



Cisco uBR10012 Universal Broadband Router Hardware Installation Guide

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Preface

This section describes the purpose, audience, organization, and conventions used in this guide. This section also provides a revision history and a list of related documents as well as instructions for obtaining technical assistance and additional information.

Document Revision History

Date	Revision	Reason
February 16, 2015	—	Updated information about the Cisco 6 Gbps Wideband Shared Port Adapter.
September 08, 2014	—	Added information about the Cisco 6 Gbps Wideband Shared Port Adapter.
August 4, 2014	—	Added Cisco uBR-MC3GX60V-RPHY Line Card information.
July 6, 2012	OL-18259-10	Added information about the second-generation cable management bracket on the Cisco uBR10012 router.
October 11, 2011	OL-18259-09	Added instructions on cabling and connecting the Lineage power shelf to the UBR10-PWR-DC-PLUS= power entry module on the Cisco uBR10012 router.
June 20, 2011	OL-18259-08	Added the SFP modules supported on the 1-Port 10-Gigabit Ethernet SPA.
April 29, 2011	OL-18259-07	Added information about Lineage power shelf for UBR10-PWR-DC PEM— brief overview and instructions on cabling the shelf to the Cisco uBR10012 chassis. Updated the ferrite beads to be used with the Lineage power shelf.
March 10, 2011	OL-18259-06	Added information about fan assembly module (UBR10012-FAN-PLUS=), 3300 W AC PEM (UBR10-PWR-AC-PLUS=), and 3300 W DC PEM module.
November 29, 2010	OL-18259-05	Added Cisco UBR-MC3GX60V cable interface line card information.
September 01, 2010	OL-18259-04	Updated for DC PEM Requalification. Added table 2-2 and Table A-1 with the updated DC PEM power specifications.

Date	Revision	Reason
May 10, 2010	OL-18259-03	Added information about the 10 and 15 downstream channel licenses.
November 16, 2009	OL-18259-02	Added Cisco UBR-MC20X20V cable interface line card information.
December 15, 2008	OL-18259-01	Updated with PRE4 information. Moved the document to online only.
April 05, 2006	78-11450-03 Rev.B0	Updated Table 3-6.
June 28, 2005	OL-5000-03	Added HHGE line card information.
October 18, 2004	OL-5000-02	Updated with PRE2 information.
December 20, 2003	OL-5000-01	Moved document to online only, updated format, added AC PEM specifications, and corrected PEM information, corrected PRE information, revised line card installation procedure.
March 20, 2001	78-11450-03	Original publication and updates.

Purpose

This installation guide explains the initial hardware installation and basic configuration procedures for the Cisco uBR10012 universal broadband router. It contains procedures for installing the router hardware, creating a basic software configuration file, and starting up the router. After you complete the installation and basic configuration procedures covered in this guide, use the appropriate companion publications to more completely configure your system. See the documents listed in the [“Related Documentation”](#) section on page xiii.

Audience

To use this publication, you should be familiar not only with Cisco router hardware and cabling, but also with electronic circuitry and wiring practices. You should be able to perform basic network configuration procedures, and preferably have experience as an electronic or electromechanical technician.



Warning

Only trained and qualified personnel should be allowed to install, replace, or service this equipment.
Statement 1030.

Document Organization

This publication is organized as follows:

Chapter	Title	Description
Chapter 1	Cisco uBR10012 Universal Broadband Router Overview	Describes the physical properties of the Cisco uBR10012 components and a functional overview of the system.
Chapter 2	Preparing for Installation	Describes safety considerations, tools required, site requirements, and procedures you should perform <i>before</i> the installation.
Chapter 3	Installing the Cisco uBR10012 Router	Provides information for installing the router hardware, connecting system cables, initial system startup, and verifying system operation.
Chapter 4	Troubleshooting the Installation	Provides basic troubleshooting procedures for the hardware installation.
Chapter 5	Maintaining the Cisco uBR10012 Router	Describes the procedures required to perform routine maintenance and to remove and replace field replaceable units (FRUs) in the Cisco uBR10012 router.
Appendix A	Technical Specifications	Contains the electrical and physical specifications for the Cisco uBR10012 router.
Appendix B	Cable Specifications	Provides cabling information and pinout information for the router.
Appendix C	Frequency Allocation	Provides the standard frequency allocation channel plans for cable networks.
Appendix D	Manufacturers for Hardware Components	Lists vendors for the auxiliary equipment that is normally required for a headend installation.

Related Documentation

The following is a list of documents and URLs for the Cisco uBR10012 router:

- *Cisco uBR10012 Universal Broadband Router Software Configuration Guide*
http://www.cisco.com/web/techdoc/cable/Config/Sw_conf.html
- *Regulatory Compliance and Safety Information for the Cisco uBR10012 Universal Broadband Router*
<http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/regulatory/compliance/ub10rcsi.html>

Additional documentation can be found here:

- For information on installing and replacing field-replaceable units (FRUs), such as the flash memory on Cisco uBR10012 routers, see the document for each FRU or go to the following URL:
http://www.cisco.com/en/US/products/hw/cable/ps2209/prod_installation_guides_list.html
- For detailed Cisco IOS software configuration information and support, refer to the modular configuration and modular command reference publications in the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware at the following URL:
http://www.cisco.com/en/US/products/ps6350/tsd_products_support_series_home.html

Specifically, you should refer to the following publications:

- For information on setting up quality of service (QoS), refer to the *Quality of Service Solutions Configuration Guide* and *Quality of Service Solutions Command Reference* publications.
- For information on encryption, refer to the *Security Configuration Guide* and the *Security Command Reference* publications.
- For information on interfaces, refer to the *Cisco IOS Interface Configuration Guide* and the *Cisco IOS Interface Command Reference* publications.
- For information on IP, refer to the *Network Protocols Configuration Guide, Part 1* and the *Network Protocols Command Reference, Part 1* publications.

You can also refer to the Cisco IOS software release notes for the version of software you are using on your Cisco uBR10012 router. Release notes for the Cisco uBR10012 router are found at the following URL:

http://www.cisco.com/en/US/products/hw/cable/ps2209/prod_release_notes_list.html

- For information about cleaning fiber-optic connections, go to the following URL:
http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml

Conventions



Note

Means *reader take note*. Notes contain helpful suggestions or references to materials not contained in this publication.



Tip

Means the following information might help you solve a problem.



Caution

Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Safety Information Referral Warning

See the following URL for the foreign language translations of all the warnings used in this guide:

<http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/regulatory/compliance/ub10rcsi.html>



Warning

IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.
Statement 1071

SAVE THESE INSTRUCTIONS

Terms and Acronyms

To fully understand the content of this guide, you should be familiar with the following terms and acronyms:



Note

A complete list of terms and acronyms is available in the *Internetworking Terms and Acronyms* guide, available on Cisco.com and the Documentation CD-ROM. Also see the Glossary section at the end of this guide.

- ABR—Available bit rate
- AAL5—ATM adaptation layer 5
- AWG—American wire gauge
- CoS—Class of service
- CPE—Customer premises equipment
- CRC—Cyclic redundancy check
- CSU—Channel service unit
- CTS—Clear To Send
- DCD—Data Carrier Detect
- DCE—Data communications equipment
- DIMM—Dual in-line memory module
- DSR—Data set ready
- DSU—Data service unit
- DTE—Data terminal equipment
- DTR—Data terminal ready
- EMC—Electromagnetic compliance
- EMI—Electromagnetic interference
- ESD—Electrostatic discharge
- FRU—Field-replaceable unit (router components that do not require replacement by a Cisco-certified service provider)
- FTP—Foil twisted-pair
- HDLC—High-Level Data Link Control
- HHGE—Half-Height Gigabit Ethernet
- IPSec—IP Security Protocol
- MAC—Media Access Control
- MB—Megabyte
- MM—Multimode
- nrt-VBR—Non-real time variable bit rate
- NVRAM—Nonvolatile random-access memory
- OAM AIS—Operation, Administration, and Maintenance alarm indication signal

- OIR—Online insertion and removal
- PCI—Peripheral Component Interconnect
- PCMCIA—Personal Computer Memory Card International Association
- PPP—Point-to-Point Protocol
- QoS—Quality of service
- rcp—remote copy protocol
- RFI—Radio frequency interference
- RIP—Routing Information Protocol
- RISC—Reduced Instruction Set Computing
- RTS—Request To Send
- SDRAM—Synchronous dynamic random-access memory
- SIMM—Single in-line memory module
- SMI—Single-mode intermediate reach
- SNMP—Simple Network Management Protocol
- TCP/IP—Transmission Control Protocol/Internet Protocol
- TDM—Time-division multiplexing
- TFTP—Trivial File Transfer Protocol
- UBR—Unspecified bit rate
- UDP—User Datagram Protocol
- UNI—User-Network Interface
- UTP—Unshielded twisted-pair
- VC—Virtual circuit
- VPN—Virtual Private Network

Obtaining Documentation and Submitting a Service Request

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

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

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



Cisco uBR10012 Universal Broadband Router Overview

The Cisco uBR10012 universal broadband router provides a high-end, high-performance, high-capacity Cable Modem Termination System (CMTS) solution. The Cisco uBR10012 router is an aggregation platform that places a new level of intelligence and performance at the edge of the network, enabling cable service providers to maximize their revenues by delivering more feature-rich services to their customers. The system can provide high-speed data, broadband entertainment, and IP telephony services to residential and commercial subscribers using cable modems or digital set-top boxes (STBs).

The Cisco uBR10012 router is based on the Data-over-Cable Service Interface Specifications (DOCSIS), which were developed by a cable industry initiative to ensure the reliable and secure operation of cable data networks. The router can interoperate with cable modems or STBs that support the DOCSIS 1.0, DOCSIS 1.1, EuroDOCSIS 1.1, DOCSIS 2.0, DOCSIS 3.0 and EuroDOCSIS 2.0 versions of the DOCSIS specification.

DOCSIS supports the 6 MHz North American channel plans using the ITU J.83 Annex B RF standard. The downstream uses a 6 MHz channel width in the 85 to 860 MHz frequency range, and the upstream supports the 5 to 42 MHz frequency range. Each chassis can support multiple standards and multiple interfaces, allowing operators to choose the appropriate services and devices that optimize their capital investment with a single CMTS platform.

The Cisco uBR10012 router supports data and digitized voice connectivity over a bidirectional cable television and IP backbone network, using advanced quality of service (QoS) techniques to ensure that real-time traffic such as voice can be reliably delivered, while still transmitting other traffic on a best-effort basis. The Cisco uBR10012 router concentrates traffic from two-way DOCSIS-based cable modems and STBs that is transmitted over the coaxial cable television (CATV) network, and presents that traffic to local and remote Internet Protocol (IP) hosts over its high-speed network uplink interfaces.

The Cisco uBR10012 universal broadband router uses the same Parallel Express Forwarding (PXF) technology used by the Cisco ESR10000 edge services router. The combination of PXF technology with Cisco's CMTS solutions creates a cost-effective, scalable, and industry-proven CMTS that provides consistent, high-performance throughput that is optimized for high-volume traffic over a cable network.

Based on the Cisco IOS networking software, the router supports the most advanced networking and routing options. Also, with access to current and future software enhancements, the router ensures investment protection as standards and customer needs continue to evolve.



Warning

Only trained and qualified personnel should be allowed to install, replace, or service this equipment.
Statement 1030.

Cisco uBR10012 Router Features

The Cisco uBR10012 router has the following features:

- 19-inch rack mount, 22.75-inch depth. See “[Cisco uBR10012 Router](#)”.
- 31.5-inch height, 18 Rack Units (RU)—2 chassis per 7-foot rack
- Twelve card slots:
 - 8 cable interface line cards
 - 4 network uplink line cards
- LCD module, see “[LCD Module](#)”.
- 64,000 subscribers—Supports up to a maximum of 64,000¹ subscribers in a basic configuration.
- Performance routing engine (PRE1, PRE2 and PRE4) modules, see “[Performance Routing Engine](#)”.
 - PRE1 modules support error checking and correction (ECC) for all onboard memory, replacing the simpler parity error algorithm of the original PRE module.
 - PRE2 modules are designed to address Internet-service-provider (ISP) requirements. The PRE2 provides 6.2 mpps of processing power and has a 500-MHz RM7000 mips processor with integrated 16-KB data and 16-KB instruction Level 1 caches integrated 256-KB Level 2 cache, and 4-MB Level 3 cache. Cisco IOS Release 12.3(9)BC.
 - The PRE4 is the fifth generation Parallel Express Forwarding (PXF) packet processing and scheduling engine for the Cisco uBR10012 router. The PRE4 provides 10 mpps of processing power and has a 800-MHz dual processor with a 512-MB packet buffer and a 128-MB control memory with error-correcting code. Cisco IOS Release 12.3(33)SB.



Note

When replacing a PRE1 module with a PRE2 module, you must also install EMI gaskets and RF absorber material, for more information, go to the following URL:

http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/pr e2gkit.html

- AC and DC power supply options:
 - Dual –48/–60 VDC hot-swappable and redundant power entry modules (DC PEMs). See “[DC Power Entry Modules](#)”.
 - Dual 200–240 VAC hot-swappable and redundant power entry modules (AC PEMs). See “[Timing, Communication, and Control Plus Card](#)”.
 - External AC-input power shelf with redundant power supply support. See [Supported External AC-Input Power Shelves](#).
- Alarm relays: minor, major, and critical.
- Two timing, communication, and control plus (TCC+) modules —each TCC+ card provides a connector for an external clock reference source, with a second connector for a backup clock source. See “[Timing, Communication, and Control Plus Card](#)”.

1. This is for reference only. The total number of subscribers for specific systems might vary depending on whether high availability is deployed, network or service loading, traffic, features deployed, and other parameters. A high availability N+1 enabled system with more than 50,000 subscribers is not recommended.

- Fan module—Forced-air convection cooling, see “[Fan Assembly Module](#)”.
 - Variable speed levels. The operating speed of the fan is determined by the temperature of the facility.
 - Multiple fans in the fan assembly provide redundancy to support single failure.
 - Status LEDs on the fan assembly indicate single or multiple fan failure.
 - Replacing the fan assembly module does not interrupt service (within certain time limits).

Comparisons with Other Cisco CMTS Platforms

The Cisco uBR10012 router is a next-generation CMTS platform with the following significant differences from the other Cisco CMTS platforms (Cisco uBR7100 series and Cisco uBR7200 series universal broadband routers):

- The Cisco uBR10012 router supports a larger form factor for cable interface line cards. The existing cable interface line cards for the Cisco uBR7200 series routers cannot be used with the Cisco uBR10012 router.
- The Cisco uBR10012 router uses high-performance PRE modules as its processor cards. It does not use any of the network processor cards used on the Cisco uBR7200 series router.
- The Cisco uBR10012 router is a high-performance, high-throughput CMTS router that requires high-performance network uplink line cards for its WAN connectivity to the Internet and other connected networks. It does not use any of the port adapters that are available for the Cisco uBR7100 series and Cisco uBR7200 series router.
- The Cisco uBR10012 router does not use the Cisco cable clock card because the TCC+ cards include national clock support.
- To accommodate the new architecture of the Cisco uBR10012 chassis, slot numbering on the router has been expanded to include a card and subcard numbering system (1/0, 2/0, and so forth). See [Figure 1-4](#) for a diagram of the slot numbering on the Cisco uBR10012 chassis.

Cisco uBR10012 Router Functional Overview

The Cisco uBR10012 router is a cable modem termination system (CMTS) that provides Internet, LAN, and WAN access for cable modems and set-top-boxes (STBs) over a coaxial cable connection. The router enables high-speed data services to be packaged like they are in basic cable television service or video programming.

The path from the CMTS to the cable modem or STB is the downstream, which carries the majority of traffic over the cable interface. The path from the cable modem or STB to the CMTS is the upstream, and it typically carries approximately 10 percent of the traffic that is sent over the downstream. A large number of users can be assigned to the same downstream, and for efficient use of bandwidth, those users can be split among several different upstreams.

The following sections provide a high-level overview of the data path over the upstream and the downstream.

Upstream Data Path

The following example describes the upstream data path.

1. A request for service is generated by a subscriber. The modem transmits the request as a series of packets to the CMTS on the upstream.
2. The cable line card receives the packets on its upstream interface and forwards them to its onboard processor.
3. The line card's processor verifies the header check sequence (HCS), frame check sequence (FCS), and system identification number (SID), processes all fields in the DOCSIS MAC header, and then removes the header.
 - a. The line card examines and processes the extended headers (Request, Acknowledgement, Privacy, PHSs and Unsolicited Grand Synchronization header elements). If Baseline Privacy Interface (BPI) is used, the processor also decrypts the Privacy EH frames using the appropriate key.
 - b. Bandwidth requests, acknowledgment (ACK) requests, and unsolicited grant syncs are reformatted and passed to the request ring of the Cisco cable line card.
 - c. The DOCSIS MAC header is removed and another header is added, which includes the SID, the upstream port information, and status bits that indicate whether any errors were detected.
4. The packet is sent across the backplane to the forwarding processor (FP) or the routing processor (RP) on the PRE.
5. The PRE performs packet operations such as access list processing, classification, switching, and QoS. It is also where major routing and IOS management functions (filtering) are run.
6. The packet is moved to the correct output queue and transmitted over the backplane to the network uplink card (OC-48 DPT/POS, GigE) or another cable interface line card.
7. The output card forwards the packet to the next interface point.

Downstream Data Path

The following example describes the downstream data path.

1. Data packets from the Internet are received by the network uplink cards (OC-48 DPT/ POS, GigE).
2. The packets are forwarded to the file processor (FP) on the PRE module.
3. The FP performs MAC classification to determine the type of frame or packet to be processed.
4. The PRE performs access list filtering, policing, and marking.
5. A forwarding information base (FIB) lookup and rewrite happens.
 - a. The rewrite consists of a downstream header and 802.3 MAC header.
 - b. The downstream header contains destination primary SID, physical DS port number, PHS rule index, and some control bits and other fields.
 - c. The packet is policed, shaped and prepared for queueing. Queueing is based on the priority of the queue and the state of the flow bits from the card. The destination card address (port) is prepended on the header of the packet being transmitted.
6. The packet is transmitted over the backplane to the appropriate cable interface line card.
7. The cable interface line card receives the packet and forwards it to all the ASICs on the line card.

- a. Each ASIC decodes the header to determine if the packet is destined for one of the downstream ports on that card. If so, the downstream header is removed and the 802.3 MAC header is saved.
 - b. The MAC header is processed to determine how to build the DOCSIS MAC header and what operations to perform on the packet. These might include prepending the DOCSIS MAC header, computing the HCS and FCS, performing Packet Header Suppression, and BPI encryption.
8. Once the packet is ready, it is immediately transmitted on the downstream.

Cisco uBR10012 Router and Cisco IOS Software

The Cisco uBR10012 router runs the Cisco IOS software, which is stored on the Type II PCMCIA flash memory disks stored in the two PCMCIA slots in the primary PRE module. A PCMCIA flash memory disk in either slot can store a Cisco IOS image or configuration file.

In addition to the flash memory disks, each PRE module contains onboard flash memory that is used to store a boot loader. The loader executes following a system reset to reload and execute the Cisco IOS software on the flash memory disks.

The PRE module also stores the system configuration in the onboard flash memory. The configuration information read from the flash memory is buffered in operational memory following initialization, and is written to the flash memory device when the configuration is saved.

Each line card also contains onboard flash memory that is used to store a boot loader, similar in function to that used on the PRE module. However, the line card loader executes following a system reset, line card reset, or line card insertion to reload and execute any code that must run on the line card.

Software images may also be stored on an external TFTP server. If the Cisco uBR10012 router is so configured, it then downloads the proper image from the TFTP server and executes it.

DOCSIS and EuroDOCSIS Data Rates and Modulation Schemes

Cisco cable interface line cards can be configured in a number of different upstream combinations based on the card used, your cable network, and the anticipated subscription and service levels. [Table 1-1](#) lists the data rates and modulation schemes for both DOCSIS 1.1 and EuroDOCSIS 1.1 standards. [Table 1-2](#) lists the data rates and modulation schemes for DOCSIS 2.0 and EuroDOCSIS 2.0 standards. [Table 1-3](#) lists the downstream data rates.

Table 1-1 DOCSIS and EuroDOCSIS 1.1 Upstream Data Rates

Upstream Channel Width	Modulation Scheme, bit/symbol	Baud Rate, symbol/sec	Raw Bit Rate, Mb/sec	Throughput (Bit Rate - Overhead), Mb/sec
3.2 MHz	16-QAM (4)	2.56 M	10.24	9.0
	QPSK (2)		5.12	4.6
1.6 MHz	16-QAM (4)	1.28 M	5.12	4.5
	QPSK (2)		2.56	2.3
800 kHz	16-QAM (4)	640 K	2.56	2.3
	QPSK (2)		1.28	1.2
400 kHz	16-QAM (4)	320 K	1.28	1.2
	QPSK (2)		0.64	0.6
200 kHz	16-QAM (4)	160 K	0.64	0.6
	QPSK (2)		0.32	0.3

Table 1-2 DOCSIS and EuroDOCSIS 2.0 Upstream Data Rates

Upstream Channel Width	Modulation Scheme, bit/symbol	Baud Rate, symbol/sec	Raw Bit Rate, Mb/sec	Throughput (Bit Rate - Overhead), Mb/sec
6.4 MHz	64-QAM	5.12M	30.96	27.2
	32-QAM		25.80	22.3
	16-QAM		20.54	19.8
	8-QAM		15.48	13.3
	QPSK		10.30	8.9
3.2 MHz	64-QAM	2.56 M	15.48	13.3
	32-QAM		12.90	11
	16-QAM		10.30	8.9
	8-QAM		7.68	6.6
	QPSK		5.12	4.4
1.6 MHz	64-QAM	1.28 M	7.68	6.6
	32-QAM		6.45	5.5
	16-QAM		5.12	4.4
	8-QAM		3.84	3.3
	QPSK		2.56	2.2
800 kHz	64-QAM	640 K	3.84	3.3
	32-QAM		3.20	2.75
	16-QAM		2.56	2.2
	8-QAM		1.92	1.65
	QPSK		1.28	1.1
400 kHz	64-QAM	320 K	1.92	1.65
	32-QAM		1.60	1.38
	16-QAM		1.28	1.1
	8-QAM		0.96	0.83
	QPSK		0.64	0.54
200 kHz	64-QAM	160 K	0.96	0.83
	32-QAM		0.80	0.63
	16-QAM		0.64	0.54
	8-QAM		0.48	0.40
	QPSK		0.32	0.27

Table 1-3 DOCSIS and EuroDOCSIS Downstream Data Rates

Downstream Channel Width, MHz	Modulation Scheme, bit/symbol	Baud Rate, MSym/sec	Raw Bit Rate, Mb/sec	Throughput (Bit Rate - Overhead), Mb/sec
6	64 QAM (6)	5.056	30.34	27
	256 QAM (8)	5.360	42.88	39
8	64 QAM (6)	6.592	39.55	36
	256 QAM (8)	6.592	52.74	51

NEBS Level 3 Compliance

The Cisco uBR10012 router is Network Equipment Building System (NEBS) Level 3 compliant. This includes the following categories:

- Filtration and front to back airflow
- Transportation and storage
- Operating temperature and humidity
- Heat dissipation and fire spread
- Packaged equipment shock
- Earthquake, office, and transportation vibration
- Airborne contaminants and acoustic noise
- Lightning immunity
- Electrical safety
- EMI emissions and immunity

Cisco uBR10012 Universal Broadband Router Hardware

This section describes the Cisco uBR10012 router and router components.

Cisco uBR10012 Router

The Cisco uBR10012 router is installed in a standard 19-inch equipment or telco rack. A rack-mount kit ships from the Cisco factory with each router. The rack-mount kit includes the hardware needed to mount the router in a standard 19-inch equipment rack or telco-type rack. Mounting in 23-inch equipment racks is possible with optional third-party mounting hardware.

The Cisco uBR10012 chassis is designed for front and rear access. The two AC or DC power entry modules (PEM)s, two Performance Routing Engine (PRE) modules, the LCD panel, and the fan assembly module are accessed from the front of the chassis, see [Figure 1-2](#). The eight slots for cable interface line cards, four full-slots for network uplink line cards, and two slots for the Timing, Communication, and Control Plus (TCC+) cards, and DOCSIS Timing, Communication, and Control Plus (DTCC) cards are accessed from the rear of the chassis, see [Figure 1-3](#).

**Note**

If the only available power supply source is 100-120 VAC, you can use the auxiliary AC-input power shelf. The AC-input power shelf converts AC to DC power for the Cisco uBR10012 router. See [“Supported External AC-Input Power Shelves”](#) for more information.

Figure 1-1 shows the front of the Cisco uBR10012 router with the front cover installed.

Figure 1-1 Cisco uBR10012 Universal Broadband Router—Front View with Front Cover

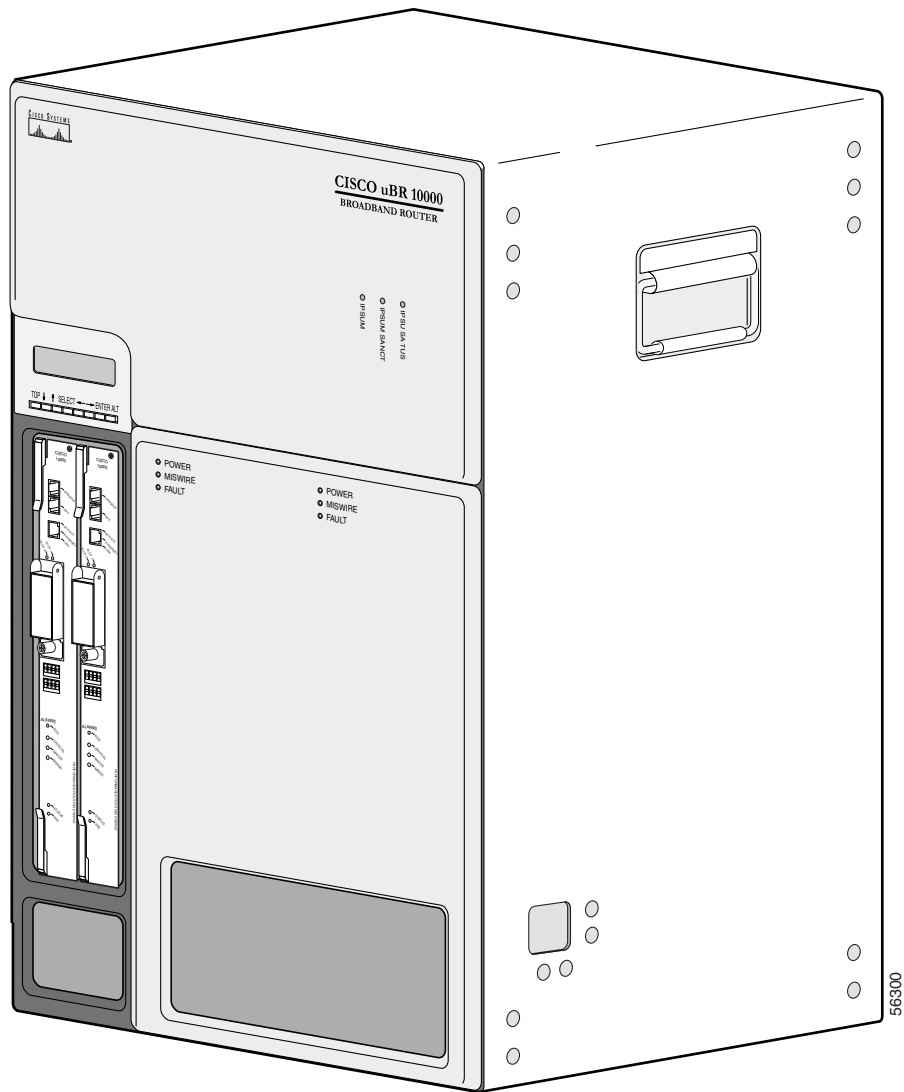


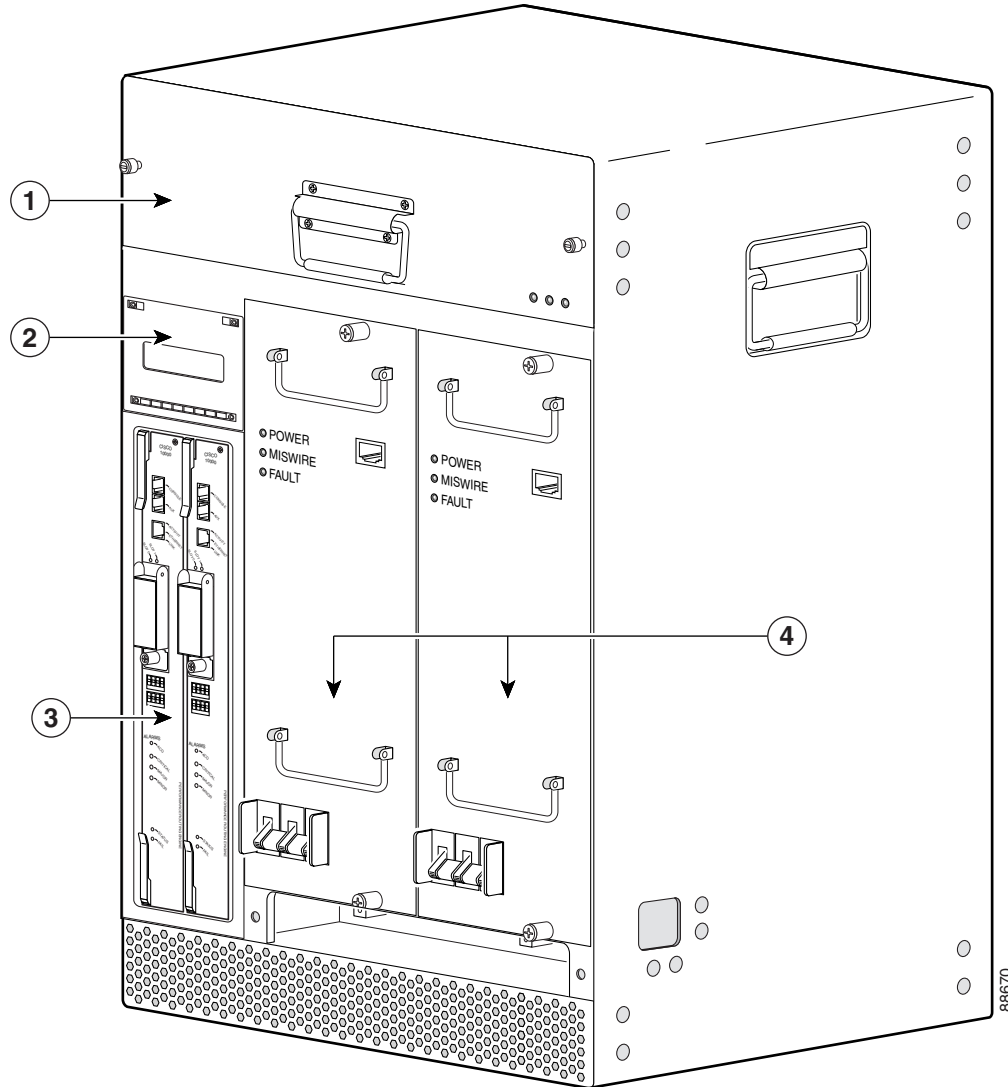
Figure 1-2 shows the front of a fully loaded chassis without the front cover.



Note

Figure 1-2 is a sample representation of the Cisco uBR10012 chassis with the DC PEM (UBR10-PWR-DC=) modules.

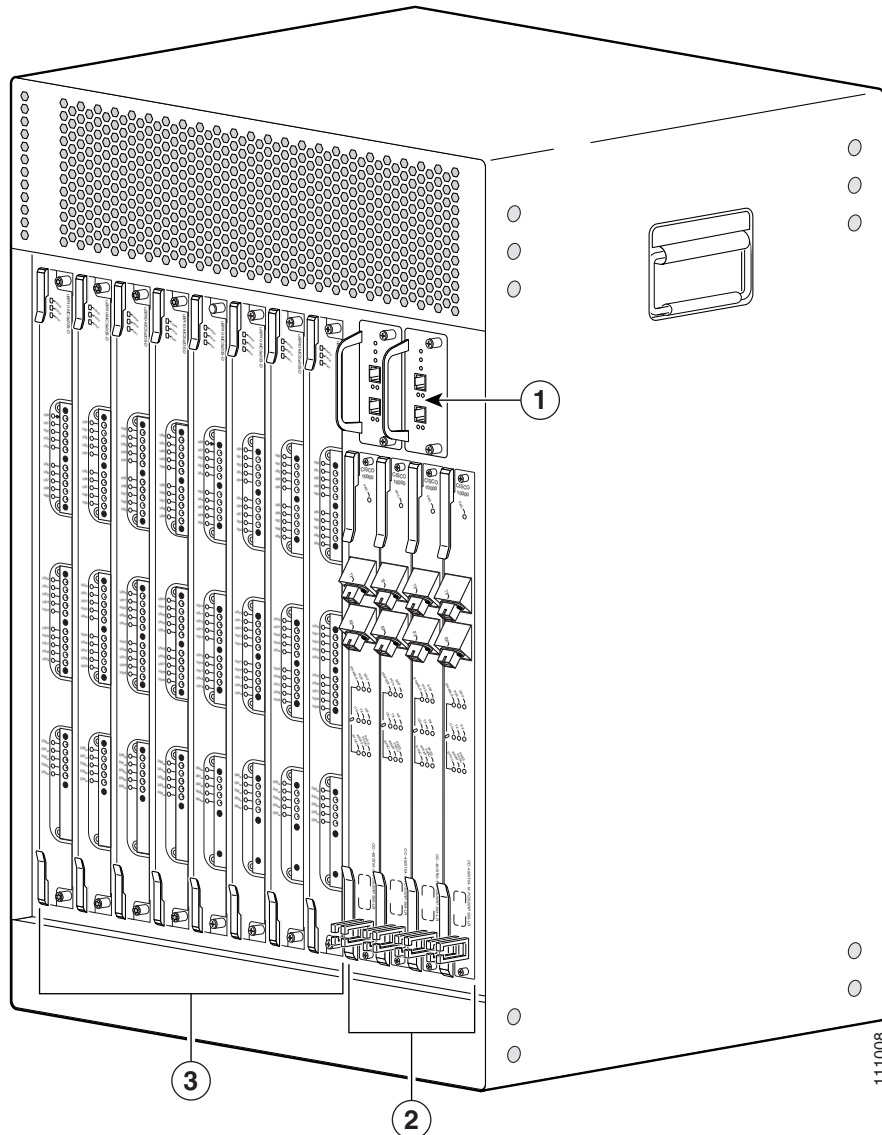
Figure 1-2 Cisco uBR10012 Router Chassis—Front View without the Front Cover



1	Fan assembly module	3	Two PRE modules
2	LCD module	4	Two DC PEM modules

Figure 1-3 shows the rear of a fully-loaded Cisco uBR10012 router.

Figure 1-3 Cisco uBR10012 Router Chassis—Rear View



1	Two TCC+ cards	3	Eight cable interface line cards
2	Four high-speed, high-performance network uplink line cards (HHGE line cards not shown)		—



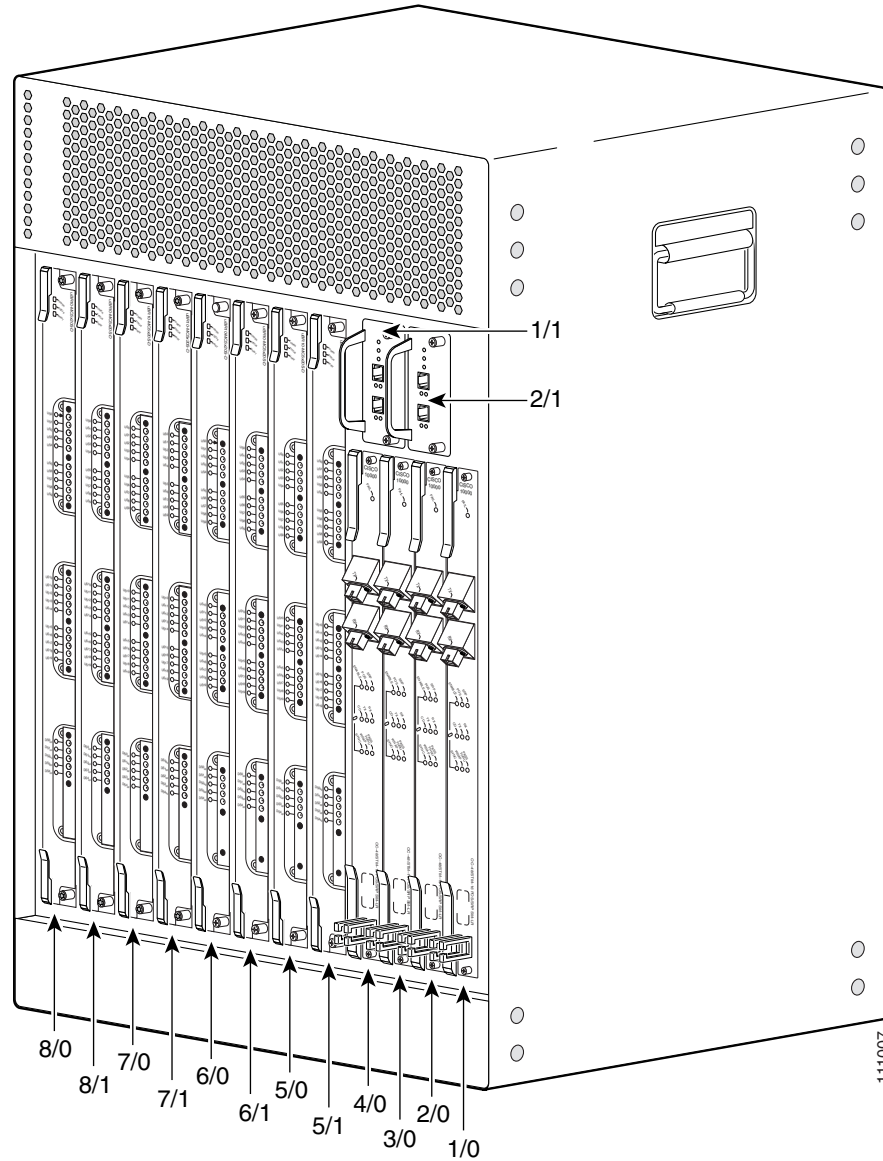
Caution

The handles shown on the left and right sides of the chassis should be used only when lifting a depopulated chassis that does not have any PEMs, fan assembly module, or line cards installed. See “[Chassis-Lifting Guidelines](#)” for more information.

Cisco uBR10012 Router Slot Numbering

Figure 1-4 shows the slot numbering for the line cards and TCC+ cards in the rear of the chassis. The Cisco uBR5X20S/U cable interface line cards are used in this Figure 1-4.

Figure 1-4 Cisco uBR10012 Chassis Slot Numbering—Rear View



Note

Half-height Gigabit Ethernet (HHGE) line cards use slot 3 and slot 4 only. These cards are used with a slot splitter that subdivides the slots so that they become slots 3/0/0, 3/0/1, and slots 4/0/0, 4/0/1.

