat steps 4–8 for the former primary SRP module.

Replacing an NVS Card

To replace an NVS card on an SRP module:

1   Obtain an antistatic container for the NVS card you will remove (see *Storing Modules and Components*, earlier in this chapter).

2   With a small flathead screwdriver, remove the faceplate from the NVS card slot on the SRP module (see Figure 9-1).

3   Use the screwdriver to depress the button next to the NVS card (see Figure 9-1).

This action releases the NVS card.

NVS card

Faceplate

Release button

g013763
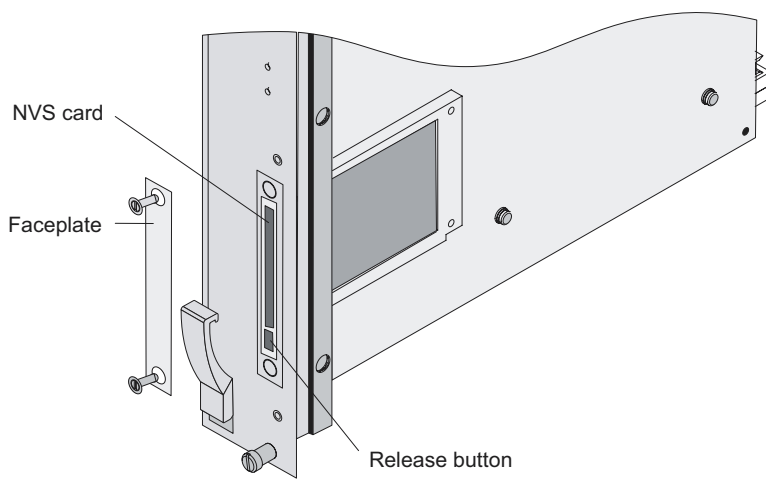
**Figure 9-1** NVS card slot on SRP module

4   Remove the NVS card and place it in the antistatic container.

5   Insert the new NVS card into the slot.

6   Push the new NVS card as far as you can in the slot.

When you push the card far enough, it will click into place.

7   Replace the faceplate on the NVS card slot.

Upgrading Memory on SRP Modules

This section describes how to upgrade memory on SRP modules. E-series software releases 3.0.x and higher require at least 512 MB of memory on each SRP module.

📄 *Note: The ERX-310 SRP module contains two SODIMM banks that use 256-MB memory, and currently is not upgradeable.*

Four main steps are involved in upgrading memory on SRP modules:

1 Check memory currently installed on the SRP module.

2 Remove the SRP module and the SODIMMs.

3 Add the new SODIMMs to the SRP module.

4 Reinstall the SRP module and verify the upgrade.

See the following sections for information on each step.

⚡ *Warning: Do not insert any metal object, such as a screwdriver, or place your hand into an open slot or the backplane when the E-series router is on. Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. These actions prevent electric shock and serious burns.*

⚠ *Caution: When handling modules, use an antistatic wrist strap connected to the E-series router's ESD grounding jack, and hold modules by their edges. Do not touch the components, pins, leads, or solder connections. These actions help to protect modules from damage by electrostatic discharge.*

Checking the Memory Installed

Before you install the new memory, issue the **show hardware** command to check how much memory is installed. Each ERX-7xx/14xx model SRP module should currently use at least 256 MB of memory. You will need one upgrade kit for each SRP module in the system.

Depending on the upgrade you are performing, the kit will contain a specific number of small outline dual inline memory modules (SODIMMs).

Removing SODIMMs

After removing the SRP module from the E-series router, you may have to remove lower-memory SODIMMs to upgrade to a higher-capacity SRP module. The SODIMM sockets are close to the NVS card and have

a cream ceramic connector at one edge. Some or all of the sockets may already contain SODIMMs.

1 Push down on the back edge of a SODIMM to release it from the socket (see Figure 9-2).

2 Gently pull up and out to disconnect the SODIMM from the connectors and remove it from the socket.

Adding New SODIMMs

1 Locate the four SODIMM sockets on the SRP module (see Figure 9-2 and Figure 9-3). See the previous section to learn how to remove SODIMMs.
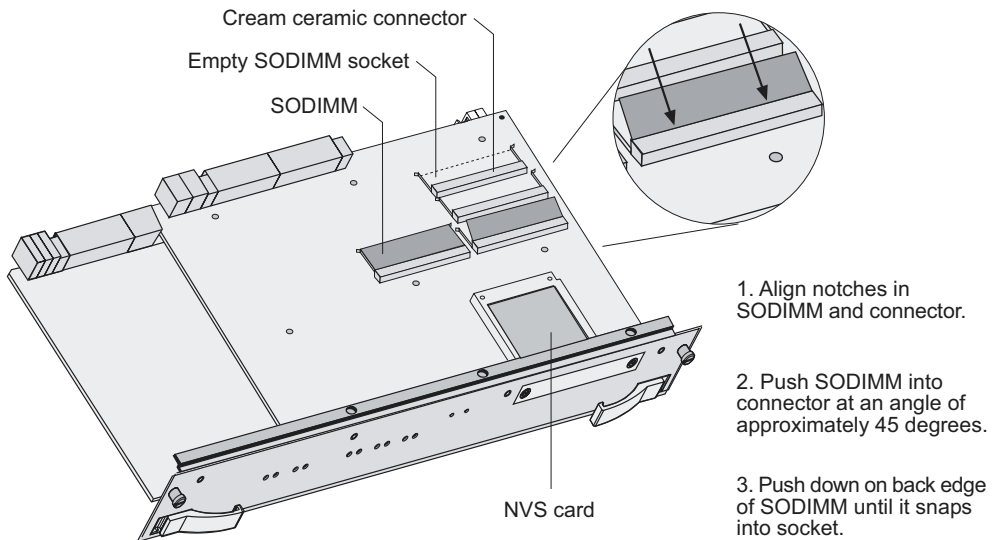

**Figure 9-2** SODIMM sockets on the SRP-5 and SRP-10 module

Empty SODIMM socket

SODIMM

g013452
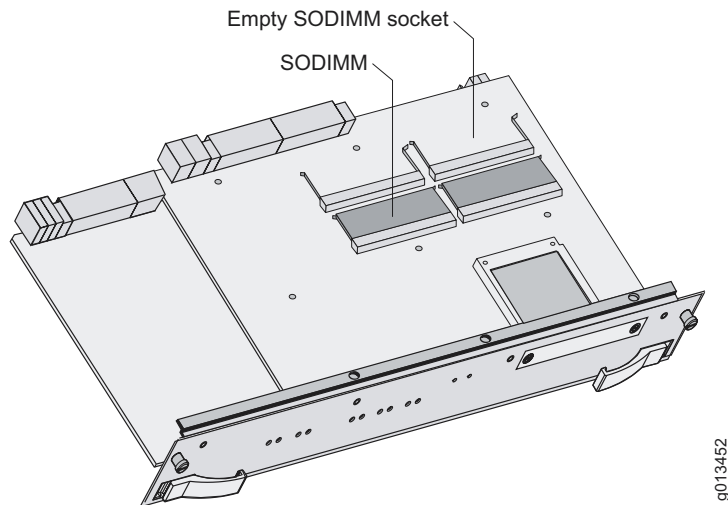
Figure 9-3 SODIMM sockets on the SRP-40 module

2 Insert a SODIMM from the upgrade kit at an angle of approximately 45 degrees into an empty ceramic connector, so that the notch in the long gold edge of the SODIMM aligns with the notch in the connector.

The notch on the long gold edge will no longer be visible when the SODIMM is pressed in far enough.

3 Press the top surface downward into the socket until the socket spring snaps into place and holds it.

4 Repeat steps 2 through 3 with the other SODIMM.

5 Repeat steps 1 through 4 for the other SRP module, if present.

Verifying the Upgrade

To verify that the upgrade is complete:

1 Place the SRP modules in the chassis.

The SRP modules will reboot.

2 Close the ejector handles and tighten the thumbscrews.

3 Issue the **show hardware** command, and verify that the display indicates that the correct amount of memory is present.

Replacing SFPs on GE I/O Modules

This section describes how to replace small form-factor pluggable transceivers (SFPs) on Gigabit Ethernet (GE) modules that support these devices. A range of SFPs that support different optical modes (multimode and single mode) and cabling distances is available. You can replace the SFPs without disabling the interfaces or removing the module from the system.

Warning: Do not insert any metal object, such as a screwdriver, or place your hand into an open slot or the backplane when the E-series router is on. Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. These actions prevent electric shock and serious burns.

Caution: When handling electronic components, use an antistatic wrist strap connected to the system's ESD grounding jack, and hold components by their edges. Do not touch, pins, leads, or solder connections. Store components in antistatic bags. These actions help to protect modules from damage by electrostatic discharge.

Removing SFPs

To remove the SFPs:

1   Obtain an antistatic container for the SFPs you will remove (see *Storing Modules and Components*, earlier in this chapter).

2   Put the antistatic wrist strap on your wrist, and connect the strap to the ESD grounding jack on the system.

3   Disconnect the cables from one of the SFPs on the module.

4   Identify the release mechanism for the SFP.

Different SFPs use different release mechanisms (see Figure 9-4). Possible release mechanisms include:

- A button that you press inward

- A ring that you press inward

- A bar that you pull sideways, then outward

- A tab that you pull sideways, then outward
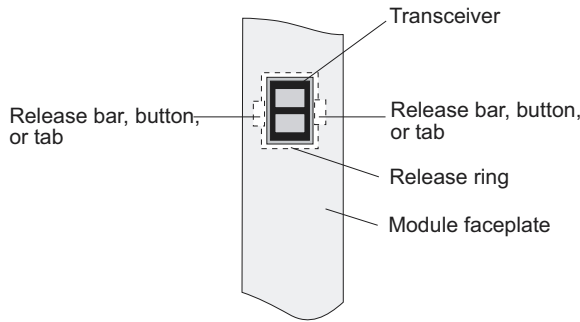
Figure 9-4 Possible release mechanisms on the SFP

5 Release the SFP and pull it out of the slot.

6 Place the SFP in an antistatic bag.

7 If you are using the redundant port on the E-series GE I/O module, repeat steps 3 through 6 for the other SFP.

> ⚠ *Caution: For port redundancy to operate correctly, both the primary and redundant ports on an E-series GE I/O module must use the same type of SFP.*

Installing SFPs

To install SFPs:

1 Put the antistatic wrist strap on your wrist, and connect the strap to the ESD grounding jack on your system.

2 Identify the following items on the SFP (see Figure 9-5):

• The connection circuitry on the base

• The cable connectors on the front

The cable connectors will be protected by a dust cover.
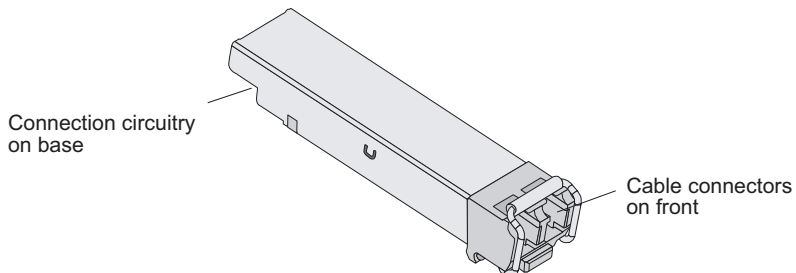
Figure 9-5 Example of SFP

⚠ *Caution: Be sure to position the SFP correctly before you install it.*

3 Hold the SFP so that:

- The connection circuitry is adjacent to the TX and RX markings on the module's faceplate.

- The front will be visible when you install the SFP.

For a picture of the correct orientation, see Figure 9-6.

TX and RX markings on I/O module

Connection circuitry on base of SFP
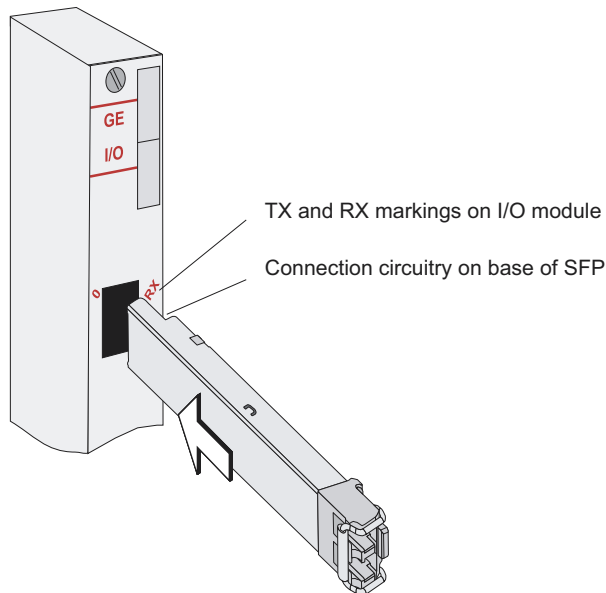
g013437

Figure 9-6 Installing an SFP on an E-series GE I/O module

4 Insert the SFP as far as you can into the I/O module.

The SFP should slide smoothly into the I/O module and should click into place. If the SFP does not slide smoothly into the I/O module, check that the orientation of the SFP is correct.

5 Gently pull the SFP to confirm that it is inserted correctly.

The SFP should not move when you pull it. If the SFP comes out of the slot when you pull it, repeat step 4.

6 Remove the dust cover that protects the ports.

7 Connect the new cables to the SFP.

If you are using the redundant port on the E-series GE I/O module, repeat steps 2 through 7 for the other port.

Verifying the Installation

When you have replaced the SFPs and connected the cables, issue the **show interface gigabitEthernet** command for each interface to check that the interface is operational (up).

- Field descriptions
  - › gigabitEthernet *interfaceSpecifier* – status of the hardware on this interface
    - up – hardware is operational
    - down – hardware is not operational
  - › Administrative status – operational state that you configured for this interface
    - up – interface is enabled
    - down – interface is disabled
- Example

  ```
  host1:vr2#show interfaces gigabitEthernet2/0
  gigabitEthernet2/0 is Up, Administrative status is Up
  ```

Replacing Fan Trays

A tray of cooling fans provides forced air cooling for components in the E-series router. The fan trays are hot-swappable and can be replaced without powering down the system. However, if you do not replace the fan tray within a few minutes, the system enters thermal protection mode. For information about thermal protection mode, see *Monitoring Temperatures of Modules* in *Chapter 10, Troubleshooting*.

⚠️ *Caution: If the FAN FAIL LED on the SRP module is illuminated and none of the fans are spinning when you remove the fan tray, power down the system until a new fan tray is available. Operating an E-series router with inadequate air circulation may damage the modules.*

⚠️ *Caution: Do not use the fan tray handle to carry the fan tray assembly. Use the handle only to pull the tray out of the chassis.*
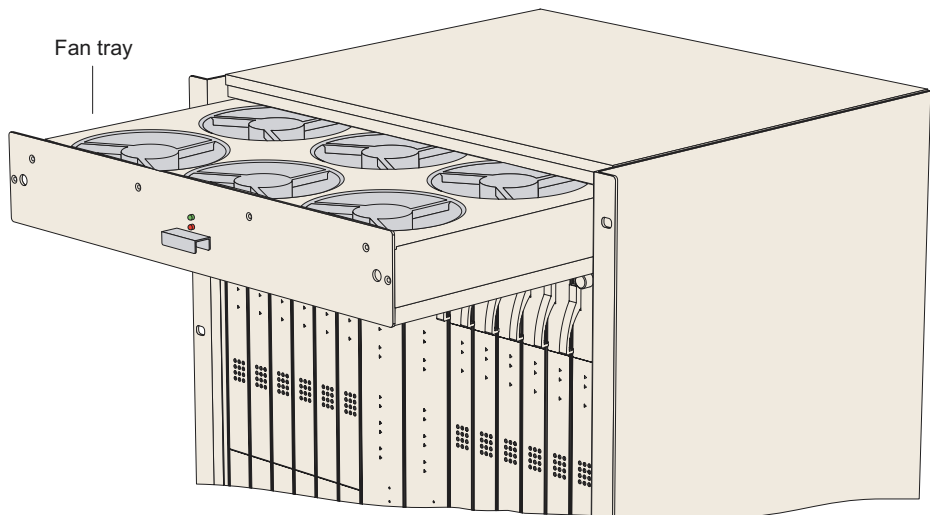

Figure 9-7 Fan tray in ERX-14xx model
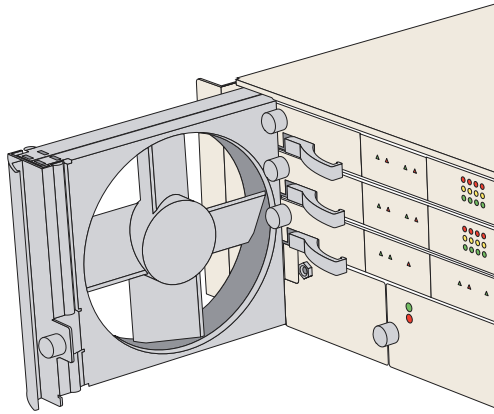
Figure 9-8 Fan tray in ERX-310 router

Removing the Fan Tray

To remove the fan tray:

1 (ERX-14xx models only) Place a flathead screwdriver in the groove where the top bezel meets the chassis on the top of the system, and lever the top bezel off the front of the system.

2 With an appropriate screwdriver, loosen the captive screws located at the corners of the fan tray.

Warning: Do not place your fingers near the fans when removing the fan tray. The blades may still be moving.

3 Pull the fan tray halfway out of the shelf.

Warning: Slowly slide the fan tray out of the chassis. The tray does not have stops to prevent it from sliding all the way out.

4 Pull the tray out of the chassis.

Installing the Fan Tray

To install the fan tray:

⚠️ *Caution: Do not use the fan tray handle to carry the fan tray assembly. Use the handle only to push the tray into the chassis.*

1 Hold the tray horizontally (ERX-14xx models) or vertically (ERX-7xx models and ERX-310 routers) or so that the captive screws point toward you and you can read text on the labels.

2 Place the bottom corners of the tray housing in the plastic shelf guides of the fan tray compartment; push toward the back of the chassis halfway, and stop.

3 Push the fan tray toward the back of the shelf until it stops.

There is an electrical connector on the back of the fan tray that pairs with an electrical connector at the back of the shelf.

4 With an appropriate screwdriver, tighten the captive screws.

Alternate between screws when tightening them to ensure that the electrical connectors at the back of the tray fit tightly.