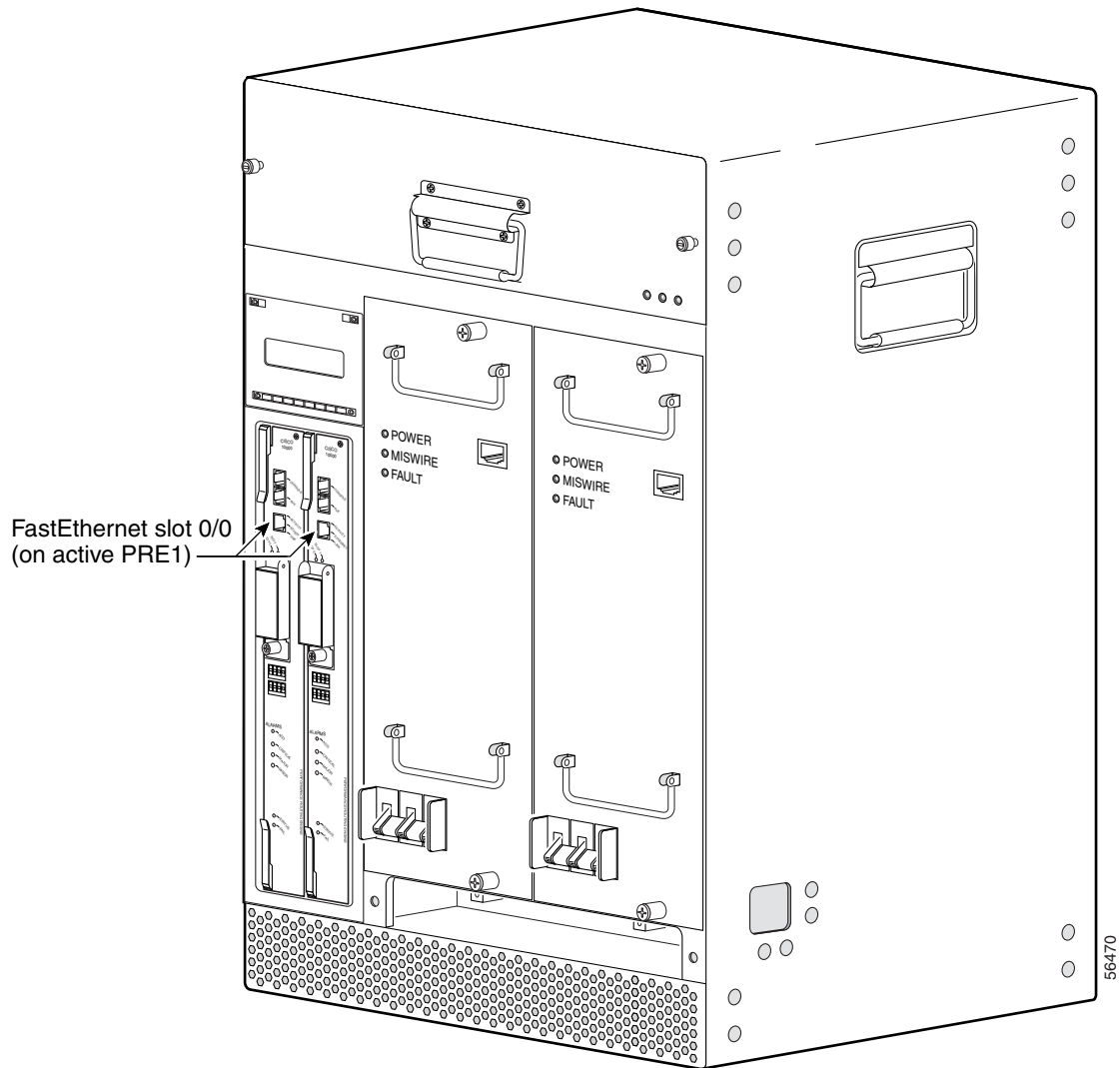


Caution

If you place a slot splitter and HHGE line card in slot 1/0 or slot 2/0, these slots shut down.

Figure 1-5 shows the slot numbering for the Fast Ethernet interface on the active PRE module.

Figure 1-5 Cisco uBR10012 Chassis Slot Numbering—Front View



Tip

The Fast Ethernet interface on the backup PRE is not used unless the primary PRE fails and the backup PRE is activated. When the backup PRE becomes the active PRE module, its Fast Ethernet interface automatically becomes the active Fast Ethernet interface at slot 0/0.



Note

The Cisco uBR10012 router also has an internal Ethernet interface, Ethernet 0/0/0, which PRE processors and line cards use to transfer packets between cards. This interface is not user-configurable, although you can see the configuration and run-time information using the **show interface** command.



Warning

Ultimate disposal of this product should be handled according to all national laws and regulations.
Statement 1040

Cisco uBR10012 Universal Broadband Router Modules

The following section describes the modules used in the Cisco uBR10012 router. For a list of field replaceable units (FRUs) used in this chassis, see [“Cisco uBR10012 Router FRU Resources”](#).

Fan Assembly Module

The Cisco uBR10012 chassis uses a fan assembly module containing fans to supply cooling air to the chassis. The fan assembly connects to the chassis through a blind mate connector that plugs into the cable assembly and then into the chassis backplane. The fan assembly modules can be identified by the product part numbers. The fan assembly module supported on the Cisco uBR10012 chassis is:

- Fan Assembly Module (UBR10-FAN-ASSY=)
- Fan Assembly Module (UBR10012-FAN-PLUS=)

For information on installing, removing and replacing the fan assembly module, see [Cisco uBR10012 Universal Broadband Router Fan Assembly Module](#).

AC Power Entry Modules

The Cisco uBR10012 router is shipped with two AC power entry modules (AC PEMs) that provide power supply to the system. One AC PEM module is sufficient to provide power for a fully configured chassis. However, if one AC PEM module fails, the other AC PEM module automatically begins providing power to the entire chassis, without impacting the system operation.

The AC PEM modules use a standard 200–240 VAC (50 or 60 Hz) input power obtained through power receptacles on the front panel of each PEM. The two AC PEMs convert the AC power to provide filtered, redundant, and load shared DC power to the Cisco uBR10012 chassis. The AC PEM modules can be identified by their product part numbers.

The AC PEM modules supported on the Cisco uBR10012 chassis are:

- AC PEM Module (UBR10-PWR-AC=)
- AC PEM Module (UBR10-PWR-AC-PLUS=)

For information on installing, removing and replacing the 2400 W AC PEM module, see [AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on installing, removing, replacing the 3300 W AC PEM module, and migrating from the 2400 W AC PEM to the 3300 W AC PEM, see [3300 W AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

DC Power Entry Modules

The Cisco uBR10012 router is shipped with two DC power entry modules (DC PEMs) that provide power to the system. One DC PEM can provide sufficient power for a fully configured chassis. However, if one DC PEM fails, the other automatically begins providing power to the entire chassis, without impacting the system operation.

The two DC PEMs provide filtered, redundant, and load shared DC power to the Cisco uBR10012 chassis. The DC PEM modules can be identified by their product part numbers.

The DC PEM modules supported on the Cisco uBR10012 chassis are:

- DC PEM Module (UBR10-PWR-DC=)
- DC PEM Module (UBR10-PWR-DC-PLUS=)

Table 4 summarizes the specifications of the DC PEM modules.

Table 4 Specifications of the DC PEM modules

Component	UBR10-PWR-DC-PLUS=	UBR10-PWR-DC=	
Cisco DC PEM (Part Number) ¹	341-0388-01	34-1651-04 and 34-1651-05	34-1651-05
Power output	3300 W	2400 W	3000 W
DC-input Voltage	-48 to -60 VDC nominal	-48 to -60 VDC nominal	-55 to -60 VDC nominal
DC-output Voltage (nominal)	-57.5 V	See footnote ²	
DC-input Current Connections	50 A + 50 A	50 A	56 A
Physical Differences			
LEDs	5	3	3
Weight	16 lbs (7.25 kg)	10 lbs (4.54 kg)	10 lbs (4.54 kg)
PRODUCT ID LED/switch	Yes	No	No

1. The 34- part number is listed on compliance label of the DC PEM.
2. For the 34-1651-04 and 34-1651-05 DC PEM modules, the DC-output voltage varies according to the DC-input voltage with a drop in voltage between 1 V and 1.85 V. The allowable DC-input range is -40.5 V to -72 V. The DC-output voltage is not constant for these DC PEM modules. For the 341-0388-01 DC PEM module, the DC-output voltage is regulated and is constant.

For information on installing, removing and replacing the 2400 W or the 3000 W DC PEM module, see [DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on installing, removing, replacing the 3300 W DC PEM module, and migrating from the 2400 W or the 3000 W DC PEM to the 3300 W DC PEM, see [3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

Supported External AC-Input Power Shelves

If 100–120 VAC is the only available power source at the facility, then use the external AC-input power shelf with the Cisco uBR10012 router. The AC-input power shelf converts AC power from an external AC power supply source into DC power that is suitable for powering on the Cisco uBR10012 router.

The external power shelves supported on the Cisco uBR10012 router are:

- 2400 W AC-Input Power Shelf
- Lineage AC-DC Power Shelf

Table 1-5 lists the specifications of the external power shelves on the Cisco uBR10012 chassis.

Table 1-5 Supported External Power Shelves for Cisco uBR10012 Router Specifications

	Lineage AC-DC Power Shelf	2400 W AC-Input Power Shelf
Part Number	J85480S1 L30 ¹	UBR10-PWR-AC-EXT
Output Power supplied to the Cisco uBR10012 chassis	3300 W	2400 W
DC Output Voltage	-54 V	-54 V

1. For more information on ordering the Lineage kit, see Table D-6.

For information about the 2400 W AC-input power shelf, see the [2400 W AC-Input Power Shelf for the Cisco uBR10012 Universal Broadband Router](#) at the following URL:

We recommend you use the external Lineage AC-DC power shelf in conjunction with the Cisco uBR10012 router chassis. For an overview of the Lineage AC-DC power shelf, see the “[Lineage AC-DC Power Shelf](#)” section on page 1-15. For information on connecting the Lineage AC-DC power shelf with the Cisco uBR10012 router, see “[Connecting the External AC-input Power Shelf to the Cisco uBR10012 Router](#)” section on page 3-28.

Table 1-6 lists the number of Lineage power shelves that are required to supply power to the DC PEM modules.

Table 1-6 Cisco uBR10012 Router DC PEM Modules and Lineage Shelves

Component	UBR10-PWR-DC-PLUS=	UBR10-PWR-DC=	
Cisco DC PEM (Part Number) ¹	341-0388-01	34-1651-04 and 34-1651-05	34-1651-05
Power Output	3300 W	2400 W	3000 W
No. of Lineage Shelves	2	1	1

1. The 34- part number is listed on the compliance label of the DC PEM.

For information on installation, power shelf safety features, safety warnings, and troubleshooting the Lineage power shelf, see the product documentation available at <http://www.lineagepower.com/>.

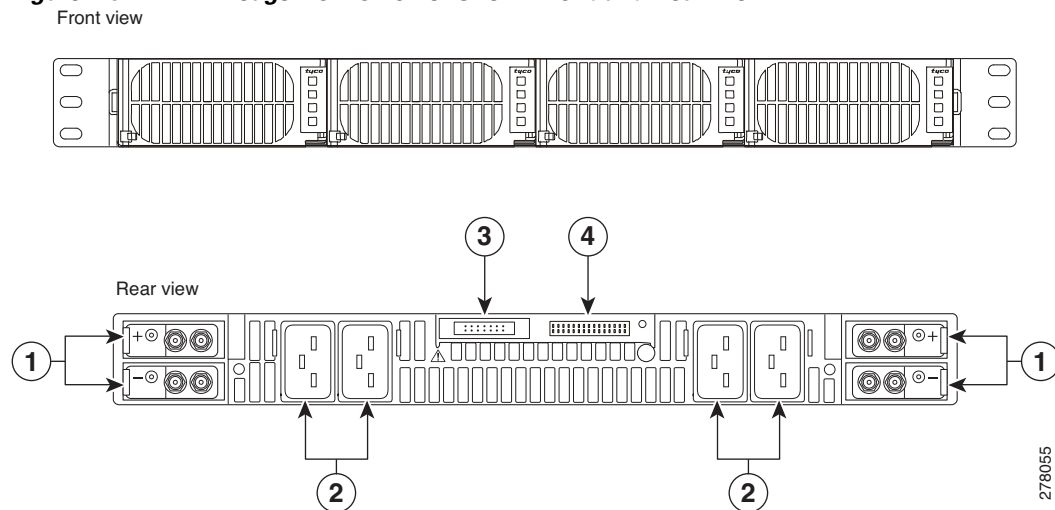
Lineage AC-DC Power Shelf

This external AC-DC power shelf from Lineage (part number J85480S1 L30) with AC module (CP2000AC54PE) is 1-rack unit high (1.75 inch) and can be mounted on a standard 19-inch 4-post equipment rack or telco-type rack. We recommend installing the Lineage power shelf in the rack in a

way that the power connections reside facing inside the rack when viewed from the front. This allows the DC output terminals of the external AC-input power shelf to be on the same side as the DC-input terminals of the Cisco uBR10012 chassis.

The Lineage AC-DC power shelf has two DC power sources, four AC-input power supply sources, and J1 and J2 connectors. Each AC-input power supply module is automatically powered on when it is plugged into the wall socket. (See [Figure 1-6](#)).

Figure 1-6 Lineage AC-DC Power Shelf - Front and Rear View



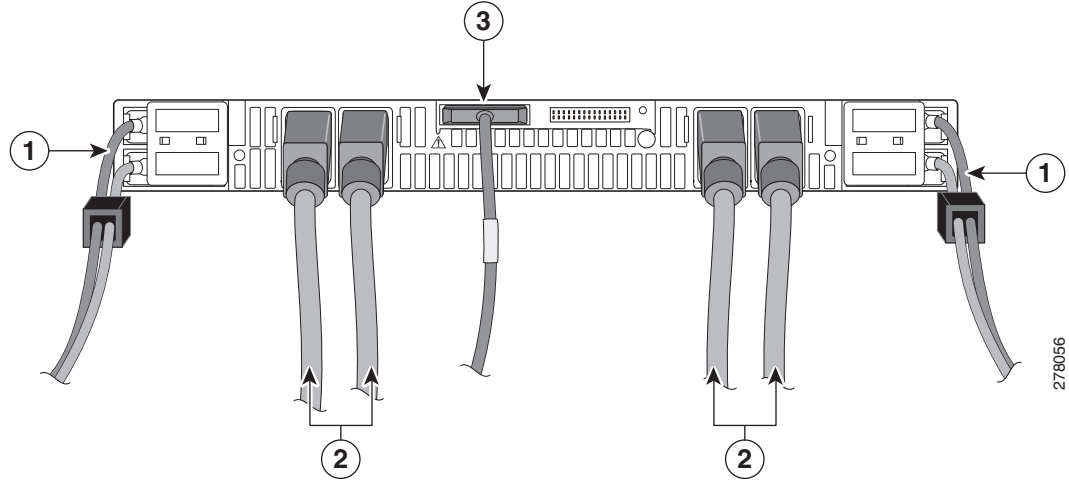
1	DC power source terminal blocks	3	J2 connector
2	AC input power connectors	4	J1 connector / alarm cable interface

All cable connections for AC-input power, DC-output power, and status signals are made from the rear of the power shelf. Each AC power supply module has an individual AC facility cord attachment. All four AC-input cords must be attached to the facility for all four AC power modules to function. Two DC-interconnect cables provide DC-output power to the DC PEM (UBR10-PWR-DC=) modules on the Cisco uBR10012 chassis. (See [Figure 1-7](#)).



Note

The AC-input power cables, DC-output power cables, and alarm monitor cable are supplied along with Lineage. We recommend that you use these cables for cabling the shelf to the Cisco uBR10012 router.

Figure 1-7 Rear View of the Lineage AC-DC Power Shelf with Cables

1	DC power supply cables	3	Alarm monitor cable
2	AC power supply cables		—

To meet compliance standards, use the DC power cables (3 m cable supplied along with Lineage power shelf), while cabling the Lineage AC-DC power shelf to the Cisco uBR10012 chassis. Ensure proper rating and fit in the chassis when connecting the cables into the input DC terminal block on the backplane of the Cisco uBR10012 chassis.

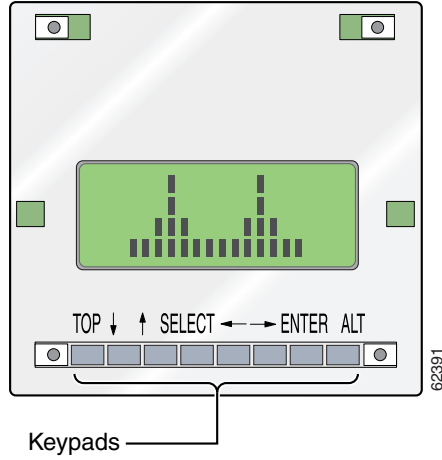
To meet the Class A emission compliance requirements, ferrite beads must be used with Lineage AC-DC power shelf when used to power on the Cisco uBR10012 router. For information on ferrite beads, see [“Attaching Ferrite Beads on DC Power Cables”](#) section on page 3-23.

For information on connecting the Lineage power shelf see, [Connecting the External AC-input Power Shelf to the Cisco uBR10012 Router](#), page 3-28.

LCD Module

The LCD module provides real-time operating status and configuration information for the chassis and line cards. The buttons below the screen provide a menu system that allows you to display different parts of the system configuration without using a terminal. [Figure 1-8](#) shows the Cisco LCD module without the chassis front cover.

Figure 1-8 LCD Module Display Panel



Note

The LCD module functions depend on the release of the Cisco IOS software running on your Cisco uBR10012 router. Refer to the release notes for the Cisco IOS release you are using, and the [Cisco uBR10012 Software Configuration Guide](#), for details. See the “[Obtaining Documentation and Submitting a Service Request](#)” section on page xvi.

LCD Cable

The LCD ribbon cable connects the LCD module to the backplane. The folded end is connected to the LCD module. See [Figure 1-9](#).

Figure 1-9 LCD Cable



Performance Routing Engine

There are four models of PREs, the original PRE module that was initially shipped with the Cisco uBR10012 router, the PRE1 module that began shipping with Cisco IOS Release 12.2(4)XF, the PRE2 module that is shipping with Cisco IOS Release 12.3(9)BC, and the PRE4 module that is shipping with Cisco IOS Release 12.2(33)SB.

- PRE1 functionality was introduced in Cisco IOS Release 12.2(4)XF.
- PRE2 functionality was introduced in Cisco IOS Release 12.3(9a)BC.
- PRE4 functionality was introduced in Cisco IOS Release 12.2(33)SCB.

You can use the CLI **show version** command to determine whether a PRE, PRE1, PRE2, or PRE4 module is installed in your system.



Note

The PRE3 is not supported on the Cisco uBR10012 router

The PRE is a single-slot module used with the Cisco uBR10012 routers. The PRE performs all Layer 2 and Layer 3 packet routing and forwarding using an advanced parallel processing architecture called Parallel eXpress Forwarding (PXF). This process separates the control plane from the data plane. The PXF architecture supports high-performance throughput with IP services enabled on every port.



Note

When replacing a PRE1 module with a PRE2 module, you must also install EMI gaskets and RF absorber material. For more information, go to the following URL:

http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/pre2gkit.html

PRE Modules and PRE1 Modules

PRE1 modules support error checking and correction (ECC) for all onboard memory, replacing the simpler parity error algorithm of the original PRE module. A general-purpose RISC processor (262–300 MHz MIPS RISCMark RM7000) support high performance Layer 3 forwarding of traffic. The

combination of a general purpose RISC processor with advanced programmable PFX network processors provides the capacity to support the aggregation of thousands of active connections in a single Cisco uBR10012 chassis when supporting IP applications such as access policy filtering, rate-based queuing, and QoS.

PRE2 Modules

PRE2 modules are designed to address Internet service provider (ISP) requirements. The PRE2 has four PFX network processors (containing 64 individual processors) with two independent 32-MB SDRAM control memories on each processor set. The PRE2 provides 6.2 Mpps of processing power and has a 500-MHz RM 7000 mips processor with integrated 16-KB data and 16-KB instruction Level 1 caches, an integrated 256-KB Level 2 cache, and a 4-MB Level 3 cache.

Cisco IOS Release 12.3(9a)BC automatically enables the following features:

- Route Processor Redundancy Plus (RPR+)
- 6.2 mpps processing power
- Software features available with PRE2 and Cisco IOS Release 12.3(9a)BC:
 - EtherChannel
 - TLS 802.1q
 - NetFlow

PRE4 Modules

The Performance Routing Engine 4 (PRE4) is the fifth-generation Parallel Express Forwarding (PXF) packet processing and scheduling engine for the Cisco uBR10012 router.

PRE4 enhances the performance capability of the Cisco uBR10012 router to 10 Mpps by providing increased density Gigabit Ethernet (GE) and higher throughput of the 10GE SPA interface.

The PRE4 runs Cisco IOS Release 12.2(33)SCB and later releases. Benefits of the PRE4 include:

- 800-MHz dual processor
- 64 PXF network processors arranged as 8 columns and 8 rows
- 512-MB packet buffer and 128-MB control memory with error-correcting code
- 4-GB ECC-protected Route Processor (RP) memory
- 10 million packets per second (Mpps) forwarding performance through the PXF complex
- 5.6-Gbps backplane bandwidth for each full-height backplane slot
- 11.2 Gbps backplane bandwidth to each SPA interface processor (SIP)
- Maximum transmission unit (MTU) support of 9216 bytes
- An external CompactFlash Disk slot (disk0)
- A 100/1000 Megabit Ethernet interface for communication between redundant PRE4s



Note

Unless otherwise indicated, all references in this document to the PRE refer to the PRE, the PRE1, the PRE2, or the PRE4 modules. The PRE is now end-of-life (EOL) and is replaced by the PRE1, PRE2, or PRE4.

Redundant PRE Modules

The PRE module supports redundant operation (two PRE modules in a Cisco uBR10012 chassis). If the primary PRE fails, the secondary PRE automatically takes over operation of the chassis. Because all Cisco uBR10012 line cards are physically connected to both the primary and secondary PRE modules, a switchover of PRE modules does not require human intervention to reset the line cards, as they automatically fail over to the redundant PRE. The PRE module is hot-swappable if there is a redundant PRE module in the chassis.



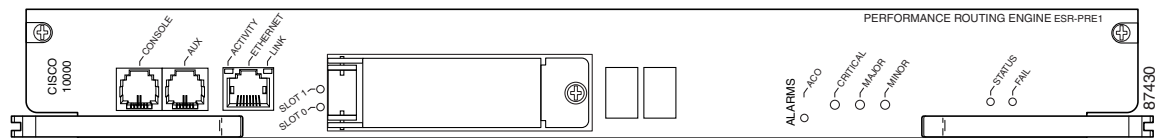
Caution

You cannot use different models of the PRE in the same chassis. If you have PRE2 modules and you wish to upgrade, you must upgrade both of your PREs to the PRE4s. You cannot use a PRE1 or a PRE2 and a PRE4 in the same system.

PRE Module Description

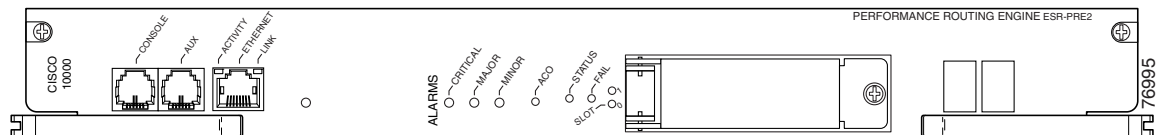
The PRE1 contains two PC media card two slots and 64 MB of onboard flash memory. [Figure 1-10](#) shows the PRE 1 faceplate.

Figure 1-10 PRE1 Faceplate



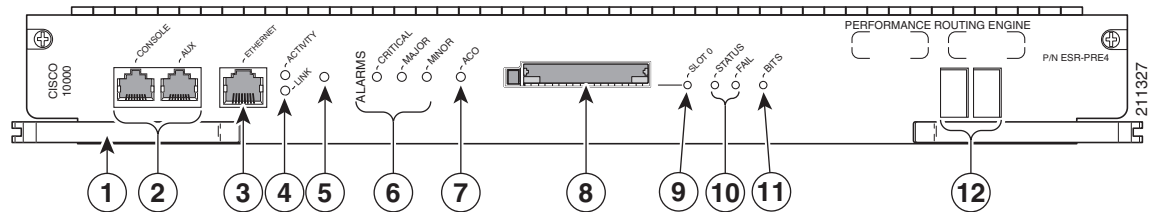
The PRE2 contains two PC media card slots and 128 MB of onboard flash memory. [Figure 1-11](#) shows the PRE2 faceplate.

Figure 1-11 PRE2 Faceplate



The PRE4 contains a CompactFlash Disk slot (disk0) and 128 MB of onboard flash memory. [Figure 1-12](#) shows the PRE4 faceplate.

Figure 1-12 PRE4 Faceplate



1	Ejector levers	7	ACO (Alarm Cut-off) button
2	Console and Auxiliary ports	8	CompactFlash Disk slot, disk0
3	Network Management Ethernet (NME) port	9	Slot 0 (disk0) LED
4	NME Activity and Link LEDs	10	Status, Fail LEDs
5	Reset button	11	Building Internal Timing Source (BITS) LED
6	Alarms: Critical, Major, Minor LEDs	12	Alphanumeric display

Connector Ports

The faceplate on the PRE contains three ports with RJ-45 connectors:

- Console port—This asynchronous EIA/TIA-232 serial port is used to connect a terminal to the PRE for local administrative access.
- Auxiliary port (AUX)—This asynchronous EIA/TIA-232 serial port is used to connect a modem to the PRE for remote administrative access.
- Fast Ethernet port—This Fast Ethernet port is used to connect the PRE to a 10/100Base-T network management LAN.



Note

The Fast Ethernet interface on the PRE module is intended for network management access and should not be used for WAN connectivity purposes. For WAN connections, use the appropriate network uplink cards, which take full advantage of the system's high-performance PXF processing subsystem.

PC Media Card Slots

Two PC media card slots (one CompactFlash Disk slot for the PRE4) can store the Cisco IOS image or a system configuration file on a PC media card or CompactFlash Disk. The system can also boot from the software stored on the PC media card or CompactFlash Disk. The PC media card slots support Type I or Type II cards. See the [“Removing and Installing a PC Media Card” section on page 16](#) for more information about inserting and removing PC media cards from the PRE.

LCD Screens

The two LCD screens below the PC media card slots display alphanumeric information about the status of the of the PRE module.

PRE LED Indicators and Buttons

LEDs on the faceplate of the PRE provide a visual indication of the status of PRE operation (see [Figure 1-10](#)). The LEDs are separated into three categories: alarms, status, and failure.

- ALARM—Alarm relay contacts on the Cisco uBR10012 router connect the router to a site alarm maintenance system. This allows critical, major, and minor alarms generated by the Cisco uBR10012 router to be displayed on the PRE faceplate and also translated to external visual or audible alarms connected to the system. See the [“Connecting Alarm Indicators” section on page 3-41](#) for more information about alarm connections. Pressing the alarm cutoff (ACO) button

on the (primary) PRE during an alarm condition shuts off the external alarm, but does not deactivate the alarm LEDs on the PRE faceplate. Alarm LEDs on the faceplate are deactivated only after the condition that caused the alarm is corrected.

- STATUS—Indicates the status of the PRE.
- FAIL—Indicates that a major failure has disabled the PRE.

Table 1-7 describes the LEDs and switch on the PRE.

Table 1-7 Cisco PRE LEDs and Cutoff Switch

LEDs/Switch	Status	Description
ACTIVITY	Green	Packets are being transmitted and received.
	Off	No packet activity.
LINK	Green	Carrier detected; the port is able to pass traffic.
	Off	No carrier detected; the port is not passing traffic.
Reset button	–	Resets the PRE4.
Alarm cutoff (ACO) button	–	Pressing this button disables an audible alarm.
CRITICAL, MAJOR, and MINOR LEDs	Off	No alarm.
	Yellow	Alarm condition.
STATUS	Green	PRE is ready and active as the primary PRE.
	Off	No power to the PRE or the PRE is acting as the secondary PRE.
	Flashing Yellow	System is booting.
	Flashing Green	PRE4 is standby.
FAIL	Off	PRE is operating properly.
	Yellow	A major failure has disabled the PRE.
CompactFlash slot 0	Green	Disk0 is active.
PC media card slot 0	Green	Flash card in Slot 0 is active ¹ .
PC media card slot 1	Green	Flash card in Slot 1 is active.
BITS	Green	BITS input to the PRE is configured and functioning normally.
	Yellow	BITS input to the PRE is configured, but not functional. For example, the framer may have detected a Loss of Signal (LOS).
	Off	BITS input to the PRE4 is not configured.

1. The Cisco uBR10012 router supports PCMCIA flash memory cards of 64 MB or above.

PRE Module Disposal

The PRE module contains a small lithium battery. Some jurisdictions restrict the ways in which you can dispose of items containing lithium batteries. In particular, never dispose of lithium batteries or products containing lithium batteries in an unregulated fire. Other restrictions might apply in your area.



Warning

Ultimate disposal of this product should be handled according to all national laws and regulations. Statement 1040.

SIP and SPA Compatibility

The Cisco uBR10012 router currently supports the following SIPs:

- Cisco Wideband SIP for the Cisco Wideband SPA



Note Effective with Cisco IOS Release 12.2(33)SCH, the Cisco Wideband SIP is not supported on the Cisco uBR10012 router.

- Cisco 10000 Series SPA Interface Processor-600

The Cisco Wideband SIP can support up to two Cisco Wideband SPAs. The Cisco uBR10012 router can support up to eight SPAs. For more information about the introduction of support for different SIPs and SPAs, refer to the *Cisco uBR10012 Universal Broadband Router SIP and SPA Software Configuration Guide* at the following location:

http://www.cisco.com/en/US/docs/interfaces_modules/shared_port_adapters/configuration/ubr10012/12.3_23_bc/sipsp_d3.html

Timing, Communication, and Control Plus Card

On the Cisco uBR10012 router, the Timing, Communication, and Control Plus (TCC+) card acts as a secondary processor that performs the following functions:

- Generates and distributes 10.24 MHz clock references to each of the cable interface line cards.
- Generates and distributes 32-bit time-stamp references to each of the cable interface line cards.
- Allows software to power off independently any or all of the cable interface line cards.
- Drives the LCD module used to display system configuration and status information.
- Monitors the supply power used by the chassis.
- Provides two redundant RJ-45 ports for external timing clock reference inputs such as a Global Positioning System (GPS) or building integrated timing supplies (BITS) clock.

When two TCC+ cards are installed, they are configured as active and backup (redundant). If the TCC+ card in the first slot is working at system power-up, it automatically becomes the active card and the TCC+ card in the second slot becomes the backup card. The TCC+ cards monitor each other's priority information so that if the active card fails, the active card role is transferred to the redundant backup card without loss of data.

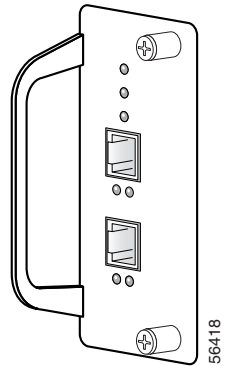
Figure 1-13 shows the faceplate of the TCC+ card. The handle provides for the insertion and removal of the card from the chassis.



Caution

Do not attempt to lift the chassis using one of these handles.

Figure 1-13 TCC+ Card Faceplate



The faceplate on the TCC+ card has seven LEDs labeled POWER, STATUS, MAINT, PRESENT, and ACTIVE. Separate PRESENT and ACTIVE LEDs are associated with the primary and secondary external clock reference inputs.

For more information, see [Cisco uBR10012 Universal Broadband Router TCC+ Card](#).

DOCSIS Timing, Communication, and Control Card

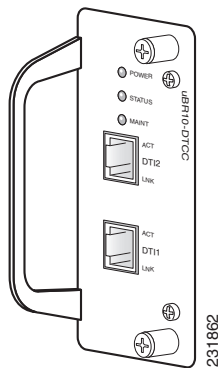
On the Cisco uBR10012 universal broadband router, the DTCC card acts as a secondary processor that performs the following functions:

- In the default DTI mode, a 10.24 MHz clock and 32-bit DOCSIS timestamp are generated by the DTI Server, propagated to DTI client using DTI protocol, and distributed by DTI client to each cable interface line card.
- Allows software to independently power off any or all cable interface line cards.
- Drives the LCD panel used to display system configuration and status information.
- Monitors the supply power usage of the chassis.
- Two RJ-45 cables with the DTI server, which, in turn, can generate the clock using its own oscillator or external timing reference inputs such as GPS or network clock.

Two DTCC cards are installed and configured as active (primary) and backup (redundant). If the DTCC card in the first slot is working at system power-up, it automatically becomes the active card and the DTCC card in the second slot becomes the backup card. The DTCC cards monitor each other's priority information, so that if the active card fails, the active card role is transferred to the redundant backup card without loss of data.

Figure 1-13 shows the faceplate of the DTCC card.

Figure 1-14 Cisco DTCC Front Panel



The front panel on the DTCC card has seven LEDs. They are labeled POWER, STATUS, MAINTENANCE, PRESENT, and ACTIVE. The second set of PRESENT and ACTIVE LEDs are associated with the primary and secondary external clock reference inputs.

For more information, see [Cisco uBR10012 Universal Broadband Router DTCC Card](#).

Cable Interface Line Cards

The following section describes the cable interface line cards used in the Cisco uBR10012 universal broadband router.

- [Cisco uBR-MC5X20S/U/H Cable Interface Card, page 1-27](#)
- [Cisco UBR-MC20X20V Cable Interface Card, page 1-28](#)
- [Cisco uBR-MC3GX60V Cable Interface Card, page 1-28](#)
- [Cisco uBR-MC3GX60V-RPHY Cable Interface Card, page 1-28](#)

Cisco uBR-MC5X20S/U/H Cable Interface Card

The Cisco uBR10-MC5X20S, U and H cable interface line cards are 20 by 16 inch cards designed specifically for the Cisco uBR10012 router. These cards transmit and receive RF signals between the subscriber and the headend over hybrid fiber-coaxial (HFC) system.

Upstream data, from the subscriber, comes through the upstream ports (US0-US19) on the Cisco uBR10-MC5X20S/U/H cable interface line card. The line card processes and configures the data and sends it across the backplane to the WAN/backhaul card and out to the Internet.

Downstream data, to the subscriber, comes from the Internet through the WAN/backhaul card, and across the backplane to the Cisco uBR10-MC5X20S/U/H cable interface line card. The Cisco uBR10-MC5X20S/U/H card processes and configures the data and sends it out through the appropriate downstream port (DS0-DS4) to be combined with the rest of the downstream signals in the headend.

The Cisco uBR10-MC5X20S/U line cards use burst receivers that report unequalized Modulation Error Ratio (MER). The Cisco uBR10-MC5X20H line cards use burst receivers that report equalized MER. Equalized MER will almost always be at least a few decibels (dB) higher than an unequalized MER measurement of the same signal under identical conditions.

Cisco uBR10-MC5X20S

The Cisco uBR10-MC5X20S cable interface line card supports downstream and upstream traffic over Data-over-Cable Service Interface Specification (DOCSIS)-based cable modem networks. The card supports downstream channels in the 70 to 860 MHz range, and upstream channels in the 5 to 42 MHz range. Each downstream port includes an onboard integrated upconverter. The Cisco uBR10-MC5X20S cable interface line card supports Annex B radio frequency (RF) data rates, channel widths, and modulation schemes and has DOCSIS MAC management and spectrum management capabilities. DOCSIS 2.0, Asynchronous Time Division Multiple Access (A-TDMA) rates are also supported.

Cisco uBR10-MC5X20U and H

The Cisco uBR10-MC5X20U/H cable interface line card supports both DOCSIS and EuroDOCSIS cable modem networks. The card supports downstream channels in the 70 to 860 MHz range, and upstream channels in the 5 to 65 MHz range. Each downstream port includes an onboard integrated upconverter. The Cisco uBR10-MC5X20U/H cable interface line card supports Annex B and Annex A radio frequency (RF) data rates, channel widths, and modulation schemes and has DOCSIS MAC management and spectrum management capabilities. DOCSIS 2.0, A-TDMA rates are also supported.

For more information, see [Cisco uBR10-MC5X20S/U/H Cable Interface Line Card Hardware Installation Guide](#).

Cisco UBR-MC20X20V Cable Interface Card

The Cisco UBR-MC20X20V cable interface line card is a 20 by 16 inch card designed specifically for the Cisco uBR10012 universal broadband router. This card transmits and receives RF signals between the subscriber and the headend over hybrid fiber-coaxial (HFC) system. It has five downstream (DS) ports and twenty upstream (US) ports. The line card supports five cable MAC domains (cable interfaces), and the 20 DS and 20 US channels are dynamically associated with any of these five MAC domains. The card has twenty US spigots and five DS spigots. Each of the US spigots supports either two-frequency stacked US channels across ten ports or a single US channel across twenty ports. Each of the DS spigots supports four-frequency stacked channels across five ports.



Note

You must ensure that two DOCSIS Timing, Communication and Control (DTCC) cards are configured on the Cisco uBR10012 router before installing the Cisco UBR-MC20X20V cable interface line card.

For more information, refer to [Cisco UBR-MC20X20V Cable Interface Line Card Hardware Installation Guide](#).

Cisco uBR-MC3GX60V Cable Interface Card

The Cisco uBR-MC3GX60V cable interface line card is a DOCSIS 3.0 compliant line card designed specifically for the Cisco uBR10012 universal broadband router. This line card conforms to the Modular CMTS (M-CMTS) architecture and has the capacity to support up to 72 downstream (DS) and 60 upstream (US) channels.

The Cisco uBR-MC3GX60V cable interface line card has 20 US spigots for RF connectivity, which are organized into 5 groups of 4 connectors each. Each connector group supports up to 12 frequency-stacked US channels, with a default configuration of 3 US channels per RF connector.

The Cisco uBR-MC3GX60V cable interface line card has six Gigabit Ethernet (GE) interface ports organized into three pairs for DS connectivity. Each pair supports 1+1 redundancy and supports 24 DS channels in Annex B mode by default. The GE interfaces connect to an external Edge Quadrature Amplitude Modulation (EQAM) device and provide M-CMTS compliant Downstream External PHY Interface (DEPI) data.

Another unique feature of the Cisco uBR-MC3GX60V cable interface line card is the use of a front panel display (FPD) to show the licensing status information of the US and DS channels.

For detailed information, refer to [Cisco uBR-MC3GX60V Cable Interface Line Card Hardware Installation Guide](#).

Cisco uBR-MC3GX60V-RPHY Cable Interface Card

The Cisco uBR-MC3GX60V-RPHY line card is DOCSIS 3.0 compliant and is designed for the Cisco uBR10012 universal broadband router. This line card conforms to the Modular CMTS (M-CMTS) architecture and has the capacity to support up to 72 downstream (DS) and 60 upstream (US) channels.

The Cisco uBR-MC3GX60V-RPHY line card has six Gigabit Ethernet interface ports organized into three pairs, which connect to the Cisco Coaxial Media Converter device via EPON, GPON, or Metro Ethernet. Each pair supports 1+1 redundancy for the Metro Ethernet ports. The

Cisco uBR-MC3GX60V-RPHY line card supports 24 downstream RF channels and 20 upstream RF channels per Gigabit Ethernet port. It has a front panel display (FPD) to show the licensing status information of the US and DS channels. For detailed information, refer to [Cisco Remote-PHY Solution Workflow](#).

Network Uplink Cards

The following sections describe the network uplink cards used in the Cisco uBR10012 universal broadband router:

- [Cisco Single Port Gigabit Ethernet Line Card, page 1-30](#)
- [Cisco Half-Height Gigabit Ethernet Line Card, page 1-32](#)
- [Cisco OC-12 POS Line Card, page 1-32](#)
- [Cisco uBR10-SRP-OC12SML DPT WAN Line Card, page 1-34](#)
- [Cisco uBR10012 OC-48 DPT/POS Interface Module, page 1-34](#)

Cisco Single Port Gigabit Ethernet Line Card

The single-port Gigabit Ethernet (GE) line card provides a trunk uplink to devices such as GSRs, as well as connections to content servers and Web caches. The GE line card provides the Cisco uBR10012 router with an IEEE 802.3z compliant Ethernet interface running at 1 Gbps in full duplex mode.

The port uses a Gigabit Interface Converter (GBIC) that supports Gigabit Ethernet rates on a variety of Gigabit Ethernet interface types (SX, LX/LH, ZX) which can be changed or upgraded at any time (see [Table 1-9](#)). The Cisco uBR10012 router supports multiple GE line cards to support connectivity to multiple destinations and to provide network layer redundancy.



Warning

Class 1 laser product. Statement 1008.



Warning

Invisible laser radiation present. Statement 1016.



Warning

Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. Statement 1056.

Warning Statement for Sweden



Warning

Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen. Statement 36.

Warning Statement for Finland

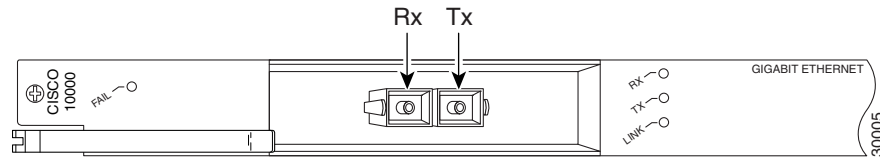


Warning

Alleviätes ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen. Statement 35

Figure 1-15 shows the faceplate for the Gigabit Ethernet line card.

Figure 1-15 Gigabit Ethernet Line Card Faceplate



Cisco Gigabit Ethernet Line Card LEDs

Table 1-8 describes the LEDs on the Gigabit Ethernet line card.

Table 1-8 Gigabit Ethernet Line Card LEDs and Their Functions

LED	Color/Status	Description
FAIL	Yellow	A major failure has disabled the line card
	Off	The line card is operating properly
RX (receive)	Green	Receiving traffic
	Off	Not receiving traffic
TX (transmit)	Green	Transmitting traffic
	Off	Not transmitting traffic
LINK	Green	Carrier detected; the port is able to pass traffic
	Off	No carrier detected; the port is not able to pass traffic

GBIC Specifications

Table 1-9 lists the GE line card GBICs and their respective cable types and lengths.

Table 1-9 GBIC Port Cabling Specifications

GBIC	Wavelength (nm)	Fiber Type	Core Size, microns	Modal Bandwidth, MHz/km	Cable Distance, feet/meters
1000Base-SX ESR-GBIC-SX	850	MMF	62.5	160	722 ft (220 m)
			62.5	200	902 ft (275 m)
			50.0	400	1640 ft (500 m)
			50.0	500	1804 ft (550 m)
1000Base-LX/LH ESR-GBIC-LH	1300	MMF ¹	62.5	500	1804 ft (550 m)
			50.0	400	1804 ft (550 m)
			50.0	500	1804 ft (550 m)
		SMF	8 to 10	—	32,808 ft (10 km)
1000Base-ZX ESR-GBIC-ZX	1550	SMF	Not conditional	N/A	43.5 miles (70 km) to 62 miles (100 km) ²

1. Mode-conditioning patch cord (CAB-GELX-625 or equivalent) is required. If you use an ordinary patch cord with MMF, 1000Base-LX/LH GBICs, and a short link distance (tens of meters), this can cause transceiver saturation, resulting in an elevated bit error rate (BER). In addition, when you use the LX/LH GBIC with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord between the GBIC and the MMF cable on both the transmit and receive ends of the link. The mode-conditioning patch cord is required for link distances greater than 984 ft (300 m).
2. 100 km over premium single-mode fiber or dispersion shifted single-mode fiber.

Cisco Half-Height Gigabit Ethernet Line Card

The Cisco HHGE line card contains a single Gigabit Ethernet port that provides a trunk uplink to switches and core routers. The Cisco HHGE line card provides an IEEE 802.3z compliant Ethernet interface that can run up to 1 Gbps in full duplex mode. The line card uses a Small Form-factor Pluggable (SFP) Gigabit interface converter (GBIC) module that supports a variety of Gigabit Ethernet interface types (SX LX/LH, and ZX), which you can change or upgrade at any time.



Note

Only SFP GBIC modules purchased from Cisco work with the Gigabit Ethernet line card software.

For more information, see [Cisco uBR10012 Universal Broadband Router Gigabit Ethernet Half-Height Line Card Installation](#).

Cisco OC-12 POS Line Card

The OC-12 POS card provides a trunk uplink that supports up to 622 Mbps over a standard SONET/SDH interface using a single-mode fiber intermediate reach SC connector.



Warning

Class 1 laser product. Statement 1008.



Warning

Invisible laser radiation present. Statement 1016.

**Warning**

Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. Statement 1056.

Warning Statement for Sweden

**Warning**

Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen. Statement 36.

Warning Statement for Finland

**Warning**

Alleviätes ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen. Statement 35

Figure 1-16 shows the faceplate for the Cisco OC-12 POS line card.

Figure 1-16 Cisco OC-12 POS Line Card Faceplate

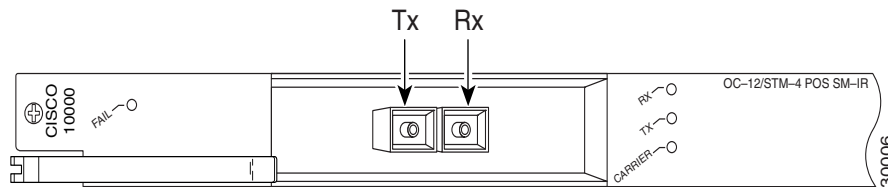


Table 1-10 lists the cable specifications for the Cisco OC12 POS card.

Table 1-10 Cisco OC-12 POS Line Card Cable Specifications

Fiber Type	Wavelength, nm	Core Size, microns	Cable Distance
Single Mode Fiber	1300	8 to 10	49,213 ft (15 km)

Cisco OC-12 POS Line Card LEDs

Table 1-11 describes the LEDs and their functions on the Cisco OC-12 POS line card.

Table 1-11 Cisco OC-12 POS Line Card LEDs and Their Functions

LED	Color/Status	Description
FAIL	Yellow	A major failure has disabled the line card
	Off	The line card is operating properly
RX (receive)	Green	Receiving traffic
	Off	Not receiving traffic

Table 1-11 Cisco OC-12 POS Line Card LEDs and Their Functions (continued)

LED	Color/Status	Description
TX (transmit)	Green	Transmitting traffic
	Off	Not transmitting traffic
CARRIER	Green	Carrier detected; the port is able to pass traffic
	Off	No carrier detected; the port is not able to pass traffic

Cisco uBR10-SRP-OC12SML DPT WAN Line Card

The Cisco uBR10 Spatial Reuse Protocol (SRP) OC12 single-mode fiber, long-reach (SML) dynamic packet transport (DPT) WAN line card provides shared IP over SONET capability for the Cisco uBR10012 router platform.

For more information, see [Cisco uBR10-SRP-OC12SML/SMI DPT Adapter Card for the Cisco uBR10012 Universal Broadband Router](#).

Cisco uBR10012 OC-48 DPT/POS Interface Module

The Cisco uBR10012 OC-48 dynamic packet transport (DPT) and packet-over-SONET interface module is a full-height line card for the Cisco uBR10012 universal broadband router. This card provides trunk uplink capabilities that support up to 1.4 Gbps full duplex throughput over a standard SONET/ITU-T Synchronous Digital Hierarchy (SDH) interface, using a single mode fiber with SC connectors.

Two versions of the Cisco uBR10012 OC-48 DPT/POS interface module are available— short reach (SR) or long reach (LR). Both versions work with the performance routing engine (PRE).

The Cisco uBR10012 OC-48 DPT/POS interface module provides a point-to-point connection to a backbone router and encapsulates IP Packets with byte-wise HDLC framing, placing them directly into the OC-48 SONET (or SDH) payload.

The Cisco uBR10012 OC-48 DPT/POS interface module is a standard implementation of packet over SONET switching, and supports the following features:

- OC-48 bandwidth between the line card and the PRE.
- North American (SONET) and European (SDH) formats
- Automatic protection switching (APS)
- Alarm processing



Note

Two Cisco uBR10012 OC-48 DPT/POS interface modules are required when using the card when using the card in DPT mode in a Cisco uBR10012 universal broadband router.

For more information, see [Cisco uBR10012 OC-48 DPT/POS Interface Module](#).

Optical Connectors and Cables

For single-mode optical fiber connections, use one duplex SC-type cable (see [Figure 1-17](#)), or two simplex SC-type cables (see [Figure 1-18](#)), one for transmit (Tx) and one for receive (Rx).

For optical connector and cable cleaning information, go to the following URL:

http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml

Figure 1-17 Duplex SC-Type Cable and Connector

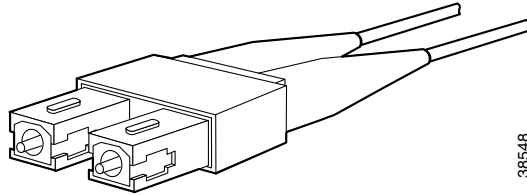
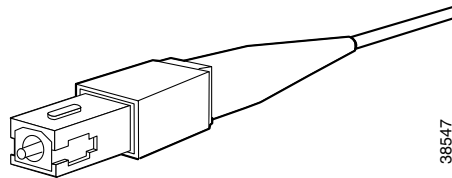


Figure 1-18 Simplex SC-Type Cable and Connector



These tables list the proper single-mode or multimode optical fiber cables to use to connect your router to a network:

- [Table 1-9](#), for the Gigabit Ethernet line card
- [Table 1-10](#), for the OC-12 POS line card

Cisco uBR10012 Router FRU Resources

The following section lists the field-replaceable units (FRUs), FRU product order numbers, and provides links to specific FRU documentation.

FRU Modules and Order Numbers

[Table 1-12](#) lists the major FRUs used in the Cisco uBR10012 router.

Table 1-12 Cisco uBR10012 Field-Replaceable Units and Product Order Numbers

Field-Replaceable Unit	Product Order Number
Chassis Components	
Performance routing engine (PRE) with 512 MB DRAM	End of life (EOL), replace with ESR-PRE
PRE 512 MB DRAM (spare)	EOL, replace with ESR-PRE/R
PRE1 (primary and redundant)	ESR-PRE1

Table 1-12 Cisco uBR10012 Field-Replaceable Units and Product Order Numbers (continued)

Field-Replaceable Unit	Product Order Number
PRE1 (spare)	ESR-PRE1/R=
PRE2 (primary and redundant)	ESR-PRE2/R
PRE2 (spare)	ESR-PRE2=
PRE4 (primary and redundant)	ESR-PRE4
PRE4 (spare)	ESR-PRE4/R=
PRE PC media card—64 MB (default)	10000-PREMEMFD64=
PRE PCM media card—128 MB	ESR-PRE-MEM-FD128=
Blank PRE1 slot cover	ESR-PRE-Cover=
TCC+ card	UBR10-TCC+-T1=
Blank TCC+ card slot cover	UBR10-TCC+-COVER=
DC power entry module (2400 W or 3000 W)	UBR10-PWR-DC=
DC power entry module (3300 W)	UBR10-PWR-DC-PLUS=
AC power entry module (2400 W)	UBR10-PWR-AC=
AC power entry module (3300 W)	UBR10-PWR-AC-PLUS=
Fan assembly module (spare)	UBR10-FAN-ASSY=
Fan assembly module (spare)	UBR10012-FAN-PLUS=
Fan assembly filter (spare)	UBR10-FAN-FILTER=
Front cover (spare)	UBR10-CHAS-COVER=
Power supply monitoring cable for the AC power shelf alarm	UB10-PWR-MON-CAB=
Cable Interface Line Cards	
Line Card Processor (spare)	UBR10-LCP2=
Cisco uBR10-MC5X20S cable interface line card	UBR10-MC5X20S=
Cisco uBR10-MC5X20U cable interface line card	UBR10-MC5X20U=
Cisco UBR-MC20X20V cable interface line card	UBR-MC20X20V-20D=, UBR-MC20X20V-5D=, UBR-MC20X20V-0D=
Cisco uBR-MC3GX60V cable interface line card	UBR-MC3GX60V=
Cisco uBR-MC3GX60V-RPHY cable interface line card	UBR-MC3GX60V-RPHY, UBR-MC3GX60V-RPHY=
Blank cable interface line card cover	UBR10-MC-COVER=
Network Line Cards	
Cisco Single Port Gigabit Ethernet line card (GigE)	UBR10-1GE, UBR10-1GE=
1000Base-SX—pluggable transceiver	ESR-GBIC-SX
1000Base-LX/LH—pluggable transceiver	ESR-GBIC-LH
1000Base-ZX—pluggable transceiver	ESR-GBIC-ZX

Table 1-12 Cisco uBR10012 Field-Replaceable Units and Product Order Numbers (continued)

Field-Replaceable Unit	Product Order Number
Cisco Half-Height Gigabit Ethernet line card	ESR-HH-1GE
Slot splitter card	ESR-HH-CARRIER
Half height slot blank cover	ESR-HH-COVER
Full height slot blank cover	ESR-COVER
1000Base-SX—pluggable transceiver	SFP-GE-S
1000Base-LX/LH—pluggable transceiver	SFP-GE-L
1000Base-TX—pluggable transceiver	SFP-GE-T
1000Base-ZX—pluggable transceiver	GLC-ZX-SM
Cisco OC12/STS12c/STM4 POS, single mode, intermediate reach line card	UBR10-OC12/P-SMI=
Cisco uBR10-SRP-OC12SML DPT WAN adapter card	UBR-SRP-OC12SML=
Cisco uBR10012 OC-48 DPT/POS Interface Module	
Single mode ¹ , short reach modules	UBR10-SRP-OC48SMS
Single spare ²	ESR1OC48/P/SRPSMS=
Single mode ¹ , long reach modules	UBR10-SRP-OC48SML=
Single spare ²	ESR1OC48/P/SRPSML=
Blank network line card cover	ESR-LC-COVER=

1. Use this number to order the dual interface modules.

2. Use this number to order a single interface module.

**Note**

The output of the **show inventory** command does not display the serial numbers for the fan assembly modules (UBR10-FAN-ASSY and UBR10012-FAN-PLUS), AC PEMs (UBR10-PWR-AC and UBR10-PWR-AC-PLUS), and DC PEMs (UBR10-PWR-DC and UBR10-PWR-DC-PLUS). Visually inspect the serial number labels printed on these FRUs to locate the serial number.

FRU Documentation

Table 1-13 lists the Cisco field replaceable unit (FRU) documentation for the modules and interface line cards that are used in the Cisco uBR10012 router and the corresponding URL where that documentation can be found. Refer to the FRU documentation for more detailed information and installation instructions for each module or card.

Table 1-13 Cisco FRU Document Title and URL

Document title	<i>2400W AC-Input Power Shelf for the Cisco uBR10012 Universal Broadband Router</i>
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ubr10acsh.html
Document title	<i>AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router</i>
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ubr10acpm.html
Document title	<i>3300 W AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router</i>
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ubr10acpem_HornBill.html
Document title	<i>DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router</i>
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ubr10dcpem.html
Document title	<i>3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router</i>
URL	http://www.cisco.com/en/US/partner/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ubr10dcpem_Hornbill.html
Document title	<i>Cisco uBR10012 Universal Broadband Router Fan Assembly Module</i>
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/fan5093.html
Document title	<i>Cisco LCD Module for the Cisco uBR10012 Universal Broadband Router</i>
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/lcd5090.html
Document title	Cisco uBR10012 Universal Broadband Router TCC+ Card
URL	http://www.cisco.com/en/US/docs/interfaces_modules/cable/installation/tcc5094.html
Document title	Cisco uBR10012 Universal Broadband Router DTCC Card
URL	http://www.cisco.com/en/US/partner/docs/interfaces_modules/cable/installation/dtcccard.html
Document title	<i>Cisco uBR10-SRP-OC12SML DPT WAN Line Card for the Cisco uBR10012 Router</i>
URL	http://www.cisco.com/en/US/docs/interfaces_modules/cable/line_cards/ubr_srp_oc12sml_dpt_wan/quick/start/ubr10oc12.html
Document title	<i>Performance Routing Engine Module for the Cisco uBR10012 Universal Broadband Router</i>
URL	http://www.cisco.com/en/US/docs/interfaces_modules/cable/performance_routing_engine/installation/guide/pre5096.html

Table 1-13 Cisco FRU Document Title and URL (continued)

Document title URL	<i>Installing EMI Gaskets and RF Absorber Material on the Cisco uBR10012 Universal Broadband Router</i> http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/pre2gkit.html
Document title URL	<i>Cisco uBR10-MC5X20S/U Cable Interface Line Card</i> http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr10_mc5x20s_u_h/installation/guide/ubrmc520.html
Document title URL	<i>Cisco UBR-MC20X20V Cable Interface Line Card Hardware Installation Guide</i> http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr_mc20x20v/installation/guide/mc20x20v_hig.html
Document title URL	<i>Cisco UBR-MC3GX60V Cable Interface Line Card Hardware Installation Guide</i> http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr_mc3gx60v/installation/guides/b_3g60_1chig.html
Document title URL	<i>Cisco Remote-PHY Solution Workflow</i> http://www.cisco.com/web/techdoc/cable/cisco-remote-phy/index.html
Document title URL	<i>Cisco Half-Height Gigabit Ethernet Line Card</i> http://www.cisco.com/en/US/docs/interfaces_modules/cable/line_cards/ubr_hh_ge/quick/start/ubr_hhge.html
Document title URL	<i>Inspection and Cleaning Procedures for Fiber-Optic Connections</i> http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml



Preparing for Installation

Before you install the Cisco uBR10012 universal broadband router, consider:

- The power and cabling requirements that must be in place at your installation sites
- The equipment required to install the router
- The environmental conditions your installation site must meet to maintain normal operation

This chapter guides you through the process of preparing for your router installation.

Do not unpack the system until you are ready to install it. Keep the chassis in the shipping container to prevent accidental damage until you determine an installation site.



Note

The Cisco uBR10012 router (using DC power supplies) is not shipped with wiring to connect to a DC power source. You must provide input, return, and earthing (grounding) wiring at the site, and install and protect the wiring in accordance with local and national wiring regulations (see [Table 3-4](#)).

Safety

When you install the Cisco uBR10012 router, observe all of the following caution and warning statements. For warning translations, refer to the regulatory compliance and safety documentation at the following URL:

<http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/regulatory/compliance/ub10rcsi.html>

The following guidelines will help ensure your safety and protect the equipment. However, these guidelines may not cover all potentially hazardous situations you may encounter during system installation, so *be alert*.

- The installation of your Cisco uBR10012 router must comply with national and local electrical codes. In the United States, this means the National Fire Protection Association (NFPA) 70, United States National Electrical Code. In Canada, Canadian Electrical Code, part I, CC22.1. In other countries, International Electrotechnical Commission (IEC) 364, part 1 through part 7.
- Review the safety warnings listed in the regulatory compliance and safety documentation before installing, configuring, or performing maintenance on the product.
- Always disconnect power at the source before you install or remove a chassis.
- Never attempt to lift an object that might be too heavy to lift safely by yourself.
- Keep the chassis area clear and as dust free as possible during and after installation.
- Keep tools and chassis components away from walk areas.

- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the chassis.
- The Cisco uBR10012 router operates safely when it is used in accordance with its marked electrical ratings and product usage instructions.

**Warning**

Only trained and qualified personnel should be allowed to install, replace, or service this equipment. Statement 1030.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage, which occurs when electronic cards or components are improperly handled, can result in complete or intermittent failures. The performance routing engine (PRE), and all line cards consist of a printed circuit card that is fixed in a metal carrier. Electromagnetic interference (EMI) shielding and connectors are integral components of the carrier. Although the metal carrier helps to protect the cards from ESD, use an antistatic strap each time you handle the modules. Handle the carriers by the edges only; never touch the cards or connector pins.

**Caution**

Always tighten the captive installation screws on all system components when you are installing them. These screws prevent accidental removal of the module, provide proper grounding for the system, and help to ensure that the bus connectors are properly seated in the backplane.

Following are guidelines for preventing ESD damage:

- Always use an ESD-preventive wrist or ankle strap and ensure that it makes good skin contact. Before removing a card from the chassis, connect the equipment end of the strap to a bare metal, unpainted surface on the chassis or rackmount.
- Handle line cards by the faceplates and carrier edges only; avoid touching the card components or any connector pins.
- When removing a line card, place the removed module component-side-up on an antistatic surface or in a static-shielding bag. If the module will be returned to the factory, immediately place it in a static-shielding bag.
- Avoid contact between the modules and clothing. The wrist strap protects the card from ESD voltages on the body only; ESD voltages on clothing can still cause damage.

**Caution**

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

Chassis-Lifting Guidelines

The Cisco uBR10012 chassis is not intended to be moved frequently. When fully populated, the Cisco uBR10012 system weighs approximately 230 pounds. A depopulated chassis weighs approximately 55 pounds.

When moving the chassis, use the following guidelines to prevent injury and damage to the equipment:

- Before you install the system, ensure that your site is properly prepared so you can avoid having to move the chassis later to accommodate power sources and network connections.
- A fully populated chassis should be moved only with a hydraulic lift or forklift. Do not attempt to manually lift a populated chassis.
- Two people are required to safely move a depopulated chassis. This should be done by using the handles on each side of the chassis.



Warning

To prevent personal injury or damage to the chassis, never attempt to lift or tilt the chassis using the handles on modules (such as power supplies, fans, or cards); these types of handles are not designed to support the weight of the unit. Statement 1032

- Never attempt to lift even a depopulated chassis by yourself. Because of the size and weight of the chassis, use at least two people to safely lift and move it without causing injury or damaging the equipment.
- To prevent injury, keep your back straight and lift with your legs, not your back.
- Ensure that your footing is solid, and balance the weight of the chassis between your feet.
- Lift the chassis slowly; never move suddenly or twist your body as you lift.
- Keep your back straight and lift with your legs, not your back. If you must bend down to lift the chassis, bend at the knees, not at the waist, to reduce the strain on your back muscles.
- If you have to move a fully populated chassis and you do not have a hydraulic lift or forklift available, you must first remove the following components from the chassis:
 - Fan assembly module
 - AC or DC power entry modules (PEMs)
 - Cable interface line cards
 - Network uplink line cards

In a fully loaded chassis, these components weigh approximately 170 pounds, so removing them allows the chassis to be safely moved with two people. The components can then be reinserted after the chassis has been moved and installed. See [Chapter 5, “Maintaining the Cisco uBR10012 Router”](#) for instructions on removing these components.



Caution

When removing and reinstalling these modules, be certain to follow the precautions given in the [“Preventing Electrostatic Discharge Damage”](#) section on page 2-2.

- Always disconnect all external cables before lifting or moving the chassis. In particular, verify that all power to the chassis has been removed. Do not try to move a chassis that is connected to power or that is powered on.

Electrical Safety

All system components are hot-swappable. They are designed to be removed and replaced while the system is operating without presenting an electrical hazard or damage to the system.

Follow these basic guidelines when you are working with any electrical equipment:

- Before beginning any procedures requiring access to the chassis interior, locate the emergency power-off switch for the room in which you are working.
- Disconnect all power and external cables before installing or removing a chassis.
- Do not work alone when potentially hazardous conditions exist.
- Never assume that power has been disconnected from a circuit; always check.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe. Never install equipment that appears damaged.
- Carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.



Warning

When installing or replacing the unit, the ground connection must always be made first and disconnected last. Statement 1046



Warning

Do not work on the system or connect or disconnect cables during periods of lightning activity. Statement 1001



Warning

Read the installation instructions before you connect the system to its power source. Statement 1004

Site Requirements

This section provides information for environmental, power, cabling, and rack mounting requirements. Be sure that you have met all of these requirements before you install your Cisco uBR10012 router.



Caution

The Cisco uBR10012 router installation must comply with all applicable codes and is approved for use with copper conductors only. The ground bond fastening hardware should be of compatible material and preclude loosening, deterioration, and electrochemical corrosion of hardware and joined material. Attachment of the chassis ground to a central office or other interior ground system should be made with a 6-AWG, copper ground conductor at a minimum.



Warning

This unit is intended for installation in restricted access areas. A restricted access area can be accessed only through the use of a special tool, lock and key, or other means of security. Statement 1017

Environmental Site Requirements

The environmental monitoring functionality in the Cisco uBR10012 router protects the system and components from potential damage from excessive voltage and temperature conditions. To ensure normal operation and avoid unnecessary maintenance, plan your site configuration and prepare your site *before* installation. After installation, make sure the site maintains an ambient temperature of 41°F through 104°F (5°C through 40°C), and keep the area around the chassis as free from dust as is practical.

Planning a proper location for the Cisco uBR10012 router and the layout of your equipment rack or wiring closet is essential for successful system operation. Equipment placed too close together or inadequately ventilated can cause system excessive temperature conditions. In addition, chassis panels made inaccessible by poor equipment placement can make system maintenance difficult.

When you plan the location and layout of your equipment rack or wiring closet, you need to consider how air flows through your router. The Cisco uBR10012 router draws cooling air in through the intake vent on the front of the chassis and moves the air across the internal components and out the exhaust vents on the top rear of the chassis (see [Figure 2-1 on page 2-6](#)).

Temperature sensors on the PRE monitor the internal air temperature and send warning messages and an alarm condition when the internal air temperature approaches a specified threshold.

The front bottom and top rear of the chassis must remain unobstructed to ensure adequate airflow and prevent overheating inside the chassis. Maintain a minimum clearance of 3 in. (7.62 cm) from the vents on the front and back of the chassis to allow for adequate airflow. Do not place the chassis where heated exhaust air from other systems could enter the air intake vent at the bottom front, as this could cause overheating of the system.

In addition, allow for approximately 3 to 4 ft (91.44 cm to 121.92 cm) clearance at the front and rear of the chassis for cabling and normal system maintenance.

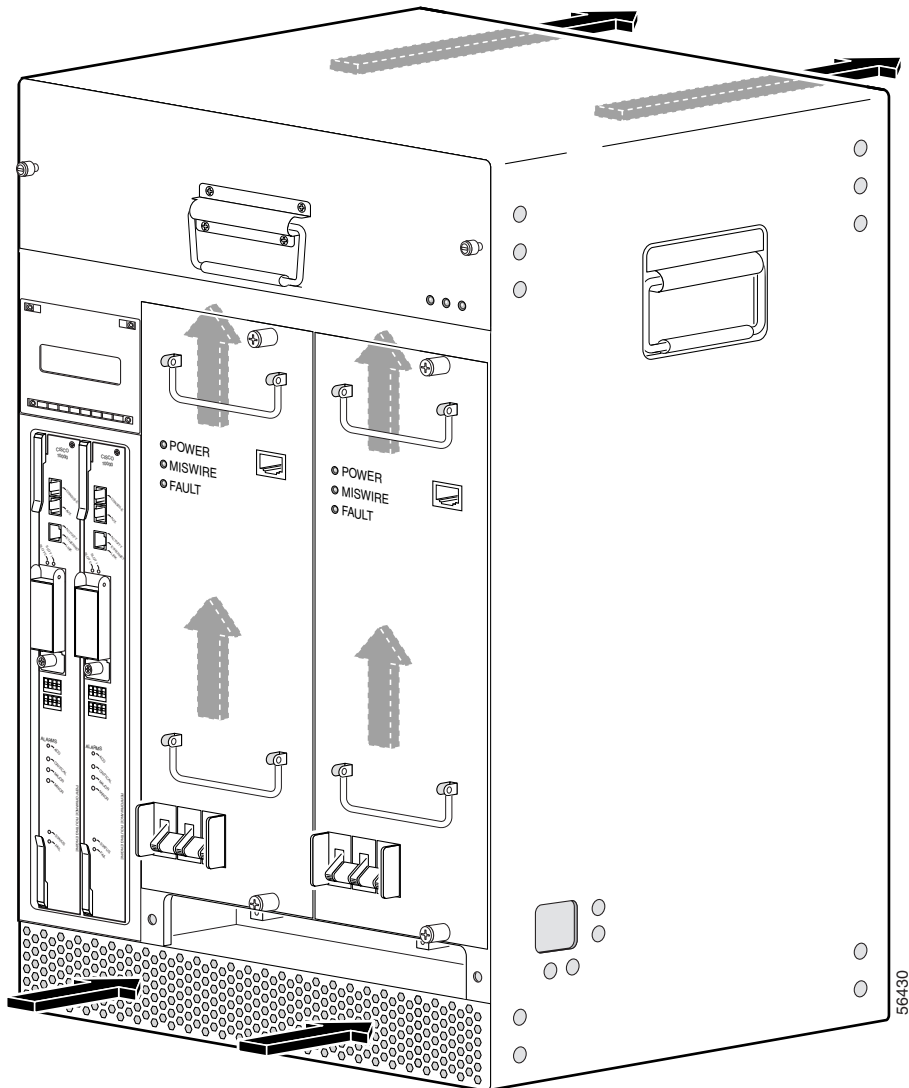


Warning

Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place. Statement 1029

To avoid problems during installation and ongoing operation, follow these general precautions when you plan the equipment locations and connections:

- Use the **show environment** command regularly to check the internal system status. The environmental monitor continually checks the interior chassis environment; it provides warnings for high temperature and creates reports on any occurrences. If warning messages are displayed, take immediate action to identify the cause and correct the problem.
- Keep the Cisco uBR10012 router off of the floor and out of areas that collect dust.
- Follow ESD prevention procedures (see [“Preventing Electrostatic Discharge Damage” section on page 2-2](#)) to avoid damage to equipment. Damage from static discharge can cause immediate or intermittent equipment failure.
- Ensure that the PRE modules, line cards, blank covers, power supplies, and any power supply covers are in place and secure. The fans direct cooling air throughout the chassis interior; a loose component or empty slot can redirect the airflow away from active components.

Figure 2-1 Cooling Air Path for the Cisco uBR10012

Temperature and Humidity Requirements

Table 2-1 lists the operating and nonoperating environmental site requirements. The ranges listed are those within which the Cisco uBR10012 router continues to operate; however, a measurement that is approaching the minimum or maximum of a range indicates a potential problem. You can maintain normal operation by anticipating and correcting environmental anomalies before they approach a maximum operating range.

Table 2-1 Specifications for Operating and Nonoperating Environments

Specification	Minimum	Maximum
Temperature, ambient operating	41°F (5°C)	104°F (40°C)
Temperature, ambient nonoperating and storage	-40°F (-40°C)	158°F (70°C)
Humidity, ambient (noncondensing) operating	5%	85%
Humidity, ambient (noncondensing) nonoperating and storage	5%	95%
Altitude, operating (over allowable temperature)	32°F -200 ft (-60.9 m)	104°F (40°C) 10,000 ft (3048 m)
Altitude, nonoperating (over allowable temperature)	-200 ft (-60.9 m)	30,000 ft (9144 m)

Power Guidelines



Caution

The Cisco uBR10012 router installation must comply with all applicable codes and is approved for use only with copper conductors. The ground bond fastening hardware should be of compatible material and preclude loosening, deterioration, and electrochemical corrosion of hardware and joined material. Attachment of the chassis ground to a central office or other interior ground system should be made with a minimum of a 6-AWG, copper ground conductor.

Follow these precautions and recommendations when planning power connections to the Cisco uBR10012 router:

- Ensure that you are using proper cables and have circuit breakers installed.
- Check the power at your site before installation and periodically after installation to ensure that you are receiving clean power. Install a power conditioner if necessary.
- Provide proper grounding to avoid damage from lightning and power surges.
- Use a 6-AWG, copper ground conductor (minimum requirement) when attaching the chassis ground to a central office or other interior ground system. An insulation rating of 167° Fahrenheit (75° Celsius) is required for the 6-AWG wire for 3000 W of power.



Warning

This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations. Statement 1045



Warning

A readily accessible two-poled disconnect device must be incorporated in the fixed wiring. Statement 1022

Power Connection Guidelines for DC-Powered Systems

The DC-input power supply allows the Cisco uBR10012 router to operate on either –48 or –60 VDC systems. Both these power supplies can operate with an input from –40.5 to –72 VDC with no harm; however, the input should be restricted to the nominal ranges defined in [Table 2-2](#) to maintain safety extra-low voltage (SELV) compliance, and to deliver the rated power at the allowed current levels. [Table 2-2](#) summarizes the power output, DC-input voltage, and DC-input current values for the DC PEM.

Table 2-2 Power Output, DC-input Voltage, and DC-input Current Values for the DC PEM

Cisco Product Part Number	Cisco DC PEM (Part Number) ¹	Power Output	DC-input Voltage	DC-input Current
UBR10-PWR-DC=	34-1651-04	2400W maximum	–48 to –60 VDC nominal	50A
	34-1651-05	2400W maximum	–48 to –60 VDC nominal	50A
		3000W maximum	–55 to –60 VDC nominal	56A
UBR10-PWR-DC-PLUS=	341-0388-01	3300 W maximum	–48 to –60 VDC nominal	50 A + 50 A

1. The 34- part number is listed on the compliance label of the DC PEM.



Warning

Connect the unit only to DC power source that complies with the safety extra-low voltage (SELV) requirements in IEC 60950 based safety standards. Statement 1033



Note

The Cisco uBR10012 router (using DC power supplies) is not shipped with wiring to connect to a DC power source. You must provide input, return, and earthing (grounding) wiring at the site, and install and protect the wiring in accordance with local and national wiring regulations. The Cisco uBR10012 router input DC terminal block accepts a minimum of 6-AWG wire. An insulation rating of 167° Fahrenheit (75° Celsius) is required for the 6-AWG wire for 3000W of power.

See [Appendix A, “Technical Specifications,”](#) for system power specifications, including input voltage and operating frequency ranges.



Warning

Connect the unit only to DC power source that complies with the safety extra-low voltage (SELV) requirements in IEC 60950 based safety standards. Statement 1033

Plant Wiring Guidelines

When planning the location of the new system, consider the distance limitations for signaling, EMI, and connector compatibility, as described in the following sections.



This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations. Statement 1045

Interference Considerations

When wires are run for any significant distance in an electromagnetic field, interference can occur between the field and the signals on the wires. This fact has two implications for the construction of plant wiring:

- Bad wiring practice can result in radio interference emanating from the plant wiring.
- Strong EMI, especially when it is caused by lightning or radio transmitters, can destroy the signal drivers and receivers in the Cisco uBR10012 router, and can even create an electrical hazard by conducting power surges through lines and into equipment. (Review the safety warnings in the [“Preventing Electrostatic Discharge Damage”](#) section on page 2-2.)



Note To predict and remedy strong EMI, you may also need to consult experts in radio frequency interference (RFI).

If you use twisted-pair cable in your plant wiring with a good distribution of grounding conductors, the plant wiring is unlikely to emit radio interference. If you exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

If wires exceed recommended distances, or if wires pass between buildings, give special consideration to the effect of a lightning strike in your vicinity. The electromagnetic pulse caused by lightning or other high-energy phenomena can easily couple enough energy into unshielded conductors to destroy electronic devices. If you have had problems of this sort in the past, you may want to consult experts in electrical surge suppression and shielding.

Cabling Guidelines

The size of your networks and the distances between connections depend on the type of signal, the signal speed, and the transmission media (the type of cabling used to transmit the signals). For example, standard coaxial cable has a greater channel capacity than twisted-pair cabling. The distance and rate limits in the following descriptions are the IEEE recommended maximum speeds and distances for signaling; however, you can usually get good results at speeds and distances far greater than these. For example, the recommended maximum rate for V.35 is 2 Mbps, but it is commonly used at 4 Mbps without any problems. If you understand the electrical problems that might arise and can compensate for them, you should get good results with rates and distances greater than those shown here; however, do so at your own risk.

When preparing your site for network connections to the Cisco uBR10012 router, you must consider a number of factors related to each type of interface:

- The type of cabling required for each type (fiber, thick or thin coaxial, foil twisted-pair, or unshielded twisted-pair cabling)

- Distance limitations for each signal type
- The specific cables you need to connect each interface
- Any additional interface equipment you need, such as transceivers, hubs, switches, modems, channel service units (CSUs), or data service units (DSUs)

The extent of your network and the distances between network interface connections depend in part on the following factors:

- Signal type
- Signal speed
- Transmission medium

The distance and rate limits referenced in the following sections are the IEEE-recommended maximum speeds and distances for signaling purposes. Use this information as a guideline in planning your network connections *prior to* installing the Cisco uBR10012 router.

Ethernet and Fast Ethernet Connections

The maximum distances for Ethernet and Fast Ethernet network segments and connections depend on the type of transmission cable being used. The terms 10Base-T and 100Base-T are industry shorthand nomenclature for the following:

- 10 Mbps transmission rate (10), or 100 Mbps transmission rate (100)
- Using baseband technology (Base)
- By means of twisted pair wires (T)

Table 2-3 shows the maximum transmission distances between stations for Ethernet and Fast Ethernet connections.

Table 2-3 Ethernet and Fast Ethernet Maximum Transmission Distances

Transceiver Speed	Cable Type	Transmission Mode	Maximum Distance between Stations
10 Mbps	Category 3	Full and half duplex	328 ft (100 m)
100 Mbps	Category 5	Full and half duplex	328 ft (100 m)

Fiber-Optic Connections

The specifications for single-mode, fiber-optic transmissions are outlined in Table 2-4.

Table 2-4 Fiber-Optic Transmission Characteristics

Characteristic	Permissible Value	Characteristic	Permissible Value
Transmitter output power	-15 to -8 dBm	Wavelength	1261 to 1360 nm
Receiver sensitivity	-28 to -8 dBm	Maximum span	9 miles (14.5 km)



Caution

Do not exceed the specified distance limits.

Rack-Mounting Considerations

The Cisco uBR10012 router should be rack-mounted for proper operation and maintenance. The rack-mounting hardware included with chassis is suitable for standard 19-inch equipment racks and telco-type racks. Optional hardware is available from third-party vendors for mounting in a 23-inch equipment rack.

Mounting Guidelines

**Warning**

The chassis should be mounted on a rack that is permanently affixed to the building. Statement 1049

When planning your rack installation, consider the following guidelines:

- Install the Cisco uBR10012 router in an open rack whenever possible.

**Caution**

To prevent overheating, never install the chassis in an enclosed rack or room that is not properly ventilated or air conditioned.

- Allow sufficient clearance around the rack for maintenance. You need 24 in. (61 cm) of clearance to remove and replace system components.

**Caution**

To prevent the rack from tipping when installing the router in telco racks, ensure that the rack is bolted to the floor and, if necessary, anchored with appropriate fixtures.

- If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack.
- Always install heavier equipment in the lower half of a rack to maintain a low center of gravity and prevent the rack from falling over.
- When mounting this unit in a partially filled rack, load the rack from the bottom to the top, with the heaviest component at the bottom of the rack.

**Note**

This unit should be mounted at the bottom of the rack if it is the only unit in the rack.

- If you plan to use an equipment shelf, ensure that the shelf is constructed to support the weight and dimensions of the chassis. Use the rack-mount kit designed for the Cisco uBR10012 router.
- To mount the chassis between two 19-inch posts or rails, the inner clearance (the width between the *inner* sides of the two posts or rails) must be at least 17.3 in. (44 cm).