5 (ERX-14xx model only) Push the top bezel back on the front of the system.
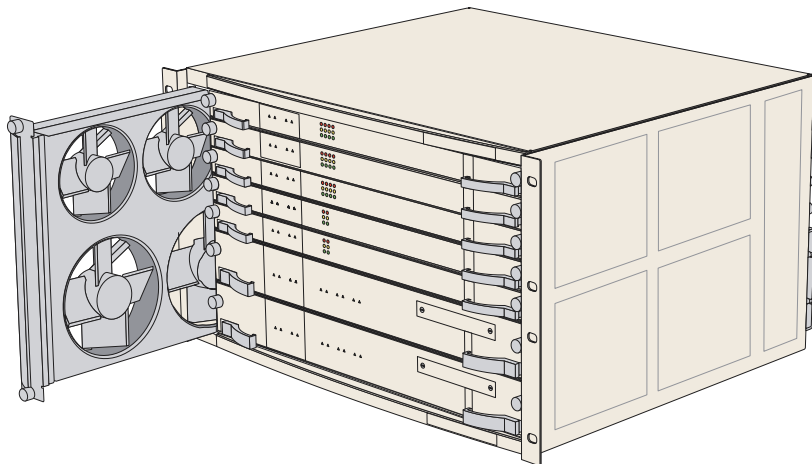
Figure 9-9 Fan tray in ERX-7xx model

Installing a Cable-Management Bracket on ERX-7xx Models

A cable-management bracket can be installed to accommodate cables of different sizes on ERX-7xx models. See Figure 9-10.

- For wider X.21/V.35 cables, mount the bracket in the last row of perforation holes in the chassis so that the bracket allows for maximum spacing (A).

- For smaller cables, mount the bracket closer to the front of the chassis (B).

Use two (2) #10 self-tapping screws to secure the bracket.
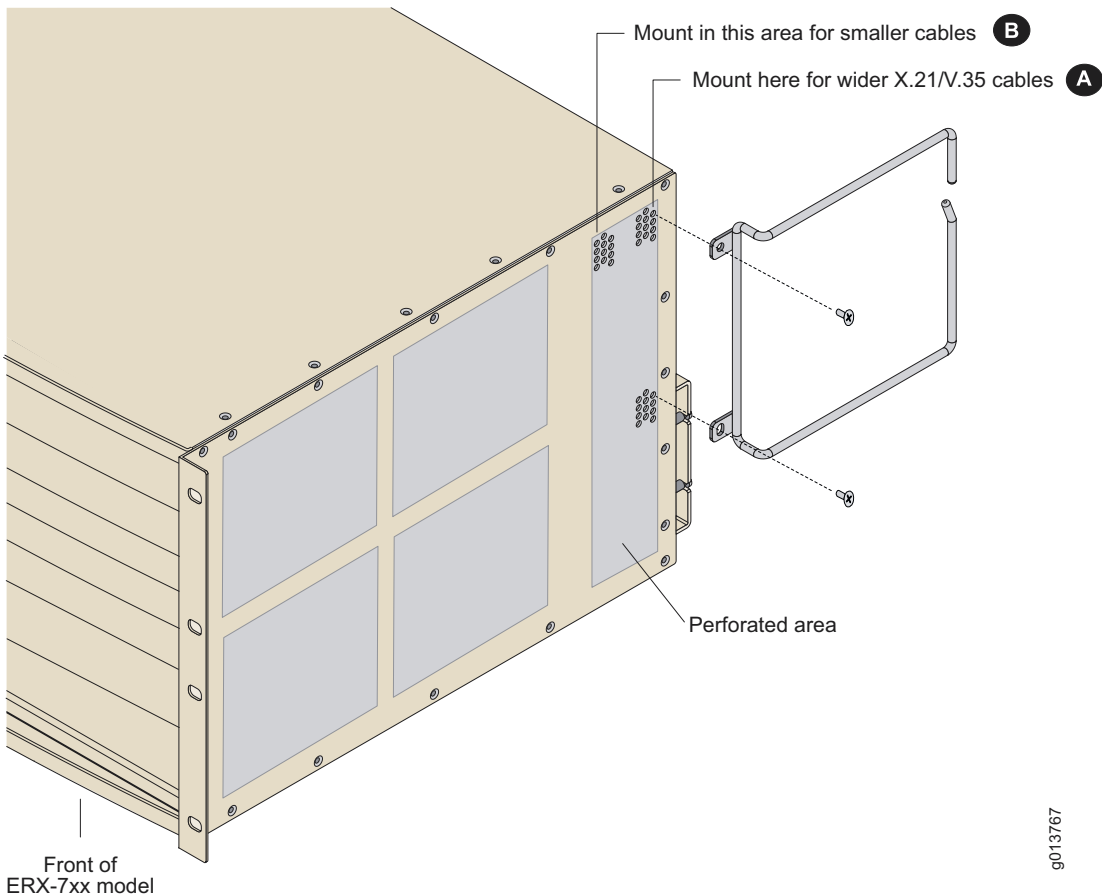
Figure 9-10 Attaching a cable management bracket

Troubleshooting

10

This chapter explains how you can troubleshoot a specific problem, such as abnormal LED activity or no system power, when you power up the router.

Diagnosing Problems

Your initial response to a system problem should be to:

1 Check power connections.

2 Observe the system's LEDs carefully.

3 Check cable connections on the system modules.

If a problem is beyond the scope of this chapter, refer to *Appendix C, Customer Support* for further instructions.

📄 *Note: Running the **show version** and **show hardware** commands is often a good first step when trying to troubleshoot a problem.*

Initialization Sequence

Each E-series line module is initialized independently. As a result, the CLI on the SRP module may become available before the line modules have completed initialization. Commands relating to a line module may fail if the module has not completed initialization. The **show version** command can be used to display line module status. Do not enter commands for a line module until its state is "online."

Troubleshooting Power Failures

The system's distributed power system is designed to consume low levels of power and dissipate low levels of heat. See *Chapter 11, System Specifications* for specifications of power consumption and heat dissipation. If you suspect a power problem, refer to Table 10-1.

Table 10-1 Causes of power failures

Symptom	Possible Problems	Actions
System does not power up.	• System is not receiving power. • A module's power supply has malfunctioned. • Power source cannot handle system load.	*Note: The following actions apply to all of the possible problems.* **1** Verify that all power connections are correct. **2** Verify that the power supply is delivering the correct voltage, current, and wattage to the system. See to *Chapter 11, System Specifications*. **3** If the system still does not operate, contact Juniper Networks Customer Service.
System shuts down.	• Temperature too high • Loss of power	*Note: The following actions apply to all of the possible problems.* **1** Verify that power connections are properly attached. **2** Verify that system is receiving power. **3** Check whether or not the LEDs are lit. **4** Run diagnostics on SRP and line modules. **5** If system will not reset, contact Juniper Networks Customer Service.

Understanding Status LEDs to Troubleshoot

Module LEDs can show you the immediate status of a module and alert you to a problem with the module or one of its ports. It is helpful to familiarize yourself with LED activity so that you can easily detect and correct a module-related problem with minimal or no system downtime.

LED Activity During Booting

When the system boots, it runs a series of tests for each module installed in the system, and the LEDs display various configurations. Refer to the tables in this section to understand normal and abnormal LED activity. For troubleshooting information, see Table 10-4.

LED Identification

The system's modules have two sets of status LEDs. The top set indicates generic router and module status. The bottom set indicates module-specific status, such as port status (line modules) or fan status (SRP module).

The number against the port status LED on a line module corresponds to the number of the port on the I/O module. Some line modules have more port status LEDs than the number of ports on the I/O module. In these cases, only the LEDs for the corresponding ports on the I/O modules are active.

For example, an OCx/STMx line module can pair with either an OC3-4 or an OC12/STM4 I/O module. Consequently, the line module has four port status LEDs for OC3/STM1 operation. However, only the top set of port status LEDs are active during OC12/STM4 operation.

Table 10-2 shows the functions of the module and port status LEDs.

Table 10-2 LED identification and activity descriptions

LED Location	LED Label	LED Indicator	LED Color	OFF to ON	ON to OFF
All modules	OK	Module status	Green	Self-test passed	Failure detected
	FAIL	Module status	Red	Failure detected	Diagnostic test running
	ONLINE	Module status	Green	Module online	Module offine
All modules	REDUNDANT	Redundancy	Green	See *Redundancy Status* later in this chapter.	
				Note: The REDUNDANT LED on the cOCx/STMx, FE-8, GE/FE, HSSI, OCx/STMx, and X.21/V.35 line modules is nonfunctional.	
SRP module	POWER A OK	Power	Green	Power online on source A	Power off
	POWER B OK	Power	Green	Power online on source B	Power off
	FAN OK	Fan	Green	Fan online	Fan failure
	FAN FAIL	Fan	Red	Fan failure	Fan online
	LINK	Ethernet	Green	Ethernet link up	Ethernet link down
	ACTIVITY	Ethernet	Green	Blinks when Ethernet traffic on link	No Ethernet traffic on link

Table 10-2 LED identification and activity descriptions (continued)

LED Location	LED Label	LED Indicator	LED Color	OFF to ON	ON to OFF
Ethernet line modules	LINK	Ethernet	Green	Ethernet link up	Ethernet link down
	ACTIVITY	Ethernet	Green	Blinks when Ethernet traffic on link	No Ethernet traffic on link
HSSI line module	SYNC	Port status	Green	If the port is configured as DTE, the LED lights when both the DCE and the clock source are available.	If the port is configured as DTE, the LED goes out when either the DCE or the clock source becomes unavailable.
				If the port is configured as DCE, the LED lights when the DTE is available.	If the port is configured as DCE, the LED goes out when the DTE becomes unavailable.
	YEL ALM	**Note:** This LED is not functional on the HSSI line module.			
	RED ALM	Port status	Red	If the port is configured as DTE, the LED lights when either the DCE or the clock source becomes unavailable.	If the port is configured as DTE, the LE goes out when both the DCE and the clock source are available.
				If the port is configured as DCE, the LED lights when the DTE becomes unavailable.	If the port is configured as DCE, the LED goes out when the DTE is available.
X.21/V.35 line module	ACTIVE	Port status	Green	Port configured	Port not configured
	LOOPBK	Port status	Yellow	Port in local loopback or remote loopback, depending on the type of connection. (See)	Port not in loopback
	ERROR	Port status	Red	Port is enabled or comes online	Port is disabled or goes offline
	V.35	Port status	Green	V.35 cable connected	V.35 cable disconnected
	X.21	Port status	Green	X.21 cable connected	X.21 cable disconnected
	DCE	Port status	Green	DCE cable connected	DCE cable disconnected
	DTE	Port status	Green	DTE cable connected	DTE cable disconnected
Other line modules	SYNC	Port status	Green	In frame	Not in frame
	YEL ALM	Port status	Yellow	Far end receive failure (FERF) exists	No FERF present
	RED ALM	Port status	Red	Loss of sync/frame	In frame

The following figures show a representative module for each of the three variations:

- SRP module (Figure 10-1)

- Ethernet line module (Figure 10-2)

- Other line modules (Figure 10-3)
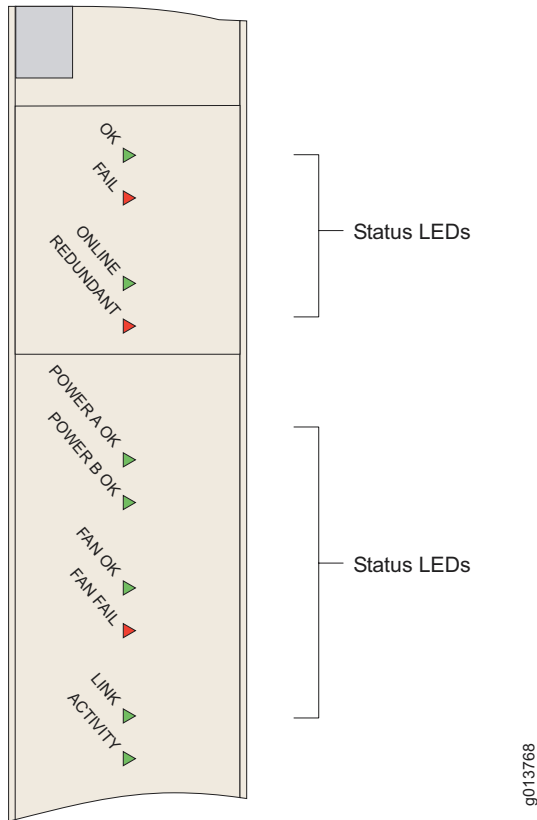
Figure 10-1 SRP module LEDs

📄 ***Note:*** *The primary SRP module illuminates the REDUNDANT LED only when the SRP module detects that there is a secondary or standby SRP module online. The standby SRP module monitors an activity signal from the primary SRP module to determine its state; it does not shadow the operations of the primary SRP module. If the standby SRP module detects that the primary SRP module is not active, it reboots the system and takes control. (ERX-7xx/14xx models only)*
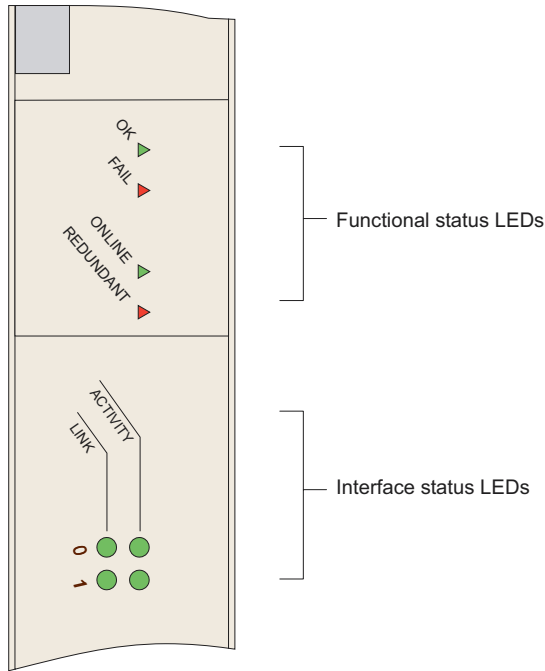
Figure 10-2 FE2 module LEDs
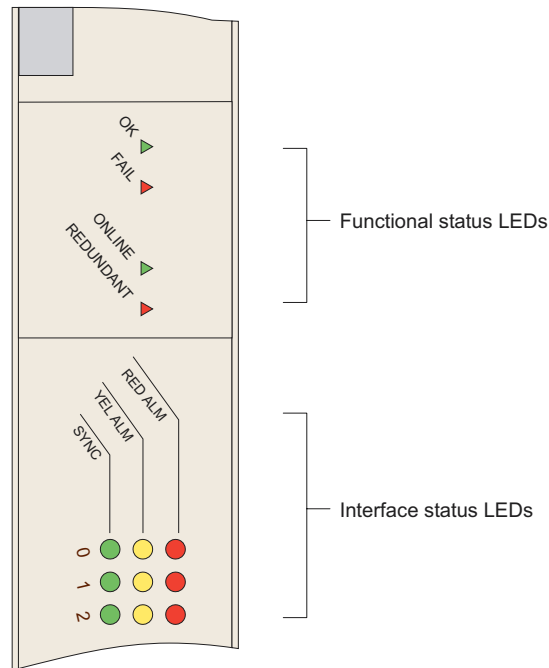
Figure 10-3 E3 and T3 module LEDs

LED Activity During Booting

When the system boots, it runs diagnostic tests, and the module status LEDs display various configurations. Observe the scenario presented in Table 10-3 to verify that the system has booted properly.

📄 *Note: When you reboot the system after installing a new version of the software, the line modules will appear to boot twice.*

Table 10-3 Normal activity of functional status LEDS during booting

OK	FAIL	ONLINE	Status Process	
off	on	off	**1**	Module is in the power-up restart state; the FAIL LED stays on briefly.
off	off	off	**2**	Module is initializing, and diagnostic tests are running.
on	off	off	**3**	Module passed the diagnostics; the system boots.
on	off	on	**4**	Module is now up and running.

If the system detects an error during booting, the FAIL LED turns on. Some failure conditions may cause the board not to boot. In this case, the LEDs may all be off. The system should then reset the board.

If the operational software detects an error, the FAIL LED turns on. Some errors may cause a board reset. Crash information can be displayed from the console and is printed to the screen on the next reboot.

Abnormal LED Activity

See Table 10-4 to diagnose and correct problems.

Table 10-4 Troubleshooting abnormal LED activity on modules

Diagnostic Signs	Possible Problems	Actions
• POWER A OK is not lit • POWER B OK is not lit	• System is not receiving power from Power A. • System is not receiving power from Power B.	**1** Check Power A and Power B terminal connections. **2** Verify that power switches are on. **3** Check connections to power sources. **4** If system still does not operate, contact Juniper Networks Customer Service.

Table 10-4 Troubleshooting abnormal LED activity on modules (continued)

Diagnostic Signs	Possible Problems	Actions
FAIL LED lights	• The line module and I/O module are incompatible. • A hardware failure, such as a failed module.	1 Check that the line and I/O modules are compatible; replace if necessary. 2 If you replaced the I/O module only, issue the **reload slot** *slot_number* command. 3 If you replaced the line module or if there was a hardware failure, the system should automatically reset the module. 4 If condition persists, contact Juniper Networks Customer Service.
• FAN OK does not light • FAN FAIL LED lights	• Fan is not working properly or has slowed down. • Fan needs replacement.	Contact Juniper Networks Customer Service; the system must be serviced.
LINK LED is not lit	• Ethernet connection is down.	1 Check that Ethernet cables are properly connected to both the Ethernet port and the appropriate network device. 2 Contact Juniper Networks Customer Service.
RED ALM	• System does not recognize a port connection. • Cabling is not connected properly. • Cable is faulty. • Clocking problem exists.	1 Check that all cables are firmly plugged into the ports and the attached network device. 2 Verify that cables are clean. 3 Test for faulty cables. 4 Verify clock source and configuration. 5 Reset system. *Note: Problem is corrected when normal LED activity is observed.*
YEL ALM **Note***: This LED is not functional on the HSSI line module.*	• Far end receive failure (FERF) exists.	1 Correct FERF problem. 2 Reset system. **Note***: Problem is corrected when normal LED activity is observed.*
• System will not boot. • Module(s) held offline. • FAIL LED lights.	A slot group is overloaded.	1 Issue the **show version** command to display board status. 2 Review section on proper slot group configuration in *Chapter 5, Installing Modules*. 3 Reconfigure system with correct slot group configuration. 4 Reset system.

Table 10-4 Troubleshooting abnormal LED activity on modules (continued)

Diagnostic Signs	Possible Problems	Actions
None	• System temperature is too high. • Vents are blocked. • Fans are not operating.	**1** Check your console for a message indicating the problem. If you have the system log set to a severity of WARNING or higher, a Warning message indicating the failure is displayed. **2** Issue the **show environment** command to display the temperatures. If the temperature is too high, power down the system. **3** Regulate temperature. **4** Reset system.

Redundancy Status

You can determine the redundancy state of line modules by examining the online and redundant status LEDs (ERX-7xx/14xx models only). See Table 10-5.

📄 *Note: The REDUNDANT LED on the cOCx/STMx, FE-8, GE/FE, HSSI, and OCx/STMx modules is nonfunctional.*

Table 10-5 Redundancy status of a line module

ONLINE LED	REDUNDANT LED	State of the Line Module
Off	Off	Module is booting or is an inactive primary line module.
On	Off	Module is active, but no standby module is available.
Off	On	Module is in standby state.
On	On	Module is active, and a standby module is available.