**Note**

The height of the chassis is 31.25 in. (79.4 cm).

- When mounting the chassis in 4-post or telco racks, be sure to use all the screws and brackets provided to secure the chassis to the rack posts.
- Install the forward rack-mount brackets before you install the chassis in the rack; and then install the rear brackets.

- If you are also using the optional AC-input power shelf, it should be installed immediately below the Cisco uBR10012 chassis for power cabling convenience. However, install the AC-input power shelf after you install the chassis.
- Ensure that the router is connected to earth ground during normal use.
- Frame ground should be tied to the single building point ground, or the closest return point to building ground.

**Warning**

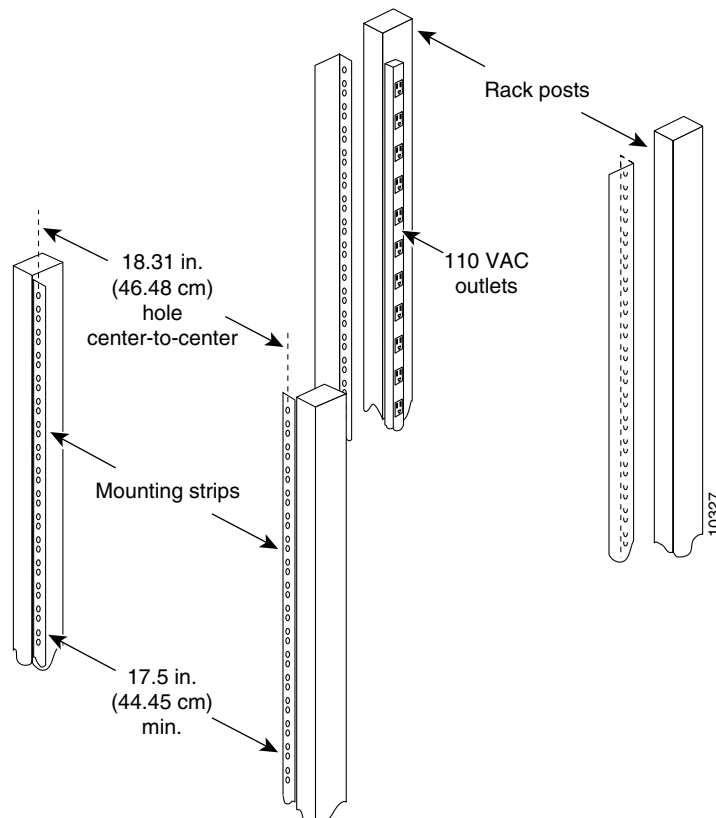
This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available. Statement 1024

Using Power Strips with a Rack-Mount Installation

Some equipment racks provide a power strip along the length of one of the mounting strips. If your rack has a power strip, consider the position of the strip when planning fastener points to ensure that you can slide cards straight out of their respective slots. If the power strip does impair a rack-mount installation, remove the power strip before installing the chassis in the rack, and then replace it after the chassis is installed. See the “[General Rack Installation Guidelines](#)” section on page 3-3 for additional information about rack-mounting your system.

Figure 2-2 shows a typical 19-inch, 4-post equipment rack with a power strip along one of the back posts.

Figure 2-2 Typical 19-Inch Equipment Rack Posts and Mounting Strips





Installing the Cisco uBR10012 Router

This chapter describes the procedures for installing the Cisco uBR10012 universal broadband router in an equipment rack. It also describes how to connect interface and power cables, the proper way to power on the system, and installation troubleshooting procedures.

Installation involves doing the following tasks in the following order:

- [Preparing the Cisco uBR10012 Router for Rack-Mounting, page 3-2](#)
- [Removing the Chassis Components Before Installation, page 3-4](#)
- [Attaching the Mounting Brackets, page 3-9](#)
- [Installing the Cable Management Brackets \(Optional\), page 3-13](#)
- [Mounting the Chassis in the Rack, page 3-19](#)
- [Attaching Ferrite Beads on the Cables, page 3-22](#)
- [Connecting the Chassis to Ground, page 3-25](#)
- [Connecting the External AC-input Power Shelf to the Cisco uBR10012 Router, page 3-28](#)
- [Connecting DC Power to the Cisco uBR10012 Router, page 3-39](#)
- [Connecting Alarm Indicators, page 3-41](#)
- [Connecting the Console Port and Auxiliary Port, page 3-55](#)
- [Installing the Modules, page 3-44](#)
- [Installing the Slot Splitter and Half-Height Gigabit Ethernet Line Card, page 3-47](#)
- [Connecting the Console Port and Auxiliary Port, page 3-55](#)
- [Connecting Network Management Cables, page 3-58](#)
- [Connecting Cable Interface Line Cards and Network Uplink Cards, page 3-61](#)
- [Replacing the Front Cover, page 3-65](#)
- [Powering On the System, page 3-66](#)
- [Configuring the Cisco uBR10012 Router at Startup, page 3-66](#)
- [Formatting PC Media Cards, page 3-71](#)



Warning

This equipment must be installed and maintained by service personnel as defined by AS/NZS 3260. Incorrectly connecting this equipment to a general-purpose outlet could be hazardous. The telecommunications lines must be disconnected 1) before unplugging the main power connector or 2) while the housing is open, or both. Statement 1043

Installation Methods

For stability and ease of use, the Cisco uBR10012 router chassis should be mounted in an equipment rack. The chassis can be mounted in a 19-inch (standard) equipment rack (either the 4-post equipment rack or the telco-type equipment rack) or in a 23-inch rack.

**Note**

For 23-inch racks, optional mounting brackets must be ordered from third-party vendors.

**Caution**

The Cisco uBR10012 router chassis should always be secured in the equipment rack for normal use and operations.

The rack-mount kit that is shipped with the Cisco uBR10012 router includes four mounting brackets for mounting the chassis in a standard 19-inch wide equipment rack (4-post equipment rack or telco-type). One set of mounting brackets is sufficient to properly secure the router chassis, but an additional set can also be ordered for mounting the chassis from the front and the back.

**Note**

Although installing the chassis in a rack-mount is preferred for permanent installations, you can mount the router in an alternate location, such as on an equipment shelf or on a tabletop for testing or diagnostic purposes.

Preparing the Cisco uBR10012 Router for Rack-Mounting

The Cisco uBR10012 router chassis can be installed in a standard 19-inch equipment rack or telco rack, either front or rear mounted, and either flush or offset from the rack.

This section describes the following guidelines and steps that must be followed before rack-mounting the Cisco uBR10012 router:

- [General Rack Installation Guidelines, page 3-3](#)
- [Removing the Chassis Components Before Installation, page 3-4](#)
- [Attaching the Mounting Brackets, page 3-9](#)
- [Installing the Cable Management Brackets \(Optional\), page 3-13](#)

**Caution**

Before performing any of the steps in this section, be certain you have read and understood the guidelines given in [Chapter 2, “Preparing for Installation.”](#)

General Rack Installation Guidelines

When planning your rack installation, consider the following guidelines:

- The Cisco uBR10012 router chassis requires a minimum of 18 rack units (31.5 in. or 80 cm) of vertical rack space. Measure the proposed rack location before mounting the chassis in the rack.
- Before using a particular rack, check for obstructions (such as a power strip) that could impair rack-mount installation. If a power strip does impair a rack-mount installation, remove the power strip before installing the chassis, and then replace it after the chassis is installed.
- Allow sufficient clearance around the rack for maintenance. If the rack is mobile, you can push it back near a wall or cabinet for normal operation and pull it out for maintenance (installing or moving line cards, connecting cables, or replacing or upgrading components). Otherwise, allow 19 in. (48.3 cm) of clearance to remove FRUs.
- Maintain a minimum clearance of 3 in. (7.62 cm) on the front and back of the chassis for the cooling air inlet and exhaust ports, respectively. Avoid placing the chassis in an overly congested rack or directly next to another equipment rack; otherwise, the heated exhaust air from other equipment can enter the inlet air vents and cause an overtemperature condition inside the router.



Caution

To prevent chassis overheating, never install a Cisco uBR10012 router in an enclosed rack or room that is not properly ventilated or air conditioned.

- If also installing the optional AC-input power shelf, allow at least two rack units below the Cisco uBR10012 chassis for the power shelf installation. Install the AC-input power shelf after you have installed the Cisco uBR10012 chassis to avoid the possibility of accidentally crushing the power shelf during the router's installation.
- Cisco recommends installing an optional equipment shelf in the rack for the Cisco uBR10012 chassis because it simplifies installation, but this is not required.
- Always install heavier equipment in the lower half of a rack to maintain a low center of gravity to prevent the rack from falling over. However, if you are also installing an AC-power shelf, leave enough space for the power shelf plus 2 rack units (RUs) underneath the Cisco uBR10012 chassis.
- Ensure that cables from other equipment already installed in the rack do not impair access to the cards, or require you to disconnect cables unnecessarily to perform equipment maintenance or upgrades.
- Install rack stabilizers (if available) before you mount the chassis.
- Provide an adequate chassis ground (earth) connection for your router chassis.

In addition to the preceding guidelines, review the precautions for avoiding excessive temperature conditions in the [“Temperature and Humidity Requirements”](#) section on page 2-7.

Removing the Chassis Components Before Installation

The Cisco uBR10012 router is shipped with all ordered components already installed in the chassis. When fully configured, the Cisco uBR10012 chassis weighs approximately 230 lbs (104.3 kg).

**Caution**

You must use a hydraulic lift or forklift to move a fully populated chassis.

If you have to move a fully populated chassis and you do not have a hydraulic lift or forklift available, you must first remove the following components from the chassis:

- AC or DC power entry modules (PEMs)
- Fan assembly module
- Cable interface line cards
- Network uplink line cards, Slot splitter, and half-height Gigabit Ethernet line cards

In a fully loaded chassis, these components weigh approximately 170 lbs (77.11 kg), removing the components allows the chassis to be moved safely using two people. Reinstall the components after the chassis has been moved and installed. Use the following procedures to remove these components.

Before You Begin

- Make sure that you have an antistatic surface available for the components that you are removing from the chassis.
- Make sure that you are wearing antistatic protection such as a wrist strap or heel strap and are properly grounded.

Removing the Half-Height Gigabit Ethernet Line Card and the Slot Splitters

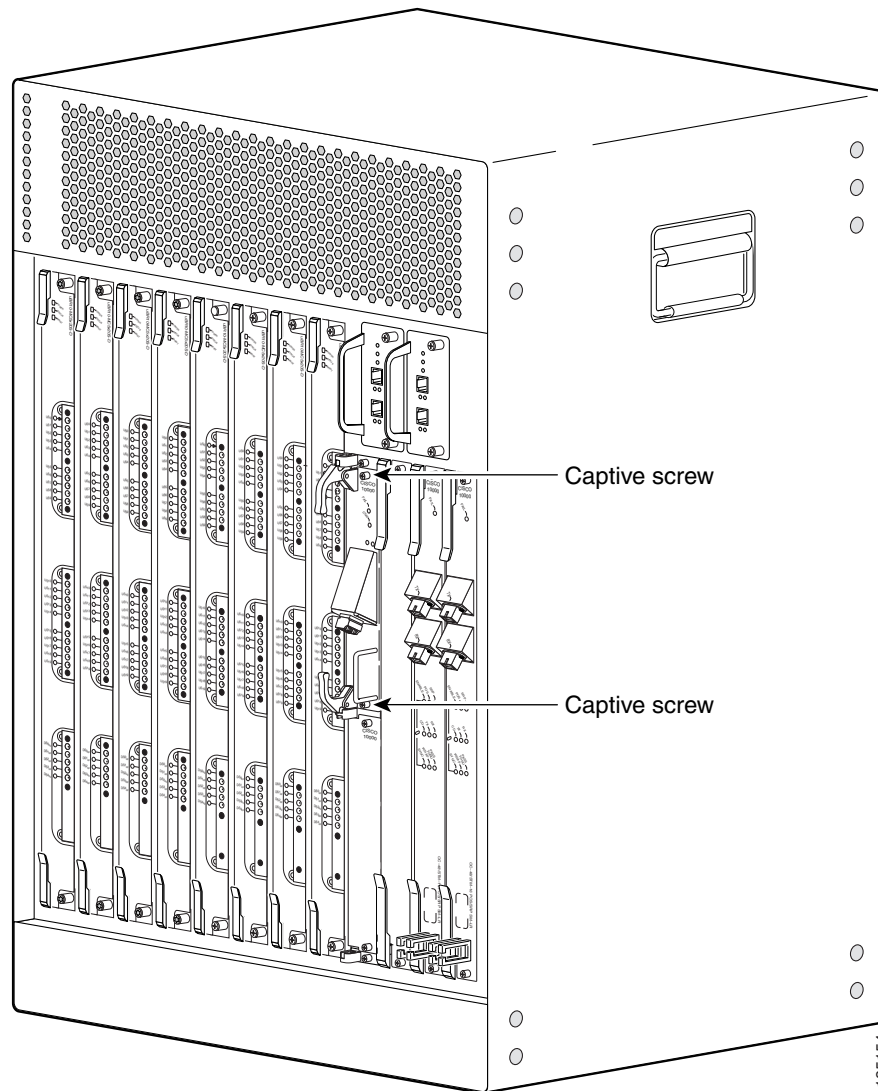
This section describes how to properly remove HHGE line cards and the slot splitter from the chassis. This section includes the following tasks:

- [Removing a Half-Height Gigabit Ethernet Line Card, page 3-4](#)
- [Removing the Slot Splitter, page 3-7](#)

Removing a Half-Height Gigabit Ethernet Line Card

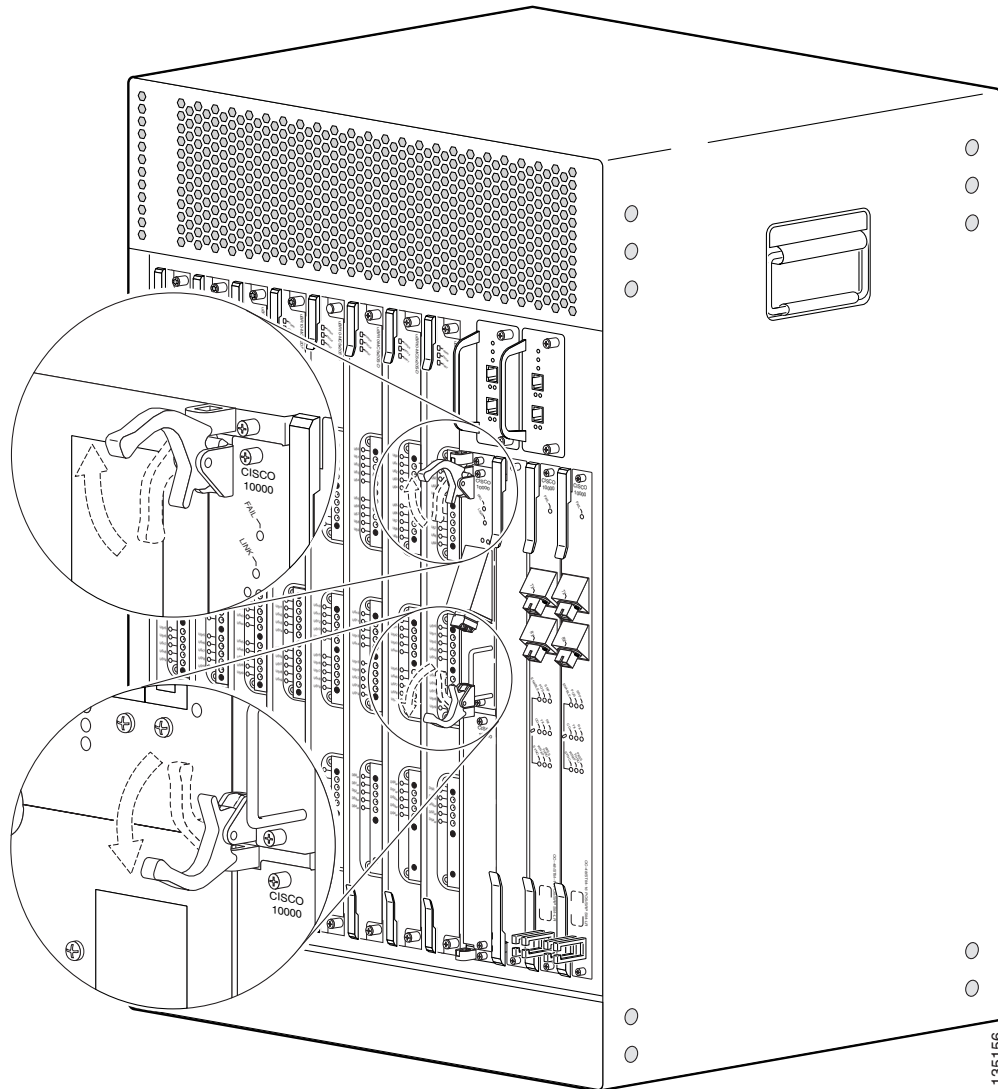
Use the following procedure to remove the HHGE line card from the slot splitter:

-
- Step 1** Verify that you are properly grounded.
- Step 2** Disconnect any network cables connected to the line card port.

Figure 3-1 Captive Screw Locations

- Step 3** Use a screwdriver to loosen the top and bottom captive screws until they disengage and spring away from the face plate (Figure 3-1).
- Step 4** Simultaneously pivot both ejector levers away from each other to disengage the line card from the backplane (Figure 3-2).
- Step 5** Slide the line card out of the slot splitter and place it on an antistatic surface or in an antistatic bag.
- Step 6** If you are not installing a replacement line card, install a blank faceplate in the slot.

Figure 3-2 Opening the Ejector Levers



135156

**Caution**

Do not operate the system unless all slots contain a line card or a blank faceplate. Always install a full-slot blank faceplate into an empty slot. Half-height blank faceplates do not have air dams, and the empty slot will rob cooling air from the other slots. A slot splitter with one half-height line card and one blank faceplate is allowed.

**Warning**

Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.

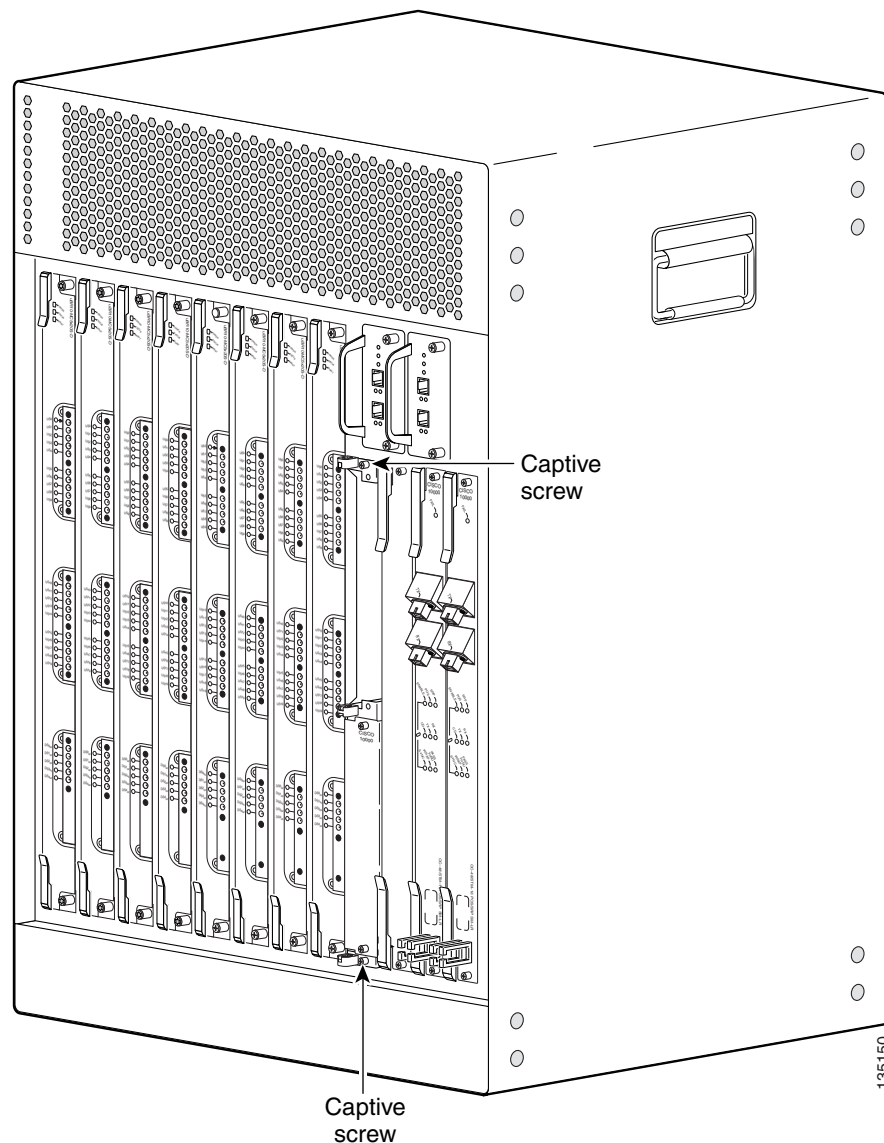
Statement 1029

Removing the Slot Splitter

Use the following procedure to remove a slot splitter from the chassis:

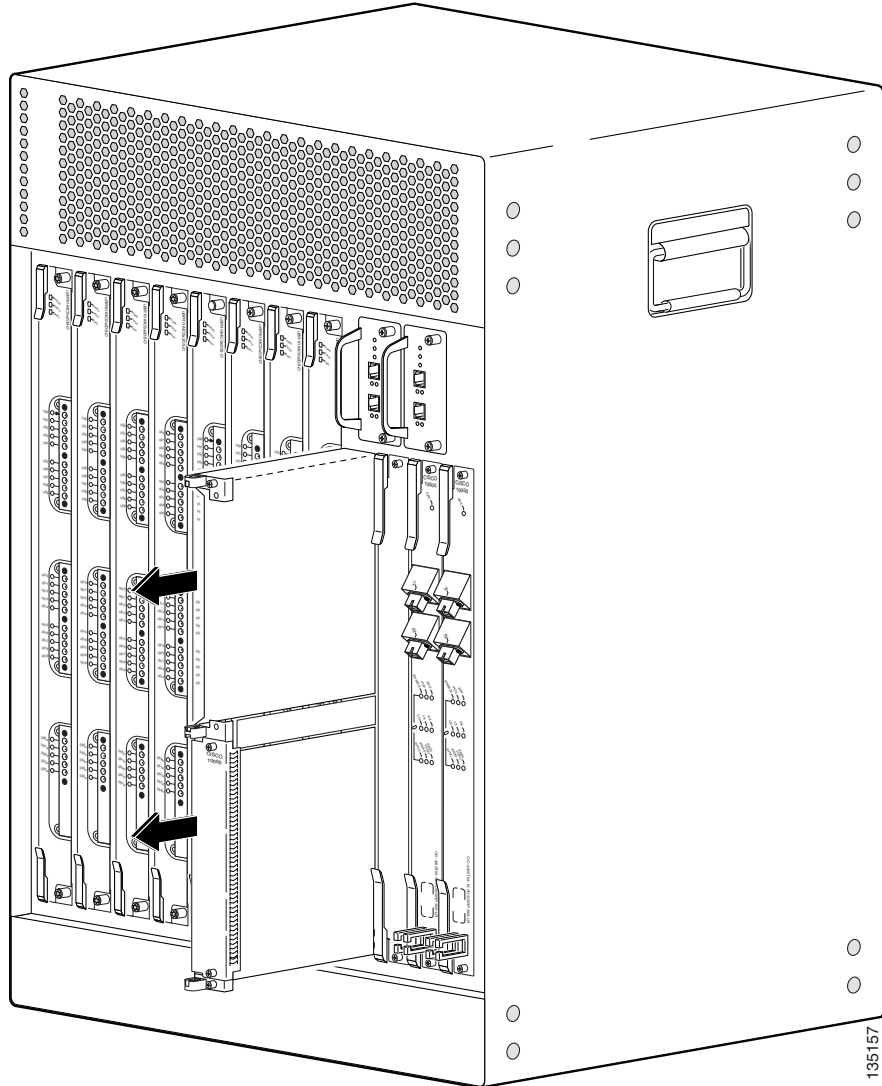
- Step 1** Attach an antistatic wrist strap to your wrist and to the ESD socket on the chassis, or to a bare metal surface on the chassis or frame).
- Step 2** Remove any line cards from the splitter, see the [“Removing a Half-Height Gigabit Ethernet Line Card” section on page 3-4](#).
The slot splitter does not have ejector levers to disengage cards from the backplane, so you must remove any line cards before you remove the splitter.
- Step 3** Loosen the top and bottom captive screws on the slot splitter ([Figure 3-3](#)).

Figure 3-3 Captive Screw Locations



- Step 4** Slide the splitter out of the slot ([Figure 3-4](#)).
- Step 5** If you are not installing a replacement splitter or a line card, install a full-slot blank faceplate in the slot.

Figure 3-4 Removing the Slot Splitter

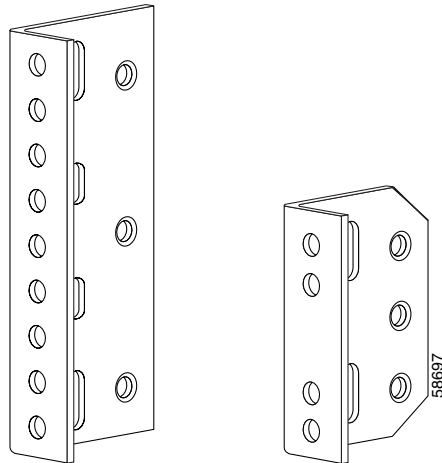


Attaching the Mounting Brackets

The Cisco uBR10012 router is shipped with four mounting brackets that can be attached to either the front or rear of the chassis, depending on your mounting preferences. The brackets can be mounted either flush with the edge of the chassis or set back to allow the chassis to be offset mounted in the rack.

[Figure 3-5](#) shows the mounting brackets shipped with the Cisco uBR10012 chassis for use with a standard 19-inch equipment or telco rack:

Figure 3-5 Mounting Brackets for the Cisco uBR10012 Router



Note

The four mounting brackets shipped with the Cisco uBR10012 router are for a standard 19-inch equipment rack or telco rack. Optional mounting brackets are orderable separately from third-party vendors to install the chassis in a 23-inch rack.

Use the following procedure to attach the mounting brackets to the chassis.

- Step 1** Determine whether you will be mounting the chassis with the front or rear facing forwards.
- Step 2** Determine whether you will flush-mount or offset-mount the chassis. Typically, flush-mounting is used for most equipment racks except for telco racks that require offset-mounting. If either style can be used, choose the one that is most convenient for your site.
- Step 3** Attach two mounting brackets to each side of the chassis in the appropriate locations. The large mounting bracket is attached to the top of the chassis, and the smaller bracket is attached to the bottom of the chassis.

Attach the brackets as shown in the following figures, using the screws that are supplied with the brackets:

- [Figure 3-6](#) shows how to attach the brackets to flush-mount the chassis with the front forwards.
- [Figure 3-7](#) shows how to attach the brackets to flush-mount the chassis with the rear forwards.
- [Figure 3-8](#) shows how to attach the brackets to offset-mount the chassis with the front forwards.

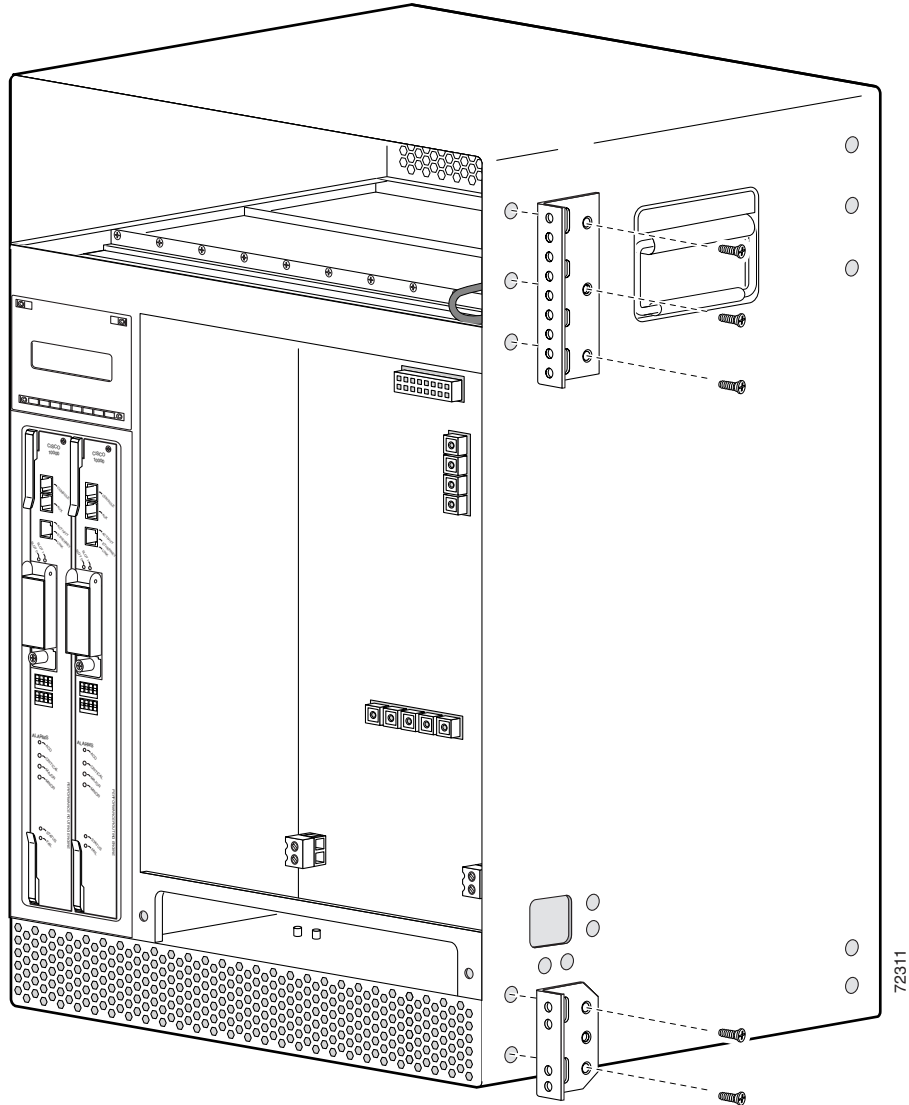
Figure 3-6 Bracket Location for Flush Front-Mounting the Chassis

Figure 3-7 Bracket Location for Flush Rear-Mounting the Chassis

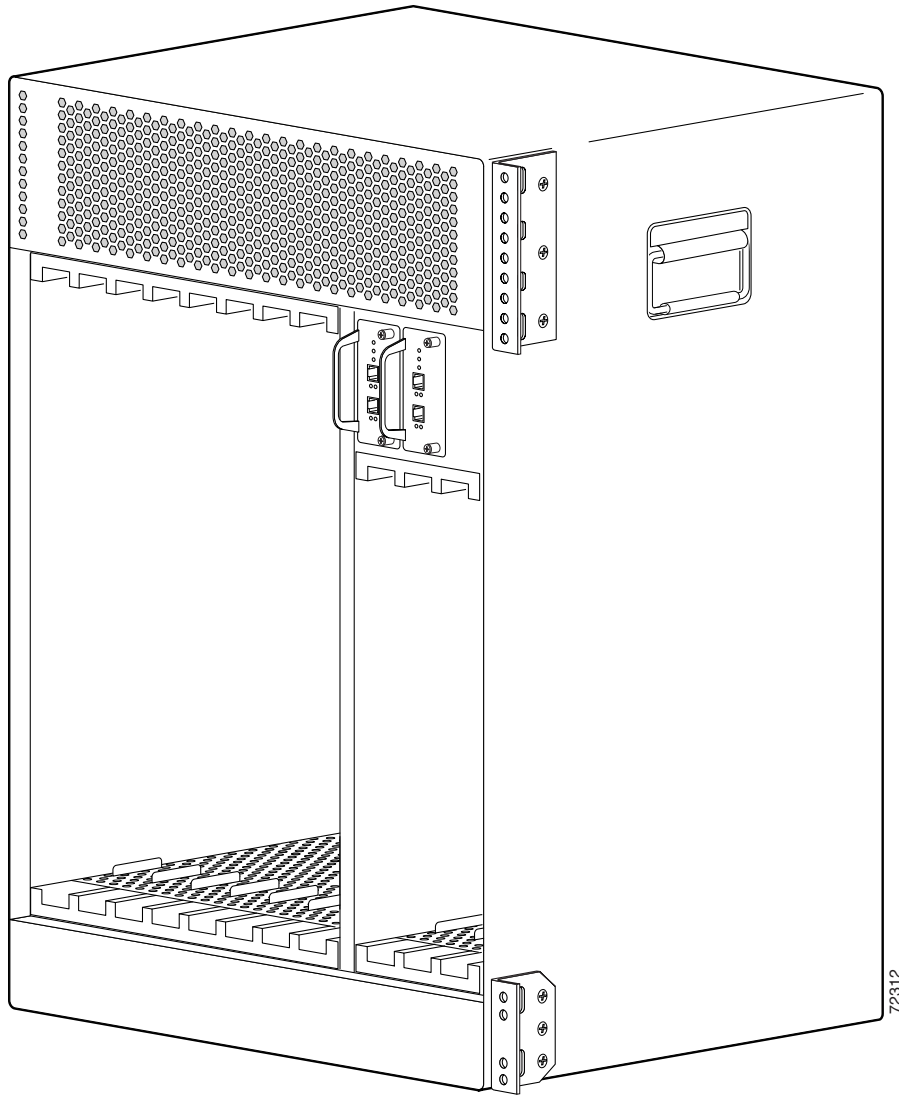
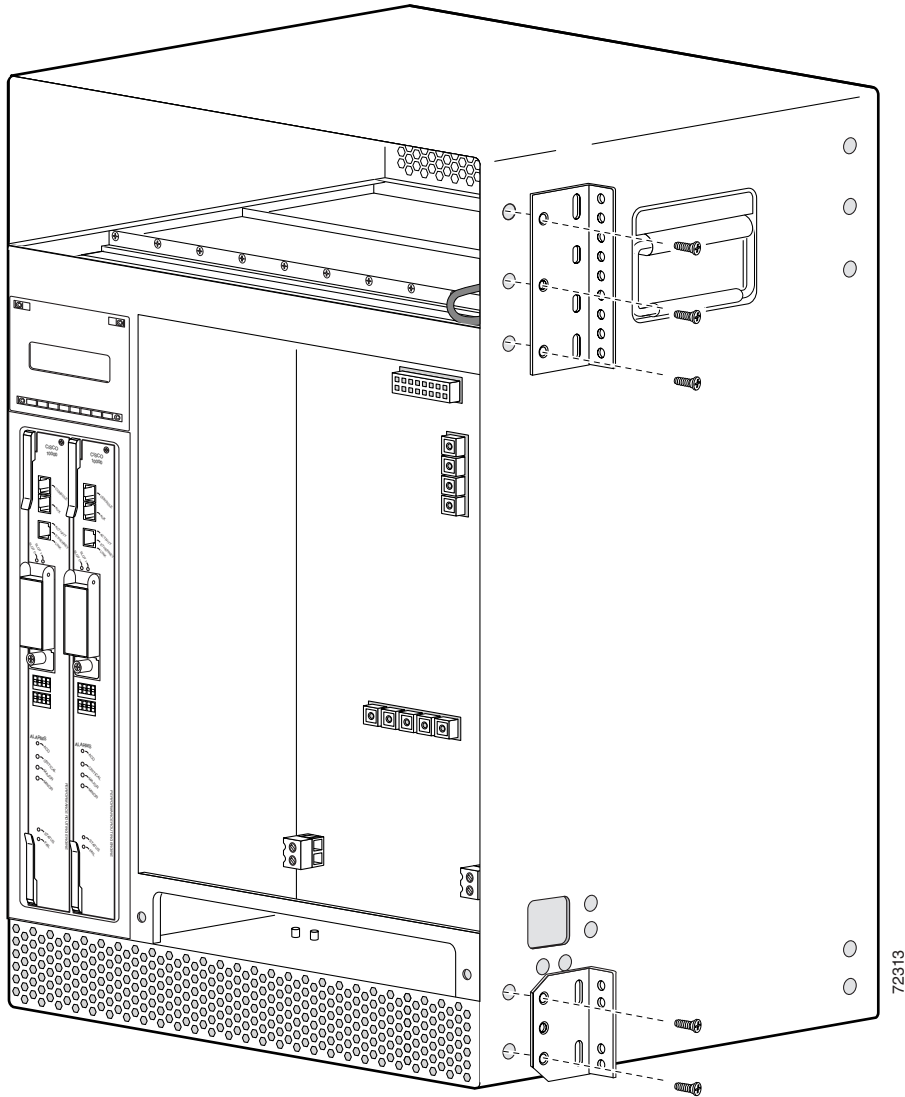


Figure 3-8 Bracket Location for Offset Front-Mounting the Chassis



Note

You must use three screws to install each large bracket and two screws to install each small bracket.

To install the optional cable management brackets, proceed to the next section. Otherwise, proceed to the [“Mounting the Chassis in the Rack”](#) section on page 3-19 for instructions on mounting the Cisco uBR10012 chassis in the equipment or telco rack.

Installing the Cable Management Brackets (Optional)

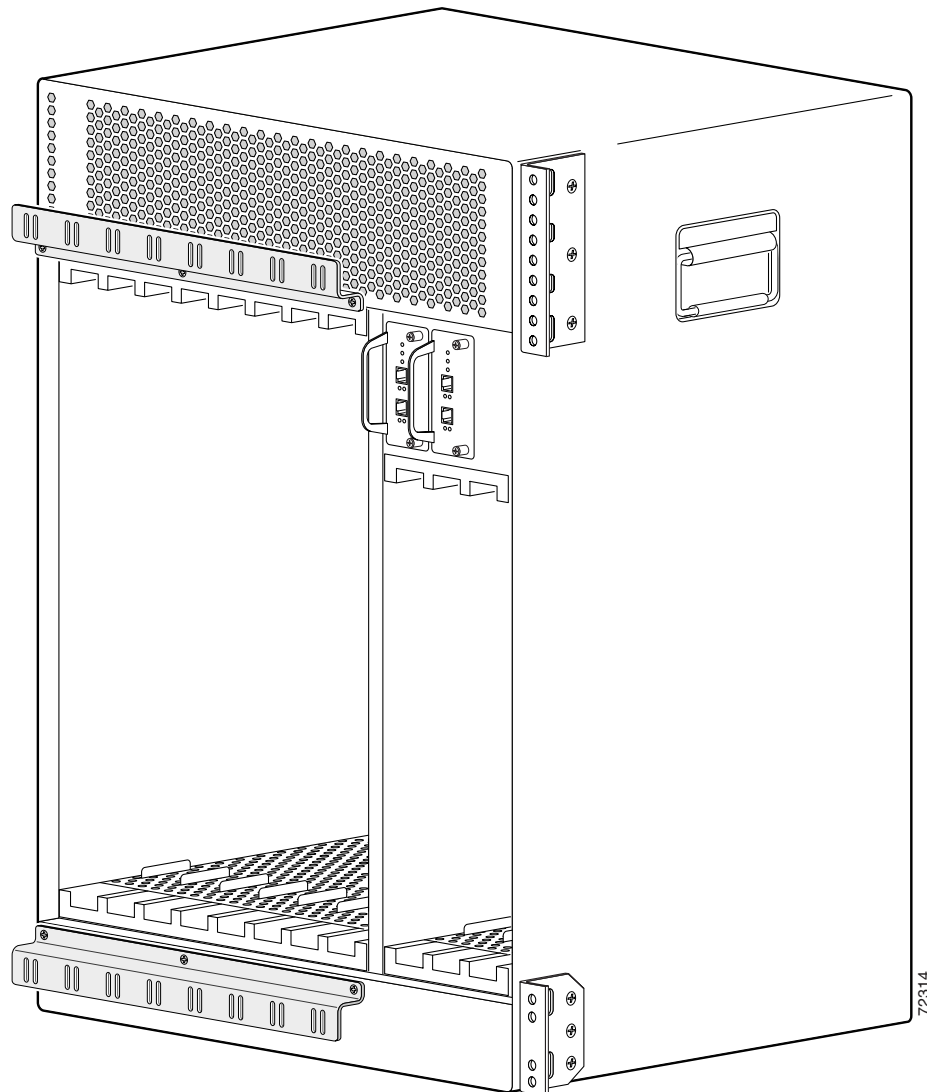
The Cisco uBR10012 router is shipped with two cable management brackets that can be installed on the rear of the router's chassis to route the cables connected to the cable interface line cards.

For installing first-generation cable management brackets see [“Installing First-Generation Cable Management Brackets” section on page 3-13](#) and for installing second-generation cable management bracket see [“Installing the Second-Generation Cable Management Bracket” section on page 3-14](#).

Installing First-Generation Cable Management Brackets

[Figure 3-9](#) shows the rear of Cisco uBR10012 chassis with the two first-generation cable management brackets installed.

Figure 3-9 *Installing the Optional First-Generation Cable Management Brackets*



Use the following procedure to install the optional first-generation cable management brackets on the rear of the Cisco uBR10012 chassis:

-
- Step 1** Position the first mounting bracket immediately above the cable interface line card installation slots. Make sure that the portion of the bracket with the slots is above the mounting holes, so that the bracket will not interfere with the insertion and removal of the line cards. See [Figure 3-9](#).
 - Step 2** Align the mounting holes on the far left and far right on the bracket first, so that the center mounting hole will be aligned properly.
 - Step 3** Use the three screws that are provided in the accessory kit to attach the bracket to the chassis.
 - Step 4** Attach the bottom cable management bracket in a similar manner, making sure that the slot edge of the bracket is pointing down. See [Figure 3-9](#).



Note Make sure that the slot edge on the bracket is pointed downward, otherwise the bracket interferes with the insertion and removal of the cable interface line cards.

- Step 5** Insert cable ties through the slots on the top and bottom of the brackets and use the cable ties as needed to secure the cables for the line card interfaces along the top and bottom of the chassis.
-

Installing the Second-Generation Cable Management Bracket

- You can install the cable management bracket above or below the line card slots. The procedures and illustrations used in this section shows the installation of cable management bracket above the line card slot. You can attach the cable management bracket below the line card slot in a similar way.
- If the chassis is installed in a rack-rail on rear flush-mounted style, as in [Figure 3-11](#), see “[Attaching Cable Management Bracket on the Rear Flush-Mounted Chassis](#)” section on page 3-14 or if the chassis is installed in a rack-rail on rear offset-mounted style, as in [Figure 3-13](#), see “[Attaching Cable Management Bracket on the Rear Offset-Mounted Chassis](#)” section on page 3-17.



Note The Cisco uBR10012 chassis now ships with only one second-generation cable management bracket.

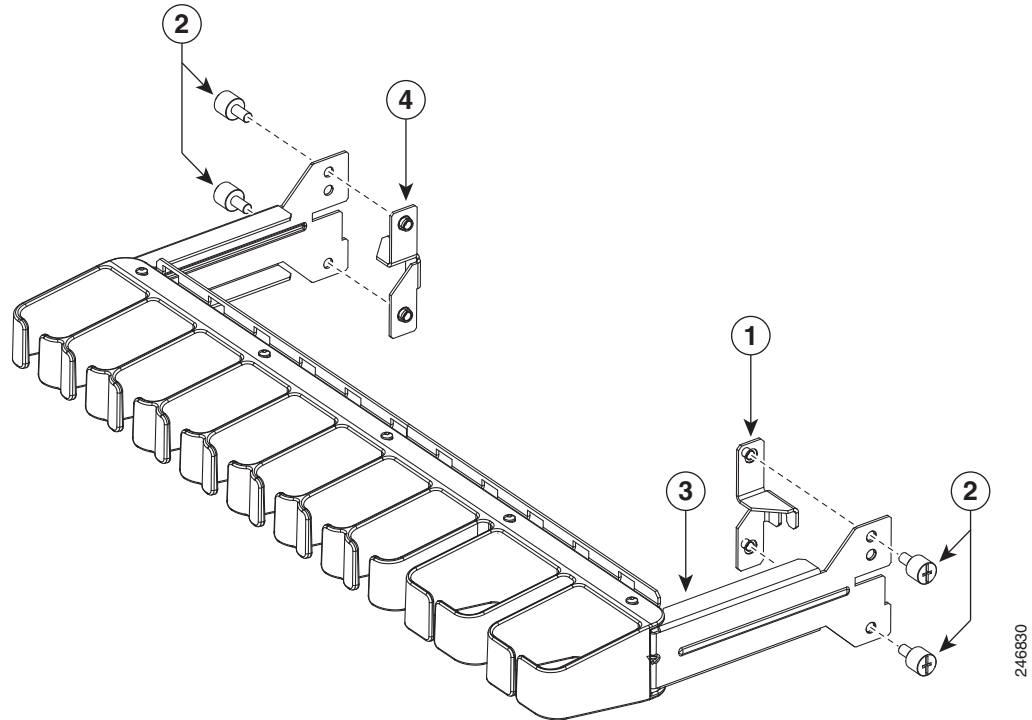
Attaching Cable Management Bracket on the Rear Flush-Mounted Chassis

To install the optional second-generation cable management bracket on the rear-side (line-card side) of the flush-mounted Cisco uBR10012 chassis:

-
- Step 1** Attach the cable management bracket rack-rail mounting left adaptor to the left side of the cable management bracket, using two of the four M5 attachment thumb screws supplied with the bracket. See [Figure 3-10](#).
 - Step 2** Attach the cable management bracket rack-rail mounting right adaptor to the right side of the cable management bracket, using the remaining two M5 attachment thumb screws supplied with the bracket. See [Figure 3-10](#).

Figure 3-10 shows the second-generation cable management bracket and the cable management rack-rail mounting adaptors used when the Cisco uBR10012 chassis is rear flush-mounted.

Figure 3-10 *Second-Generation Cable Management Bracket and Rack-Rail Mounting Adaptors*

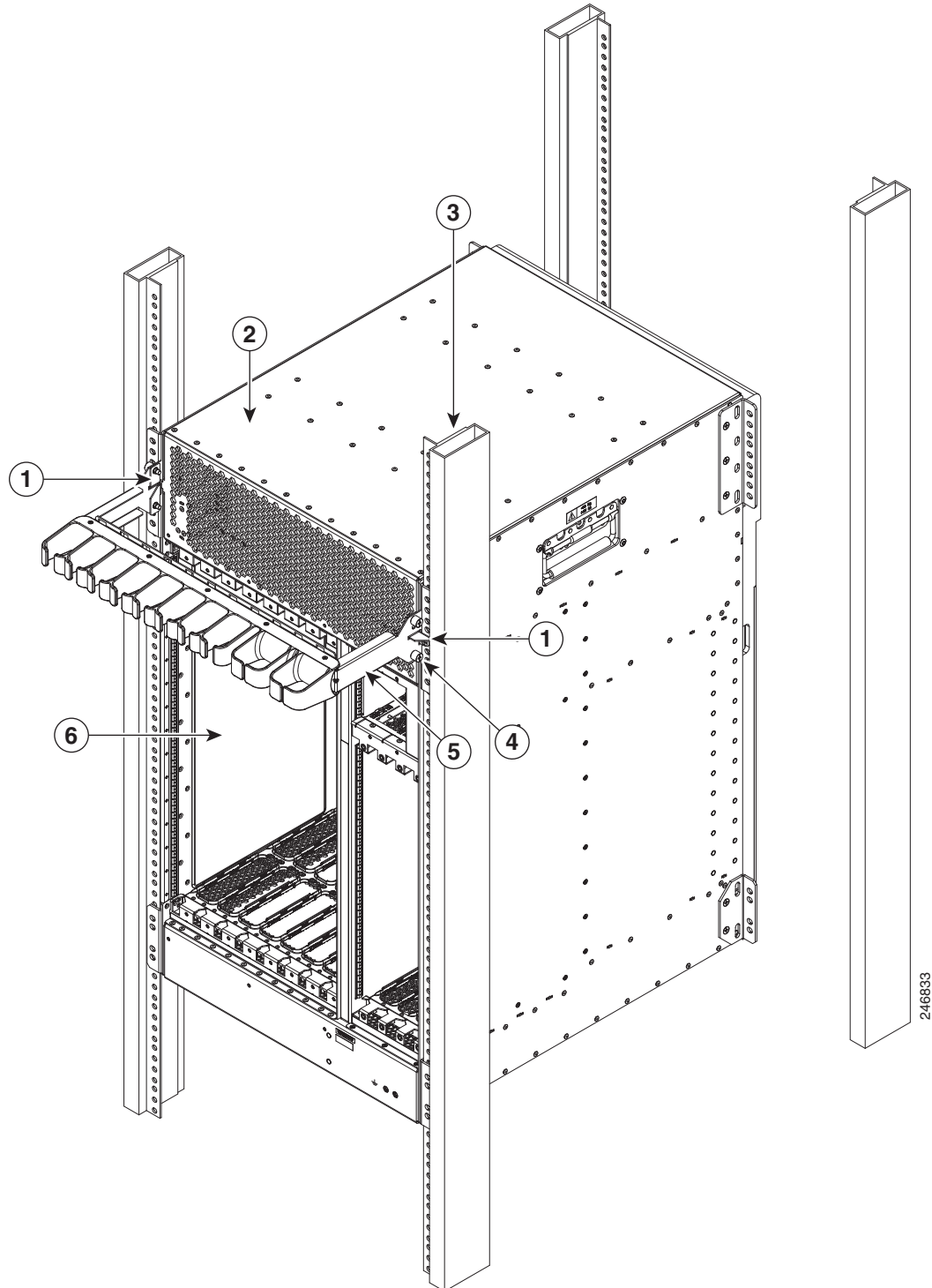


1	Second-generation cable management bracket rack-rail mounting right adaptor	3	Second-generation cable management bracket
2	M5 attachment thumb screws	4	Second-generation cable management bracket rack-rail mounting left adaptor

Step 3 Attach the cable management assembly to the rack-rails, using screws. See [Figure 3-11](#).

Figure 3-11 shows the rear flush-mounted Cisco uBR10012 chassis in rack-rails with a second-generation cable management bracket installed above the line card slots.

Figure 3-11 Second-Generation Cable Management Bracket on the Rear Flush-Mounted Chassis



1	Second-generation cable management bracket rack-rail mounting adaptors	4	M5 attachment thumb screws
2	Cisco uBR10012 chassis	5	Second-generation cable management bracket
3	Rack pole	6	Line card slots

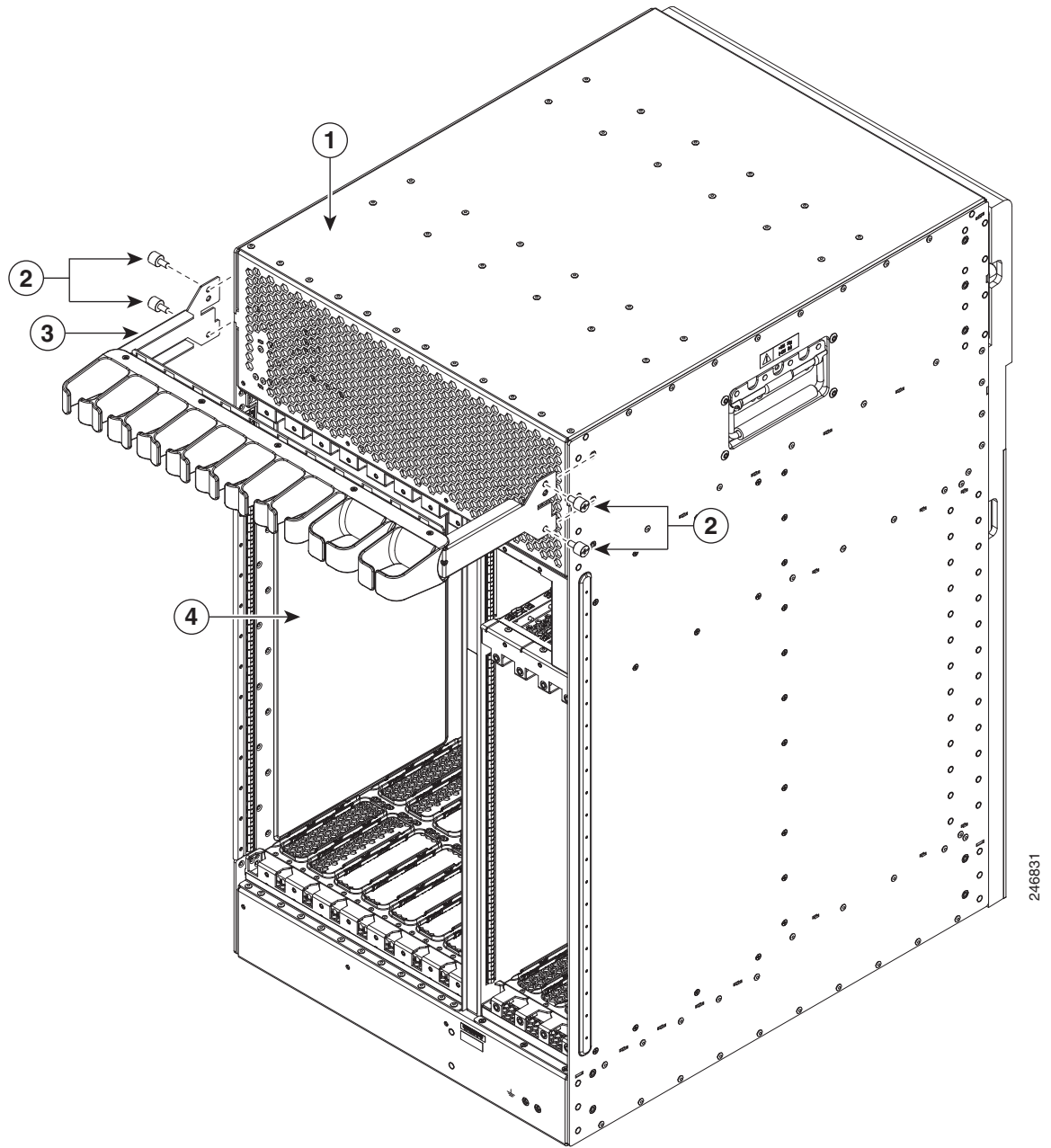
Attaching Cable Management Bracket on the Rear Offset-Mounted Chassis

To install the optional second-generation cable management bracket on the rear-side (line-card side) of the offset-mounted Cisco uBR10012 chassis:

-
- Step 1** Align the holes of the cable management bracket with holes meant for the mounting bracket on the left and right side of the chassis. See [Figure 3-12](#).
- Step 2** Attach the cable management bracket to the chassis, using the four M5 attachment thumb screws that are supplied with the bracket. See [Figure 3-12](#).

Figure 3-12 shows the rear offset-mounted Cisco uBR10012 chassis with a second-generation cable management bracket installed above the line card slot.

Figure 3-12 *Installing the Second-Generation Cable Management Bracket on the Rear Offset-Mounted Chassis*



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1	Cisco uBR10012 chassis	3	Cable management bracket
2	M5 attachment thumb screws	4	Line card slots

Mounting the Chassis in the Rack

With the fan assembly, PEMs, and line cards removed from the chassis and the mounting brackets installed on the chassis, the Cisco uBR10012 chassis is ready for installation in a 19-inch equipment rack or telco rack. Use the following procedure to install the chassis.



Warning

To prevent bodily injury when mounting or servicing this unit in a rack, you must take special precautions to ensure that the system remains stable. The following guidelines are provided to ensure your safety:

- **This unit should be mounted at the bottom of the rack if it is the only unit in the rack.**
- **When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.**
- **If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack.** Statement 1006



Tip

(Optional) Install a shelf in the rack to support the Cisco uBR10012 router chassis. This simplifies installation and provides additional support for the chassis. If you are installing an equipment shelf, it must be able to support the weight of a fully loaded chassis which is approximately 230 lbs (104.3 kg).



Tip

If you are installing the chassis in an equipment rack, it is helpful to have a third person available to maneuver the chassis into position and attach the brackets to the rack.

Recommended Tools and Supplies

Table 3-1 lists the tools, equipment, and supplies necessary to connect the system ground to the chassis.

Table 3-1 Tools and Supplies

Quantity	Description	Comments
1	Number 2 Phillips screwdriver	—
1	A 3/16-inch flat-blade screwdriver s	—
1	A 1/4-inch flat-blade screwdriver	—
12	Mounting bracket screws	Included in accessory kit
1	ESD-preventive wrist strap	—
—	Tape measure (optional)	—
—	Level (optional)	—

Installing the Cisco uBR10012 Chassis in the Rack

When you are installing the chassis in a rack, please be aware of the following issues.

- AC power shelf installation precautions
- Loaded and unloaded chassis weight



Caution

If you are using the optional AC-input power shelf, do not install the shelf until after you have installed the Cisco uBR10012 chassis to avoid the possibility of crushing the shelf during the router's installation.

For more information about installing the power shelf, see *2400W AC-Input Power Shelf for the Cisco uBR10012 Universal* at the following URL:

http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10acsh.html



Caution

A fully populated chassis weighs approximately 230 lbs (104.3 kg) and should be lifted only with a forklift or hydraulic lift. A depopulated chassis weighs approximately 55 lbs (24.95 kg) and should be lifted by two people. When handling the chassis, always follow proper lifting practices, as outlined in the “[Chassis-Lifting Guidelines](#)” section on page 2-3



Warning

Two people are required to lift the chassis. Grasp the chassis underneath the lower edge and lift with both hands. To prevent injury, keep your back straight and lift with your legs, not your back. Statement 210



Warning

At least three people are required to mount the shelf in the equipment rack: two people are needed to hold the shelf in place while a third person tightens the mounting screws. Statement 336

Step 1

Verify that you have removed the fan assembly module, DC PEMs, cable interface line cards, and network uplink line cards before attempting to move the chassis (see “[Removing the Chassis Components Before Installation](#)” section on page 3-4).



Caution

Do not attempt to lift even a depopulated chassis by yourself. Have at least two people to lift the chassis. Three people might be needed to position the chassis into a rack, depending on whether you are using an equipment shelf and on how high you are mounting it.

If you have to lift the chassis to a higher location, have a third person present who can lift the middle of the chassis as the other two people lift it straight up.

Step 2

With each person standing on a side of the chassis, bend straight down at the knees, and grab one of the handles on the side of the chassis.

Step 3

Carefully lift the chassis straight up and walk with slow, deliberate steps to your destination.



Caution

To prevent injury, keep your back straight and lift with your legs, not your back.

- Step 4** When you reach your destination, bend at the knees to lower the chassis to the ground.
- Step 5** Lift the chassis up to the height that it will be positioned in the rack.
- Step 6** Maneuver the chassis into position in the rack.
- Step 7** Align the mounting bracket holes with the rack post holes ([Figure 3-13](#)) and attach the chassis to the rack with the appropriate-sized screws (performed by the third person unless the chassis is resting on a shelf).
- Step 8** Go to the [Connecting the Chassis to Ground](#) section to continue the installation.

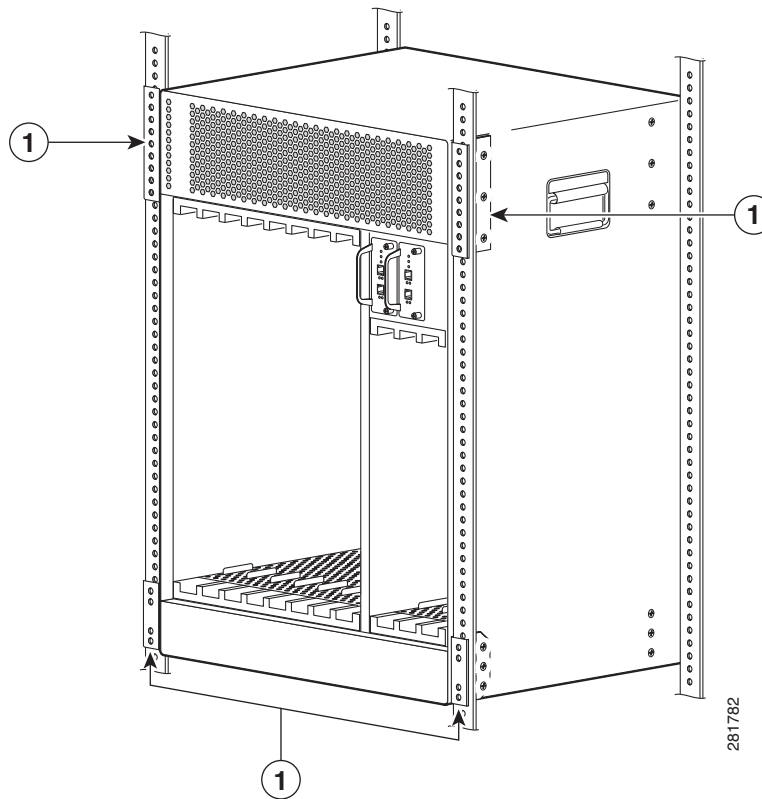
**Warning**

This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available. Statement 1024

**Note**

[Figure 3-13](#) shows the chassis flush-mounted at the rear. The procedure is identical for the other mounting methods. This figure also shows two sets of mounting brackets being used, one set at the front and one set at the rear of the chassis. Only one set of brackets is necessary to support the chassis.

Figure 3-13 Installing the Chassis in a Rack using the Rear Mounting Brackets



1	Rear mounting brackets	—
---	------------------------	---

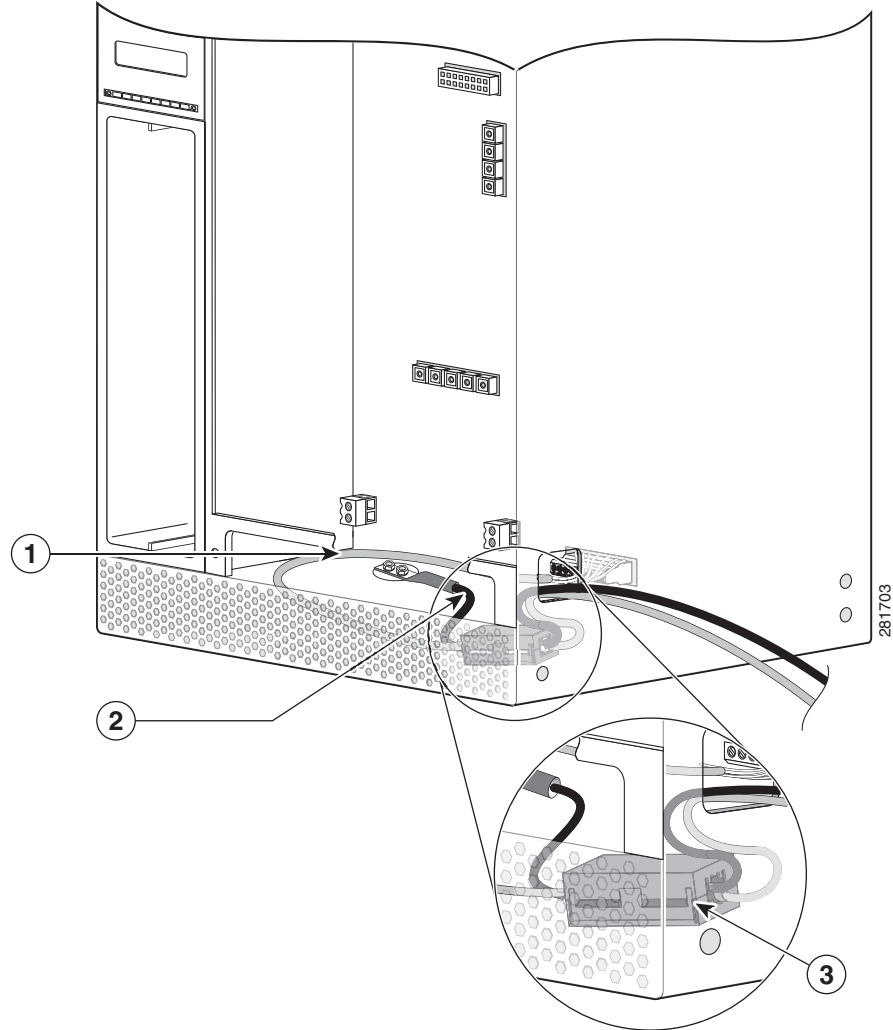
Attaching Ferrite Beads on the Cables

Ferrite beads can be clamped on where the beads are attached without wrapping the wires. Two ferrite beads (part number 36-0219-01) are included in the Cisco uBR10012 router accessory kit, and one ferrite bead is shipped with the spare of AC and DC power entry modules.

Attaching Ferrite Beads on Grounding and Alarm Cables

For Class B emission compliance requirements, one ferrite bead must be installed on the alarm port and chassis ground wire exiting the chassis. This is applicable for UBR10-PWR-AC, UBR10-PWR-AC-PLUS=, and UBR10-PWR-DC-PLUS= PEM modules. The ferrite bead should be installed (within 3 inches) close to the notch where the cables exit the chassis.

Figure 3-14 Ferrite Beads on Ground Cable and Alarm Cable



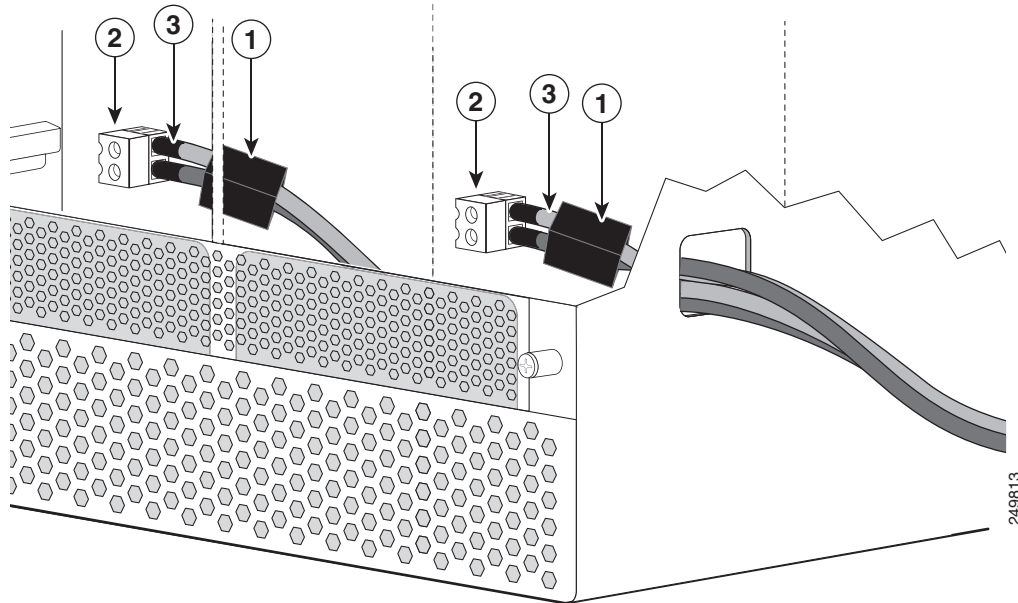
1	Alarm cable	3	Ferrite bead attached to both the ground and alarm cable
2	Ground cable		—

Attaching Ferrite Beads on DC Power Cables

For Class B emission compliance requirements, two ferrite beads must be installed on the DC-input power cables. This is applicable for UBR10-PWR-DC= PEMs. These ferrite beads should be installed (within 6 inches) close to the DC-input power connector (DC-input terminal connector).

Figure 3-15 shows the ferrite beads attached to the DC-input power cables connected to the DC-input terminal connector located beneath the UBR10-PWR-DC= module on the midplane of the chassis.

Figure 3-15 Ferrite Beads Attached on DC-input Power Cables



1	Ferrite beads attached to DC-input power cables	3	DC power cables
2	DC-input terminal connector on midplane of the chassis		—

Attaching Ferrite Beads on the Lineage Power Shelf

An additional set of ferrite beads are required if you are using the external Lineage power shelf to supply power to the Cisco uBR10012 router. These ferrite beads must be installed on the DC power cables that are provided in the Lineage accessory kit to meet the Class A compliance requirements. Table 3-2 lists the ferrite beads that should be installed on the different DC power cables.

Table 3-2 Ferrite Beads, DC Power Cables, and DC PEM Modules

Ferrite Beads (Type / Part Number)	DC Power Cable	DC PEM Module (Part Number)
Steward 28A5776-0A2	4 DC power cables	UBR-PWR-DC=
Steward 28A5131-0A2	2 DC “Y” power cables	UBR-PWR-DC-PLUS=

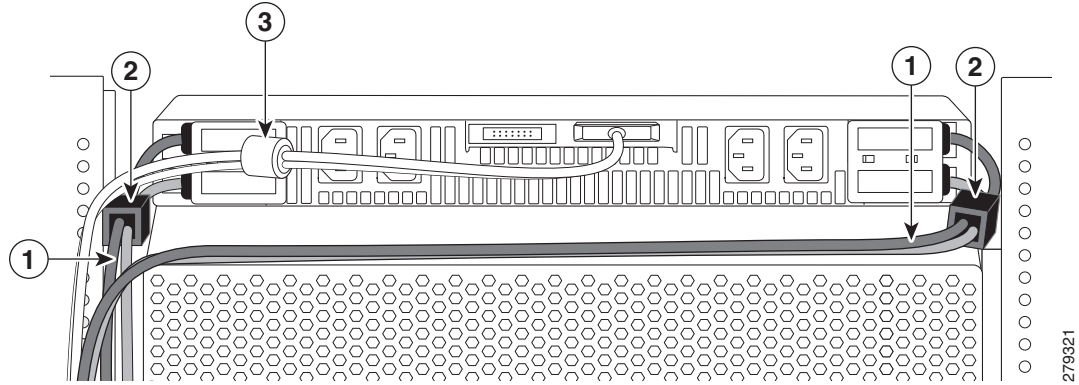
The ferrite beads should be installed within 6 inches of the DC terminal blocks on the Lineage power shelf. (See Figure 3-16.)



Note

The ferrite beads must be installed on both sides of the DC power cables (DC-input and DC-output) when Lineage power shelf is connected to the DC PEM modules (UBR-PWR-DC=) on the Cisco uBR10012 router.

Figure 3-16 Ferrite Beads on the Lineage Power Shelf



1	DC power cables connected on the Lineage power shelf	3	Alarm cable connected to the J1 connector with built-in ferrite bead
2	Ferrite beads attached on the DC power cables		—

279821

Connecting the Chassis to Ground

Connecting the Cisco uBR10012 router chassis to earth ground is required for all DC powered installations. Have the recommended tools and supplies available before you begin this procedure (see Table 3-3).

 Warning

The importance of proper grounding cannot be overemphasized. It will minimize the potential for damage to your system and maximize safety at the system site. We recommend you consult a licensed electrician or your local electric utility company if you have any questions. Statement 269

 Warning

When installing or replacing the unit, the ground connection must always be made first and disconnected last. Statement 1046

Recommended Tools and Supplies

Table 3-3 lists the tools, equipment, and supplies necessary to connect the system ground to the chassis.

Table 3-3 Tools and Supplies

Quantity	Description	Comments
1	Number 2 Phillips screwdriver	—
1	Wire stripping tool	—
1	Crimping tool	Must fit diameter of grounding lugs.
1	2-hole grounding lug	Included in the accessory kit
1	Grounding wire	6 AWG (16 mm ²), customer provided.

Table 3-3 Tools and Supplies (continued)

Quantity	Description	Comments
2	M5 Pan Head screws with captive, lock washers	Included in accessory kit.
	Antistatic mat and ESD-wrist strap	—

Attaching the Grounding Cable

The following procedure describes how to attach:

- The grounding lug to the grounding cable.
- The grounding cable to the chassis.
- The grounding cable to the earth grounding point.



Warning

Use copper conductors only. Statement 1025



Warning

Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position. Statement 7

- Step 1** Verify that there is no power going to the Cisco uBR10012 chassis and the PEMs are not installed.
- Step 2** Strip about 3/4 inch (2 cm) of the covering from the end of the grounding wire).
- Step 3** Insert the stripped end of the grounding wire into the open end of the grounding lug and crimp the grounding lug securely to the wire.
- Step 4** Using the two M5 screws provided in the accessory kit, fasten the grounding lug firmly to the bottom of the chassis. Fasten the lug to the chassis. See the location marked “Grounding points” in [Figure 3-18](#)).
- Step 5** Attach the other end of the ground cable to a suitable grounding location in accordance with local practice at your site.
- Step 6** Proceed to the next section, [Connecting DC Power to the Cisco uBR10012 Router, page 3-39](#).

Figure 3-17 Attaching Grounding Wire to the Grounding Lug

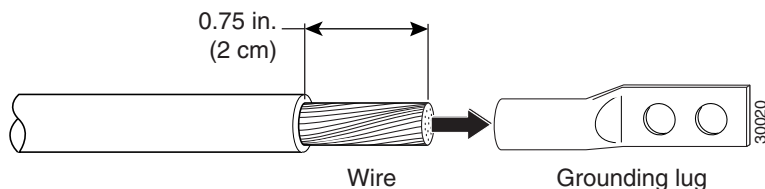
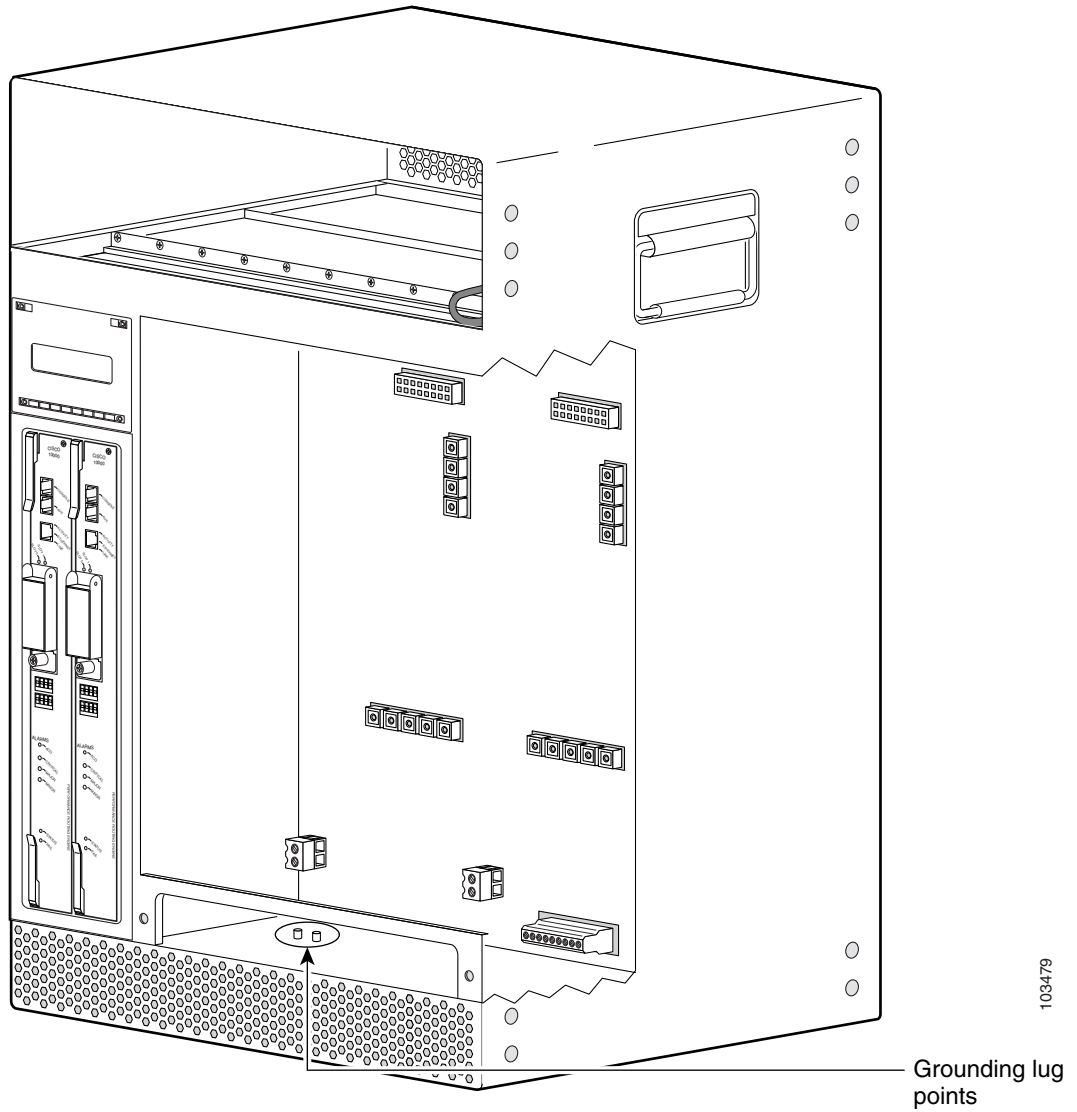


Figure 3-18 Location of the Ground Lug Connectors



Connecting the External AC-input Power Shelf to the Cisco uBR10012 Router

The following sections describe how to connect the Lineage AC-DC power shelf to the Cisco uBR10012 router:

- [Cabling the Lineage AC-DC Power Shelf, page 3-28](#)
- [Connecting the Lineage AC-DC Power Shelf to the Cisco uBR10012 Router, page 3-29](#)
- [Connecting the Alarm Monitor Cable, page 3-36](#)
- [Disconnecting Cables from the Lineage AC-DC Power Shelf and the Cisco uBR10012 Router, page 3-39](#)

For information on cabling, and installation of the external 2400 W AC-input power shelf, see the [2400 W AC-input Power Shelf Installation Guide](#).

Cabling the Lineage AC-DC Power Shelf

Prerequisites

- To meet compliance standards, it is recommended that you use the AC-input cables, DC power cables, and alarm monitor cable that are provided in the Lineage AC-DC power shelf accessory kit.
- To meet Class A compliance standards, the ferrite beads provided in the Lineage AC-DC power shelf accessory kit must be installed on the DC power cables. For more details, see [Attaching Ferrite Beads on the Lineage Power Shelf, page 3-24](#).

Required Tools and Equipment

- Lineage AC-DC power shelf
- Alarm monitor cable, provided in Lineage accessory kit
- DC power cables, provided in Lineage accessory kit
- AC-input power cables, provided in Lineage accessory kit
- Ferrite beads, provided in Lineage accessory kit
- 10 mm hex socket driver

Steps

To attach the cables to the Lineage AC-DC power shelf:



Warning

Before performing any of the following procedures, ensure that power is removed from the DC circuit.
Statement 1003



Caution

Do not connect the AC power cables to the facility power source until the DC power cables and the alarm monitor cables are connected to the power shelf, and to the Cisco uBR10012 router.