Monitoring Temperatures of Modules

You can view the temperature of each module by issuing the **show environment all** and **show environment table** commands. In addition, the system generates detailed log messages if the temperature of a module is outside normal operating limits.

If the temperature of any module exceeds the upper temperature limit, the system immediately goes into thermal protection mode. Once the system has entered thermal protection mode, you must resolve the cause of the high temperature.

Table 10-6 Troubleshooting high-temperature conditions

Cause of High Operating Temperature	Symptoms	Resolution
Air vents to system are blocked	Space around system does not meet specifications (see *Chapter 11, System Specifications*).	Increase space around system.
Ambient temperature exceeds specifications	Ambient temperature exceeds specifications (see *Chapter 11, System Specifications*).	Provide extra cooling or heating in the room where the system is located.
Cooling fan failure	• FAN OK LED on SRP module is not illuminated. • FAN FAIL LED on SRP module is illuminated.	Replace fan tray (see *Chapter 9, Maintaining E-Series Routers*).
Module failure	FAIL LED on module is illuminated.	Replace module (see *Chapter 5, Installing Modules*).

When you have resolved the cause of the high temperature, you must power cycle the system to reset the modules.

Resetting Line Modules and SRP Modules

Two recessed buttons on line modules and SRP modules provide the mechanisms for resetting. You can use the NMI button to reset the software on the module and the board reset button to reset the module. See Figure 1-12.

If a line module fails to respond for an extended time, there may be a software problem with that module. You can depress the software reset button with a paper clip to suspend the current software task. Depending on the situation, this action may also reset the software on the module.

If depressing the software reset button fails to correct the issue with the line module, depress the board reset button. This action reboots the line module.

The buttons work in the same way for the SRP module. Depressing the board reset button on an SRP module is equivalent to rebooting the E-series router and causes all the line modules to reboot.

Double-Bit Errors on SRP Modules

SRP modules include error checking and correction (ECC) to protect their SDRAM. ECC provides error detection of single-bit and double-bit errors and correction of single-bit errors for the SDRAM as follows:

- If ECC detects a single-bit error, it automatically corrects the error, and operation continues.

- If ECC detects a double-bit error, it logs the error, stops the main processor on the controller, and takes the SRP module offline.

Detecting Double-Bit Errors

The following message appears on the console if ECC detects a double-bit error:

```
ALERT 05/10/2000 13:10:33 os: failed: ECC DOUBLE BIT ERROR
  OCCURRED
  Address = 0xe95db10
  Data (Upper 32Bits) = 0xe95db20
  Data (Lower 32Bits) = 0x55d06c
  ECC Data Bits =  0x2b
  ECC 1Bit Error Counter =  0x0
  *** YOU MUST PERFORM A HARD RESET TO CONTINUE ***
ALERT 05/10/2000 13:10:34 os: PROCESSOR EXCEPTION: 0x200n
```

If ECC detects a double-bit error in a system that contains a redundant SRP module, the redundant module becomes active and the system continues to operate. However, you must still troubleshoot the SRP module with the double-bit error. If ECC detects a double-bit error in a system that does not contain a redundant SRP module, you must troubleshoot the SRP module immediately. See *Fixing Double-Bit Errors*.

Fixing Double-Bit Errors

To fix a double-bit error:

1 Remove the second SRP module, if there is one.

2 Reboot the system with the board reset button on the primary SRP module (see Figure 1-12).

These actions attempt to correct a transient double-bit error. However, if the console displays a memory test failure for the SRP module after you reboot, or if the FAIL LED on the SRP module stays on during rebooting, the SDRAM is permanently damaged and needs replacing. In this event, call Juniper Networks Customer Service to arrange for repair.

Part 2

System and Module Specifications

System Specifications 11

ERX-14xx Models Specifications

Table 11-1 ERX-14xx models specifications

Category	Specification	
Weight		
Chassis only	42 lb	18.9 kg
Chassis fully configured	88 lb	39.6 kg
Dimensions	22.75 (H) x 19 (W) x 16 (D) inches; 57.78 x 48.26 x 40.64 cm	
Environmental Requirements	NEBS GR-63-CORE compliant	
Ambient operating temperature	• Long term: 41˚ to 104˚ F (5˚ to 40˚ C) Short term: 23˚ to 122˚ F (–5˚ to 50˚ C)	
Ambient operating humidity	• Long term: 5% to 85% (noncondensing) Short term: 5% to 95% (noncondensing)	
Ambient storage temperature	–40˚ to 158˚ F (–40˚ to +70˚ C), 95% relative humidity	
Ambient storage humidity	5% to 95% (noncondensing)	
Heat Dissipation	2400 W, 8190 BTU/hour maximum	
Space Requirements	• 3 feet (90 cm) behind router or rack • No space requirements for sides of units or rack • Do not block air vents on front or back of the router	

Table 11-1 ERX-14xx models specifications (continued)

Category	Specification
Airflow	• An integral air plenum directs router's exhaust air below the router and out the back. See Figure 3-2 in *Chapter 3, Installation Guidelines and Requirements*.
DC Input	
Voltage	–40 to –72 VDC[a]
Current	50 A @ –48 VDC
Power	2400 W maximum
Redundancy (input power)	2 independent line feeds
NEBS Certification	• SR-3580 (FD-15): Network Equipment Building System (NEBS) Criteria Levels, Issue 1, November 1995
	• GR-63 (LSSGR, FD-15): Network Equipment Building System (NEBS) Requirements: Physical Protection, Issue 1, October 1995
	• GR-1089 (LSSGR, FD-15): Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment, Issue 2, Revision 1, February 1999
Safety Agency Certification	• AS/NZS 3260:1993, Safety of Information Technology Equipment Including Electrical Business Equipment
	• CAN/CSA C22.2, No. 60950-00, 3rd Edition, Safety of Information Technology Equipment
	• EN60825-1, Safety of Laser Products - Part 1: Equipment Class, Requirements, and User's Guide (2001)
	• EN60950:2000, 3rd Edition, Safety of Information Technology Equipment
	• IEC 60950-1(2001-10) Ed. 1.0 Information technology equipment - Safety - Part 1: General requirements
	• Low Voltage Directive (73/23/EEC)
	• UL 60950, 3rd Edition, Safety of Information Technology Equipment
Electromagnetic Emissions Agency Certification	• AS/NZS 3548:1995 (CISPR 22 Class A)
	• EMC Directive (89/336/EEC)
	• EN55022 Class A (CISPR-22 Class A)
	• EN55024, Annex C for WAN Equipment Performance Criteria A, B, and C
	• ETSI 300-386, Telecommunication Network Equipment; ElectroMagnetic Compatibility (EMC) requirements
	• FCC Part 15 Class A
	• IECS-003 Issue 3 Class A
	• VCCI (Voluntary Control Council for Interference by Information Technology Equipment)

Table 11-1 ERX-14xx models specifications (continued)

Category	Specification
Telecommunications Certification	• ACA TS 016-1997
	• CTR13 – Commission Decision of 9 July 1997 on a common technical regulation for attachment requirements for terminal equipment interface for connection to 2048 kbit/s digital structured ONP leased lines: 97/521/EC – OJ No. L215 Vol. 40, August 1997
	• CTR24 – Commission Decision of 9 September 1997 on a common technical regulation for attachment requirements for terminal equipment interface for connection to 34 Mbit/s digital unstructured and structured leased lines: 97/639/EC – OJ No. L271 Vol. 40, 3 October 1997
	• FCC PART 68
	• IECS-003 Issue 3 Class A
	• PD7024 – Essential requirements for terminal equipment intended for connection to unstructured digital leased circuits of the public telecommunications network using a CCITT recommendation G,703 interface at a rate of 2048 kbit/s with a 75 ohm unbalanced presentation, 1994
	• RTTE Directive (1999/5/EEC)

a.If the voltage rises above –40 VDC, the system will power off. The system will not power on again until the input voltage reaches –43 +/– 0.5 VDC.

ERX-7xx Models Specifications

Table 11-2 ERX-7xx models specifications

Category	Specification	
Weight		
Chassis only	22 lb	9.9 kg
Chassis fully configured	46 lb	20.7 kg
Dimensions	10.5 (H) x 19 (W) x 16 (D) inches; 26.67 x 48.26 x 40.64 cm	
Environmental Requirements	NEBS GR-63-CORE compliant	
Ambient operating temperature	• Long term: 41˚ to 104˚ F (5˚ to 40˚ C) Short term: 23˚ to 122˚ F (–5˚ to 50˚ C)	
Ambient operating humidity	• Long term: 5% to 85% (noncondensing) Short term: 5% to 95% (noncondensing)	
Ambient storage temperature	–40˚ to 158˚ F (–40˚ to +70˚ C), 95% relative humidity	
Ambient storage humidity	5% to 95% (noncondensing)	
Heat Dissipation	1400 W, 4780 BTU/hour maximum	
Space Requirements	• 3 feet (90 cm) behind router or rack	
	• Do not block air vents on sides of the router.	
	• Do not place equipment that exhausts hot air to left on the right of the router.	
	• Be aware that router exhausts hot air from its left side.	

Table 11-2 ERX-7xx models specifications (continued)

Category	Specification
Airflow	• Airflow direction is in through the right side and out through the left side. See Figure 3-2 in *Chapter 3, Installation Guidelines and Requirements*.
DC Input	
Voltage	–40 to –72 VDC
Current	30 A @ –48 VDC
Power	1400 W maximum
Redundancy (input power)	2 independent line feeds
NEBS Certification	• SR-3580 (FD-15): Network Equipment Building System (NEBS) Criteria Levels, Issue 1, November 1995 • GR-63 (LSSGR, FD-15): Network Equipment Building System (NEBS) Requirements: Physical Protection, Issue 1, October 1995 • GR-1089 (LSSGR, FD-15): Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment, Issue 2, Revision 1, February 1999
Safety Agency Certification	• AS/NZS 3260:1993, Safety of Information Technology Equipment Including Electrical Business Equipment • CAN/CSA C22.2, No. 60950-00, 3rd Edition, Safety of Information Technology Equipment • EN60825-1, Safety of Laser Products - Part 1: Equipment Class, Requirements, and User's Guide (2001) • EN60950:2000, 3rd Edition, Safety of Information Technology Equipment • IEC 60950-1(2001-10) Ed. 1.0 Information technology equipment - Safety - Part 1: General requirements • Low Voltage Directive (73/23/EEC) • UL 60950, 3rd Edition, Safety of Information Technology Equipment
Electromagnetic Emissions Agency Certification	• AS/NZS 3548:1995 (CISPR 22 Class A) • EMC Directive (89/336/EEC) • EN55022 Class A (CISPR-22 Class A) • EN55024, Annex C for WAN Equipment Performance Criteria A, B, and C • ETSI 300-386, Telecommunication Network Equipment; ElectroMagnetic Compatibility (EMC) requirements • FCC Part 15 Class A • IECS-003 Issue 3 Class A • VCCI (Voluntary Control Council for Interference by Information Technology Equipment)

Table 11-2 ERX-7xx models specifications (continued)

Category	Specification
Telecommunications Certification	• ACA TS 016-1997
	• CTR13 – Commission Decision of 9 July 1997 on a common technical regulation for attachment requirements for terminal equipment interface for connection to 2048 kbit/s digital structured ONP leased lines: 97/521/EC – OJ No. L215 Vol. 40, August 1997
	• CTR24 – Commission Decision of 9 September 1997 on a common technical regulation for attachment requirements for terminal equipment interface for connection to 34 Mbit/s digital unstructured and structured leased lines: 97/639/EC – OJ No. L271 Vol. 40, 3 October 1997
	• FCC PART 68
	• IECS-003 Issue 3 Class A
	• PD7024 – Essential requirements for terminal equipment intended for connection to unstructured digital leased circuits of the public telecommunications network using a CCITT recommendation G,703 interface at a rate of 2048 kbit/s with a 75 ohm unbalanced presentation, 1994
	• RTTE Directive (1999/5/EEC)

ERX-310 Router Specifications

Table 11-3 ERX-310 router specifications

Category	Specification	
Weight: DC model		
Chassis only	25.5 lb	11.57 kg
Chassis, fully configured	36 lb	16.33 kg
Weight: AC model		
Chassis with single power supply	27.5 lb	12.47 kg
Chassis with dual power supply	31.5 lb	14.29 kg
Chassis with single power supply, fully configured	38 lb	17.24 kg
Chassis with dual power supply, fully configured	42 lb	19.05 kg
Dimensions	5.2 (H) x 19 (W) x 16 (D) inches; 13.21 x 48.26 x 40.64 cm	
Environmental Requirements	NEBS GR-63-CORE compliant	
Ambient operating temperature	Long term: 41˚ to 104˚ F (5˚ to 40˚ C) Short term: 23˚ to 122˚ F (–5˚ to 50˚ C)	
Ambient operating humidity	Long term: 5% to 85% (noncondensing) Short term: 5% to 95% (noncondensing)	
Ambient storage temperature	–40˚ to 158˚ F (–40˚ to +70˚ C), 95% relative humidity	
Ambient storage humidity	5% to 95% (noncondensing)	
Heat Dissipation	500 W, 1706 BTU/hour maximum	

Table 11-3 ERX-310 router specifications (continued)

Category	Specification
Space Requirements	• 3 feet (90 cm) behind router or rack
	• Do not block air vents on sides of the router.
	• Do not place equipment that exhausts hot air to left on the right of the router.
	• Be aware that router exhausts hot air from its left side.
Airflow	• Airflow direction is in through the right side and out through the left side. See Figure 3-2 in *Chapter 3, Installation Guidelines and Requirements*.
DC Input	
Voltage	–40 to –72 VDC[a]
Current	9 A @ –48 VDC
Power	500 W maximum
Redundancy (input power)	2 independent line feeds
AC Input	
Power required	90-265 VAC @ ~5 A
AC line frequency	50-60 Hz
Power	500 W
NEBS Certification	• *Not yet available for the ERX-310 router*
Safety Agency Certification	• AS/NZS 3260:1993, Safety of Information Technology Equipment Including Electrical Business Equipment
	• CAN/CSA C22.2, No. 60950-00, 3rd Edition, Safety of Information Technology Equipment
	• EN60825-1, Safety of Laser Products - Part 1: Equipment Class, Requirements, and User's Guide (2001)
	• EN60950:2000, 3rd Edition, Safety of Information Technology Equipment
	• IEC 60950-1(2001-10) Ed. 1.0 Information technology equipment - Safety - Part 1: General requirements
	• Low Voltage Directive (73/23/EEC)
	• UL 60950, 3rd Edition, Safety of Information Technology Equipment
Electromagnetic Emissions Agency Certification	• AS/NZS 3548:1995 (CISPR 22 Class A)
	• EMC Directive (89/336/EEC)
	• EN55022 Class A (CISPR-22 Class A)
	• EN55024, Annex C for WAN Equipment Performance Criteria A, B, and C
	• ETSI 300-386, Telecommunication Network Equipment; ElectroMagnetic Compatibility (EMC) requirements
	• FCC Part 15 Class A
	• IECS-003 Issue 3 Class A
	• VCCI (Voluntary Control Council for Interference by Information Technology Equipment)

Table 11-3 ERX-310 router specifications (continued)

Category	Specification
Telecommunications Certification	• ACA TS 016-1997
	• CTR13 – Commission Decision of 9 July 1997 on a common technical regulation for attachment requirements for terminal equipment interface for connection to 2048 kbit/s digital structured ONP leased lines: 97/521/EC – OJ No. L215 Vol. 40, August 1997
	• CTR24 – Commission Decision of 9 September 1997 on a common technical regulation for attachment requirements for terminal equipment interface for connection to 34 Mbit/s digital unstructured and structured leased lines: 97/639/EC – OJ No. L271 Vol. 40, 3 October 1997
	• FCC PART 68
	• IECS-003 Issue 3 Class A
	• PD7024 – Essential requirements for terminal equipment intended for connection to unstructured digital leased circuits of the public telecommunications network using a CCITT recommendation G,703 interface at a rate of 2048 kbit/s with a 75 ohm unbalanced presentation, 1994
	• RTTE Directive (1999/5/EEC)

a. If the voltage rises above –40 VDC, the system will power off. The system will not power on again until the input voltage reaches –43 +/– 0.5 VDC.

Module Specifications 12

This chapter provides information about line modules, SRP modules, and I/O modules available for E-series routers. All line modules, with the exception of the IPSec Service and Tunnel Service module, combine with I/O modules to provide particular capabilities and connections.

📄 *Note: In this chapter, the term module assembly is used to describe the combination of a line module and an I/O module.*

Module Functionality

See Table 12-1 for module details such as assembly name, capabilities, module and I/O module label, and software release compatibility.

The table lists the first software release that each module and its corresponding I/O modules support. If a module has been deprecated, the final software release that supports the module is listed; otherwise, *N/A* is displayed. Because of modifications and updates, some versions of modules support only later software releases than those indicated in the table.

Table 12-1 Module functionality

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information	
					First Supported[a]	Final Supported
CE1						
CE1	Channelized E1	E1 HDLC framing	CE1	CE1 FULL I/O	1.1.0	N/A
cOC3/STM1						
cOC3/STM1 multimode	OC3/STM1 channelized to DS3, DS1, E1, and DS0	OC3/STM1 DS3 T1, E1 DS0 HDLC Framing	cOCx/STMx F0	cOC3 STM1 F0 I/O MULTI MODE	2.2.0	N/A
cOC3/STM1 single mode intermediate reach	OC3/STM1 channelized to DS3, DS1, E1, and DS0	OC3/STM1 DS3 T1, E1 DS0 HDLC Framing	cOCx/STMx F0	cOC3 STM1 F0 I/O SINGLE MODE	2.2.0	N/A
cOC3/STM1 single mode long reach	OC3/STM1 channelized to DS3, DS1, E1, and DS0	OC3/STM1 DS3 T1, E1 DS0 HDLC Framing	cOCx/STMx F0	cOC3 STM1 F0 I/O LONG HAUL	2.2.0	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	First Supported[a]	Final Supported
cOC12/STM4						
cOC12/STM4 multimode without APS/MSP redundancy	OC12/STM4 channelized to DS3, DS1, E1, and DS0	OC12/STM4 OC3/STM1 DS3 T1, E1 DS0 HDLC Framing	cOCx/STMx F0	cOC12 STM4 F0 I/O MULTI MODE	2.2.0	N/A
cOC12/STM4 multimode with APS/MSP redundancy	OC12/STM4 channelized to DS3, DS1, E1, and DS0	OC12/STM4 OC3/STM1 DS3 T1, E1 DS0 HDLC Framing	cOCx/STMx F0	cOC12 F0 APS MULTI MODE	2.2.0	N/A
cOC12/STM4 single mode intermediate reach	OC12/STM4 channelized to DS3, DS1, E1, and DS0	OC12/STM4 OC3/STM1 DS3 T1, E1 DS0 HDLC Framing	cOCx/STMx F0	cOC12 STM4 F0 I/O SINGLE MODE	2.2.0	N/A
cOC12/STM4 single mode long reach	OC12/STM4 channelized to DS3, DS1, E1, and DS0	OC12/STM4 OC3/STM1 DS3 T1, E1 DS0 HDLC Framing	cOCx/STMx F0	cOC12 STM4 LONG HAUL	2.2.0	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information	
					First Supported[a]	Final Supported
CT1						
CT1	Channelized T1	DS1, DS0 HDLC Framing	CT1	CT1 FULL I/O	1.1.0	N/A
CT3						
CT3 (3 ports)	Channelized T3	DS3, DS1, DS0 HDLC Framing	CT3	CT3/T3 I/O	1.0.0	N/A
CT3/T3 12 (12 ports)	Channelized and unchannelized T3	DS3, DS1, DS0 HDLC Framing	CT3/T3-F0	CT3/T3 12 I/O	3.2.0	N/A
E3						
E3 ATM	Unchannelized E3 for ATM	ATM/AAL5	E3 ATM	E3 I/O	1.1.0	N/A
E3 FRAME (3 ports)	Unchannelized E3 for Frame	E3 HDLC Framing	E3 FRAME	E3 I/O	1.1.0	N/A
E3 FRAME (12 ports)	Unchannelized E3 for Frame	E3 HDLC Framing	COCX-F3	E3-12 FRAME I/O	4.0.2	N/A
FE						
FE-2 (2 ports)	Fast Ethernet	Ethernet (IEEE 802.3) 10/100Base-T	FE-2	FE-2 I/O	1.30	N/A
FE-8 (8 ports)	Fast Ethernet	Ethernet (IEEE 802.3) 10/100Base-T	GE/FE[b]	FE-8 I/O	2.00 5.0.0[c]	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information	
					First Supported[a]	Final Supported
GE						
GE 1000 Base-LH	Gigabit Ethernet	Ethernet (IEEE 802.3z) 1000 Base-LH	GE/FE[b]	GE I/O SFP[d]	2.0.0 5.0.0[c]	N/A
GE 1000 Base-SX	Gigabit Ethernet	Ethernet (IEEE 802.3z) 1000 Base-SX	GE/FE[b]	GE I/O SFP[d]	2.0.0 5.0.0[c]	N/A
GE 1000 Base-ZX	Gigabit Ethernet	Ethernet (IEEE 802.3z) 1000 Base-ZX	GE/FE[b]	GE I/O SFP[d]	2.0.0 5.0.0[c]	N/A
GE multimode[e]	Gigabit Ethernet	Ethernet (IEEE 802.3z)	GE/FE	GE I/O MULTI MODE	2.0.0	N/A
GE single mode[e]	Gigabit Ethernet	Ethernet (IEEE 802.3z)	GE/FE	GE I/O SINGLE MODE	2.0.0	N/A
HSSI						
HSSI	High Speed Serial Interface	Up to 44.736 MHz data rate HDLC Framing	HSSI-3F	HSSI-3 I/O	3.1.0	N/A
IPSec Service						
IPSec Service	IPSec Tunnel Service	IPSec Tunnels	IPSEC SERVICE	No I/O module	4.0.2	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information	
					First Supported[a]	Final Supported
OC3/STM1						
OC3 (dual port) multimode	Obsolete, no longer supported	N/A	OC3	OC3 I/O MULTI MODE	1.0.0	4.1.x
OC3 (dual port) single mode	Obsolete, no longer supported	N/A	OC3	OC3 I/O SINGLE MODE	1.0.0	4.1.x
OC3/STM1 ATM						
OC3/STM1 ATM multimode without APS/MSP redundancy	Unchannelized, concatenated OC3/STM1 for ATM	OC3/STM1 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATMf	OC3-4 I/O MULTI MODE	2.0.0 5.0.0g	N/A
OC3/STM1 ATM multimode with APS/MSP redundancy	Unchannelized, concatenated OC3/STM1 for ATM	OC3/STM-1 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM	4XOC3 APS I/O MULTI MODE	5.1.0	N/A
OC3/STM1 ATM single mode, intermediate reach without APS/MSP redundancy	Unchannelized, concatenated OC3/STM1 for ATM	OC3/STM1 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATMf	OC3-4 I/O SINGLE MODE	2.0.0 5.0.0g	N/A
OC3/STM1 ATM single mode, intermediate reach with APS/MSP redundancy	Unchannelized, concatenated OC3/STM1 for ATM	OC3/STM-1 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM	4XOC3 APS I/O SINGLE MODE	5.1.0	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information First Supported[a]	Release Information Final Supported
OC3/STM1 ATM single mode, long reach	Unchannelized, concatenated OC3/STM1 for ATM	OC3/STM1 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM[f]	OC3-4 I/O LONG HAUL	2.0.0 5.0.0[g]	N/A
OC3/STM1 POS						
OC3/STM1 POS multimode without APS/MSP redundancy	Unchannelized, concatenated OC3/STM1 for POS	OC3/STM1 HDLC Framing	OCx/STMx POS	OC3-4 I/O MULTI MODE	2.0.0	N/A
OC3/STM1 POS multimode with APS/MSP redundancy	Unchannelized, concatenated OC3/STM1 for POS	OC3/STM-1 HDLC Framing	OCx/STMx POS	4XOC3 APS I/O MULTI MODE	5.1.0	N/A
OC3/STM1 POS single mode, intermediate reach without APS/MSP redundancy	Unchannelized, concatenated OC3/STM1 for POS	OC3/STM1 HDLC Framing	OCx/STMx POS	OC3-4 I/O SINGLE MODE	2.0.0	N/A
OC3/STM1 POS single mode, intermediate reach with APS/MSP redundancy	Unchannelized, concatenated OC3/STM1 for POS	OC3/STM-1 HDLC Framing	OCx/STMx POS	4XOC3 APS I/O SINGLE MODE	5.1.0	N/A
OC3/STM1 POS single mode, long reach	Unchannelized, concatenated OC3/STM1 for POS	OC3/STM1 HDLC Framing	OCx/STMx POS	OC3-4 I/O LONG HAUL	2.0.0	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information First Supported[a]	Release Information Final Supported
OC12/STM4 ATM						
OC12/STM4 ATM multimode without APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for ATM	OC12/STM4 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM[f]	OC12 STM4 I/O MULTI MODE	2.0.0 5.0.0[g]	N/A
OC12/STM4 ATM multimode with APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for ATM	OC12/STM4 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM[f]	OC12 STM4 APS MULTI MODE	2.0.0 5.0.0[g]	N/A
OC12/STM4 ATM single mode, intermediate reach without APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for ATM	OC12/STM4 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM[f]	OC12 STM4 I/O SINGLE MODE	2.0.0 5.0.0[g]	N/A
OC12/STM4 ATM single mode, intermediate reach with APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for ATM	OC12/STM4 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM[f]	OC12 STM4 APS SINGLE MODE	2.0.0 5.0.0[g]	N/A
OC12/STM4 ATM single mode, long reach without APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for ATM	OC12/STM4 ATM:AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM[f]	OC12 STM4 I/O LONG HAUL	2.0.0 5.0.0[g]	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information	
					First Supported[a]	Final Supported
OC12/STM4 ATM single mode, long reach with APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for ATM	OC12/STM4 ATM:AAL5	OCx/STMx ATM *or* OCx/STMx /DS3-ATM[f]	OC12 STM4 APS LONG HAUL	2.0.0 5.0.0[g]	N/A
OC12/STM4 POS						
OC12/STM4 POS multimode without APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for POS	OC12/STM4 HDLC Framing	OCx/STMx POS	OC12 STM4 I/O MULTI MODE	2.0.0	N/A
OC12/STM4 POS multimode with APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for POS	OC12/STM4 HDLC Framing	OCx/STMx POS	OC12 STM4 APS MULTI MODE	2.0.0	N/A
OC12/STM4 POS single mode, intermediate reach without APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for POS	OC12/STM4 HDLC Framing	OCx/STMx POS	OC12 STM4 I/O SINGLE MODE	2.0.0	N/A
OC12/STM4 POS single mode, intermediate reach with APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for POS	OC12/STM4 HDLC Framing	OCx/STMx POS	OC12 STM4 APS SINGLE MODE	2.0.0	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information	
					First Supported[a]	Final Supported
OC12/STM4 POS single mode, long reach without APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for POS	OC12/STM4 HDLC Framing	OCx/STMx POS	OC12 STM4 I/O LONG HAUL	2.0.0	N/A
OC12/STM4 POS single mode, long reach with APS/MSP redundancy	Unchannelized, concatenated OC12/STM4 for POS	OC12/STM4 HDLC Framing	OCx/STMx POS	OC12 STM4 APS LONG HAUL	2.0.0	N/A
OC48/STM16						
OC48/STM16 POS single mode, intermediate reach	Unchannelized, concatenated OC48/STM16 for POS	OC48/STM16 HDLC Framing	OC48	OC48 FRAME APS	4.1.x	N/A
SM						
SM	Tunnel Service for IP tunnels, L2F tunnels and LNS termination	IP tunnels LNS termination	SERVICE MODULE	No I/O module	5.1.0	N/A
SRPs						
SRP-5G[e]	Switch route processor (5 Gbps)	Ethernet (IEEE 802.3) 10/100Base-T RS-232	SRP-5G	SRP I/O	1.0.0	N/A
SRP-5G+	Switch route processor (5 Gbps)	Ethernet (IEEE 802.3) 10/100Base-T RS-232	SRP-5G+	SRP I/O	3.3.2	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information	
					First Supported[a]	Final Supported
SRP-10G	Switch route processor (10 Gbps)	Ethernet (IEEE 802.3) 10/100Base-T RS-232	SRP-10G	SRP I/O	1.1.0	N/A
SRP-40G	Switch route processor (40 Gbps)	Ethernet (IEEE 802.3) 10/100Base-T RS-232	SRP-40G	SRP I/O	3.3.2	N/A
SRP-40G+	Switch route processor (40 Gbps)	Ethernet (IEEE 802.3) 10/100Base-T RS-232	SRP-40G+	SRP I/O	4.0.2	N/A
SRP-SE10G	Switch route processor for ERX-310 router (10 Gbps)	Ethernet (IEEE 802.3) 10/100Base-T RS-232	SRP-SE10G	SRP-SE I/O	5.1.0	N/A
T3						
T3 ATM (3 ports)	Unchannelized T3 for ATM	ATM/AAL5	T3 ATM	CT3/T3 I/O	1.1.0	N/A
T3 ATM (4 ports)	Unchannelized T3 for ATM	ATM/AAL5	OCx/STMx ATM or OCx/STMx /DS3-ATM	4xDS3 ATM I/O	4.1.0	N/A
T3 FRAME (3 ports)	Unchannelized T3 for Frame	DS3 Subrate DS3 HDLC Framing	T3 FRAME	CT3/T3 I/O	1.1.0	N/A

Table 12-1 Module functionality (continued)

Module Assembly Name	Description	Capability	Line Module Label	I/O Module Label	Release Information	
					First Supported[a]	Final Supported
T3 FRAME (12 ports)	Unchannelized T3 for Frame	DS3 Subrate DS3 HDLC Framing	COCX-F3	CT3/T3 12 I/O	4.0.2	N/A
TSM						
TSM	Tunnel Service for IP tunnels, L2F tunnels and LNS termination	IP Tunnels LNS termination	TUNNEL SERVICE	No I/O module	3.0.2	N/A
X.21/V.35						
X.21/V.35	X.21/V.35 synchronous serial interface	HDLC	X.21/V.35-16	X.21/V.35-16 I/O	2.10.1, 3.3.2	N/A

a. A release may support multiple versions of a module. For information, see *Software Compatibility* in *E-Series System Basics Configuration Guide*, *Chapter 5, Managing Line Modules and SRP Modules*.

b. This module assembly can use either the 128-MB GE/FE line module or the 256-MB GE/FE line module.

c. The 256-MB GE/FE line module was first supported in Release 5.0.0.

d. The GE SFP I/O module uses a range of simple form-factor pluggable transceivers (SFPs) to support different modes and cable lengths.

e. Assembly is superseded by a newer assembly; however, assembly is supported by current software.

f. This module assembly can use either the 128-MB OCx/STMx ATM line module or the 256-MB OCx/STMx/DS3-ATM line module.

g. The 256-MB OCx/STMx/DS3-ATM line module was first supported in Release 5.0.0.

Module Specifications

See Table 12-2 on the following pages for module details such as E-series model compatibility, SRP module compatibility, module type, redundancy support, and power use.

Table 12-2 Module specifications

Line Module or SRP Module Label	Type	Model Compatibility	SRP Module Compatibility	Redundancy Support[a]	Power Use
CE1	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	1:N redundancy	40 W
cOCx/STMx F0	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1:N redundancy	130 W
COCX-F3	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1:N redundancy	135 W
CT1	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	1:N redundancy	40 W
CT3	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	1:N redundancy	60 W
CT3/T3-F0	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1:N redundancy	130 W
E3 ATM	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	1:N redundancy	60 W
E3 FRAME	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	1:N redundancy	60 W

Table 12-2 Module specifications (continued)

Line Module or SRP Module Label	Type	Model Compatibility	SRP Module Compatibility	Redundancy Support[a]	Power Use
FE-2	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	N/A	60 W
GE/FE (128 MB)	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	N/A	130 W
GE/FE (256 MB)	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	N/A	130 W
HSSI-3F	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	N/A	60 W
IPSec Service	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	Multiple IPSec Service modules provide redundancy[c]	130 W
OCx/STMx ATM *or* OCx/STMx/DS3-ATM (128 MB)	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1:N redundancy	130 W
OCx/STMx/DS3-ATM (256 MB)	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1:N redundancy	130 W
OCx/STMx POS	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1:N redundancy	120 W
OC48	ASIC	ERX-1440 router	SRP-40G SRP-40G+	N/A	120 W

Table 12-2 Module specifications (continued)

Line Module or SRP Module Label	Type	Model Compatibility	SRP Module Compatibility	Redundancy Support[a]	Power Use
SERVICE MODULE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	Multiple SMs provide redundancy[c]	130 W
SRP-5G[b]	N/A	ERX-705 router	SRP-5G	1:1 redundancy	100 W
SRP-5G+	N/A	ERX-705 router	SRP-5G+	1:1 redundancy	125 W
SRP-10G	N/A	ERX-710 router ERX-1410 router	SRP-10G	1:1 redundancy	125 W
SRP-40G	N/A	ERX-1440 router	SRP-40G SRP-40G+	1:1 redundancy	210 W
SRP-40G+	N/A	ERX-1440 router	SRP-40G SRP-40G+	1:1 redundancy	210 W
SRP-SE10G	N/A	ERX-310 router	SRP-SE10G	N/A	35 W
T3 ATM	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	1:N redundancy	60 W
T3 FRAME	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	1:N redundancy	60 W
TUNNEL SERVICE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	Multiple TSMs provide redundancy[c]	130 W
X.21/V.35	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	N/A	60 W

a. Line module redundancy and SRP module redundancy are not supported on the ERX-310 router.
b. Assembly is superseded by a newer assembly; however, assembly is supported by current software.
c. See *E-Series Physical Layer Configuration Guide, Chapter 9, Managing Tunnel Service and IPSec Service Interfaces*.

I/O Module Specifications

See Table 12-3 on the following pages for I/O module details such as module type, E-series model compatibility, SRP module compatibility, number of ports, connector type, and cabling specifications.

Table 12-3 I/O module specifications

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
CE1						
CE1 FULL I/O	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	20	• RJ-48C,120 ohm • BNC, 75 ohm via a balun panel that connects to the I/O module	• Use shielded cables to maintain EMC compliance. • The transmitted signal complies with *ITUT G.703, Physical/electrical characteristics of hierarchical digital interfaces (November 2001)* for cable lengths up to 450 m (492 yards).
cOC3/STM1						
cOC3 STM1 F0 I/O MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4	SC full duplex	• Tx power: › min: –19 dBm › max: –14 dBm • Center wavelength: 1310 nm • Rx input power: › min: –30 dBm › max: –14 dBm • Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications

cOC3 STM1 F0 I/O SINGLE MODE	ASIC	ERX-7xx models
		ERX-14xx models
		ERX-310 router
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				4	SC full duplex	• Tx power:
						  › min: –15 dBm
						  › max: –8 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –31 dBm
						  › max: –8 dBm
						• Rated for 15 km (9.3 miles) of 9-micron core cable

cOC3 STM1 F0 I/O LONG HAUL	ASIC	ERX-7xx models
		ERX-14xx models
		ERX-310 router
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				4	SC full duplex	• Tx power:
						  › min: –5.0 dBm
						  › max: 0 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –34 dBm
						  › max: –7 dBm
						• Fiber type: 9-micron core
						• Rated for 40 km (24.8 miles) of 9-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
cOC12/STM4						
cOC12 STM4 F0 I/O MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1	SC full duplex	• Tx power: › min: −19 dBm › max: −14 dBm • Center wavelength: 1310 nm • Rx input power: › min: −30 dBm › max: −14 dBm • Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB
cOC12 F0 APS MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	SC full duplex	• Tx power: › min: −19 dBm › max: −14 dBm • Center wavelength: 1310 nm • Rx input power: › min: −30 dBm › max: −14 dBm • Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
cOC12 STM4 F0 I/O SINGLE MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1	SC full duplex	• Tx power: › min: –15 dBm › max: –8 dBm • Center wavelength: 1310 nm • Rx input power: › min: –31 dBm › max: –8 dBm • Rated for 15 km (9.3 miles) of 9-micron core cable
cOC12 STM4 LONG HAUL	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1	SC full duplex	• Tx power: › min: –5.0 dBm › max: 0 dBm • Center wavelength: 1310 nm • Rx input power: › min: –34 dBm › max: –7 dBm • Fiber type: 9-micron core • Rated for 40 km (24.8 miles) of 9-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
CT1						
CT1 FULL I/O	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	24	RJ-48C 100 ohm	• Use shielded cables to maintain EMC compliance. • The line interface unit supports multiple line build-outs. • Signal strength is software controlled. • The transmitted signal complies with ANSI T1.102-1993 Digital Hierarchy - Electrical Interfaces (1999) for cable lengths up to 201 m (660 feet).
CT3						

CT3/T3 I/O	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	3	BNC 75 ohm	• The line interface unit supports two line build-outs:
						  › 0–68.5 m (0–225 feet)
						  › 69–137 m (226–450 feet)
						• Signal strength is software controlled.
						• The transmitted signal complies with ANSI T1.102-1993 Digital Hierarchy - Electrical Interfaces (1999) for cable lengths up to 201 m (660 feet).