-
- Step 1** Open the safety cover from above the DC terminal blocks by rotating the safety cover up and off of the DC terminal blocks of the power shelves.
- Step 2** Loosen and remove the M6 nuts.
- Step 3** Install the DC power cables to both the DC power terminal blocks on the power shelf using the removed M6 nuts, and close the safety cover.



Note If you are connecting two Lineage power shelves to the Cisco uBR10012 router, then connect the DC “Y” power cables only to the left DC terminals block on the two power shelves.

- Step 4** Attach the ferrite beads to the DC power cables pairs exiting the power shelf within 6 inches from the DC terminal blocks on the power shelf. See [“Attaching Ferrite Beads on the Lineage Power Shelf” section on page 3-24](#).
- Step 5** Connect the alarm monitor cable to the power shelf, see [Connecting the Alarm Monitor Cable, page 3-36](#)
- Step 6** Proceed to connecting the Lineage power shelf to the Cisco uBR10012 router.
- UBR-PWR-DC= module—If you are using this module, see [“Connecting the Lineage Power Shelf to the UBR-PWR-DC= Module” section on page 3-30](#).
 - UBR-PWR-DC-PLUS= module—If you are using this module, see [“Connecting the Lineage Power Shelf to the UBR-PWR-DC-PLUS= Module” section on page 3-32](#).
- Step 7** Connect the un-energized AC power cables to the power shelf.



Caution The AC power cables must not be connected to the wall socket until, all the DC power cables and alarm monitor cables are connected between the power shelf and the Cisco uBR10012 router.

- Step 8** Connect the AC power cables to the facility wall socket to energize the power shelf.



Caution Exercise caution while connecting the AC power cables to the an energized wall socket as the power shelf will start supplying power to the Cisco uBR10012 router.

Connecting the Lineage AC-DC Power Shelf to the Cisco uBR10012 Router

The Lineage power shelves are used with the DC PEM modules on the Cisco uBR10012 router. Two DC PEM modules are supported on the Cisco uBR10012 router:

- DC PEM module (UBR10-PWR-DC=)
- DC PEM module (UBR10-PWR-DC-PLUS=)

The following sections explain how to connect the Lineage power shelves to the Cisco uBR10012 router:

Connecting the Lineage Power Shelf to the UBR-PWR-DC= Module

Prerequisites

- Connect the DC power cables, alarm cables, and the AC-input cables to the Lineage power shelf, see “[Cabling the Lineage AC-DC Power Shelf](#)” section on page 3-28.
- To meet Class A compliance standards, install the ferrite beads on the DC power cables exiting the Lineage power shelf within 6 inches from the DC terminal blocks of the shelf. For more details, see [Attaching Ferrite Beads on the Lineage Power Shelf](#), page 3-24.

Required Tools and Equipment

- 2400 W DC PEM module (UBR-PWR-DC=)
- One Lineage AC-DC power shelf
- Four DC power cables, provided in Lineage accessory kit
- One alarm monitor cable, provided in Lineage accessory kit
- Ferrite beads (part number 36-0219-01), provided in Cisco uBR10012 router accessory kit
- Ferrite beads, provided in Lineage accessory kit
- Flat-head screwdriver

Steps

To connect the power shelf to the UBR-PWR-DC= module:

Step 1 Cable the Lineage AC-DC power shelf, see “[Cabling the Lineage AC-DC Power Shelf](#)” section on page 3-28.



Caution Do not connect the AC power cables to the standard wall socket.

Step 2 Connect the alarm monitor cable to the Cisco uBR10012 router, see “[Connecting the Alarm Monitor Cable](#)” section on page 3-36.

Step 3 Attach the pair of the ferrite beads to the ends of DC power cables that connect to the Cisco uBR10012 router. See “[Attaching Ferrite Beads on DC Power Cables](#)” section on page 3-23.

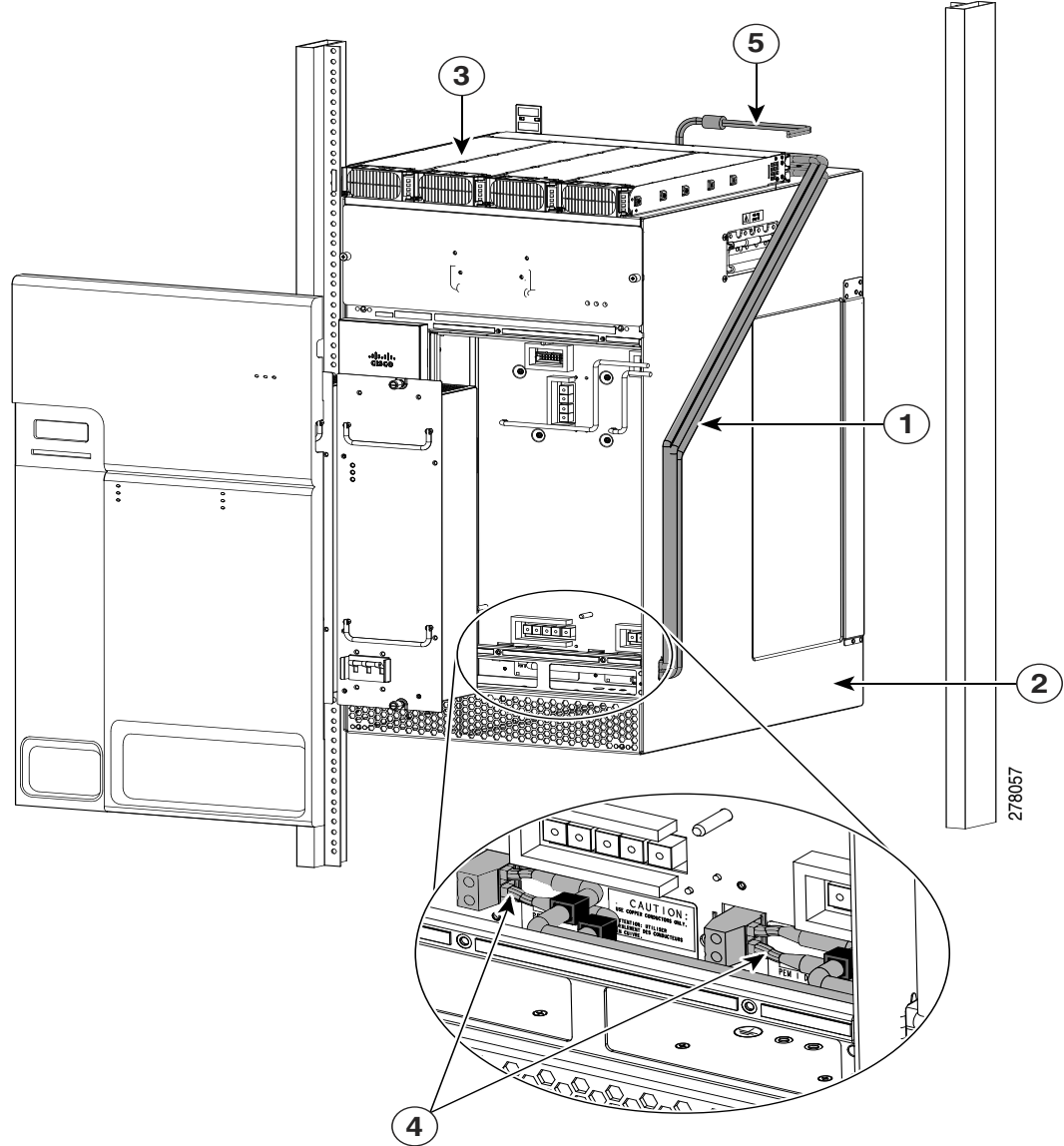
Step 4 Connect into the DC power cables into DC-input terminal connectors at the backplane of the Cisco uBR10012 router. For information connecting the DC power cables to the Cisco uBR10012 router, see [DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).



Caution The DC power cables have joggles at the ends of the cables. While connecting these joggled ends to the Cisco uBR10012 router, ensure that the ends face away from each other. (See [Figure 3-19](#).)

[Figure 3-19](#) shows the Lineage power shelf connected to the UBR-PWR-DC= PEM module on Cisco uBR10012 router.

Figure 3-19 Lineage AC-DC Power Shelf Connected to UBR-PWR-DC= PEM Module



1	DC power cables connected from the Lineage power shelf to the backplane of the router	4	Joggled ends of the DC-input power cables connected DC-input terminal blocks at the backplane of the router
2	Cisco uBR10012 router	5	Alarm monitor cable
3	Lineage AC-DC power shelf	—	

Step 5 Connect the AC power cables to a standard wall socket (facility power source) to provide power to the Cisco uBR10012 router.

Connecting the Lineage Power Shelf to the UBR-PWR-DC-PLUS= Module

Prerequisites

- Two Lineage AC-DC power shelves are required to supply power to the UBR-PWR-DC-PLUS= modules to power on the Cisco uBR10012 router.
- To meet Class A compliance standards, the ferrite beads must be installed on the DC “Y” power cables exiting the Lineage power shelf within 6 inches from the DC terminal blocks. For more details, see [Attaching Ferrite Beads on the Lineage Power Shelf, page 3-24](#).

Required Tools and Equipment

- 3300 W DC PEM module (UBR-PWR-DC-PLUS=)
- Two Lineage AC-DC power shelves
- Two DC “Y” power cables (Amphenol), provided in Lineage accessory kit
- Two alarm monitor cables, provided in Lineage accessory kit
- Ferrite beads, provided in Lineage accessory kit
- Flat-screw driver
- 10 mm hex socket driver



Note

We recommend that you use the DC “Y” power cables provided in the Lineage accessory kit. If you are using a 4 AWG cable, use a high-flex high strand count power cable for optimal routing of the cables under the front cover of the Cisco uBR10012 router. The 2 AWG wire is not supported on the UBR-DC-PWR-PLUS= DC PEM module.

Steps

To connect the power shelf to the UBR-PWR-DC-PLUS= DC PEM module:



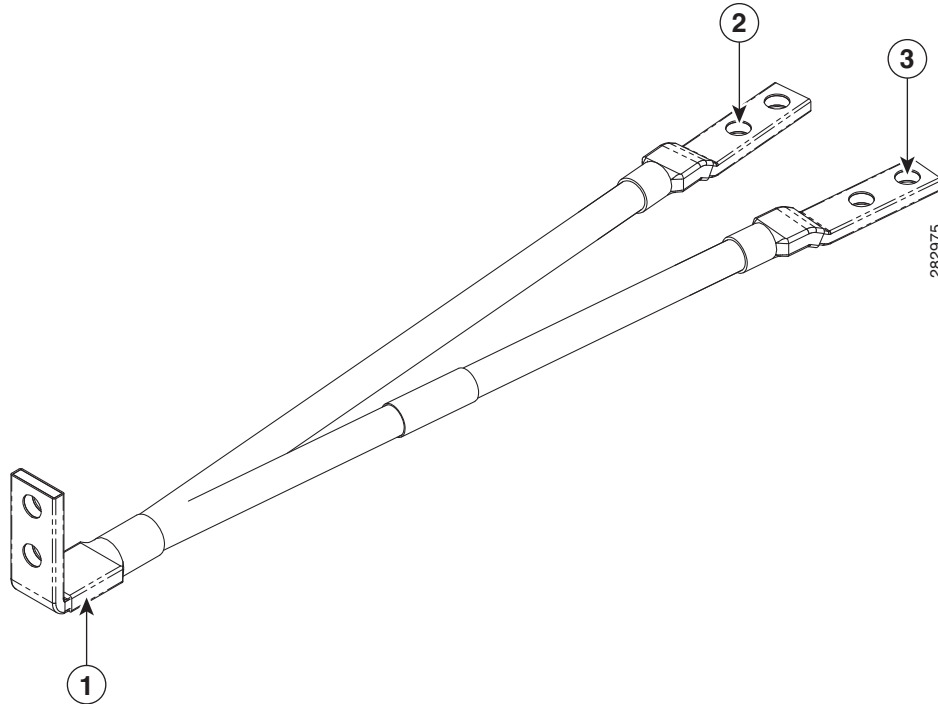
Caution

Do not have the AC power cables attached from the Lineage power shelves to the facility power sources, while attempting to connect the DC power cables from the power shelves to the UBR-PWR-DC-PLUS= modules of the Cisco uBR10012 router.

Step 1

Follow the steps to connect cables to the two Lineage power shelves, see [Figure 3-21](#):

- Open the safety cover from above the DC terminal blocks by rotating the safety cover up and off of the DC terminal blocks of the shelves
- Loosen and remove the M6 nuts.
- Attach the lugged ends of the DC “Y” power cables to left DC power terminal blocks of the two power shelves. Secure the cables with the removed M6 nuts using a 10 mm hex socket driver with an installation torque of 45-in lbs. (See [Figure 3-20](#).)
- Close the safety cover on the DC terminal blocks.
- Attach the ferrite beads (Steward 28A5131-0A2) to the DC “Y” power cables pairs (both -48 V and RTN cables) exiting the Lineage power shelves within 6 inches from the DC terminal blocks. See [“Attaching Ferrite Beads on the Lineage Power Shelf” section on page 3-24](#).

Figure 3-20 DC Y Power Cable with Lugged Ends

1	Lugged end of DC Y power cable that connects to Lineage power shelves	3	Lugged end of DC Y power cable that connects to the DC terminal blocks on the UBR-PWR-DC-PLUS= modules.
2	Lugged end of DC Y power cable that connects to the DC terminal blocks on the UBR-PWR-DC-PLUS= modules.		—

**Caution**

Only the left DC power terminals of the two Lineage shelves are used with UBR-PWR-DC-PLUS= modules on the Cisco uBR10012 router. Ensure that the right DC power terminals on the Lineage shelves are covered with the provided plastic covers.

- f. Attach the alarm monitor cables to the two Lineage power shelves, see “[Connecting the Alarm Monitor Cable](#)” section on page 3-36.

**Note**

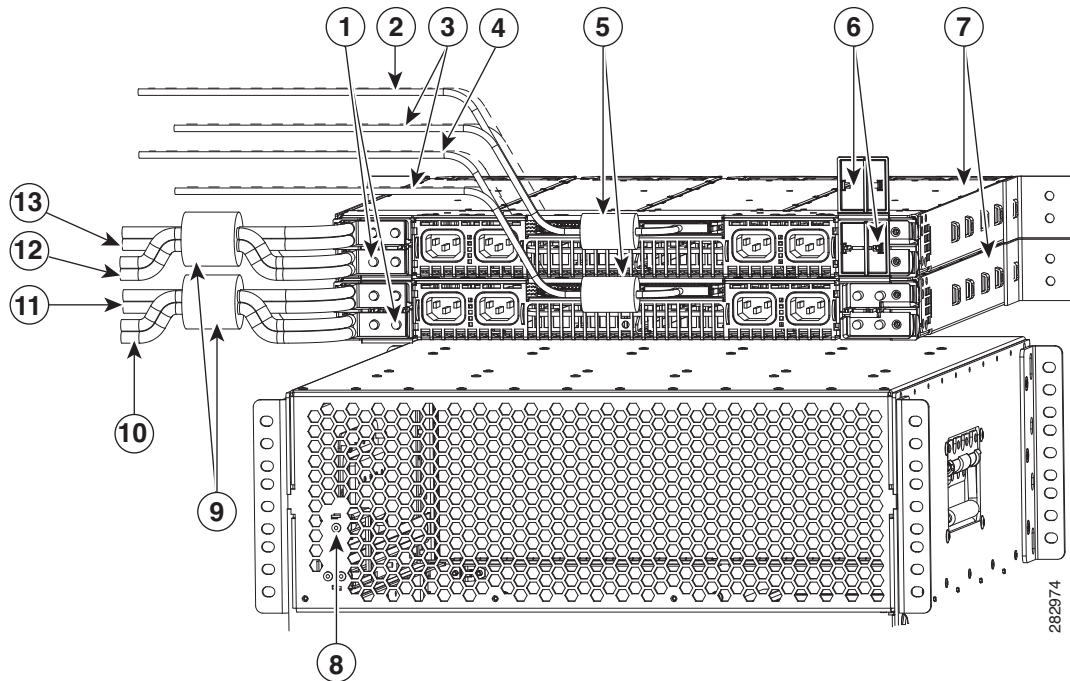
Only one cable of alarm monitor cable is connected to each Lineage power shelf. The other end of the cable is unused. (See [Figure 3-21](#).)

- g. Connect the un-energized AC power cables to the power shelf.

**Caution**

Do not connect the AC power cables to the facility power sources until the DC power cables and the alarm monitor cables are connected to the power shelf, and to the Cisco uBR10012 router.

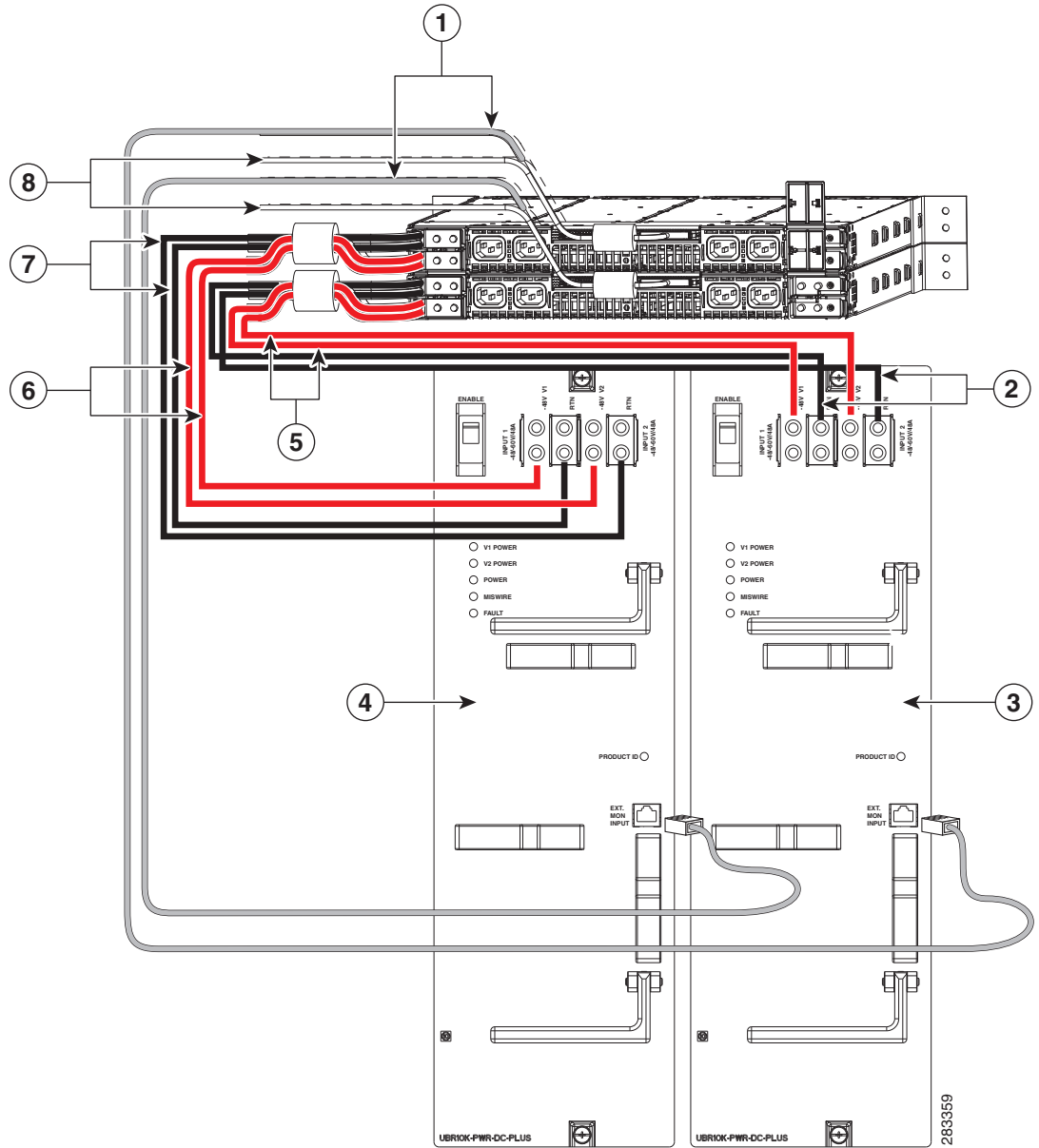
Figure 3-21 Cabling Two Lineage Power Shelves with DC Y Power Cables and Alarm Cables



1	Left DC power terminal blocks	8	Cisco uBR10012 router
2	Alarm monitor cable connected to the J1 connector that connects to external alarm input connector on DC PEM 1	9	Ferrite beads installed on DC power cables
3	Unused end of the alarm monitor cables	10	Red Y cables that connects to -48 V terminals on DC PEM 0
4	Alarm monitor cable connected to the J1 connector that connects to external alarm input connector on DC PEM 0	11	Black Y cables that connects to RTN terminals on DC PEM 0
5	Built-in ferrite beads on alarm cable	12	Red Y cables that connects to -48 V terminals on DC PEM 1
6	Unused right DC power terminal blocks	13	Black Y cables that connects to RTN terminals on DC PEM 1
7	Lineage power shelves		—

- Step 2** Connect the DC “Y” power cables to the DC-input terminal blocks on the UBR-PWR-DC-PLUS= modules on the Cisco uBR10012 router. For information on connecting the cables, see [3300 W DC PEM Module for Cisco UBR10012 Broadband Router Chassis](#).
- Step 3** Connect the alarm monitor cables to the external alarm input connectors on the UBR-PWR-DC-PLUS= modules.
- Step 4** Route the DC “Y” power cables through the front of the chassis through the three power cord clips. [Figure 3-22](#) shows the DC “Y” power cables—Black cables are connected to RTN terminals and the red cables are connected to -48 V terminals on the DC PEMs. The alarm monitor cables (marked in grey) are connected to the alarm input connectors on each PEM module.

Figure 3-22 DC Y Power Cables and Alarm Cables Connected from Lineage Power Shelves to UBR-PWR-DC-PLUS= Modules



1	Alarm monitor cables connected to J1 connectors, which in turn are connected to external alarm input connectors on DC PEMS	5	Red Y cables connected to -48 V terminals on DC PEM 0
2	Black Y cables connected to RTN terminals on DC PEM 0	6	Red Y cables connected to -48 V terminals on DC PEM 1
3	DC PEM 0	7	Black Y cables connected to RTN terminals on DC PEM 1
4	DC PEM 1	8	Unused end of the alarm monitor cables

**Note**

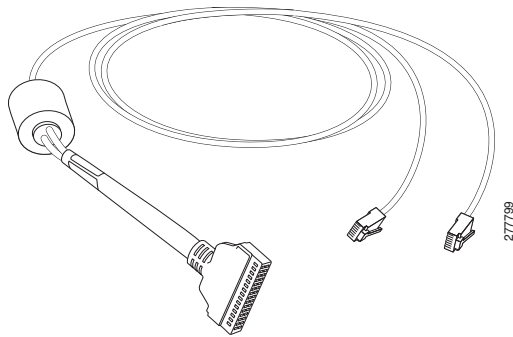
Ensure that you lift the handles and route the cables underneath the handles and through the power cord clips of the PEM modules so that the front cover fits on the Cisco uBR10012 chassis.

- Step 5** Connect the AC power cables to a standard wall socket (facility power source) to provide power to the Cisco uBR10012 router.

Connecting the Alarm Monitor Cable

The alarm monitor cable when connected to the Cisco uBR10012 router provides information on whether a power module in the power shelf is missing, reporting a fault, experiencing an over-temperature condition, or is not receiving AC-input power. This alarm monitor cable is connected from the power shelf to the external alarm input connectors on the DC PEM faceplates of the Cisco uBR10012 router. (See [Figure 3-23](#).)

Figure 3-23 Alarm Monitor Cable



Prerequisites

- Install the Lineage power shelf in the rack in a way that the power connections reside facing inside the rack when viewed from the front.
- Use the alarm monitor cables provided in the Lineage accessory kit.

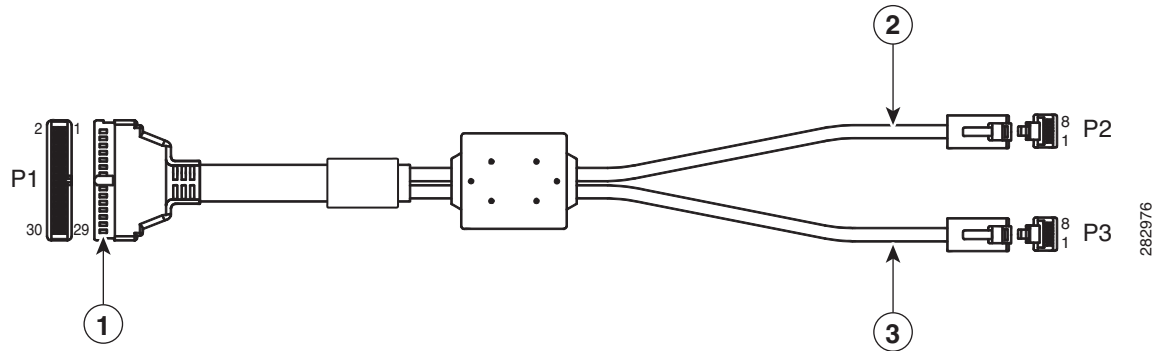
Required Tools and Equipment

- Alarm monitor cable, provided in Lineage accessory kit
- Lineage power shelf

Steps

To connect the alarm monitor cable from the Lineage power shelf to the Cisco uBR10012 router:

1. Connect the PIN end of the alarm monitor cable to the JI housing on the power shelf. (See [Figure 3-24](#).)

Figure 3-24 Alarm Monitor Cable with PIN and RJ-45 connectors

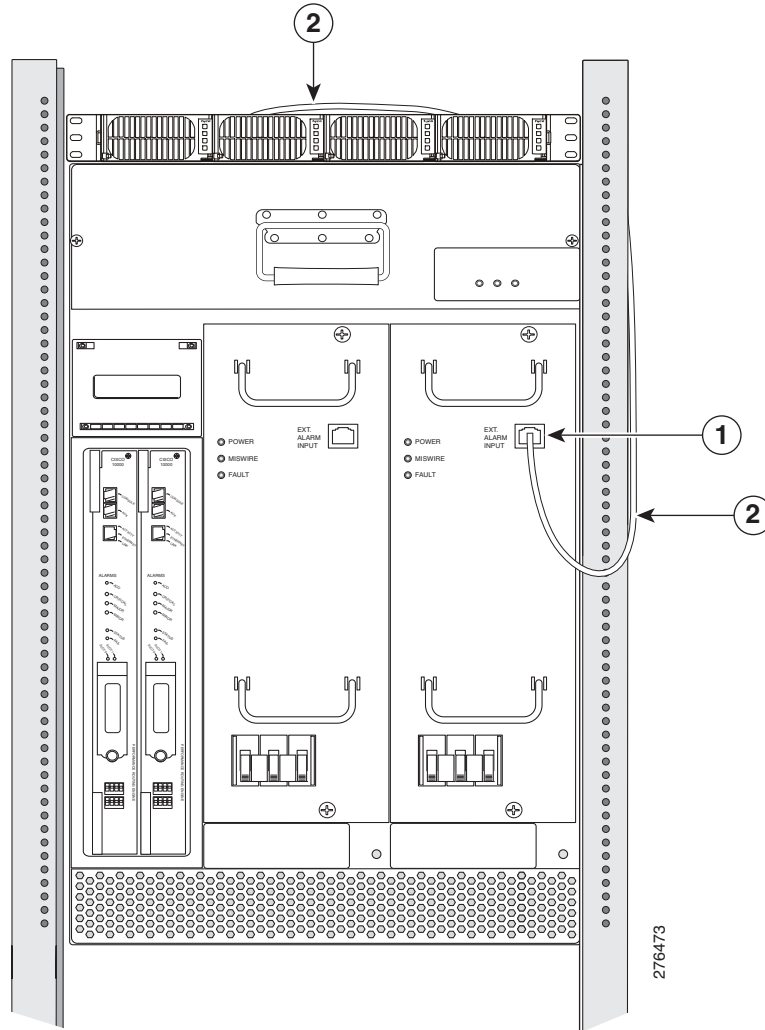
1	PIN end of Alarm monitor cable that connects to the Lineage power shelves.	3	RJ-45 connector end that connects to the alarm input connector on the DC PEM modules.
2	RJ-45 connector end that connects to the alarm input connector on the DC PEM modules.		—

2. Connect the two RJ-45 connector ends of the alarm monitor cable into the alarm input connectors on the DC PEM modules of the Cisco uBR10012 router. (See [Figure 3-25](#).)

**Note**

Two alarm monitor cables are required when connecting two Lineage power shelves with the UBR-PWR-DC-PLUS= PEM modules. Use one RJ-45 connector end of each alarm monitor cable to connect to the alarm input connectors on each UBR-PWR-DC-PLUS= PEM modules. (See [Figure 3-21](#)).

Figure 3-25 Alarm Monitor Cable Connected From the Lineage AC-DC Power Shelf to UBR-PWR-DC= Module



1	Alarm input connector on the UBR-PWR-DC= module	2	Alarm monitor cable
---	---	---	---------------------

Disconnecting Cables from the Lineage AC-DC Power Shelf and the Cisco uBR10012 Router

To disconnect cables from the Lineage AC-DC power shelf and the Cisco uBR10012 router:



Caution

Ensure that the power is turned off on the power shelf by disconnecting the power supply at the facility before proceeding to disconnect the other cables.

1. Power off the power shelf by disconnecting the power supply at the facility. Wait a few minutes before disconnecting the power cables so that they discharge.
1. Disconnect the AC cables from the standard wall socket. Disconnect the AC power cables from each of the AC-input power supply sources on the power shelf.
2. Disconnect the alarm monitor cable from the J1 housing on the power shelf, and from the alarm input connectors on the DC PEM modules of the Cisco uBR10012 router.
3. Disconnect the DC power cables on each side of the DC power sources, on the power shelf.
4. Disconnect the other ends of the DC power cable from the DC power terminal blocks of the Cisco uBR10012 router.

Connecting DC Power to the Cisco uBR10012 Router

This section describes how to connect the Cisco uBR10012 router to the two –48/–60 VDC power sources that provide its operating power. The DC power sources can either be already present at the site, or they can be provided by the external AC-input power shelves. If using the external 2400 W AC-input power shelf, be certain you have already installed it, as described in the [2400 W AC-Input Power Shelf Installation Guide](#).



Note

For full power redundancy, each terminal block on the external power shelf must be connected to a separate power source. If using the optional 2400 W AC-input power shelf, full power redundancy also requires that each of the AC power supplies in the shelf be connected to AC power sources that are on separate circuit breakers.



Warning

A readily accessible two-poled disconnect device must be incorporated in the fixed wiring. Statement 91



Warning

Connect the unit only to DC power source that complies with the safety extra-low voltage (SELV) requirements in IEC 60950 based safety standards. Statement 1033



Warning

Secure all power cabling when installing this unit to avoid disturbing field-wiring connections. Statement 38

**Warning****Care must be given to connecting units to the supply circuit so that wiring is not overloaded.**

Statement 51

**Warning****This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations.** Statement 1045**Warning****Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position.** Statement 7**Caution**

Be sure that you have connected the chassis to earth ground as described in the previous section before beginning this procedure.

Recommended Tools and Supplies

Table 3-4 lists the tools and supplies that you need to connect the Cisco uBR10012 router to DC power sources.

Table 3-4 Tools and Supplies for Connecting DC Power

Quantity	Description	Comments
1	Flat-blade screwdriver	—
1	Number 2 Phillips Screwdriver	—
1	Wire stripping tool	—
1	10 mm hex socket driver	—
4 (length varies)	6 AWG (16 mm ²) wire cables	Cables must reach from the Cisco uBR10012 router to the DC power source. The end of the cable intended to be connected to the chassis needs to have insulation stripped back not more than 5/16-in. (8 mm). Note The UBR10-PWR-DC-PLUS= module accepts a maximum of 6 AWG wire or 4 AWG high-flex wire for the DC-input cables. If you are using the 4 AWG wire, use a high-flex high strand count power cable for optimal routing of the cables under the front cover. The 2 AWG wire is not supported on the UBR10-PWR-DC-PLUS= module.
4	0.625-inch dual-hole lugs	Prepare the DC-input cables by attaching 0.625-inch center to center dual-hole lugs.

Table 3-4 *Tools and Supplies for Connecting DC Power*

Quantity	Description	Comments
2	Tie wraps	The tie wraps bind the cables together and also bind the cables to the side of the chassis.
	Antistatic mat and ESD-wrist strap	If necessary

Connecting the Cisco uBR10012 Chassis to a DC Power Source

The DC power sources can be present at the site, or they can be provided by an external AC-input power shelf. If you are using the 2400 W AC-input power shelf, ensure that you have already installed it, as described in the [2400 W AC-input Power Shelf Installation Guide](#).

For information on connecting the DC-input power cables for the UBR10-PWR-DC= module to the Cisco uBR10012 router, see [DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on connecting the DC-input power cables for the UBR10-PWR-DC-PLUS= DC PEM module to the Cisco uBR10012 router, see [3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

Connecting Alarm Indicators

The Cisco uBR10012 router provides relay contacts for optional (customer-supplied) audible or visual alarm indicators. Relay contacts are provided for three levels of severity:

- Minor—This is an informational alarm and does not affect the system operation.
- Major—A condition that affects system operation and should be investigated as soon as possible.
- Critical—A condition that affects system operation and requires immediate attention.

Recommended Tools and Supplies

[Table 3-5](#) lists the tools and supplies that you need to connect the alarm indicators.

Table 3-5 *Tools and Supplies for Connecting Alarm Indicators*

Quantity	Description	Comments
1	Flat-blade screwdriver	—
1	Wire stripping tool	—
6	14 AWG wire cables	—
	ESD-preventive wrist strap	If necessary

Use the following procedure to connect an alarm indicator to the chassis:

- Step 1** Obtain sufficient wire for the desired connections. You will need two wires for each set of relays, or six separate wires to connect all three relay contacts. Use the gauge of wire required by the audible or visual alarm indicator equipment you are using (14 AWG maximum gauge).



Warning

Use copper conductors only. Statement 1025

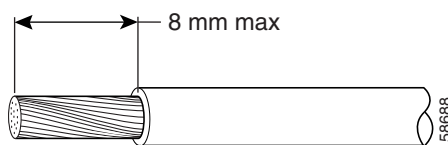


Caution

The alarm contacts on the Cisco uBR10012 router are only relays and do not provide any power from the unit. These relays are rated for 60 VDC, 1 A maximum—ensure that the connected alarm equipment does not exceed these voltage and current ratings.

- Step 2** Strip approximately 0.31 in. (8 mm) of insulation off the ends of the alarm indicator wire (see [Figure 3-26](#)).

Figure 3-26 Stripping Insulation



- Step 3** Connect one set of alarm indicator wires to the alarm terminal block as follows (see [Figure 3-27](#)):
- Connect one lead to the common (COM) terminal.
 - If you are wiring the router in with other equipment for the alarm indicators, wire the other lead to the normally closed (NC) terminal.
 - If you are wiring the router in *parallel* with other equipment for the alarm indicators, wire the other lead to the normally open (NO) terminal.

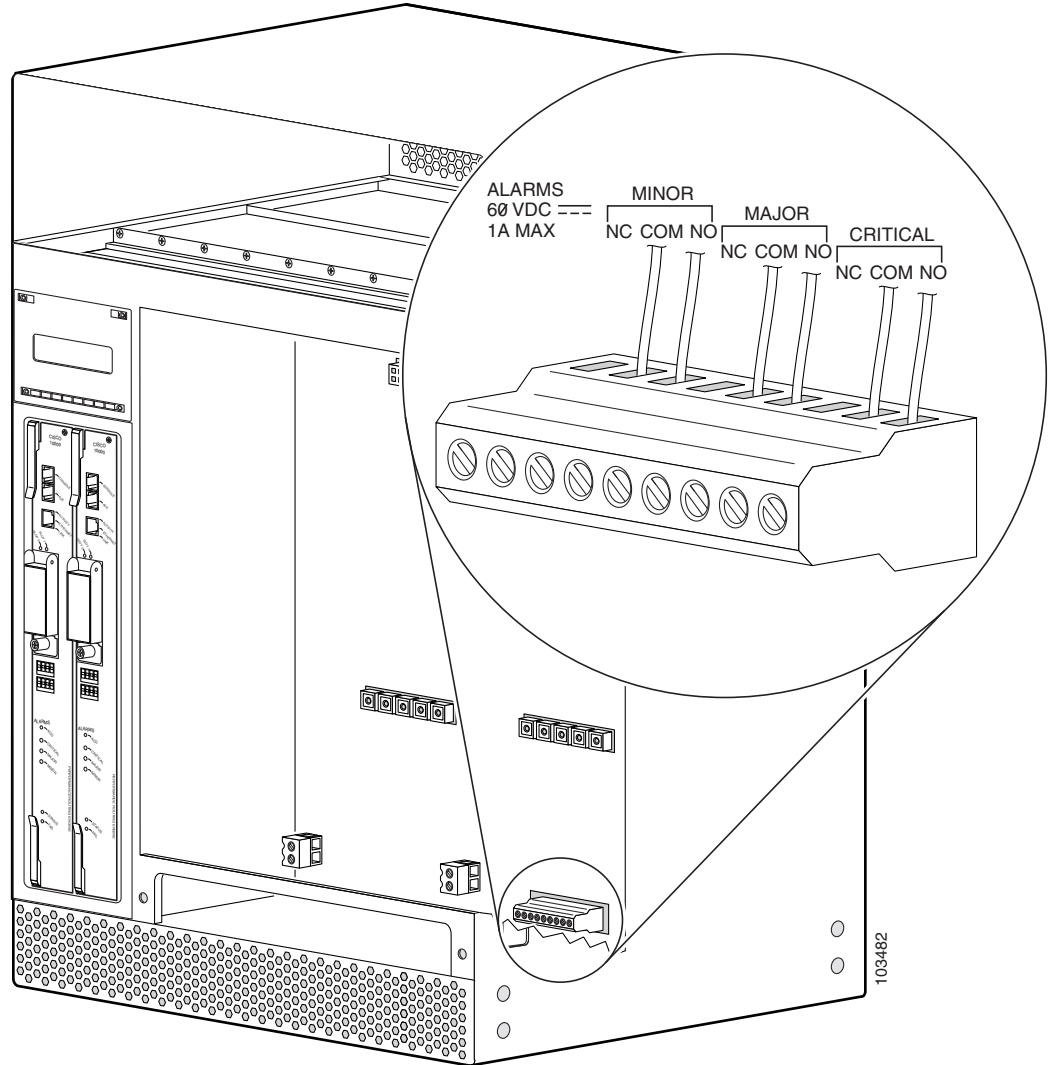


Caution

[Figure 3-27](#) shows the wiring configuration for NO alarm relays. The wiring configuration for NC alarm relays is similar but uses the NC contacts.

- Step 4** Repeat [step 3](#) for the remaining alarm indicators.
- Step 5** Secure the power cabling to the chassis by feeding a tie wrap through the square slot on the left front side of the chassis (next to the alarm indicator terminal block) and binding the wires.

Figure 3-27 Alarm Terminal Block Connections



Step 6 Go to the next section, [Connecting the Console Port and Auxiliary Port, page 3-55](#), to continue the installation.

Installing the Modules

To install the modules in the Cisco uBR10012 router:

- Step 1** Remove the front cover by pulling the cover towards you and carefully set it aside.
- Fan assembly module—Align the module with the slot in the chassis. Push the fan module back firmly into the chassis, making sure that the module securely connects to the backplane. Tighten the captive screws on each side of the fan assembly module.