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
CT3/T3 12 I/O	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	12	BT43 SMB (cable that adapts to 75-ohm BNC is available)	• The line interface unit supports two line build-outs: › 0–68.5 m (0–225 feet) › 69–137 m (226–450 feet) • Signal strength is software controlled. • The transmitted signal complies with ANSI T1.102-1993 Digital Hierarchy - Electrical Interfaces (1999) for cable lengths up to 201 m (660 feet).
E3						
E3 I/O	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	3	BNC 75 ohm	The transmitted signal complies with ITUT G.703, Physical/electrical characteristics of hierarchical digital interfaces (November 2001) for cable lengths from 0–137 m (0–450 feet).
E3-12 FRAME I/O	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	12	BT43 SMB (cable that adapts to 75-ohm BNC is available)	The transmitted signal complies with ITUT G.703, Physical/electrical characteristics of hierarchical digital interfaces (November 2001) for cable lengths from 0–137 m (0–450 feet).

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
FE						
FE-2 I/O	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	2	RJ-45	• For 10-Mbps operation, use CAT 3, 4, or 5 UTP cable. • For 100-Mbps operation, use only CAT 5 UTP cable. • The transmitted signal complies with IEEE 802.3/802.3u for cable lengths up to 100 m (328 feet).
FE-8 I/O	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	8	RJ-45	• For 10-Mbps operation, use CAT 3, 4, or 5 UTP cable. • For 100-Mbps operation, use only CAT 5 UTP cable. • The transmitted signal complies with IEEE 802.3/802.3u for cable lengths up to 100 m (328 feet).
GE						

GE I/O SFP[b,c]	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	LC full duplex	• Tx power:
						  › min: –9.5 dBm
						  › max: –4 dBm
						• Center wavelength: 850 nm
						• Rx input power:
						  › min: –17 dBm
						  › max: –3 dBm
						• Rated for 275 m (300 yards) over 62.5-micron core cable
						• Rated for 550 m (601 yards) over 50-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
GE I/O SFP[b,d]	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	LC full duplex	• Tx power: › min: –9.5 dBm › max: –3 dBm • Center wavelength: 1300 nm • Rx input power: › min: –20 dBm › max: –3 dBm • Rated for 10 km (6.2 miles) over 10-micron core cable
GE I/O SFP[b,e]	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	LC full duplex	• Tx power: › min: –3 dBm › max: 2 dBm • Center wavelength: 1550 nm • Rx input power: › min: –23 dBm › max: –3 dBm • Rated for 70 km (43.4 miles) over 10-micron core cable
GE I/O MULTI MODE[c]	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	SC full duplex	• Tx power: › min: –9.5 dBm › max: –4 dBm • Center wavelength: 850 nm • Rx input power: › min: –17 dBm › max: –3 dBm • Rated for 275 m (300 yards) over 62.5-micron core cable • Rated for 550 m (601 yards) over 50-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
GE I/O SINGLE MODE[f]	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	SC full duplex	• Tx power: › min: −11 dBm › max: −3 dBm • Center wavelength: 1300 nm • Rx input power: › min: −20 dBm › max: −3 dBm • Rated for 550 m (601 yards) over 62.5-micron core or 50-micron core MM fiber • Rated for 5 km (3.1 miles) over 10-micron core cable
HSSI						
HSSI-3 I/O	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	3	Standard HSSI connector: 2-row, 50-pin, receptacle header with rails and latch blocks	• 50 feet (15.24 m) maximum cable length
IPSec Service						
No I/O module	N/A	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	N/A	N/A	N/A
OC3/STM1						
OC3 I/O MULTI MODE	Obsolete, no longer supported					

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
OC3 I/O SINGLE MODE	Obsolete, no longer supported					
OC3/STM1 ATM						
OC3-4 I/O MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4	SC full duplex	• Tx power: › min: –19 dBm › max: –14 dBm • Center wavelength: 1310 nm • Rx input power: › min: –30 dBm › max: –14 dBm • Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB
4XOC3 APS I/O MULTI MODE	ASIC	ERX-700 series ERX-1400 series ERX-310 system	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4 active 4 redundant	LC full duplex	• Tx power: › min: –19 dBm › max: –14 dBm • Center wavelength: 1310 nm • Rx input power: › min: –30 dBm › max: –14 dBm • Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
OC3-4 I/O SINGLE MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4	SC full duplex	• Tx power: › min: −15 dBm › max: −8 dBm • Center wavelength: 1310 nm • Rx input power: › min: −31 dBm › max: −8 dBm • Rated for 15 km (9.3 miles) of 9-micron core cable
4XOC3 APS I/O SINGLE MODE	ASIC	ERX-700 series ERX-1400 series ERX-310 system	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4 active 4 redundant	LC full duplex	• Tx power: › min: −15 dBm › max: −8 dBm • Center wavelength: 1310 nm • Rx input power: › min: −31 dBm › max: −8 dBm • Rated for 15 km (9.3 miles) of 9-micron core cable
OC3-4 I/O LONG HAUL	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4	SC full duplex	• Tx power: › min: −5.0 dBm › max: 0 dBm • Center wavelength: 1310 nm • Rx input power: › min: −34 dBm › max: −7 dBm • Rated for 40 km (24.8 miles) of 9-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
OC3/STM1 POS						

OC3-4 I/O MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4	SC full duplex	• Tx power:
						  › min: –19 dBm
						  › max: –14 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –30 dBm
						  › max: –14 dBm
						• Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB

4XOC3 APS I/O MULTI MODE	ASIC	ERX-700 series ERX-1400 series ERX-310 system	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4 active 4 redundant	LC full duplex	• Tx power:
						  › min: –19 dBm
						  › max: –14 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –30 dBm
						  › max: –14 dBm
						• Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications

OC3-4 I/O SINGLE MODE	ASIC	ERX-7xx models
		ERX-14xx models
		ERX-310 router
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				4	SC full duplex	• Tx power:
						  › min: –15 dBm
						  › max: –8 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –31 dBm
						  › max: –8 dBm
						• Rated for 15 km (9.3 miles) of 9-micron core cable

4XOC3 APS I/O SINGLE MODE	ASIC	ERX-700 series
		ERX-1400 series
		ERX-310 system
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				4 active
				4 redundant
					LC full duplex	• Tx power:
						  › min: –15 dBm
						  › max: –8 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –31 dBm
						  › max: –8 dBm
						• Rated for 15 km (9.3 miles) of 9-micron core cable

OC3-4 I/O LONG HAUL	ASIC	ERX-7xx models
		ERX-14xx models
		ERX-310 router
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				4	SC full duplex	• Tx power:
						  › min: –5.0 dBm
						  › max: 0 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –34 dBm
						  › max: –7 dBm
						• Fiber type: 9-micron core
						• Rated for 40 km (24.8 miles) of 9-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
OC12/STM4						
OC12 STM4 I/O MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1	SC full duplex	• Tx power: › min: –19 dBm › max: –14 dBm • Center wavelength: 1310 nm • Rx input power: › min: –30 dBm › max: –14 dBm • Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB
OC12 STM4 APS MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	SC full duplex	• Tx power: › min: –19 dBm › max: –14 dBm • Center wavelength: 1310 nm • Rx input power: › min: –30 dBm › max: –14 dBm • Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications

OC12 STM4 I/O SINGLE MODE	ASIC	ERX-7xx models
		ERX-14xx models
		ERX-310 router
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				1	SC full duplex	• Tx power:
						  › min: –15 dBm
						  › max: –8 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –31 dBm
						  › max: –8 dBm
						• Rated for 15 km (9.3 miles) of 9-micron core cable

OC12 STM4 APS SINGLE MODE	ASIC	ERX-7xx models
		ERX-14xx models
		ERX-310 router
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				1 active
				1 redundant
					SC full duplex	• Tx power:
						  › min: –15 dBm
						  › max: –8 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –31 dBm
						  › max: –8 dBm
						• Rated for 15 km (9.3 miles) of 9-micron core cable

OC12 STM4 I/O LONG HAUL	ASIC	ERX-7xx models
		ERX-14xx models
		ERX-310 router
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				1	SC full duplex	• Tx power:
						  › min: –5.0 dBm
						  › max: 0 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: –34 dBm
						  › max: –7 dBm
						• Fiber type: 9-micron core
						• Rated for 40 km (24.8 miles) of 9-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications

OC12 STM4 APS LONG HAUL	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	SC full duplex	• Tx power:
						  › min: −5.0 dBm
						  › max: 0 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: −34 dBm
						  › max: −7 dBm
						• Fiber type: 9-micron core
						• Rated for 40 km (24.8 miles) of 9-micron core cable

OC12/STM4 POS						•

OC12 STM4 I/O MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1	SC full duplex	• Tx power:
						  › min: −19 dBm
						  › max: −14 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: −30 dBm
						  › max: −14 dBm
						• Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0−9 dB or 50-micron core cable with an optical loss of 7 dB

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications

OC12 STM4 APS MULTI MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	SC full duplex	• Tx power:
						  › min: −19 dBm
						  › max: −14 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: −30 dBm
						  › max: −14 dBm
						• Rated for 2 km (1.2 miles) over 62.5-micron core cable with an optical loss of 0–9 dB or 50-micron core cable with an optical loss of 7 dB

OC12 STM4 I/O SINGLE MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1	SC full duplex	• Tx power:
						  › min: −15 dBm
						  › max: −8 dBm
						• Center wavelength: 1310 nm
						• Rx input power:
						  › min: −31 dBm
						  › max: −8 dBm
						• Rated for 15 km (9.3 miles) of 9-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
OC12 STM4 APS SINGLE MODE	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	SC full duplex	• Tx power: › min: –15 dBm › max: –8 dBm • Center wavelength: 1310 nm • Rx input power: › min: –31 dBm › max: –8 dBm • Rated for 15 km (9.3 miles) of 9-micron core cable
OC12 STM4 I/O LONG HAUL	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1	SC full duplex	• Tx power: › min: –5.0 dBm › max: 0 dBm • Center wavelength: 1310 nm • Rx input power: › min: –34 dBm › max: –7 dBm • Rated for 40 km (24.8 miles) of 9-micron core cable
OC12 STM4 APS LONG HAUL	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	1 active 1 redundant	SC full duplex	• Tx power: › min: –5.0 dBm › max: 0 dBm • Center wavelength: 1310 nm • Rx input power: › min: –34 dBm › max: –7 dBm • Rated for 40 km (24.8 miles) of 9-micron core cable

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
OC48/STM16						
OC48 FRAME APS	ASIC	ERX-1440	SRP-40G+	1	LC full duplex	• Tx power: › min: –5.0 dBm › max: 0 dBm • Center wavelength: 1310 nm • Rx input power: › min: –18 dBm › max: –0 dBm • Rated for 15 km (9.3 miles) of 9-micron core cable
SM						
No I/O module	N/A	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	N/A	N/A	N/A
SRPs						
SRP-5G[e] SRP I/O	N/A	ERX-705 router	SRP-5G	7	Terminal blocks BNC Wire wrap posts RJ-45 RS-232 (DB-9)	See *Chapter 6, Cabling E-Series Routers*.
SRP-5G+ SRP I/O	N/A	ERX-705 router	SRP-5G+	7	Terminal blocks BNC Wire wrap posts RJ-45 RS-232 (DB-9)	See *Chapter 6, Cabling E-Series Routers*.

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
SRP-10G SRP I/O	N/A	ERX-710 router ERX-1410 router	SRP-10G	7	Terminal blocks BNC 75 ohm Wire wrap posts RJ-45 RS-232 (DB-9)	See *Chapter 6, Cabling E-Series Routers.*
SRP-40G SRP I/O	N/A	ERX-1440 router	SRP-40G SRP-40G+	7	Terminal blocks BNC 75 ohm Wire wrap posts RJ-45 RS-232 (DB-9)	See *Chapter 6, Cabling E-Series Routers.*
SRP-40G+ SRP I/O	N/A	ERX-1440 router	SRP-40G SRP-40G+	7	Terminal blocks BNC 75 ohm Wire wrap posts RJ-45 RS-232 (DB-9)	See *Chapter 6, Cabling E-Series Routers.*
SRP-SE I/O	N/A	ERX-310 router	SRP-SE10G	2	RJ-45 RS-232 (DB-9)	See *Chapter 6, Cabling E-Series Routers.*

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
T3						
CT3/T3 I/O	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	3	BNC 75 ohm	• The line interface unit supports two line build-outs: ➤ 0–68.5 m (0–225 feet) ➤ 69–137 m (226–450 feet) • Signal strength is software controlled. • The transmitted signal complies with ANSI T1.102-1993 Digital Hierarchy - Electrical Interfaces (1999) for cable lengths up to 201 m (660 feet).
4xDS3 ATM I/O	ASIC	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	4	BNC 75 ohm	• The line interface unit supports two line build-outs: ➤ 0–68.5 m (0–225 feet) ➤ 69–137 m (226–450 feet) • Signal strength is software controlled. • The transmitted signal complies with ANSI T1.102-1993 Digital Hierarchy - Electrical Interfaces (1999) for cable lengths up to 201 m (660 feet).

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications

CT3/T3 I/O	Non-ASIC	ERX-7xx models
		ERX-1410 router
			SRP-5G
			SRP-5G+
			SRP-10G
				3	BNC
					75 ohm
						• The line interface unit supports two line build-outs:
						  › 0–68.5 m (0–225 feet)
						  › 69–137 m (226–450 feet)
						• Signal strength is software controlled.
						• The transmitted signal complies with ANSI T1.102-1993 Digital Hierarchy - Electrical Interfaces (1999) for cable lengths up to 201 m (660 feet).

CT3/T3 12 I/O	ASIC	ERX-7xx models
		ERX-14xx models
		ERX-310 router
			SRP-5G+
			SRP-10G
			SRP-40G
			SRP-40G+
			SRP-SE10G
				12	BT43 SMB
					(cable that adapts to 75-ohm BNC is available)
						• The line interface unit supports two line build-outs:
						  › 0–68.5 m (0–225 feet)
						  › 69–137 m (226–450 feet)
						• Signal strength is software controlled.
						• The transmitted signal complies with ANSI T1.102-1993 Digital Hierarchy - Electrical Interfaces (1999) for cable lengths up to 201 m (660 feet).

TSM						
No I/O module	N/A	ERX-7xx models ERX-14xx models ERX-310 router	SRP-5G+ SRP-10G SRP-40G SRP-40G+ SRP-SE10G	N/A	N/A	N/A

Table 12-3 I/O module specifications (continued)

I/O Module Label[a]	Type	Model Compatibility	SRP Module Compatibility	No. of Ports	Connector Type	Cabling Specifications
X.21/V.35						
X.21/V.35-16 I/O	Non-ASIC	ERX-7xx models ERX-1410 router	SRP-5G SRP-5G+ SRP-10G	16	200-pin proprietary socket on I/O module DB15 X.21 or DB34 V.35 at remote end	See Table 12-4.

a. A release may support multiple versions of a module. For information, see *Software Compatibility* in *E-Series System Basics Configuration Guide, Chapter 5, Managing Line Modules and SRP Modules*.

b. The GE SFP I/O module uses a range of simple form-factor pluggable transceivers (SFPs) to support different modes and cable lengths.

c. The transceivers on this GE I/O module are 1000 Base-SX compliant.

d. The transceivers on this GE I/O module are 1000 Base-LX/LH compliant.

e. The transceivers on this GE I/O module are 1000 Base-ZX compliant.

f. The transceivers on this GE I/O module are 1000 Base-LX compliant.

Cable Lengths for X.21/V.35 Cables

Serial signals can travel a limited distance without significant degradation. Slower serial signals can travel farther without degradation than faster serial signals. Table 12-4 shows the maximum cable lengths you can use to prevent signal degradation at various transmission speeds.

Table 12-4 Maximum cable lengths for X.21/V.35 connections

Transmission Speed (Hz)	Cable Length (Feet)	Cable Length (m)
2400	4,100	1,250
4800	2,050	625
9600	1,025	312
19200	513	156
38400	256	78
56000	102	31
2048000	25	8

Protocol Support

13

This chapter lists the layer 2 and layer 3 protocols and applications that line modules and their corresponding I/O modules support. Modules are identified by their physical labels. See *Chapter 12, Module Specifications*, for a list of modules and their identifying labels.

Channelized OCx/STMx Modules

Table 13-1 Channelized OCx/STMx modules

Protocol or Application	cOCx Line Module with cOC3/STM1 Modules	cOCx Line Module with cOC12/STM4 FO I/O Modules
Acceptance of traffic for IP tunnels	Yes	Yes
APS/MSP	No	Multimode I/0 module only
ATM (point-to-point)	No	No
BERT	Yes	Yes
BGP	Yes	Yes
Bridged Ethernet	No	No
Bridged IP	No	No
CBF	No	No
Cisco HDLC	Yes	Yes
DHCP local server	No	No
Dynamic interfaces	No	No
F4 OAM (ATM Administration)	No	No
FDL (facilities data link)	Yes	Yes
Frame Relay	Yes	Yes
IP	Yes	Yes
IP Multicasting	Yes	Yes
IPv6	No	No
IS-IS	Yes	Yes
LAC Support – access side	No	No
LAC Support – peer side	No	No
LNS Support – Internet side	No	No
LNS Support – peer side	No	No
Local loopback	Yes	Yes
MDL (maintenance data link)	Yes	Yes
MPLS	No	No
Multilink Frame Relay	Yes	Yes
Multilink PPP	Yes	Yes
NBMA (multipoint ATM)	No	No
OSPF	Yes	Yes
Packet over SONET	No	No

Table 13-1 Channelized OCx/STMx modules (continued)

Protocol or Application	cOCx Line Module with cOC3/STM1 Modules	cOCx Line Module with cOC12/STM4 FO I/O Modules
PPP	Yes	Yes
PPPoE	No	No
Remote loopback	Yes	Yes (T3 layer)
RIP	Yes	Yes
SMDS (trunk encapsulation)	No	No
Subscriber interfaces (static)	No	No
Subscriber interfaces (dynamic)	No	No
Transparent bridging	No	No
VRRP	No	No

Channelized T1 and E1 Modules

Table 13-2 Channelized T1 and E1 modules

Protocol or Application	CT1 Line Module with CT1 Full I/O Modules	CE1 lIne Modules with CE1 Full I/O Modules
Acceptance of traffic for IP tunnels	Yes	Yes
APS/MSP	No	No
ATM (point-to-point)	No	No
BERT	Yes	Yes
BGP	Yes	Yes
Bridged Ethernet	No	No
Bridged IP	No	No
CBF	No	No
Cisco HDLC	Yes	Yes
DHCP local server	No	No
Dynamic interfaces	No	No
F4 OAM (ATM Administration)	No	No
FDL (facilities data link)	Yes	No
Frame Relay	Yes	Yes
IP	Yes	Yes
IP Multicasting	No	No
IPv6	No	No

Table 13-2 Channelized T1 and E1 modules (continued)

Protocol or Application	CT1 Line Module with CT1 Full I/O Modules	CE1 lIne Modules with CE1 Full I/O Modules
IS-IS	Yes	Yes
LAC Support – access side	No	No
LAC Support – peer side	No	No
LNS Support – Internet side	No	No
LNS Support – peer side	No	No
Local loopback	Yes (T1 layer with AIS)	No
MPLS	No	No
Multilink Frame Relay	Yes	Yes
Multilink PPP	Yes	Yes
NBMA (multipoint ATM)	No	No
OSPF	Yes	Yes
Packet over SONET	No	No
PPP	Yes	Yes
PPPoE	No	No
Remote loopback	Yes	No
RIP	Yes	Yes
SMDS (trunk encapsulation)	No	No
Subscriber interfaces (static)	No	No
Subscriber interfaces (dynamic)	No	No
Transparent bridging	No	No
VRRP	No	No

Channelized T3 Modules

Table 13-3 Channelized T3 modules

Protocol or Application	CT3 line Modules with CT3/T3 I/O Modules	CT3/T3-F0 Line Modules with CT3/T3 12 I/O Modules
Acceptance of traffic for IP tunnels	Yes	Yes
APS/MSP	No	No
ATM	No	No
BERT	Yes (T1 layer)	Yes

Table 13-3 Channelized T3 modules (continued)

Protocol or Application	CT3 line Modules with CT3/T3 I/O Modules	CT3/T3-F0 Line Modules with CT3/T3 12 I/O Modules
BGP	Yes	Yes
Bridged Ethernet	No	No
Bridged IP	No	No
CBF	No	No
Cisco HDLC	Yes	Yes
DHCP local server	No	No
Dynamic interfaces	No	No
F4 OAM (ATM Administration)	No	No
FDL (facilities data link)	Yes	Yes
Frame Relay	Yes	Yes
IP	Yes	Yes
IP Multicasting	No	Yes
IPv6	No	No
IS-IS	Yes	Yes
LAC Support – access side	No	No
LAC Support – peer side	No	No
LNS Support – Internet side	No	No
LNS Support – peer side	No	No
Local loopback	Yes (with AIS)	Yes
MDL (maintenance data link)	Yes	Yes
MPLS	No	Yes
Multilink Frame Relay	Yes	Yes
Multilink PPP	Yes	Yes
NBMA (multipoint ATM)	No	No
OSPF	Yes	Yes
Packet over SONET	No	No
PPP	Yes	Yes
PPPoE	No	No
Remote loopback	Yes	Yes
RIP	Yes	Yes
SMDS (trunk encapsulation)	No	No
Subscriber interfaces (static)	No	No
Subscriber interfaces (dynamic)	No	No

Table 13-3 Channelized T3 modules (continued)

Protocol or Application	CT3 line Modules with CT3/T3 I/O Modules	CT3/T3-F0 Line Modules with CT3/T3 12 I/O Modules
Transparent bridging	No	No
VRRP	No	No

Ethernet Modules

Table 13-4 Ethernet modules

Protocol or Application	FE-2 Line Module with FE-2 I/O Modules	GE/FE Line Module with FE-8 I/O Modules	GE/FE Line Modules with GE I/O Modules
Acceptance of traffic for IP tunnels	Yes	Yes	Yes
APS/MSP	No	No	No
ATM	No	No	No
BERT	No	No	No
BGP	Yes	Yes	Yes
Bridged Ethernet	No	No	No
Bridged IP	No	No	No
CBF	No	No	No
Cisco HDLC	No	No	No
DHCP local server	Yes	Yes	Yes
Dynamic interfaces	Yes	Yes	Yes
F4 OAM (ATM Administration)	No	No	No
Frame Relay	No	No	Yes
IP	Yes	Yes	Yes
IP Multicasting	No	Yes	Yes
IPv6	No	Yes	Yes
IS-IS	Yes	Yes	Yes
LAC Support – access side	Yes	Yes	No
LAC Support – peer side	Yes	Yes	Yes
LNS Support – Internet side	No	No	No

Table 13-4 Ethernet modules (continued)

Protocol or Application	FE-2 Line Module with FE-2 I/O Modules	GE/FE Line Module with FE-8 I/O Modules	GE/FE Line Modules with GE I/O Modules
LNS Support – peer side	Yes	Yes	Yes
Local loopback	No	No	No
MPLS	Yes	Yes	Yes
Multilink Frame Relay	No	No	No
Multilink PPP	No	No	No
NBMA (multipoint ATM)	No	No	No
OSPF	Yes	Yes	Yes
Packet over SONET	No	No	No
PPP	No	No	No
PPPoE	Yes	Yes	Yes
Remote loopback	No	No	No
RIP	Yes	Yes	Yes
SMDS (trunk encapsulation)	No	No	No
Subscriber interfaces (static)	No	Yes	Yes
Subscriber interfaces (dynamic)	No	Yes	Yes
Transparent bridging	No	Yes	Yes
VRRP	Yes	Yes	Yes

HSSI Modules

Table 13-5 HSSI modules

Protocol or Application	HSSI-3F Line Modules with HSSI-3F I/O Modules
Acceptance of traffic for IP tunnels	No
APS/MSP	No
ATM	No
BERT	No
BGP	Yes
Bridged Ethernet	No
Bridged IP	No

Table 13-5 HSSI modules (continued)

Protocol or Application	HSSI-3F Line Modules with HSSI-3F I/O Modules
CBF	Yes
Cisco HDLC	Yes
DHCP local server	No
Dynamic interfaces	No
F4 OAM (ATM Administration)	No
Frame Relay	Yes
IP	Yes
IP Multicasting	No
IPv6	No
IS-IS	Yes
LAC Support – access side	No
LAC Support – peer side	No
LNS Support – Internet side	No
LNS Support – peer side	No
Local loopback	No
MPLS	No
Multilink Frame Relay	No
Multilink PPP	No
NBMA (multipoint ATM)	No
OSPF	Yes
Packet over SONET	No
PPP	Yes
PPPoE	No
Remote loopback	No
RIP	Yes
SMDS (trunk encapsulation)	Yes
Subscriber interfaces (static)	No
Subscriber interfaces (dynamic)	No
Transparent bridging	No
VRRP	No

OCx/STMx ATM Modules

Table 13-6 OCx/STMx ATM modules

Protocol or Application	OCx/STMx ATM Line Modules with OC3-4 I/O Modules	OCx/STMx ATM Line Modules with OC12/STM4 I/O Modules
Acceptance of traffic for IP tunnels	Yes	Yes
APS/MSP	No	Yes
ATM	Yes	Yes
BERT	No	No
BGP	Yes	Yes
Bridged Ethernet	Yes	Yes
Bridged IP	Yes	Yes
CBF	No	No
Cisco HDLC	No	No
DHCP local server	Yes	Yes
Dynamic interfaces	Yes	Yes
F4 OAM (ATM Administration)	Yes	Yes
Frame Relay	No	No
IP	Yes	Yes
IP Multicasting	Yes	Yes
IPv6	Yes	Yes
IS-IS	Yes	Yes
LAC Support – access side	Yes	Yes
LAC Support – peer side	Yes	Yes
LNS Support – Internet side	No	No
LNS Support – peer side	Yes	Yes
Local loopback	No	Yes
MPLS	Yes	Yes
Multilink Frame Relay	No	No
Multilink PPP	No	No
NBMA (multipoint ATM)	Yes	Yes
OSPF	Yes	Yes

Table 13-6 OCx/STMx ATM modules (continued)

Protocol or Application	OCx/STMx ATM Line Modules with OC3-4 I/O Modules	OCx/STMx ATM Line Modules with OC12/STM4 I/O Modules
Packet over SONET	No	No
PPP	Yes	Yes
PPPoE	Yes	Yes
Remote loopback	No	No
RIP	Yes	Yes
SMDS (trunk encapsulation)	No	No
Subscriber interfaces (static)	Yes (over bridged Ethernet and IPoA)	Yes (over bridged Ethernet and IPoA)
Subscriber interfaces (dynamic)	Yes (over bridged Ethernet)	Yes (over bridged Ethernet)
Transparent bridging	Yes	Yes
VRRP	No	No

OCx/STMx POS and OC48 Modules

Table 13-7 OCx/STMx POS and OC48 modules

Protocol or Application	OCx/STMx POS Line Modules with OC3-4 I/O Modules	OCx/STMx POS Line Modules with OC12/STM4 I/O Modules	OC48 Line Module with OC48 Frame APS I/O Module
Acceptance of traffic for IP tunnels	Yes	Yes	Yes
APS/MSP	No	Yes	No
ATM	No	No	No
BERT	No	No	No
BGP	Yes	Yes	Yes
Bridged Ethernet	Yes	Yes	No
Bridged IP	No	No	No
CBF	No	No	No
Cisco HDLC	Yes	Yes	Yes
DHCP local server	No	No	No
Dynamic interfaces	No	No	No

Table 13-7 OCx/STMx POS and OC48 modules (continued)

Protocol or Application	OCx/STMx POS Line Modules with OC3-4 I/O Modules	OCx/STMx POS Line Modules with OC12/STM4 I/O Modules	OC48 Line Module with OC48 Frame APS I/O Module
F4 OAM (ATM Administration)	No	No	No
Frame Relay	Yes	Yes	Yes
IP	Yes	Yes	Yes
IP Multicasting	Yes	Yes	Yes
IPv6	No	No	No
IS-IS	Yes	Yes	Yes
LAC Support – access side	No	No	No
LAC Support – peer side	Yes	Yes	Yes
LNS Support – Internet side	No	No	No
LNS Support – peer side	Yes	Yes	Yes
Local loopback	No	No	No
MPLS	Yes	Yes	Yes
Multilink Frame Relay	No	No	No
Multilink PPP	No	No	No
NBMA (multipoint ATM)	No	No	No
OSPF	Yes	Yes	Yes
Packet over SONET	Yes	Yes	Yes
Policy Management	Yes	Yes	Yes
PPP	Yes	Yes	Yes
PPPoE	No	No	No
QoS	Yes	Yes	Yes
Remote loopback	No	No	No
RIP	Yes	Yes	Yes
SMDS (trunk encapsulation)	No	No	No
Subscriber interfaces (static)	Yes (over POS)	Yes (over POS)	No

Table 13-7 OCx/STMx POS and OC48 modules (continued)

Protocol or Application	OCx/STMx POS Line Modules with OC3-4 I/O Modules	OCx/STMx POS Line Modules with OC12/STM4 I/O Modules	OC48 Line Module with OC48 Frame APS I/O Module
Subscriber interfaces (dynamic)	No	No	No
Transparent bridging	No	No	No
VRRP	No	No	No

Tunnel Service Modules

Table 13-8 Tunnel Service modules

Protocol or Application	Tunnel Service Line Module (TSM)	Service Line Module (SM)	IPSec Service Line Module
Acceptance of traffic for IP tunnels	No	No	No
APS/MSP	No	No	No
ATM	No	No	No
BERT	No	No	No
BGP	Yes	Yes	Yes
Bridged Ethernet	No	No	No
Bridged IP	No	No	No
CBF	No	No	No
Cisco HDLC	No	No	No
DHCP local server	No	No	No
Dynamic interfaces	No	No	No
F4 OAM (ATM Administration)	No	No	No
Frame Relay	No	No	No
IP	Yes	Yes	Yes
IP Multicasting	No	No	No
IPSec	No	No	Yes
IPv6	No	No	No
IS-IS	Yes	Yes	Yes
LAC Support – access side	No	No	No

Table 13-8 Tunnel Service modules (continued)

Protocol or Application	Tunnel Service Line Module (TSM)	Service Line Module (SM)	IPSec Service Line Module
LAC Support – peer side	No	No	No
LNS Support – Internet side	Yes	Yes	No
LNS Support – peer side	Yes	Yes	No
Local loopback	No	No	No
MPLS	No	No	No
Multilink Frame Relay	No	No	No
Multilink PPP	No	No	No
NBMA (multipoint ATM)	No	No	No
OSPF	Yes	Yes	Yes
Packet over SONET	No	No	No
PPP	No	No	No
PPPoE	No	No	No
Remote loopback	No	No	No
RIP	Yes	Yes	Yes
SMDS (trunk encapsulation)	No	No	No
Subscriber interfaces (static)	No	No	No
Subscriber interfaces (dynamic)	No	No	No
Transparent bridging	No	No	No
VRRP	No	No	No

Unchannelized E3 Modules

Table 13-9 Unchannelized E3 modules

Protocol or Application	E3 ATM Line Modules with E3 I/O Modules	E3 FRAME Line Modules with E3 I/O Modules	COCX-F3 Line Modules with E3-12 FRAME I/O Modules
Acceptance of traffic for IP tunnels	Yes	Yes	Yes

Table 13-9 Unchannelized E3 modules (continued)

Protocol or Application	E3 ATM Line Modules with E3 I/O Modules	E3 FRAME Line Modules with E3 I/O Modules	COCX-F3 Line Modules with E3-12 FRAME I/O Modules
APS/MSP	No	No	No
ATM (point-to-point)	Yes	No	No
BERT	No	No	No
BGP	Yes	Yes	Yes
Bridged Ethernet	Yes	No	No
Bridged IP	Yes (over bridged Ethernet)	No	No
CBF	No	Yes	Yes
Cisco HDLC	No	Yes	Yes
DHCP local server	Yes	No	No
Dynamic interfaces	Yes	No	No
F4 OAM (ATM Administration)	Yes	No	No
Frame Relay	No	Yes	Yes
IP	Yes	Yes	Yes
IP Multicasting	No	No	Yes
IPv6	No	No	No
IS-IS	Yes	Yes	Yes
LAC Support – access side	Yes	No	No
LAC Support – peer side	Yes	No	No
LNS Support – Internet side	No	No	No
LNS Support – peer side	Yes	No	No
Local loopback	No	No	No
MDL (maintenance data link)	No	No	No
MPLS	No	No	Yes (over PPP)
Multilink Frame Relay	No	No	Yes
Multilink PPP	No	No	Yes

Table 13-9 Unchannelized E3 modules (continued)

Protocol or Application	E3 ATM Line Modules with E3 I/O Modules	E3 FRAME Line Modules with E3 I/O Modules	COCX-F3 Line Modules with E3-12 FRAME I/O Modules
NBMA (multipoint ATM)	No	No	No
OSPF	Yes	Yes	Yes
Packet over SONET	No	No	No
PPP	Yes	Yes	Yes
PPPoE	Yes (over bridged Ethernet)	No	No
Remote loopback	No	No	No
RIP	Yes	Yes	Yes
SMDS (trunk encapsulation)	No	Yes	Yes
Subscriber interfaces (static)	No	No	No
Subscriber interfaces (dynamic)	No	No	No
Transparent bridging	No	No	No
VRRP	No	No	No

Unchannelized T3 Modules

Table 13-10 Unchannelized T3 modules

Protocol or Application	T3 ATM Line Modules with CT3/T3 I/O Modules	T3 FRAME Line Modules with CT3/T3 I/O Modules	COCX-F3 Line Modules with CT3/T3 12 I/O Modules	OCx/STMx ATM Line Modules with 4xDS3 ATM I/O Modules	CT3/T3-F0 Line Modules with CT3/T3 12 I/O Modules
Acceptance of traffic for IP tunnels	Yes	Yes	Yes	Yes	Yes
APS/MSP	No	No	No	No	No
ATM (point-to-point)	Yes	No	No	Yes	No
BERT	No	No	Yes	No	Yes
BGP	Yes	Yes	Yes	Yes	Yes

Table 13-10 Unchannelized T3 modules (continued)

Protocol or Application	T3 ATM Line Modules with CT3/T3 I/O Modules	T3 FRAME Line Modules with CT3/T3 I/O Modules	COCX-F3 Line Modules with CT3/T3 12 I/O Modules	OCx/STMx ATM Line Modules with 4xDS3 ATM I/O Modules	CT3/T3-F0 Line Modules with CT3/T3 12 I/O Modules
Bridged Ethernet	Yes	No	No	Yes	No
Bridged IP	Yes (over bridged Ethernet)	No	No	Yes	No
CBF	No	Yes	Yes	No	No
Cisco HDLC	No	Yes	Yes	No	Yes
DHCP local server	Yes	No	No	Yes	No
Dynamic interfaces	Yes	No	No	Yes	No
F4 OAM (ATM Administration)	Yes	No	No	Yes	No
FDL (facilities data link)	No	No	No	No	No
Frame Relay	No	Yes	Yes	No	Yes
IP	Yes	Yes	Yes	Yes	Yes
IP Multicasting	No	No	Yes	Yes	Yes
IPv6	No	No	No	No	No
IS-IS	Yes	Yes	Yes	Yes	Yes
LAC Support – access side	Yes	No	No	Yes	No
LAC Support – peer side	Yes	No	No	Yes	No
LNS Support – Internet side	No	No	No	No	No
LNS Support – peer side	Yes	No	No	Yes	No
Local loopback	No	Yes	Yes	No	Yes
MDL (maintenance data link)	Yes	Yes	Yes	No	Yes
MPLS	No	No	Yes (over PPP)	Yes	Yes
Multilink Frame Relay	No	No	Yes	No	Yes
Multilink PPP	No	No	Yes	No	Yes

Table 13-10 Unchannelized T3 modules (continued)

Protocol or Application	T3 ATM Line Modules with CT3/T3 I/O Modules	T3 FRAME Line Modules with CT3/T3 I/O Modules	COCX-F3 Line Modules with CT3/T3 12 I/O Modules	OCx/STMx ATM Line Modules with 4xDS3 ATM I/O Modules	CT3/T3-F0 Line Modules with CT3/T3 12 I/O Modules
NBMA (multipoint ATM)	No	No	No	Yes	No
OSPF	Yes	Yes	Yes	Yes	Yes
Packet over SONET	No	No	No	No	No
PPP	Yes	Yes	Yes	Yes	Yes
PPPoE	Yes (over bridged Ethernet)	No	No	Yes	No
Remote loopback	No	Yes	Yes	No	Yes
RIP	Yes	Yes	Yes	Yes	Yes
SMDS (trunk encapsulation)	No	Yes	Yes	No	No
Subscriber interfaces (static)	No	No	No	Yes (over bridged Ethernet and IPoA)	No
Subscriber interfaces (dynamic)	No	No	No	Yes (over bridged Ethernet)	No
Transparent bridging	No	No	No	Yes	No
VRRP	No	No	No	No	No

X.21/V.35 Modules

Table 13-11 X.21/V.35 modules

Protocol or Application	X.21/V.35-16 Line Modules with X.21/V.35-16 I/O Modules
Acceptance of traffic for IP tunnels	No
APS/MSP	No
ATM	No
BERT	No
BGP	Yes
Bridged Ethernet	No

Table 13-11 X.21/V.35 modules (continued)

Protocol or Application	X.21/V.35-16 Line Modules with X.21/V.35-16 I/O Modules
Bridged IP	No
CBF	No
Cisco HDLC	Yes
DHCP local server	No
Dynamic interfaces	No
F4 OAM (ATM Administration)	No
Frame Relay	Yes
IP	Yes
IP Multicasting	No
IPv6	No
IS-IS	Yes
LAC Support – access side	No
LAC Support – peer side	No
LNS Support – Internet side	No
LNS Support – peer side	No
Local loopback	No
MPLS	No
Multilink Frame Relay	Yes
Multilink PPP	Yes
NBMA (multipoint ATM)	No
OSPF	Yes
Packet over SONET	No
PPP	Yes
PPPoE	No
Remote loopback	No
RIP	Yes
SMDS (trunk encapsulation)	No
Subscriber interfaces (static)	No
Subscriber interfaces (dynamic)	No
Transparent bridging	No
VRRP	No

Part 3
Appendixes

Cable Pinouts

A

This appendix lists the cables and connector pinout assignments for the cables used with the ERX-7xx models and ERX-14xx models.