Note To tighten the captive screws on the fan assembly modules, the installation torque used should be 8 in-lbs.



Caution

The total service window for removal and replacement of the fan tray is 3 minutes before possible system shutdown. Ensure that you complete the replacement procedure within this time limit.

For more information on installing the fan assembly module, see [Cisco uBR10012 Universal Broadband Router Fan Assembly Module](#).

- DC power entry module—Position the DC PEM in the power bay and slide it all the way in and ensure it makes a secure connection with the backplane.

For information on installing the UBR10-PWR-DC= module, see [DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on installing the UBR10-PWR-DC-PLUS= module, see [3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

- AC power entry module—Position the AC PEM in the power bay and slide it all the way in and ensure it makes a secure connection with the backplane.

For information on installing the UBR10-PWR-AC= module, see [AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on installing the UBR10-PWR-AC-PLUS= module, see [3300 W AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

Installing the Line Cards and Uplink Cards

After the chassis has been firmly attached to the rack, reinstall the cards in the chassis (also see [Removing and Replacing a Cable Interface Line Card, page 5-41](#) for details).



Caution

The Cisco uBR10012 router supports only the Cisco uBR10-LCP2-MC28C cable interface line card or Cisco uBR10-LCP2-MC16x cable interface line card bundles. Do not install the Cisco uBR10-LCP2 adapter card in the Cisco uBR10012 chassis without either the Cisco MC16x or the Cisco MC28C installed in the adapter card.

Also, do not attempt to remove the Cisco MC28C card or the Cisco MC16x card from their carriers (adapter cards) while they are installed in the chassis. See the “[Removing and Replacing a Cable Interface Line Card](#)” section on page 5-41 for information on this procedure.

-
- Step 1** Grasp the faceplate of the first line card with one hand and place your other hand under the card carrier (to support the weight of the card) and position the card in front of the appropriate card cage slot.
- Step 2** Carefully align the upper and lower edges of the line card with the upper and lower guides in the chassis, and slide the cable interface line card into the slot until you can feel it begin to seat in the backplane connectors (Figure 3-28).
- Step 3** Simultaneously pivot both ejector levers toward each other (until they are parallel to the faceplate) to firmly seat the card in the backplane (Figure 3-29).
- Step 4** Finger tighten the captive screws to secure the card in the chassis.

**Caution**

Do not tighten the captive screws until *after* you insert all the additional cards. Tightening the captive screws before all the line cards are installed, can cause the installation slot for the last line card to be restricted and make it difficult to install the card.

-
- Step 5** Repeat Step 1 through Step 4 for each cable interface line card and network uplink card.
- Step 6** After all the line cards and network uplink cards are inserted, tighten the captive screws. (Torque 5 to 7 in-lbs.)

**Tip**

Tighten line card 1, then tighten line card 8, tighten line card 2 then line card 7. Alternate back and forth between the line cards until all of them are secure in the chassis.

**Tip**

These screws prevent accidental removal and provide proper grounding for electromagnetic interference (EMI) shielding.

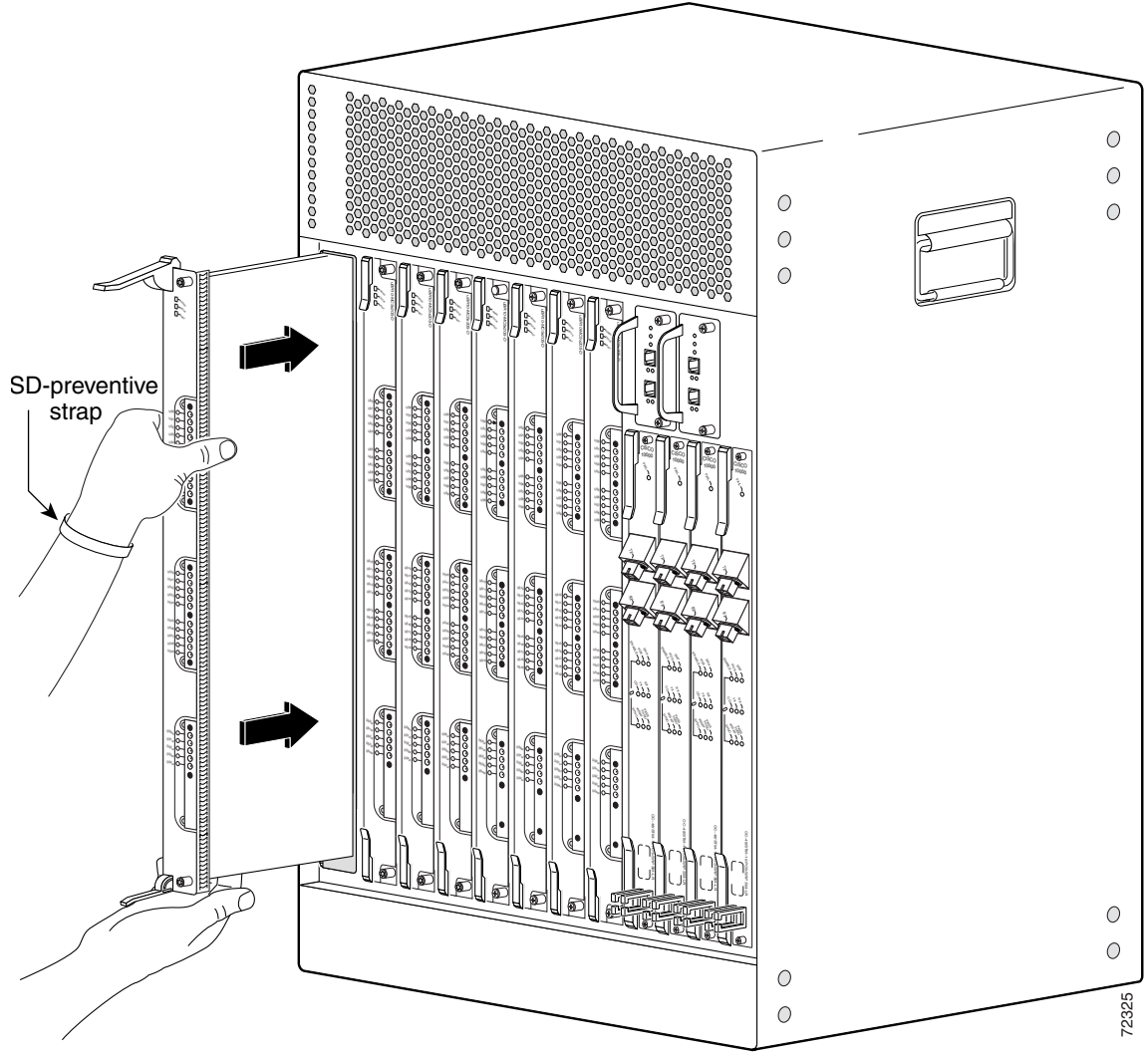
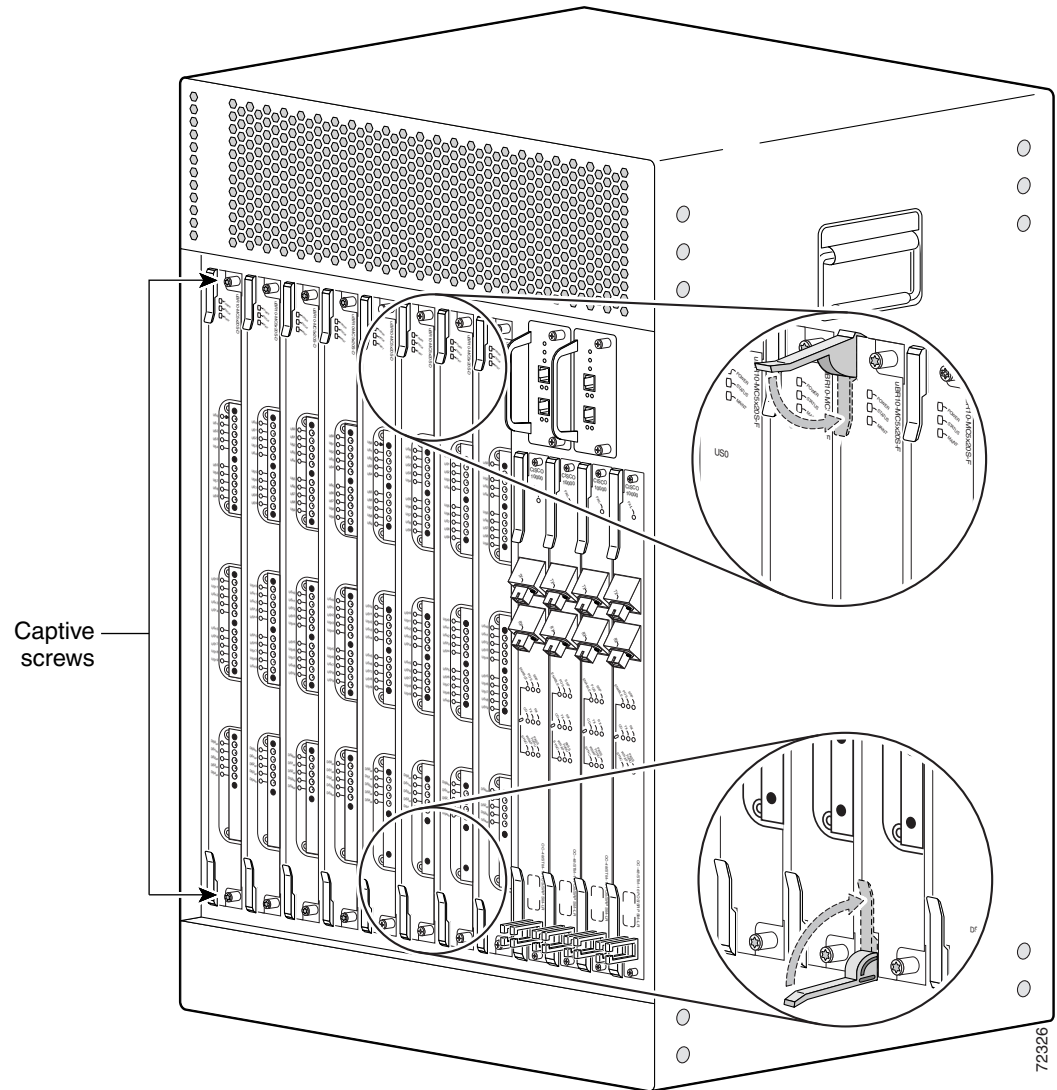
Figure 3-28 *Inserting the Cable Interface Line Card*

Figure 3-29 Closing the Ejector Levers

Installing the Slot Splitter and Half-Height Gigabit Ethernet Line Card

This section describes how to install the line card in the Cisco uBR10012 router. This section includes the following tasks:

- [Installing the Slot Splitter, page 3-48](#)
- [Installing the Half-Height Gigabit Ethernet Line Card, page 3-52](#)

**Caution**

You must use slot 3 or slot 4 when installing the slot splitter and HHGE line card in the Cisco uBR10012 router, using slot 1 or slot 2 will cause the router to shut down those slots.

**Caution**

Do not install two half-height blank faceplates into the same slot in the slot splitter. Instead, install a full-slot blank faceplate into the slot. The half-height blank faceplates do not have air dams, and the empty slot will rob cooling air from the other slots. A slot splitter with one half-height line card and one blank faceplate is allowed.

**Caution**

Do not install a line card into the slot splitter before installing the splitter into the chassis. The slot splitter does not have ejector levers that allow you to seat the line card in the backplane.

Installing the Slot Splitter

You must install the half-height line card into a slot that contains a slot splitter, which can hold two half-height line cards. If both slots of the slot splitter are not used, then you must install a blank faceplate in the empty slot.

Follow these steps to install a slot splitter into slot 3 or slot 4 ([Figure 3-30](#)) of the Cisco uBR10012 chassis.

- Step 1** Attach an antistatic wrist strap to your wrist and to an ESD socket on the chassis, or to a bare metal surface on the chassis or frame.
- Step 2** Grasp the front of the slot splitter with one hand and place your other hand under the splitter. Position the splitter in front of the card cage slot.
- Step 3** Carefully align the upper and lower edges of the slot splitter with the upper and lower guides in the chassis, and slide the splitter into the slot until the front is flush with the chassis.

**Note**

The slot splitter shown in [Figure 3-31](#) has one open slot (top) and one slot with a slot cover (bottom)

Secure the slot splitter to the chassis by tightening the top and bottom captive screws ([Figure 3-32](#)).

Figure 3-30 HHGE Line Card Locations

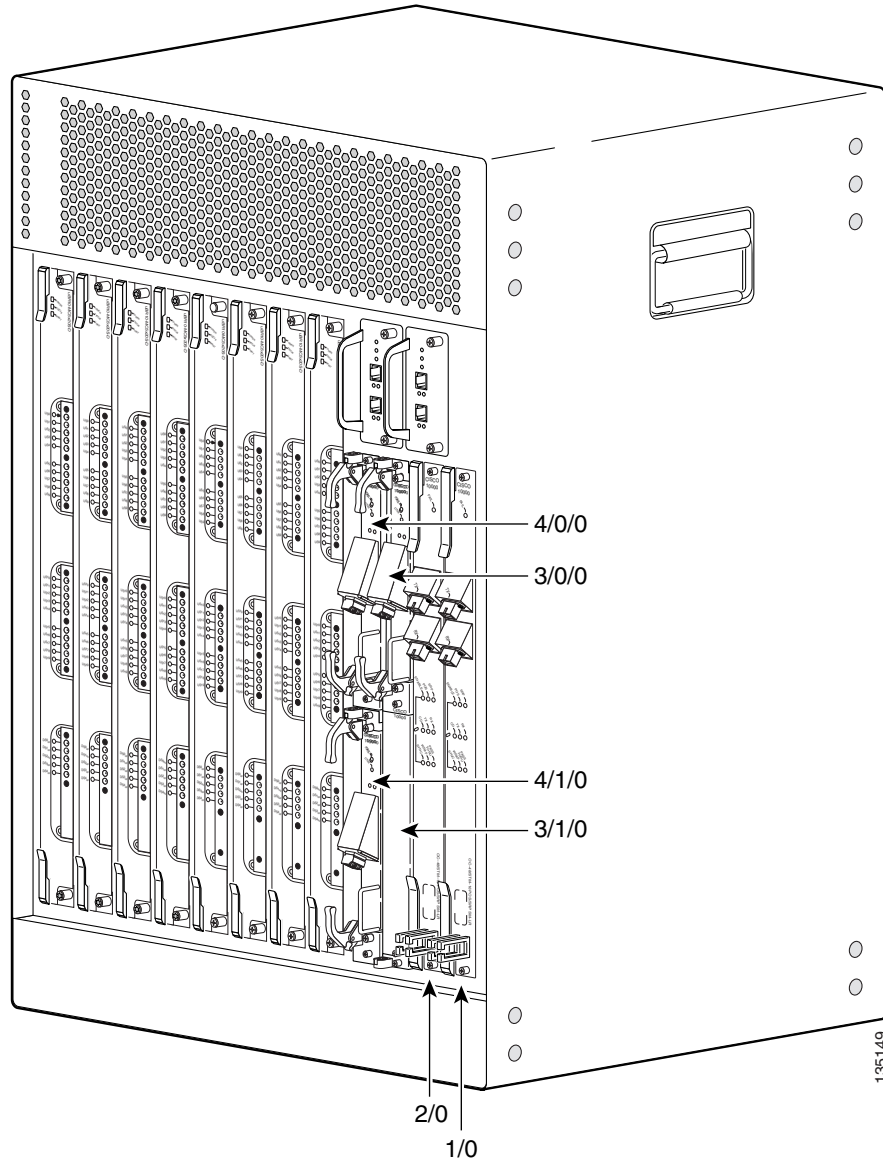


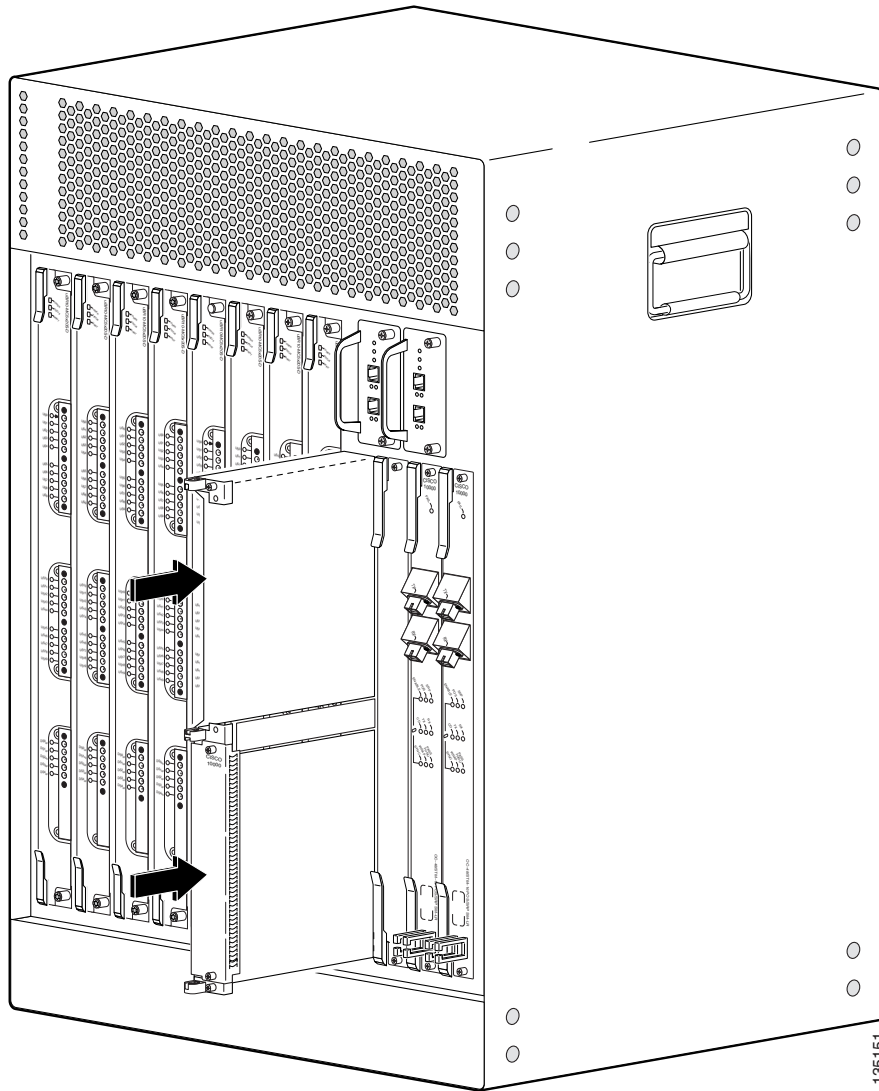
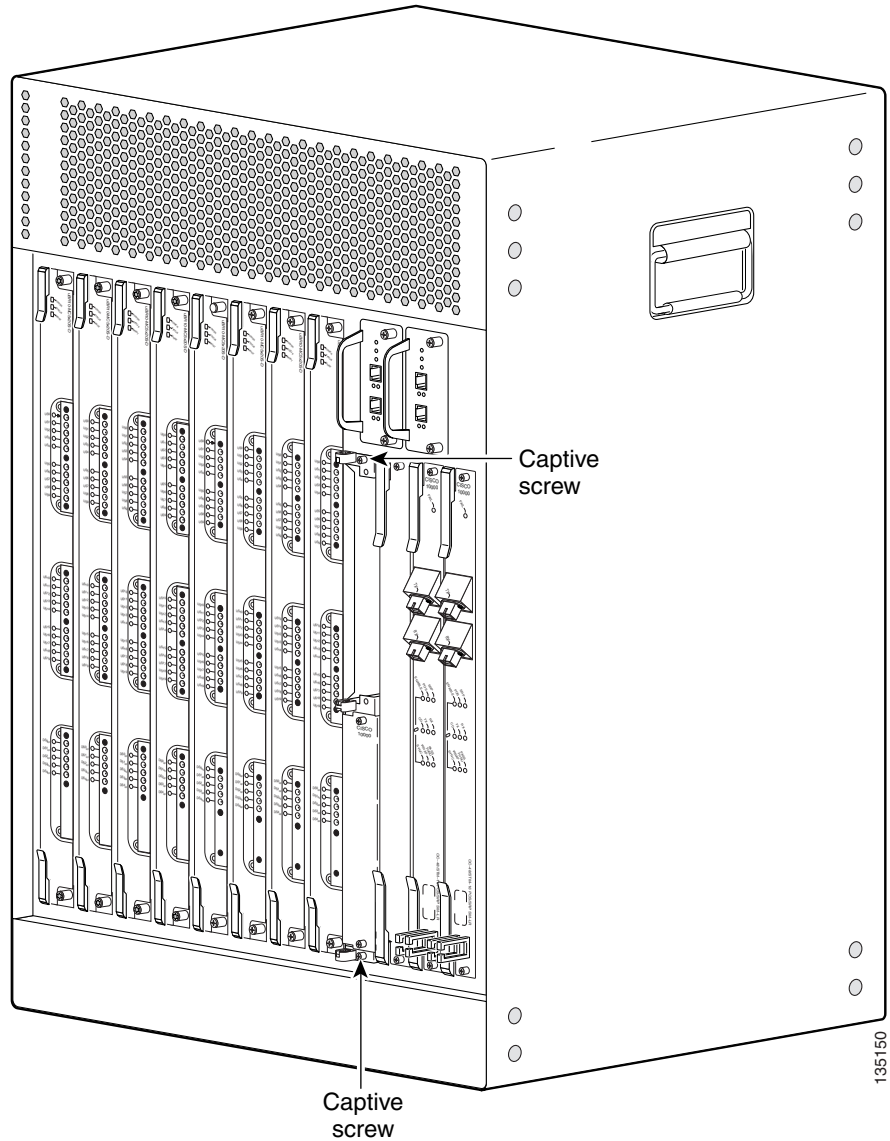
Figure 3-31 Inserting the Slot Splitter

Figure 3-32 Captive Screw Locations

**Warning**

Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.

Statement 1029

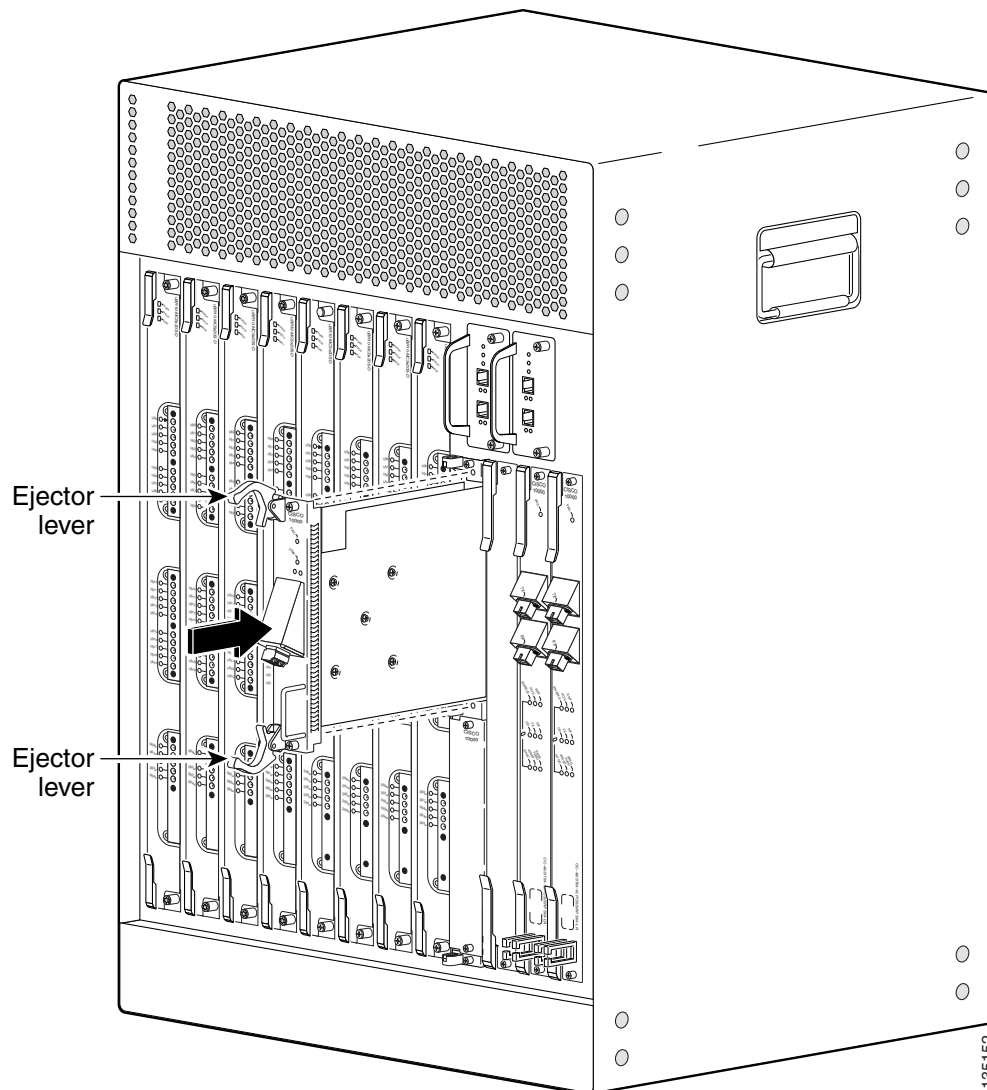
Installing the Half-Height Gigabit Ethernet Line Card

Use the following procedure to install a HHGE line card into an installed slot splitter. See the [“Installing the Slot Splitter”](#) section on page 3-48 to install the slot splitter.

If you are replacing a line card, see the [“Removing a Half-Height Gigabit Ethernet Line Card”](#) section on page 3-4 before you begin this procedure.

- Step 1** Attach an antistatic wrist strap to your wrist and to an ESD socket on the chassis, or to a bare metal surface on the chassis or frame.

Figure 3-33 Inserting the Line Card



- Step 2** Grasp the faceplate of the line card with one hand and place your other hand under the card carrier (to support the weight of the card). Position the card in front of the slot splitter.
- Step 3** Carefully align the upper and lower edges of the line card with the upper and lower guides in the slot splitter, and slide the line card about half-way into the splitter.

- Step 4** Be sure the ejectors are in the open position (as shown) and continue to push the line card into the splitter until you can feel it begin to seat in the backplane connectors.
- Step 5** Verify that the captive screws are properly aligned with the captive screw holes in the splitter. If the captive screws are not properly aligned, the card will not seat properly in the backplane.
- Step 6** Simultaneously pivot both ejector levers toward each other (until they are parallel to the faceplate) to firmly seat the card in the backplane (Figure 3-34).

The line card cycles through its power-on self-test. The FAIL LED lights during portions of the POST (Power-On Self Test), but remains off after POST on a properly working line card. If the FAIL LED remains on, go to the [“Troubleshooting the HHGE Installation”](#) section on page 4-17.

Figure 3-34 Closing the Ejector Levers

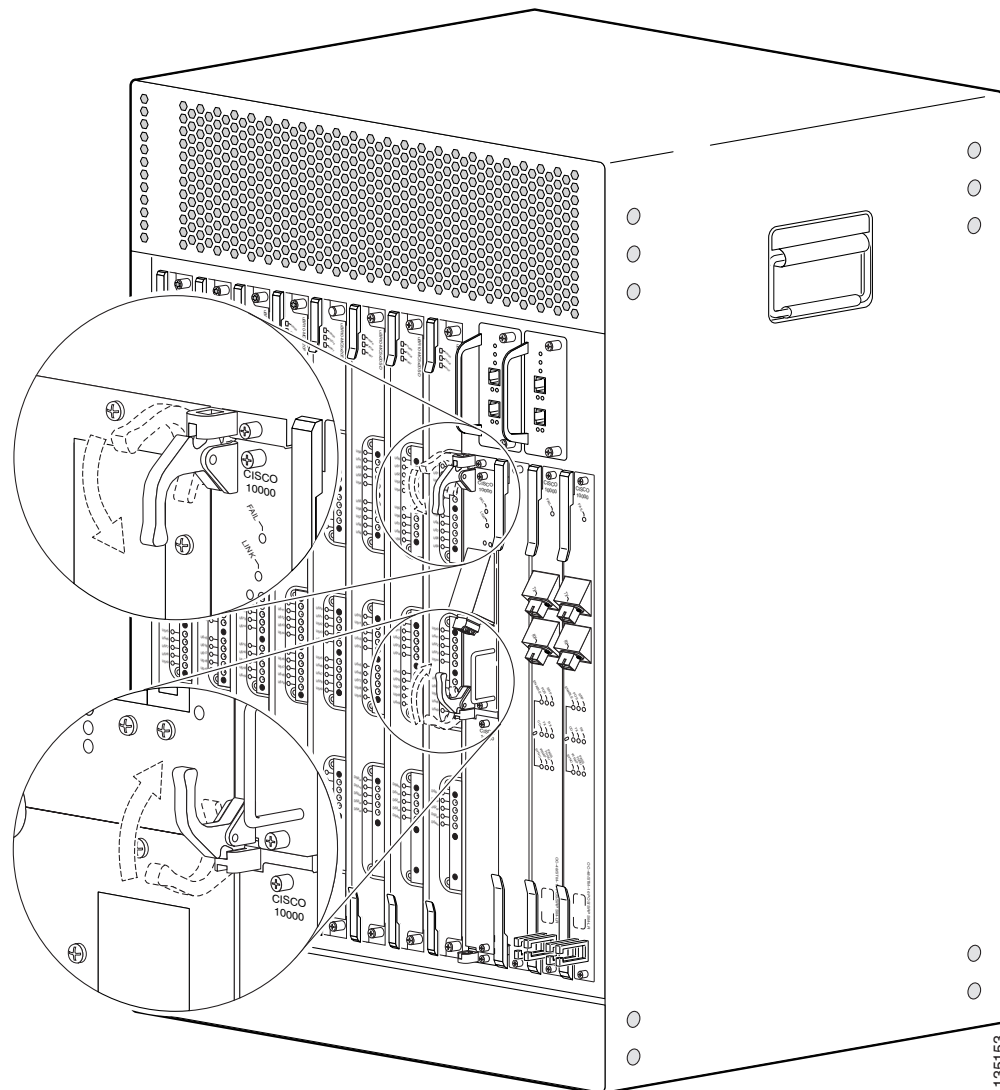
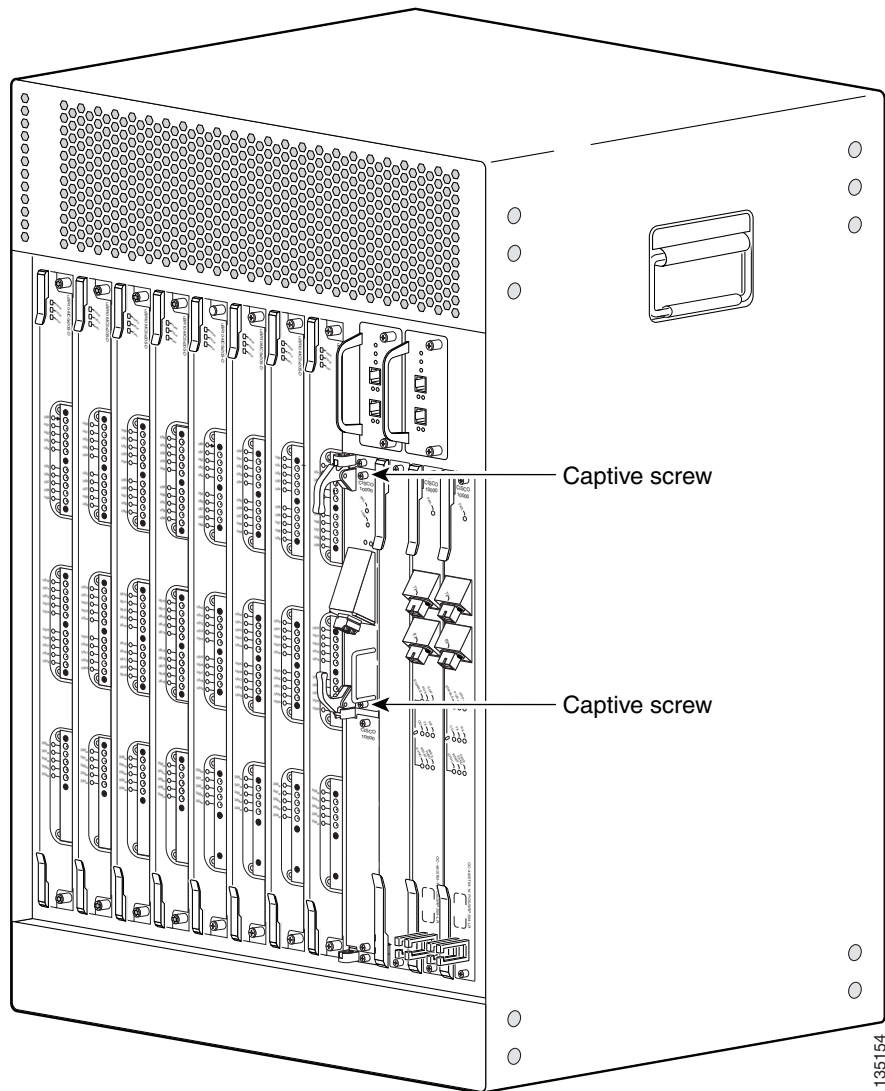


Figure 3-35 Captive Screw Locations



Step 7 Secure the line card in the slot splitter by tightening the top and bottom captive screws (Figure 3-35).

**Caution**

To ensure that there is adequate space for additional line cards, always tighten the captive screws on each newly installed line card *before* you insert any additional line cards. These screws prevent accidental removal and provide proper grounding for electromagnetic interference (EMI) shielding.

Connecting the Console Port and Auxiliary Port

The PRE module on the Cisco uBR10012 router has two asynchronous serial (EIA/TIA-232) RJ-45 ports that provide connections for a console (an ASCII terminal or PC running terminal emulation software) and modem for remote access.

Recommended Tools and Supplies

The Cisco uBR10012 router arrives with a console and auxiliary cable kit, which contains the cable and adapters you need for the most common connections to these devices.

[Table 3-6](#) lists the tools and supplies that you need to connect the Console and auxiliary ports.

Table 3-6 *Tools and Supplies for Connecting the Console Port and Auxiliary Port*

Quantity	Description	Comments
—	RJ-45 to RJ-45 crossover cable	—
—	RJ-45-to-DB-25 male DCE adapter	labeled MODEM
—	ESD-preventive wrist strap	—



Note

A crossover cable reverses pin connections from one end to the other. In other words, it connects pin 1 (at one end) to pin 8 (at the other end), pin 2 to pin 7, pin 3 to pin 6, and so on. You can identify a crossover cable by comparing the two modular ends of the cable. Hold the cable ends in your hand, side-by-side, with the tabs at the back. Ensure that the wire connected to the outside (left) pin of the left plug (pin 1) is the same color as the wire connected to the outside (right) pin of the right plug (pin 8).

Also see [“How to Identify an RJ-45 Crossover Cable”](#) section on page B-5.

Use the following procedures to connect to the console and auxiliary ports on a PRE module.



Note

For more information about the console port and auxiliary port connectors, see the [“Console and Auxiliary Port Cables and Pinouts”](#) section on page B-2.

Connecting to the Console Port

The console port provides local administrative access to the router and its command-line interface (CLI).

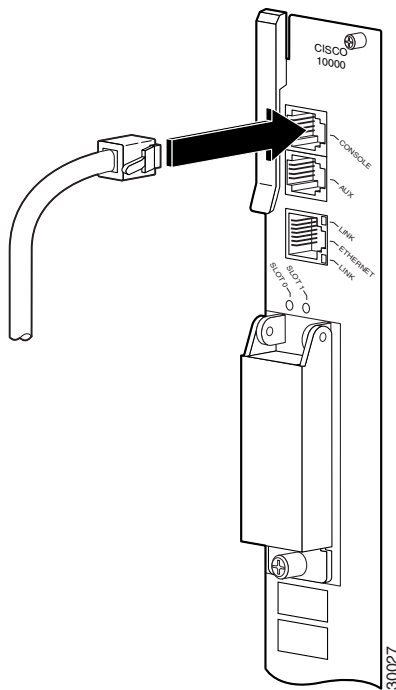


Note

Each PRE module must have a console port connection (typically to a terminal server) when running a redundant configuration in the chassis.

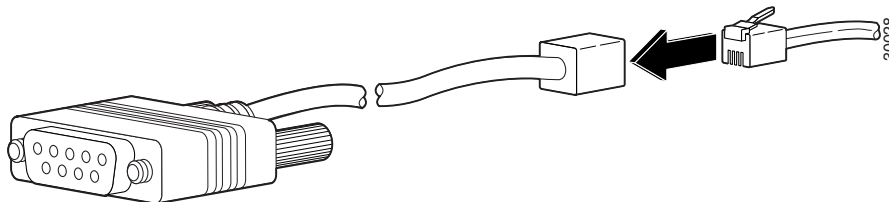
- Step 1** Connect one end of the RJ-45 crossover cable to the serial RJ-45 port (labelled CONSOLE) on the PRE module (Figure 3-36).

Figure 3-36 Console Port Connection on the PRE Module



- Step 2** Run the other end of the crossover cable through the square hole at the left front side of the chassis, and connect it to the RJ-45-to-DB-9 adapter (see Figure 3-37):

Figure 3-37 Connecting an RJ-45-to-DB-9 Console Cable Adapter



- Step 3** Connect the adapter to the appropriate serial port on the PC or terminal to complete the console port cable connection.
- Step 4** Power on the PC or terminal.
- Step 5** Configure the PC terminal emulation software or the terminal for the following default settings:

- 9600 baud
- 8 data bits
- No parity generation or checking
- 1 stop bit
- No flow control

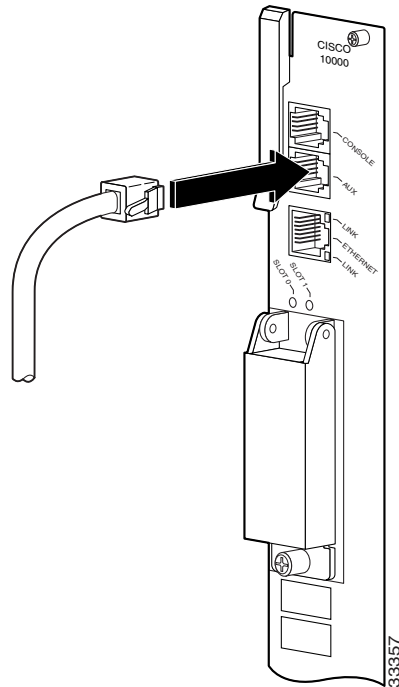
Step 6 If also connecting a modem to the auxiliary port, go to the next section, “[Connecting to the Auxiliary Port.](#)” Otherwise, go to the “[Connecting Network Management Cables](#)” section on page 3-58 to continue the installation.

Connecting to the Auxiliary Port

The auxiliary port provides a connection for a modem to allow remote access to the router and its command-line interface (CLI).

Step 1 Connect one end of the RJ-45 crossover cable to the serial RJ-45 port (labelled AUX) on the PRE module ([Figure 3-38](#)).

Figure 3-38 Auxiliary Port Connection on the PRE Module



Step 2 Run the other end of the crossover cable through the square hole at the left front side of the chassis, and connect it to the RJ-45-to-DB-25 adapter.

Step 3 Connect the adapter to the serial port on the modem to complete the auxiliary port cable connection.