SRP I/O Module

The SRP I/O module provides two management ports. You can connect a console directly to the RS-232 serial port using a shielded straight-through cable with a female DB-9 connector on one end and a male DB-25 with a crossover adapter on the DB-25 end. This port is called the serial port, the RS-232 port, or the console serial port. Figure A-1 shows the location of the serial port and the sequence of the pins in the RS-232 connector.

The console port is considered a data terminal equipment interface (DTE). Direct connection to a terminal or PC (which also have DTE interfaces) requires a crossover cable.
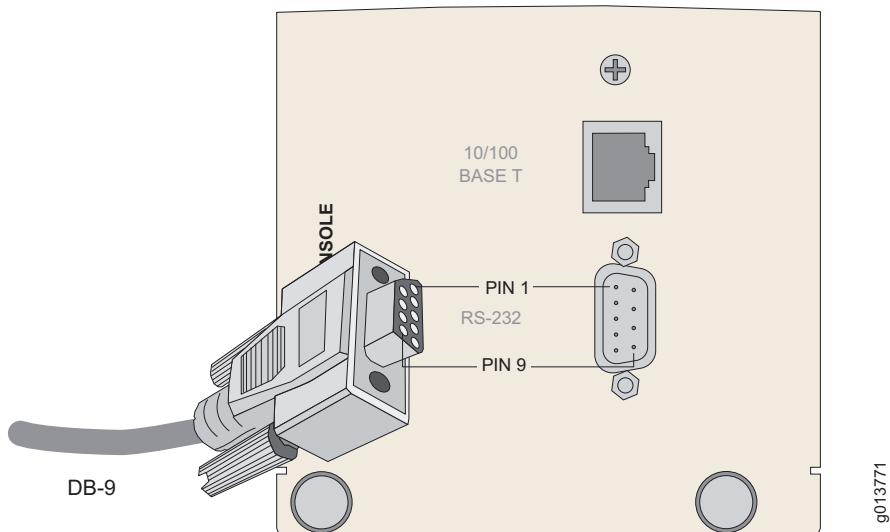
Figure A-1 SRP I/O module serial port

Table A-2 lists the pinout for the serial cable's RS-232 connector.

Table A-1 SRP I/O module – RS-232 serial connector pinout

Pin	Signal
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RNG

Once you have configured an IP address on the system, you can connect using a host running Telnet over the 10/100Base-T Ethernet port on the SRP I/O module. The router ships with a straight-through cable having a male RJ-45 Ethernet connector on each end. Figure A-2 shows the location of the Ethernet port and the sequence of the pins in the RJ-45 connector.
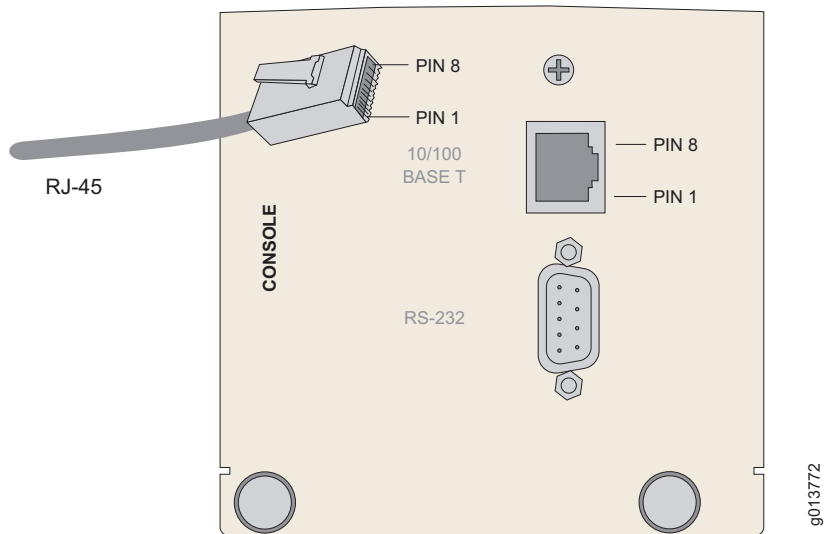
Figure A-2 SRP I/O module Ethernet port

Table A-2 lists the pinouts for the Ethernet cable's RJ-45 connector.

Table A-2 SRP I/O module – RJ-45 connector pinout

Pin	Signal
1	TX +
2	TX –
3	RX +
4	n/c[a]
5	n/c
6	RX –
7	n/c
8	n/c

a. n/c=no connect

To facilitate connecting the system to a terminal, the system is shipped with one of each of the following cable adapters:

• DB-9 female to RJ-45 female crossover null modem adapter

• DB-9 female to RJ-45 female straight-through adapter

Table A-3 lists the pinouts for the crossover adapter.

Table A-3 DB-9 – RJ-45 crossover adapter pinout

DB-9 Pin	Signal	RJ-45 Pin
1	DCD	1
2	RXD	3
3	TXD	2
4	DTR	6
5	GND	5
6	DSR	4
7	RTS	8
8	CTS	7
9	RNG	n/c[a]

a. n/c=no connect

Table A-4 lists the pinout for the straight-through adapter.

Table A-4 DB-9 – RJ-45 straight-through adapter pinout

DB-9 Pin	RS-232 Signal Name	RJ-45 Pin	Ethernet Signal Name
1	DCD	1	TX +
2	RXD	2	TX –
3	TXD	3	RX +
4	DTR	4	n/c[a]
5	GND (signal)	5	n/c
6	DSR	6	RX –
7	RTS	7	n/c
8	CTS	8	n/c
9	RNG	n/c	none

a. n/c=no connect

CT1 and CE1 I/O Modules

CT1 I/O modules have 24 RJ-48C female connectors. CE1 I/O modules have either 20 RJ-48C female connectors or two 25-pair female Telco connectors. Figure A-3 shows the location of the ports on a CT1 I/O module and the sequence of the pins in the RJ-48C connector. CE1 I/O modules equipped with RJ-48C connectors have the same configuration as CT1 I/O modules equipped with RJ-48C connectors.
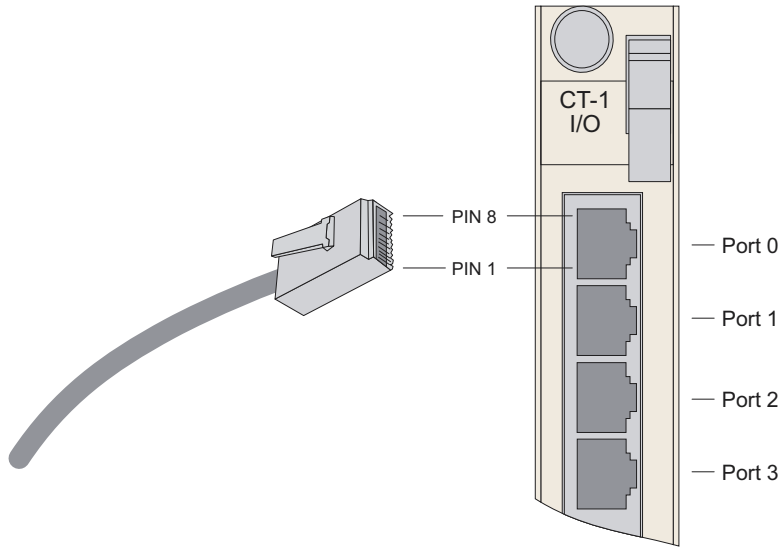
Figure A-3 CT1 I/O module ports

Table A-5 lists the pinout for the CT1/CE1 connector.

Table A-5 CT1/CE1 I/O module – RJ-48C connector pinout

Pin	Signal
1	RX Ring
2	RX Tip
3	n/c[a]
4	TX Ring
5	TX Tip
6	n/c
7	n/c
8	n/c

a. n/c=no connect

For CE1 I/O modules with Telco connectors, the other ends of the cables are attached to a balun panel that splits the signals from two Telco connectors to 20 pairs of BNC connectors. We supply the Telco cables if you purchase a balun panel. Figure A-4 shows the location of the Telco connectors on a CE1 I/O module and the sequence of the pins in the connectors.
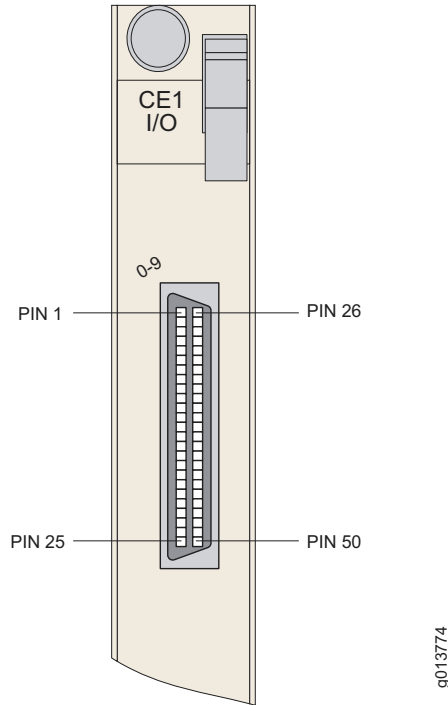
Figure A-4 CE1 I/O module with Telco connectors

Figure A-5 shows the location of the 20 pairs of BNC connectors on a balun panel. The cables from the CE1 I/O module are plugged into the two 50-pin Telco connectors on the other side of the panel.
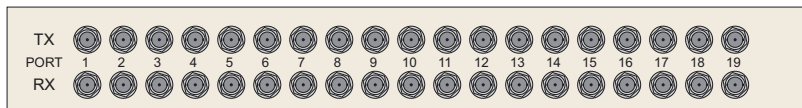
Figure A-5 Twenty-port balun panel

Table A-6 and Table A-7 list the pinout for the Telco connectors on each cable.

Table A-6 Pinout of 50-pin Telco connector to ports 0–9

Pin	Signal	Pin	Signal
1	Port 0 RX TIP	26	Port 0 RX RING
2	Port 0 TX TIP	27	Port 0 TX RING
3	Port 1 RX TIP	28	Port 1 RX RING

Table A-6 Pinout of 50-pin Telco connector to ports 0–9 (continued)

Pin	Signal	Pin	Signal
4	Port 1 TX TIP	29	Port 1 TX RING
5	Port 2 RX TIP	30	Port 2 RX RING
6	Port 2 TX TIP	31	Port 2 TX RING
7	Port 3 RX TIP	32	Port 3 RX RING
8	Port 3 TX TIP	33	Port 3 TX RING
9	Port 4 RX TIP	34	Port 4 RX RING
10	Port 4 TX TIP	35	Port 4 TX RING
11	Port 5 RX TIP	36	Port 5 RX RING
12	Port 5 TX TIP	37	Port 5 TX RING
13	Port 6 RX TIP	38	Port 6 RX RING
14	Port 6 TX TIP	39	Port 6 TX RING
15	Port 7 RX TIP	40	Port 7 RX RING
16	Port 7 TX TIP	41	Port 7 TX RING
17	Port 8 RX TIP	42	Port 8 RX RING
18	Port 8 TX TIP	43	Port 8 TX RING
19	Port 9 RX TIP	44	Port 9 RX RING
20	Port 9 TX TIP	45	Port 9 TX RING
21	n/c[a]	46	n/c
22	n/c	47	n/c
23	n/c	48	n/c
24	n/c	49	n/c
25	n/c	50	n/c

a. n/c=no connect

Table A-7 Pinout of 50-pin Telco connector to ports 10–19

Pin	Signal	Pin	Signal
1	Port 10 RX TIP	26	Port 10 RX RING
2	Port 10 TX TIP	27	Port 10 TX RING
3	Port 11 RX TIP	28	Port 11 RX RING
4	Port 11 TX TIP	29	Port 11 TX RING
5	Port 12 RX TIP	30	Port 12 RX RING
6	Port 12 TX TIP	31	Port 12 TX RING
7	Port 13 RX TIP	32	Port 13 RX RING
8	Port 13 TX TIP	33	Port 13 TX RING

Table A-7 Pinout of 50-pin Telco connector to ports 10–19 (continued)

Pin	Signal	Pin	Signal
9	Port 14 RX TIP	34	Port 14 RX RING
10	Port 14 TX TIP	35	Port 14 TX RING
11	Port 15 RX TIP	36	Port 15 RX RING
12	Port 15 TX TIP	37	Port 15 TX RING
13	Port 16 RX TIP	38	Port 16 RX RING
14	Port 16 TX TIP	39	Port 16 TX RING
15	Port 17 RX TIP	40	Port 17 RX RING
16	Port 17 TX TIP	41	Port 17 TX RING
17	Port 18 RX TIP	42	Port 18 RX RING
18	Port 18 TX TIP	43	Port 18 TX RING
19	Port 19 RX TIP	44	Port 19 RX RING
20	Port 19 TX TIP	45	Port 19 TX RING
21	n/c[a]	46	n/c
22	n/c	47	n/c
23	n/c	48	n/c
24	n/c	49	n/c
25	n/c	50	n/c

a. n/c=no connect

B

Installing JUNOSe Software

⚠️ **Caution:** *Check the Release Notes for extra information about installing and upgrading the software.*

The E-series software resides on an NVS card located in the SRP module. We ship every SRP module with an NVS card that contains a software release. We ship new software releases on a CD. This appendix provides information on how to install a new software release on an E-series router.

Overview

If the router contains only one SRP module, you should divert traffic to another router before you install a new software release, because the router will be unavailable during the installation process. Depending on whether a firewall separates the E-series router from the network host, you can then complete the appropriate software installation (see *Installing Software When a Firewall Exists* or *Installing Software When a Firewall Does Not Exist*). However, if the router contains two SRP modules, you can upgrade the software while the system is operating (see *Upgrading Systems That Are Operating with Two SRP Modules*).

When installing new JUNOSe software, you must mount the software CD on a network host and transfer the release files to at least one E-series

router in the network. Depending on the network configuration, you can copy the release files from either the network host or the first E-series router to the other E-series routers in the network (see *Copying Release Files from One E-Series Router to Another*).

Identifying the Software Release File

The JUNOSe software CD contains two software releases: one for the ERX-1440 model and one for all other E-series routers. Both releases are in the software directory, which is identified by the release number. For example, if the release number is x.y.z, the name of the directory is x-y-z. To identify the software release file:

1 Access the software directory.

2 Find the files with the extension .rel.

- The software release file for the ERX-1440 router has the format erx40_x-y-z.rel, where x-y-z is the release number.

- The software release file for all other E-series routers has the format erx_x-y-z.rel, where x-y-z is the release number.

The procedures outlined in the following sections provide detailed instructions for typical installations. For additional information about commands and troubleshooting, see the *E-Series System Basics Configuration Guide*, the *E-Series Command Reference Guide A to M*, and the *E-Series Command Reference Guide N to Z*.

Installing Software When a Firewall Exists

When a firewall separates the E-series router from the network host, you must use FTP to transfer the software release files from the network host to the E-series router. In this case, you must configure the FTP server on the E-series router and ensure that FTP client software is installed on the network host.

For this network configuration, you must install the software from the normal operational mode of the command line interface (CLI). You can access the CLI through either the local console or a Telnet session. If you have not yet configured the E-series router to support Telnet, then you must use the local console. See *Chapter 8, Accessing E-Series Routers*, for information on using a local console or a Telnet session.

To install the software, perform the following tasks:

1   Obtain the required information for the installation.

2   For routers that are currently operating, divert network traffic to another router.

3   Access the Privileged Exec CLI command mode.

4   Configure IP on an interface.

5   Mount the CD on the network host.

6   Configure access to the network host.

7   Enable the FTP server on the E-series router.

8   Identify the files to transfer.

9   Transfer the files to the user space on the E-series router.

10 Install the software release file to the system space on the E-series router.

11 Save the current configuration.

12 Reboot the system.

Task 1: Obtain the Required Information

Before you install the software, obtain the following information:

- The password (if one is configured) that allows you to access Privileged Exec mode on the E-series router

- The IP address of the network host

- The IP address of the E-series router

- The IP address of the next hop to reach the destination network (for example, a gateway)

- The login name and password for the vty line

- The procedure for mounting a CD on the network host

Task 2: Divert Network Traffic to Another Router

The system will be unavailable during the installation process.

Task 3: Access Privileged Exec Mode

To access this mode via the CLI:

1 Issue the enable command.

```
host1>enable
```

2 Type the password if the system prompts you.

Task 4: Configure IP on an Interface

Typically, you configure IP on the Fast Ethernet interface of the SRP module. To configure IP on an interface:

1 Determine the slot number of the module.

```
host1#show version
```

2 Determine the port number of the module.

3 Determine whether the interface already has an IP address.

```
host1#show ip interface fastEthernet 6/0
```

📄 *Note: If an IP interface is not configured, you see the message "Invalid interface."*

If the interface already has an IP address, go to step 5. Otherwise, proceed with step 4.

4 Configure an IP address on the interface.

```
host1#configure
Configuring from terminal or file [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#interface fastEthernet 6/0
host1(config-if)#ip address ipAddress [ mask ]
```

5 Press <CTRL-Z> to return to Privileged Exec mode.

Task 5: Mount the CD on the Network Host

The way you mount the CD on the network host depends on the type of computer you use, the operating system, and the network configuration. To find out how to mount a CD on the network host, review the manual for the operating system, or check with your network administrator.

Task 6: Configure Access to the Network Host

To configure access to the network host:

1 Use the **ping** command to determine whether the E-series router can reach the network host.

```
host1#ping hostname
```

If the E-series router can reach the network host, go to the next section. Otherwise, go to step 2.

2 Determine whether a route exists between the E-series router and the network host.

```
host1#show ip route
```

If the appropriate route is displayed, go to step 5. Otherwise, proceed with step 3.

3 Configure a route to reach the network host.

```
host1#configure
Configuring from terminal or file [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#ip route ipNetwork networkMask ipNextHop
```

4 Press <CTRL-Z> to return to Privileged Exec mode.

5 Determine whether the E-series router has been configured to recognize the network host.

```
host1#show host
```

If the network host is listed, go to step 8. Otherwise, proceed with step 7.

6 Add an entry to the Static Host Table so that the E-series router can access the network host. The **host** command allows you to specify the network host name and IP address.

```
host1#configure
Configuring from terminal or file [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#host hostName ipAddress ftp loginname password
```

7 Press <CTRL-Z> to return to Privileged Exec mode.

8 Use the **ping** command to determine whether the E-series router can now reach the network host.

```
host1#ping hostname
```

If the E-series router cannot reach the network host, verify that you performed the previous steps in this procedure correctly and that the network host is operational.

Task 7: Enable the FTP Server on the E-Series Router

The E-series router divides its vty resources among Telnet, SSH, and FTP services. Each FTP session requires one vty line, and the FTP service uses the authentication method configured for the vty line. If you configured more than one vty line for Telnet access, the FTP service will use one of those lines. If you configured only one line for Telnet access, configure another vty line. See *Chapter 8, Accessing E-Series Routers*.

To enable the FTP server, use the **ftp-server enable** command.

```
host1(config)#ftp-server enable
```

Task 8: Identify the Files to Transfer

To identify all the files for the release, open the software release (.rel) file on the E-series software CD with a text editor. The software release file contains a list of all the files associated with the release. You must transfer the software release file and all the files it contains to the user space.

Task 9: Transfer Files to the User Space

To transfer the files for the release to the E-series user space, use the FTP client software on the network host to connect to the FTP server on the E-series router. Transfer the files to a subdirectory within the incoming directory. If you specify a subdirectory that does not exist, the E-series router creates the directory.

📄 *Note: Be sure to transfer the software release file and all the files it lists.*

Task 10: Install Files on the System Space

Installing the software release file to the system space installs all files listed in the software release file. To install the software release file from the incoming directory in the E-series user space to the E-series router space, use the **copy** command.

📄 *Note: The destination file must have a .rel extension.*

For example:

```
host1#copy /incoming/releases/x-y-z.rel x-y-z.rel
```

The software release will be copied from the user space to the system space. This process can take several minutes.

Task 11: Save the Current Configuration

To save the current configuration, use the **copy running-configuration** command:

```
host1#copy running-configuration filename.cnf
```

Task 12: Reboot the System

To reboot the system using the newly installed software:

1   Access Global Configuration mode.

```
host1#configure
Configuring from terminal or file [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#
```

2   Run the **boot system** command, specifying the .rel filename of the software release.

For example:

```
host1(config)#boot system x-y-z.rel
```

The following message appears when you execute this command:

```
WARNING: It is recommended that you copy the current
  running-configuration to a file prior to reloading a
  different release of software.
```

3   Press <CTRL-Z> to return to Privileged Exec mode.

4   Check that the E-series router is ready to boot with the new software release.

```
host1#show boot
```

If the old software version is still listed, verify that you completed the previous steps correctly.

5   Run the **reload** command.

```
host1#reload
```

The following message appears when you execute this command:

```
WARNING: Execution of this command will cause the system to
  reboot. Proceed with reload? [confirm]
```

The system reboots. The reboot may take longer than normal because line modules initialize with the old version of the software,

acquire the new version from the SRP module, and reinitialize. When you observe the LEDs on the line modules, the line modules appear to boot twice.

Installing Software When a Firewall Does Not Exist

If there is no firewall between the E-series router and the network host on which you mount the software CD, you can transfer the software release files from the network host to the E-series router via the E-series FTP server or by issuing the **copy** command. To transfer files via the E-series FTP server, refer to the previous section, *Installing Software When a Firewall Exists*. This section describes how to transfer files by issuing the **copy** command.

If you use the **copy** command to transfer the files, the network host must be an FTP server. This command activates an FTP client on the E-series router.

For this network configuration, you can install the software in the normal command line interface (CLI) operational mode or in boot mode.

Installing Software in Normal Operational Mode

For this procedure, you must access the CLI through either the local console or a Telnet session. If you have not yet configured the E-series router to support Telnet, then you must use the local console. See *Chapter 8, Accessing E-Series Routers*, for information on using a local console or a Telnet session.

To install the software, perform the following tasks:

1   Obtain the required information for the installation.

2   (For systems that are operating) Stop operation.

3   Access the Privileged Exec CLI command mode.

4   Configure IP on an interface.

5   Configure access to the network host.

6   Mount the CD on the network host.

7   Copy the software release file to the E-series router.

8   Save the current configuration.

9   Reboot the system.

Task 1: Obtain the Required Information

Before you install the software, obtain the following information:

- The password (if one is configured) that allows you to access Privileged Exec mode on the E-series router

- The IP address of the network host

- The IP address of the E-series router

- The IP address of the next hop to reach the destination network (for example, a gateway)

- The login name and password for the FTP server

- The procedure for mounting a CD on the network host

Task 2: Divert Network Traffic to Another Router

The system will be unavailable during the installation process.

Task 3: Access Privileged Exec Mode

To access this mode via the CLI:

1   Issue the enable command.

```
host1>enable
```

2   Type the password if the system prompts you.

Task 4: Configure IP on an Interface

Typically, you configure IP on the Fast Ethernet interface of the SRP module. To configure IP on an interface:

1   Determine the slot number of the module.

```
host1#show version
```

2   Determine the port number of the module.

3   Determine whether the interface already has an IP address.

```
host1#show ip interface fastEthernet 6/0
```

📄   *If an IP interface is not configured, you see the message: "Invalid interface."*

If the interface already has an IP address, go to Task 5. Otherwise, proceed with step 4.

4 Set an IP address on the interface.

```
host1#configure
Configuring from terminal or file [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#interface fastEthernet 6/0
host1(config-if)#ip address ipAddress [ mask ]
```

5 Press <CTRL-Z> to return to Privileged Exec mode.

Task 5: Configure Access to the Network Host

To configure access to the network host:

1 Use the **ping** command to determine whether the E-series router can reach the network host.

```
host1#ping ipAddress
```

If the E-series router can reach the network host, go to the next section. Otherwise, go to step 2.

2 Determine whether a route exists between the E-series router and the network host.

```
host1#show ip route
```

If the appropriate route is displayed, go to step 4. Otherwise, proceed with step 3.

3 Configure a route to reach the network host.

```
host1#configure
Configuring from terminal or file [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#ip route ipNetwork networkMask ipNextHop
```

4 Press <CTRL-Z> to return to Privileged Exec mode.

5 Determine whether the E-series router has been configured to recognize the network host.

```
host1#show host
```

If the network host is listed, go to step 8. Otherwise, proceed with step 7.

6 Add an entry to the Static Host Table so that the E-series router can access the network host. The **host** command allows you to specify the network host name and IP address.

```
host1#configure
Configuring from terminal or file [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#host hostName ipAddress ftp loginname password
```

7 Press <CTRL-Z> to return to Privileged Exec mode.

8 Use the **ping** command to determine whether the E-series router
can now reach the network host.

```
host1#ping hostname
```

If the E-series router cannot reach the network host, verify that you
performed the previous steps in this procedure correctly and that the
network host is operational.

Task 6: Mount the CD on the Network Host

The way you mount the CD on the network host depends on the type of
network host you use, the operating system, and the way your network is
configured. To find out how to mount a CD on the network host, review
the manual for the operating system, or check with your network
administrator.

Task 7: Copy the Software Release File

To copy the software release file to the E-series router, use the **copy**
command.

Note: The destination file must have a .rel extension.

For example:

```
host1#copy hostname:/cdrom/x-y-z/x-y-z.rel x-y-z.rel
```

The software release will be copied from the network host to the
E-series router. This process can take several minutes.

Task 8: Save the Current Configuration

To save the current configuration, use the **copy running-configuration**
command:

```
host1#copy running-configuration filename.cnf
```

Task 9: Reboot the System

To reboot the system using the newly installed software:

1 Access Global Configuration mode.

```
host1#configure
Configuring from terminal or file [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
host1(config)#
```

2 Run the **boot system** command, specifying the .rel filename of the software release. For example:

```
host1(config)#boot system x-y-z.rel
```

The following message appears when you execute this command:

```
WARNING: It is recommended that you copy the current
  running- configuration to a file prior to reloading a
  different release of software.
```

3 Press <CTRL-Z> to return to Privileged Exec mode.

4 Check that the E-series router is ready to boot with the new software release.

```
host1#show boot
```

If the old software version is still listed, verify that you completed the previous steps correctly.

5 Run the **reload** command.

```
host1#reload
```

The following message appears when you execute this command:

```
WARNING: Execution of this command will cause the system to
  reboot. Proceed with reload? [confirm]
```

The system reboots. The reboot may take longer than normal because line modules initialize with the old version of the software, acquire the new version from the SRP module, and reinitialize. When you observe the LEDs on the line modules, the line modules appear to boot twice.

Installing Software in Boot Mode

To install the E-series software in Boot mode, you must access the CLI via the local console.

To install the software:

1 Obtain the required information for the installation.

2 Divert network traffic to another router.

3 Access the Boot mode.

4 Assign an IP address to the E-series router.

5 Configure access to the network host.

6 Mount the CD on the network host.

7 Copy the software release file to the E-series router.

8 Reboot the system.

Task 1: Obtain the Required Information

Before you install the software, obtain the following information:

- The IP address of the network host

- The IP address of the E-series router

- The IP address of the next hop to reach the destination network (for example, a gateway)

- The login name and password for the FTP server

- The procedure for mounting a CD on the network host

Task 2: Divert Network Traffic to Another System

The system will be unavailable during the installation process.

Task 3: Access the Boot Mode

To access Boot mode from the local console:

1 At the Privileged Exec prompt, type the **reload** command.

Information on the reloading process appears.

2 When the countdown begins, press the key sequence <mb>.

This action puts the CLI in Boot mode and the `:boot##` prompt appears.

📄 *Note: If you do not press the key sequence <mb> before the countdown ends, the reloading process continues and returns the CLI to the normal User Exec mode.*

Task 4: Assign an IP Address

When you assign an IP address to the E-series router in Boot mode, the address is configured on the Fast Ethernet port of the primary SRP module. To assign an Internet address to the E-series router, use the **ip address** command.

```
:boot##ip address ipAddress [ mask ]
```

Task 5: Configure Access to the Network Host

To configure access to the network host:

1 Configure a gateway through which the E-series router will reach the network host.

```
:boot##ip gateway ipAddress
```

2 Determine whether the E-series router has been configured to recognize the network host.

```
:boot##show host
```

If the network host is listed, go to the next section. Otherwise, proceed with step 3.

3 Add an entry to the Static Host Table so that the E-series router can access the network host.

```
:boot##host hostName ipAddress ftp login-name password
```

The **host** command allows you to specify the network host name and IP address.

Task 6: Mount the CD on the Network Host

The way you mount the CD on the network host depends on the type of network host you use, the operating system, and the way your network is configured. To find out how to mount a CD on the network host, review the manual for the operating system, or check with your network administrator.

Task 7: Copy the Software Release File

To copy the software release file to the E-series router, use the **copy** command.

📄 *Note: The destination file must have a .rel extension.*

For example:

```
:boot##copy hostname:/cdrom/x-y-z/x-y-z.rel x-y-z.rel
```

The software release will be copied from the network host to the
E-series router. This process can take several minutes.

Task 8: Reboot the System

To reboot the system using the newly installed software:

1 Run the **boot system** command, specifying the .rel filename of the
software release. For example:

```
:boot##boot system x-y-z.rel
```

The following message appears when you execute this command:

```
WARNING: It is recommended that you copy the current
  running-configuration to a file prior to reloading a
  different release of software.
```

2 Run the **reload** command.

```
:boot##reload
```

The following message appears when you execute this command:

```
WARNING: Execution of this command will cause the system to
  reboot. Proceed with reload? [confirm]
```

The system reboots. The reboot may take longer than normal
because line modules initialize with the old version of the software,
acquire the new version from the SRP module, and reinitialize.
When you observe the LEDs on the line modules, the line modules
appear to boot twice.

Copying Release Files from One E-Series Router to Another

When you have copied the release files from a network host to one
E-series router, you can transfer files from that E-series router to other
E-series routers on the network. This feature is useful when:

- The other E-series routers are unreachable from the network host but
  have network connectivity to the E-series router on which you installed
  the new software.

- The connection between E-series routers is faster than the connection
  between an E-series router and the network host to which it is
  connected.

The procedures for transferring release files from a source E-series router to a destination E-series router are almost identical to transferring release files from a network host to an E-series router on the same side of the firewall.

Note: You must enable the FTP server on the source E-series router.

To transfer release files from a source E-series router to a destination E-series router, follow the instructions in *Installing Software When a Firewall Does Not Exist,* with the following changes:

• Substitute the source E-series router for the network host.

• Omit the step about mounting the CD.

• Copy the file to the system space of the second E-series router from the user space of the first E-series router.

```
host1#copy boston:/outgoing/releases/x-y-z.rel x-y-z.rel
```

Upgrading Systems That Are Operating with Two SRP Modules

Use this procedure if the system contains two SRP modules and is already operating with an earlier software release. Each SRP module will keep the system operational while you upgrade the software on the other, so that you can avoid interrupting service.

Caution: You must upgrade the software on the redundant SRP module when you upgrade the software on the primary SRP module. This action prevents the redundant SRP module from overwriting the new software on the primary SRP module if the primary SRP module fails and the redundant SRP module assumes control.

To upgrade the software on a system that is operational and contains two SRP modules:

1 Turn off autosynchronization.

```
host1(config)#disable-autosync
```

2 Copy the new release of the software to NVS of the primary SRP module.

• If a firewall separates the E-series router from the network host, transfer files to the user space with the FTP client on the network host, and install files on the system space (see *Installing Software When a Firewall Exists*, earlier in this appendix).

```
host1#copy /incoming/releases/x-y-z.rel x-y-z.rel
```

- If no firewall separates the E-series router from the network host, copy the files to the E-series router (see *Installing Software When a Firewall Does Not Exist*, earlier in this appendix).

```
host1#copy hostname:/cdrom/x-y-z/x-y-z.rel x-y-z.rel
```

- If you are transferring the files from one E-series router to another, copy the file to the system space of the second E-series router from the user space of the first E-series router (see *Copying Release Files from One E-Series Router to Another*, earlier in this appendix).

```
host1#copy boston:/outgoing/releases/x-y-z.rel x-y-z.rel
```

3 Save the current configuration.

```
host1#copy running-configuration system2.cnf
```

4 Specify that the E-series router should use the new software release when it reboots.

```
host1(config)#boot system x-y-z.rel
```

5 Synchronize the NVS file system of the redundant module with that of the primary module.

```
host1#synchronize
```

The redundant SRP module will automatically reboot, because the software release that it is configured to run differs from the software release it is running.

6 Wait for the redundant SRP module to boot, initialize, and reach the standby state.

When the module is in standby state, the REDUNDANT LED is on and the ONLINE LED is off. If you issue the **show version** command, the state field for the module should be "standby".

After any type of reboot, the primary and redundant SRP module NVS file systems will be unsynchronized again.

7 Synchronize the NVS file system of the redundant module with that of the primary module.

```
host1#synchronize
```

8 Switch from the primary SRP module to the redundant SRP module.

```
host1#srp switch
```

The redundant SRP module assumes the primary role. The former primary SRP module reboots and assumes the redundant role.

Customer Support

C

For your convenience, we provide multiple options for requesting and receiving technical support from the Juniper Networks Technical Assistance Center (JTAC).

See the Juniper Networks Web site for complete customer service information:

- http://www.juniper.net/support/guidelines.html

Contact Information

A valid router serial number is required to initiate a request for service. This number enables the customer support engineer to quickly and efficiently determine the support level you are entitled to. Customers with Juniper Networks service agreements receive technical assistance 7 days a week, 24 hours a day, from the JTAC.

You have the option of submitting a problem via the Web using Case Manager, by e-mail, or by telephone, using the following contact information:

- Case Manager:
  https://www.juniper.net/casemanager/cgi/mgr/welcome.htm

- E-mail: support@juniper.net

- Phone: 1-888-314-JTAC (U.S., Canada, and Mexico customers)

- Phone: 408-745-9500 (all other customers)

Note: When requesting service via phone, e-mail, or the Web, please be sure to have your router serial number available. Your Juniper Networks support engineer will need this number to verify your support level.

Information You Need to Supply

When requesting technical support from the JTAC by phone, be prepared to provide the following information when prompted.

For existing cases:

- Enter your 11 digit case number followed by the # sign.

  You will be routed to your case owner; if your engineer is not available, your call will be routed to the general queue and will be answered by the next available engineer.

For new cases:

- Press the * key

  You will be routed to a general queue, and your call will be answered by the next available engineer.

The JTAC engineer will also need the following information:

- Priority level

- Indication of what activity was being performed on the router when the problem occurred

- Problem detail and configuration data, obtained by these commands:

  ```
  > show version
  > show chassis firmware
  > show chassis hardware
  > show chassis environment
  > show configuration
  ```

When a new request for technical support is submitted, the JTAC engineer:

1 Opens a case and assigns a number

2 Begins troubleshooting, diagnostics, and problem replication (if appropriate)

3 Provides you with periodic updates on problem status and escalates the problem as appropriate according to escalation management guidelines

4 Closes the case when you agree that the problem has been resolved

Returning Products for Repair or Replacement

In the event of a hardware failure, please contact Juniper Networks to obtain a Return Material Authorization (RMA) number. This number is necessary to ensure proper tracking and handling of returned material at the factory. Do not return any hardware until you have received an RMA. Juniper Networks reserves the right to refuse shipments that do not have an RMA. Refused shipments will be returned to the shipper via collect freight.

See the customer support Web page for complete repair and return policies and procedures.

Declaration of Conformity

D

CE

Declaration of Conformity according to ISO/IEC Guide 22 and EN4514	
Manufacturer's Name:	Juniper Networks, Inc.
Manufacturer's Address:	Juniper Networks, Inc. 10 Technology Park Drive Westford, Massachusetts 01886 USA
Declares, that the product(s)	
Product Name:	Edge Switching Router
Model Number(s):	ERX-310, ERX-700, ERX-705, ERX-1400, ERX-1440
Product Options:	All Modules
Conforms to the following Product Specifications:	
Safety:	IEC 60950-1(2001-10) Ed. 1.0 Information technology equipment - Safety - Part 1: General requirements EN60950:2000, 3rd Edition, Safety of Information Technology Equipment EN60825-1, Safety of Laser Products - Part 1: Equipment Class, Requirements, and User's Guide (2001)
EMC:	EN55022 Class A (CISPR-22 Class A) EN55024, Annex C for WAN Equipment Performance Criteria A, B, and C ETSI 300-386, Telecommunication Network Equipment; ElectroMagnetic Compatibility (EMC) requirements
Supplementary Information:	The products herewith comply with the requirements of the Low Voltage Directive (73/23/EEC), the EMC Directive (89/336/EEC), and the RTTE Directive (1999/5/EEC), and carry the CE markings accordingly. Products were tested in a typical configuration.
	Westford, MA, May 01, 2003 David H. Schilling Regulatory Affairs

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