Step 4 Power on the modem.

- Step 5** Make sure that the modem and auxiliary port on the router are configured for the same transmission speed (38.4 Kbps and 56 Kbps are typical). Configure the modem for auto-answer and for hardware flow control using the Data Carrier Detect (DCD) and Data Terminal Ready (DTR) signals.
- Step 6** Go to the [“Connecting Network Management Cables” section on page 3-58](#) to continue the installation.
-

Connecting Network Management Cables

The Cisco uBR10012 router has connections to both the internal Ethernet management network and the external data network. The internal Ethernet management network connections are made through an Ethernet port on the front panel of the PRE module. These connections are described in the [Ethernet Network Management Cable Connections](#).

Keep the following guidelines in mind when connecting external cables to the Cisco uBR10012 router:

- To reduce the chance of interference, avoid crossing power lines with any interface cables.
- Verify all cabling limitations (particularly distance) before powering on the system.

Ethernet Network Management Cable Connections

The PRE module provides an Ethernet port to a LAN for a 10Base-T or 100Base-T connection for network management. Use the following procedures to connect the Cisco uBR10012 router to an Ethernet network.



Note

Each PRE module must have an Ethernet port connection (typically to the same Ethernet hub) if you are running a redundant configuration in the chassis. However, only the active PRE module has an active Ethernet connection to the network.

Connecting to a 10Base-T Ethernet Network

To make a 10Base-T Ethernet LAN connection, you need the following additional equipment (not included):

- An Ethernet hub (such as a Cisco Micro Hub)
- An Ethernet cable that meets the following specifications:
 - RJ-45 (male) to RJ-45 (male) straight-through cable
 - 100-ohm category 3, 4, or 5, no longer than 328 feet (100 meters)

You can identify a straight-through Ethernet cable either by using a cable tester or by making a visual inspection. To make a visual inspection, hold the two ends of a cable side by side, with the tab for each at the back.

- The wire connected to the left-most pin (pin 1) on one connector should be the same color as the wire connected to the left-most pin on the other connector.
- The same rule applies to pins 2 through 8 on each connector. The color of the wire attached to a pin on one connector should match the color of the wire attached to the corresponding pin on the other connector.

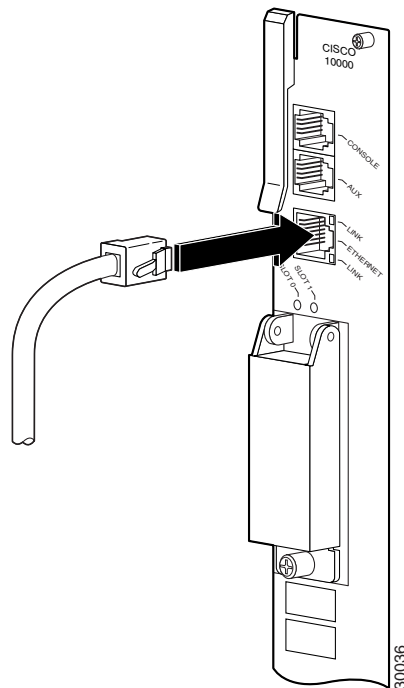
Follow these steps to connect the PRE to a 10Base-T Ethernet LAN.

- Step 1** Connect one end of the Ethernet cable to the RJ-45 port on the primary PRE, labeled Ethernet (see [Figure 3-39](#)).
- Step 2** Run the other end of the Ethernet cable through the square hole at the left front side of the chassis, and connect this end of the cable to any unoccupied port on the Ethernet hub.

**Tip**

When power is applied to the chassis, check the LNK (Link) LED on the PRE faceplate port next to the Ethernet port. This LED lights (green) if the PRE is correctly connected to the 10Base-T Ethernet LAN.

Figure 3-39 Connecting 10Base-T to an Ethernet Port



Connecting to a 100Base-T Ethernet Network

To make a 100Base-T Ethernet LAN connection, you need the following additional equipment (not included):

- An Ethernet hub (such as a Cisco Micro Hub)
- An Ethernet UTP cable that meets the following specifications:
 - RJ-45 (male) to RJ-45 (male) straight-through cable.
 - 100-ohm category 5 cable not longer than 328 feet (100 meters).

You can identify a straight-through Ethernet cable either by using a cable tester or by making a visual inspection. To make a visual inspection, hold the two ends of a cable side by side, with the tab for each at the back.

- The wire connected to the left-most pin (pin 1) on one connector should be the same color as the wire connected to the left-most pin on the other connector.

- The same rule applies to pins 2 through 8 on each connector. The color of the wire attached to a pin on one connector should match the color of the wire attached to the corresponding pin on the other connector.

**Caution**

If the Cisco uBR10012 router is used in an environment in which lightning-induced transients are likely to couple to the signal lines, use of shielded interconnection cables for the 100Base-T ports is highly recommended. In addition, use of shielded interconnection cables for the 100Base-T ports is required to meet Telcordia (formerly Bellcore) GR1089 CORE Section 4.5.9 and ETSI Section 5.2.2.2 (intrabuilding lightning surge).

The RJ-45 port on the PRE is configurable for 100-Mbps full-duplex or half-duplex operation (half-duplex is the default) and supports IEEE 802.3, Ethernet, and IEEE 802.3u interfaces compliant with 100Base-T specifications.

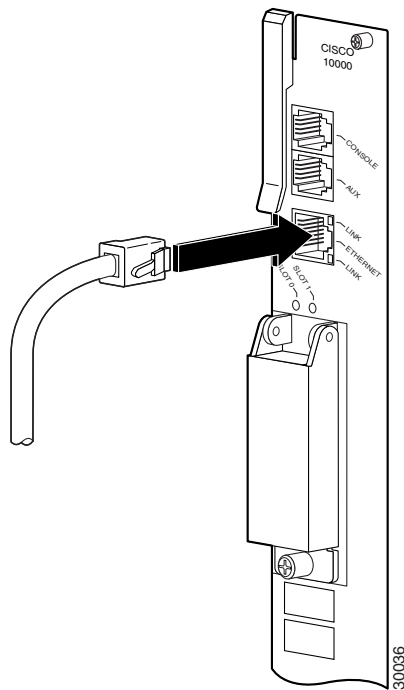
Follow these steps to connect the PRE to a 100Base-T Ethernet LAN.

- Step 1** Connect one end of the Ethernet cable to the RJ-45 port on the primary PRE, labeled Ethernet (Figure 3-40).
- Step 2** Run the cable up and through the cable management bracket and connect the other end of the Ethernet cable to any unoccupied port on the Ethernet hub.

**Tip**

When power is applied to the chassis, check the LNK (Link) LED on the PRE faceplate port next to the Ethernet port. This LED lights (green) if the PRE is correctly connected to the 100Base-T Ethernet LAN.

Figure 3-40 Connecting 100Base-T to Ethernet Port



Connecting Cable Interface Line Cards and Network Uplink Cards

Because there are very specific requirements for cabling the different line cards and uplink cards used with the Cisco uBR10012 CMTS, please review the documentation for the cards that you are installing in your system.

Cable Interface Line Card Connections

For cabling instructions, refer to the appropriate cable interface line card documentation at the following URL:

http://www.cisco.com/en/US/products/hw/cable/ps2209/prod_installation_guides_list.html

Network Uplink Cable Connections

These cards use fiber optic connections which require specific cleaning and preparation before they are cabled. For cleaning and inspecting instructions for the fiber optic connections, see *Inspection and Cleaning Procedures for Fiber-Optic Connections* at the following URL:

http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml

For cabling instructions, refer to the appropriate network uplink card documentation at the following URL:

http://www.cisco.com/en/US/products/hw/cable/ps2209/prod_installation_guides_list.html



Class 1 laser product. Statement 1008



Invisible laser radiation present. Statement 1016.



Because invisible laser radiation may be emitted from the aperture of the port when no cable is connected, avoid exposure to laser radiation and do not stare into open apertures. Statement 1056.

Warning Statement for Sweden



Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen. Statement 36.

Warning Statement for Finland



Alleviätes ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen. Statement 35

**Note**

If you have completed all cable connections, go to the “[Replacing the Front Cover](#)” section on page 3-65 to continue the installation. If you are using Gigabit Ethernet line cards, go to “[Connecting a Single-Port Gigabit Ethernet Line Card](#)” section on page 3-62.

Connecting a Single-Port Gigabit Ethernet Line Card

The single-port Gigabit Ethernet (GE) line card provides a trunk uplink running at 1 Gbps in full duplex mode to devices such as content servers and Web caches. The port uses a Gigabit Interface Converter (GBIC) that supports Gigabit Ethernet rates on a variety of Gigabit Ethernet interface types (SX, LX/LH, ZX). For a list of qualified GBICs and cable lengths, see [Table 1-9](#).

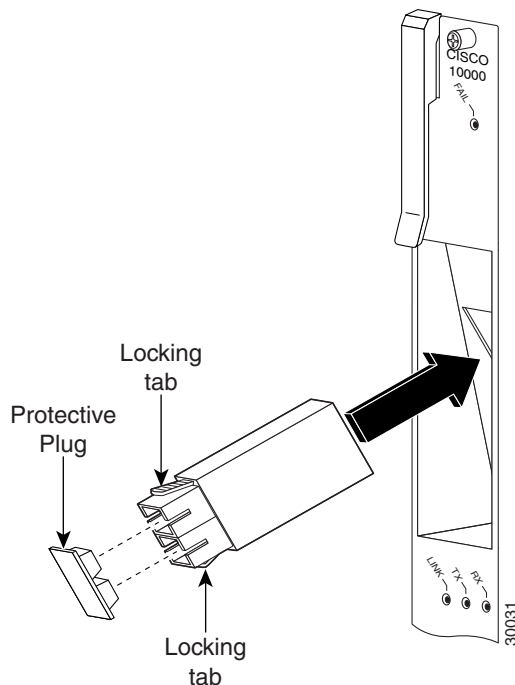
Use the following procedure to install a GBIC and then connect a fiber cable to the GBIC.

**Note**

If a GBIC is already installed in the GE line card, begin this procedure at Step 2.

- Step 1** Review the warnings at the start of the network uplink section.
- Step 2** Insert the GBIC into the GE line card port until the tabs lock into place ([Figure 3-41](#)).

Figure 3-41 Inserting the GBIC

**Note**

The GBIC is “keyed” and can only be fully inserted one way. If you can only insert the GBIC one quarter of the way into the port, remove it, turn it over, and reinsert it into the port.

- Step 3** Remove the protective plug from the GBIC by pulling it off.

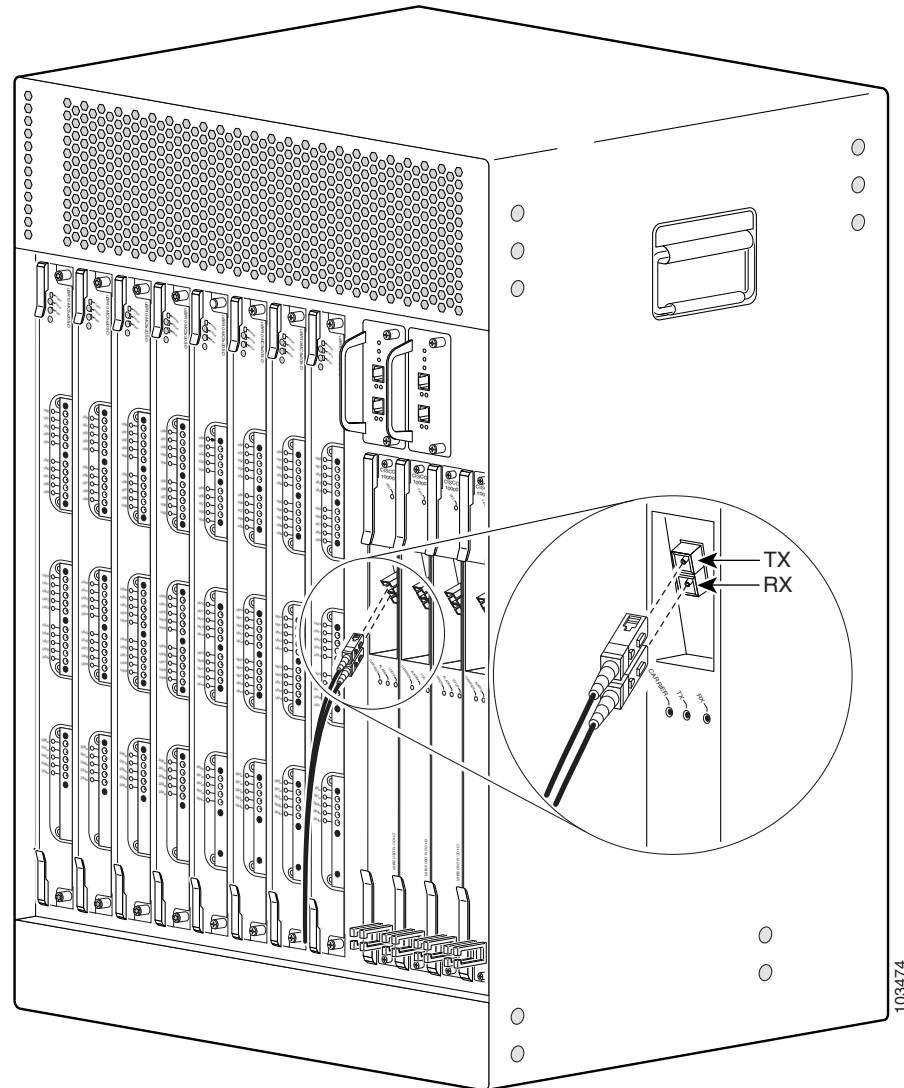
**Caution**

Make sure your fiber optic connectors are clean and debris free. Refer to *Inspection and Cleaning Procedures for Fiber-Optic Connections* at the following URL:

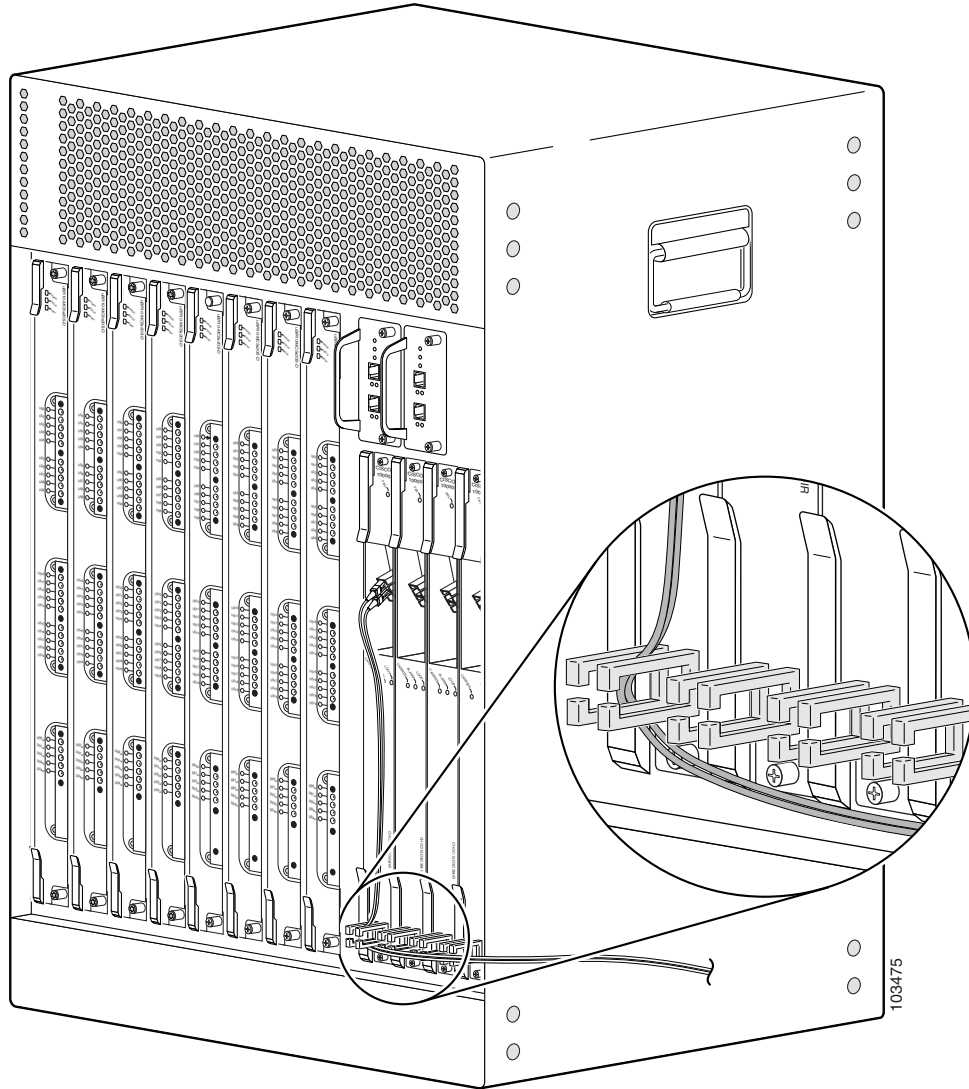
http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml

Step 4 Attach the fiber optic cable to the GBIC port (Figure 3-42).

Figure 3-42 Connecting the Cable to the GBIC Port



Step 5 Run the cable through the cable bracket on the bottom of the line card and then out to the left or right of the chassis (Figure 3-43).

Figure 3-43 Gigabit Ethernet Cable Management

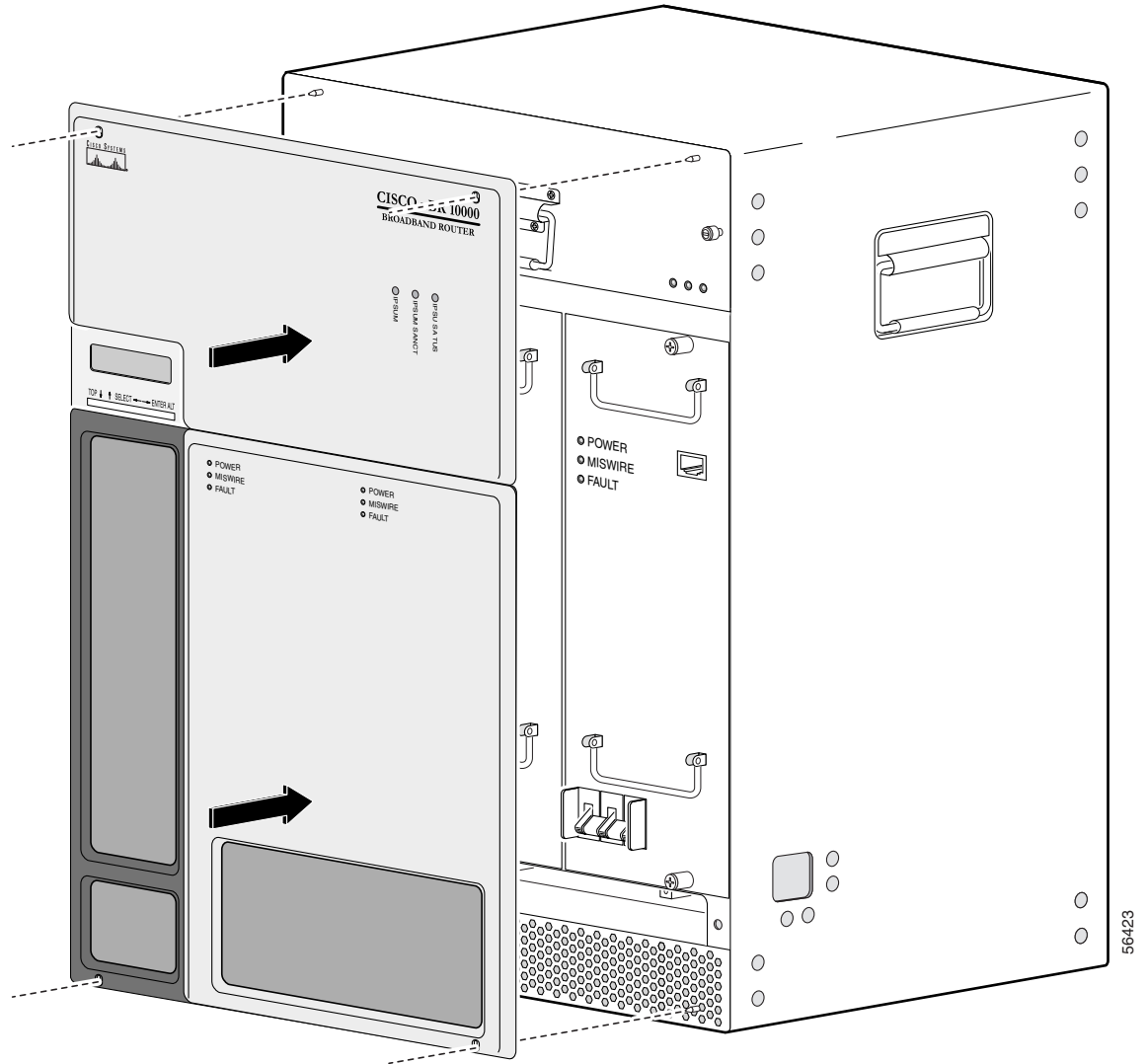
Step 6 If you have completed all cable connections, go to the next section, [“Replacing the Front Cover”](#) to continue the installation.

Replacing the Front Cover

Use the following procedure to replace the front cover on the chassis:

- Step 1** Slide the cover onto the four corner posts of the chassis and then push down so that the posts are seated in the grooves above the cover holes (Figure 3-44).

Figure 3-44 Attaching the Cover to the Chassis



- Step 2** Continue with the “[Powering On the System](#)” section to continue the installation.

Powering On the System

After all of the interfaces and other cables are connected, perform a visual check of all connections and then check that:

- The ejector levers on each line card are in the locked position.
- All top and bottom line card captive screws are tight.
- All network interface cables are connected.
- The console terminal is turned on.
- A PC media card is installed in the PRE module.

For information on powering up the Cisco uBR10012 router using the UBR10-PWR-DC= DC PEM module, see [DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on powering up the Cisco uBR10012 router using the UBR10-PWR-DC-PLUS= DC PEM module, see [3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on powering up the Cisco uBR10012 router using the UBR10-PWR-AC= AC PEM module, see [AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on powering up the Cisco uBR10012 router using the UBR10-PWR-AC-PLUS= AC PEM module, see [3300 W AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

Configuring the Cisco uBR10012 Router at Startup

This section explains how to create a basic running configuration for your Cisco uBR10012 router using the Cisco uBR10012 router setup facility or the IOS command line interface (CLI). For information on modifying the configuration after you create it, refer to:

- The online *Cisco uBR10012 Router Useful Links* document
- Cisco IOS configuration and command reference guides

To configure a Cisco uBR10012 router from the console, you must connect a terminal or terminal server to the router's console port. To configure the Cisco uBR10012 router over your management Ethernet, you must have available the router's IP address.

Startup Display

When you power on your Cisco uBR10012 router or execute the **reload** command, the console screen displays a message similar to the following:

```
Restricted Rights Legend
Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
```

cisco Systems, Inc.

```
170 West Tasman Drive
San Jose, California 95134-1706

Cisco Internetwork Operating System Software
IOS (tm) 10012 Software (UBR10K-P6-M), Released Version 12.2(1)
Copyright (c) 1986-2001 by cisco Systems, Inc.
Compiled Thu 19-Apr-01 13:47 by samants
Image text-base: 0x60008960, data-base: 0x612B0000

ROM: System Bootstrap, Version 12.0(9r)SL1, RELEASE SOFTWARE (fc1)
BOOTFLASH: 10012 Software (C10K-EBOOT-M), Released Version 12.1(5)

System returned to ROM by reload at 12:59:35 PDT Thu Apr 19 2001
System restarted at 13:00:51 PDT Thu Apr 19 2001

cisco C10012 (PRE-RP) processor with 98304K/32768K bytes of memory.
Processor board ID ABCDEFEDCBA
R7000 CPU at 262Mhz, Implementation 39, Rev 2.1, 256KB L2, 2048KB L3 Cache
Backplane version 1.0, 16 slot

Last reset from unexpected value
Toaster processor tmc0 is running.
Toaster processor tmcl is running.
1 Ethernet/IEEE 802.3 interface(s)
1 FastEthernet/IEEE 802.3 interface(s)
1 Gigabit Ethernet/IEEE 802.3 interface(s)
3 Cable Modem network interface(s)
509K bytes of non-volatile configuration memory.

16384K bytes of Flash PCMCIA card at slot 1 (Sector size 128KB).
32768K bytes of Flash internal SIMM (Sector size 256KB).
Press RETURN to get started!
```

Basic Configuration Using the Setup Facility

The first time you power on a Cisco uBR10012 router, the setup facility starts. You can also initiate the facility by running the **setup** command in privileged EXEC mode. This facility helps you enhance a default configuration that already exists on the Cisco uBR10012 router. The setup facility uses a question and answer sequence called the System Configuration Dialog to walk you through configuring the router.

You do not have to configure the interfaces immediately; however, you cannot enable the interfaces or connect them to any networks until you have configured them.



Tip

Basic configuration setup is often used as a quick way to achieve network connectivity, allowing you to retrieve a configuration file from a TFTP server.

System Configuration Dialog

Use the System Configuration Dialog to help you perform a basic configuration. Proceed through the dialog by answering questions and then pressing the Enter key. In most cases, you can get additional information by entering a question mark (?). Throughout the dialog, default values are shown in square brackets [].

**Tip**

If you have experience using Cisco routers, consider configuring the router by using the procedure described in the [“Basic Configuration in Global Configuration Mode”](#) section on page 3-70.

To cancel the configuration dialog, press **Ctrl-C**, or you can let the dialog help you perform one of two configuration types:

- Basic configuration setup configures only enough connectivity for management of the system.
- Extended setup asks you to configure each interface and is not appropriate for configuring the Cisco uBR10012 router. For more information, see the *Cisco IOS Configuration Fundamentals Configuration Guide*.

You can run the setup facility any time you are at the enable prompt (#) by entering the command **setup**.

Configuring the System Using System Configuration Dialog

Use the following procedure to perform a basic configuration using the System Configuration Dialog:

-
- Step 1** The dialog starts by asking if you want to continue with the configuration dialog. Enter **Yes**. To return to the enable prompt, enter **No**.
- ```
--- System Configuration Dialog ---
Continue with configuration dialog? [yes/no]: yes
```
- Step 2** Enter **Yes** to perform a basic management setup. Enter **No** to perform an extended configuration setup.
- ```
Would you like to enter basic management setup? [yes/no]: yes
```
- Step 3** Specify a hostname. The hostname becomes part of the IOS prompt.
- ```
Enter host name [Router]: my-router
```
- Step 4** Specify a secret password. It appears in encrypted form in the configuration file.
- ```
Enter enable secret: my_secret
```
- Step 5** Specify the enable password. It is used if you did not assign a secret one.
- ```
Enter enable password: my_password
```
- Step 6** Specify the password to use for telnet sessions.
- ```
Enter virtual terminal password: my_vt
```
- Step 7** At the configure system management prompt, enter **No**.
- ```
Configure System Management? [yes/no]: no
```
- Step 8** If you want to access the router using SNMP, enter **Yes** at the prompt:
- ```
Configure SNMP Network Management? [yes]: yes
```
- Step 9** Specify an SNMP community string.
- ```
Community string [public]: public
```
-



## Setting Up the Interface

After you respond to the SNMP questions, the setup script lists the interfaces. The following table lists typical interfaces found on a Cisco uBR10012 router.

| Interface            | IP-Address | OK? | Method | Status | Protocol |
|----------------------|------------|-----|--------|--------|----------|
| Ethernet0/0/0        | unassigned | YES | unset  | up     | up       |
| FastEthernet0/0/0    | unassigned | NO  | unset  | up     | up       |
| GigabitEthernet3/0/0 | unassigned | NO  | unset  | up     | up       |
| Cable6/1/0           | unassigned | NO  | unset  | up     | up       |
| Cable6/1/1           | unassigned | NO  | unset  | up     | up       |
| Cable7/0/0           | unassigned | NO  | unset  | up     | up       |



### Tip

Interfaces that are not okay (NO) do not have a valid configuration.

To set up an interface on the Cisco uBR10012 router:

- 
- Step 1** Enter the interface for the FastEthernet interface to achieve network connectivity.
- ```
Enter interface name used to connect to the management network from the above interface
summary: FastEthernet0/0/0
```
- Step 2** Accept the default value for the type of connector. RJ-45 is the only connector that can be used on the Cisco uBR10012 router Ethernet port.
- ```
Configuring interface FastEthernet0/0/0:
Use the 100 Base-TX (RJ-45) connector? [yes]: yes
```
- Step 3** Configure both the Cisco uBR10012 router and the remote device to use the same mode.
- ```
Operate in full-duplex mode? [no]: no
```
- Step 4** Enter the IP address to achieve network connectivity.
- ```
Configure IP on this interface? [yes]: yes
```
- Step 5** Specify the IP address.
- ```
IP address for this interface: 172.27.48.209
```
- Step 6** Enter the subnet mask for the IP address.
- ```
Subnet mask for this interface [255.255.0.0]: 255.255.0.0
```

The system displays the information you entered as well as several default commands, such as the **no shutdown** command. For example:

```
The following configuration command script was created:
hostname c10012
enable secret 5 $$1$uror$EFU0hKOBQXhk975qKFZ1L0
enable password <xxx>
line vty 0 4
password <xxx>
no snmp-server
!
no ip routing
!
```

```

interface FastEthernet0/0/0
no shutdown
media-type 100BaseX
half-duplex
ip address 172.27.48.209 255.255.0.0
!
end

```

**Step 7** Exit the setup script without saving, start the setup script, or save the configuration file:

```

[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.

```

Enter your selection [2]:

**Step 8** Enter global configuration mode after you complete the configuration, and enable ip routing by entering the ip routing command:

```
router(config)#ip routing
```

---

## Basic Configuration in Global Configuration Mode

The following command sequence allows you to perform a configuration similar to that generated by the `setup` command.

```

Router>configure terminal
Router(config) #hostname c10012
Router(config) #enable secret <my_router>
Router(config) #enable password <my_rtr>
Router(config) #snmp-server community public
Router(config) #ip routing
Router(config) #interface FastEthernet0/0/0
Router(config-if) #no shutdown
Router(config-if) #media-type 100BaseX
Router(config-if) #half-duplex
Router(config-if) #ip address 192 255.255.0.0
Router #copy running-config startup-config

```

You can now configure the line cards. For specific information on system and interface configuration, refer to the *Cisco uBR10012 Universal Broadband Router Software Configuration Guide* at the following URL:

<http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/configuration/guide/scg.html>

## Formatting PC Media Cards

The PC media card that shipped with your PRE contains the default Cisco IOS image for booting your router. This section explains how to format a PC media card, modify its contents, or resolve a problem with the card.

**Caution**

---

The formatting procedure erases all information on the PC media card.

---

**Note**

---

The Cisco uBR10012 router uses PC media cards that are a minimum of 64 MB in size.

---

Flash memory ATA disks and Flash memory cards use similar commands. The primary syntax change is that *disk0:* or *disk1:* refers to Flash memory ATA disks while *slot0:* or *slot1:* refers to Flash memory cards.

Use the following procedure to format a Flash memory disk:

- 
- Step 1** Ensure there is a PC media card in slot 0 or slot 1 of the PRE.
- Step 2** Enter the **format disk*n*:** command at the privileged EXEC mode prompt to format the card. The example shows the display after you enter the **format disk0:** command:

```
Router# format disk0:

All sectors will be erased, proceed? [confirm]
Enter volume id (up to 30 characters): MyNewdisk
Formatting sector 1
Format device slot0 completed
```

The PC media card is ready for use.

---





## Troubleshooting the Installation

---

This chapter provides basic troubleshooting information to solve the most common installation problems with the Cisco uBR10012 universal broadband router. Your Cisco uBR10012 router went through extensive testing before leaving the factory. However, if you encounter problems starting the router, use the information in this chapter to help isolate the cause of the problems.

This chapter contains the following sections:

- [Troubleshooting Methods, page 4-2](#)
- [Troubleshooting Installation Problems, page 4-3](#)
- [Troubleshooting Ethernet Connections, page 4-4](#)
- [Troubleshooting the Console Port Serial Connection, page 4-5](#)
- [Identifying Startup Problems, page 4-6](#)
- [Troubleshooting the Power Subsystem, page 4-7](#)
- [Troubleshooting the Processor Subsystem, page 4-13](#)
- [Troubleshooting the Cooling Subsystem, page 4-14](#)
- [Troubleshooting the Line Cards, page 4-16](#)
- [Troubleshooting the HHGE Installation, page 4-17](#)



### Note

---

The procedures in this chapter assume that you are troubleshooting the initial system startup, and that your router is in the original factory configuration. If you have removed or replaced components or changed any default settings, the recommendations in this chapter might not apply.

---

Make sure to review the safety warnings listed in this manual, especially in [Chapter 2, “Preparing for Installation,”](#) before using the troubleshooting procedures in this chapter.

# Troubleshooting Methods

This section describes the troubleshooting methods used in this chapter and describes how Cisco uBR10012 routers are divided into subsystems for more efficient problem solving.

## Before You Call for Technical Assistance

If you are unable to easily solve the problem, contact a customer service representative for assistance and further instructions. Provide the representative with the following information:

- Date you received the router
- Chassis serial number
- Type of software and release number
- Brief description of the problem you are having
- Brief explanation of the steps you have taken to isolate and resolve the problem
- Maintenance agreement or warranty information

## Problem Solving Using a Subsystems Approach

The key to solving problems with the system is isolating the problem to a specific subsystem. Because a startup problem is usually caused by a single component, it is more efficient to first isolate the problem to a subsystem rather than troubleshoot each component in the system. For these troubleshooting procedures, consider the following subsystems:

- Power subsystem—Includes the power supply and the external power cable.
- Processor subsystem—Includes the network processing card, the modular port adapter, the service module, and the fixed RF ports. The system memory and management functions reside on the network processing card, and the enabled LED on each port indicates if the port is initialized. A port adapter that is partially installed in the router can cause the system to hang and crash.
- Cooling subsystem—Includes the fans.

The following sections help you isolate a problem to one of these subsystems and direct you to the appropriate troubleshooting section.

# Troubleshooting Installation Problems

This section contains general troubleshooting information to help you solve any problems you might encounter during the installation of the system.

## General Troubleshooting Tips

All Cisco uBR10012 router FRUs (field replaceable units) are hot-swappable. Procedures for removing and replacing the FRUs can be found in [Chapter 5, “Maintaining the Cisco uBR10012 Router.”](#)

List of FRU modules:

- Fan module
- TCC+ modules
- Power entry modules (PEM)
- PRE modules
- Cable interface cards and uplink cards

[Table 4-1](#) lists general FRU fault symptoms and recommendations.

**Table 4-1**      **General Troubleshooting Tips**

| Symptom                                                             | Steps to Take                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| System fails to power on                                            | <p>Check that:</p> <ul style="list-style-type: none"> <li>• All power cords are properly connected to the Cisco uBR10012 router and at the power connection end.</li> <li>• The DC PEM power switches are turned on and the POWER LED is illuminated (green).</li> <li>• The AC PEM power switches are turned on and the POWER LED is illuminated (green).</li> <li>• The fan assembly module is fully inserted, and the FANS OK LED is lighted (green).</li> </ul> |
| System fails to boot up properly                                    | <p>If the system has power, check the FAIL LED on the PRE and any information on the alphanumeric display. If the FAIL LED is on, see <a href="#">Troubleshooting the Power Subsystem, page 4-7</a></p>                                                                                                                                                                                                                                                             |
| DC PEM problem                                                      | <ul style="list-style-type: none"> <li>• If the FAULT LED is illuminated, see <a href="#">Troubleshooting the Power Subsystem, page 4-7</a>.</li> <li>• If the MISWIRE LED is on, the -48/-60VDC and return (RTN+) wires are reversed. Power off the PEM and reconnect the wires correctly (see the <a href="#">“Connecting DC Power to the Cisco uBR10012 Router”</a> section on page 3-39).</li> </ul>                                                            |
| AC PEM problem                                                      | <ul style="list-style-type: none"> <li>• If the power LED on the AC PEM is off, check the AC power source.</li> <li>• If the fault LED is illuminated (yellow), check to see if the PEM is properly inserted in the chassis.</li> <li>• Check the Cisco IOS Release version that you are using. Versions earlier than Cisco IOS Release 12.2(4)XFI, 12.2(4)BC1, or later do not correctly identify the AC PEM’s error messages.</li> </ul>                          |
| System experiences a critical alarm (Critical LED on the PRE is on) | <p>Enter the <b>show facility-alarm status</b> command at the console.</p>                                                                                                                                                                                                                                                                                                                                                                                          |

**Table 4-1**      **General Troubleshooting Tips (continued)**

| Symptom                                                            | Steps to Take                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| System experiences a major alarm (Major LED on the PRE is on)      | Enter the <b>show facility-alarm status</b> command at the console.                                                                                                                                                                                                                                                                                                                                                                                       |
| System experiences a minor alarm (Minor LED on the PRE is on)      | Enter the <b>show facility-alarm status</b> command at the console.                                                                                                                                                                                                                                                                                                                                                                                       |
| You cannot establish a console or Telnet connection to the system. | For information about troubleshooting Ethernet connections, see the “ <a href="#">Troubleshooting Ethernet Connections</a> ” section on page 4-4.<br>For information about troubleshooting the console port serial connections, see the “ <a href="#">Troubleshooting the Console Port Serial Connection</a> ” section on page 4-5.                                                                                                                       |
| Fan failure                                                        | Perform the following if the fan failure LEDs illuminate: <ul style="list-style-type: none"> <li>• Reseat the fan assembly module (see the “<a href="#">Removing and Replacing the Fan Assembly Module</a>” section on page 5-6).</li> <li>• Remove the rear safety cover and be sure that the fan assembly module cable is connected securely (see the “<a href="#">Removing and Replacing the Fan Assembly Module</a>” section on page 5-6).</li> </ul> |
| System overheats                                                   | This may be due to a failure in the fan assembly module (see Fan Failure above), insufficient ventilation, or high ambient temperature. See the “ <a href="#">Troubleshooting the Cooling Subsystem</a> ” section on page 4-14 for additional information.                                                                                                                                                                                                |

## Troubleshooting Ethernet Connections

If an Ethernet connection to your Cisco uBR10012 router fails to work properly, and the corresponding LNK (Link) LED is not illuminated, check for the following problems:

- Visually check that an Ethernet cable is connected to the correct Ethernet port on the PRE, and that the other end of the cable is connected to an Ethernet hub that is powered on and functioning properly.
- Check to see if you are using the correct type of cable. The cable must meet the specifications given in the “[Connecting to a 10Base-T Ethernet Network](#)” section on page 3-58.
- The cable might be bad or broken. Replace the cable with a known, reliable straight-through Ethernet cable, checking to be sure the LNK LED comes on (green).
  - If the LNK LED is still not illuminated, it is possible that the Ethernet port might be functioning properly, but the LED is not working. Check the Ethernet port (by trying to ping over it, for example) to determine if the problem is due to a bad LED or if the Ethernet link is bad.
- Make sure the PRE has booted up properly as follows:
  - The Status LED should be illuminated (green).
  - If the Fail LED is illuminated (yellow), refer to [Troubleshooting the Processor Subsystem](#), page 4-13.



- Check the hub:
  - Is the cable connected into the correct hub port (for example, the hub LED is illuminated, but the LNK LED on the PRE is not illuminated).
  - Be sure that the cable is not connected to an uplink port.
- If the LNK LED is illuminated (green), but the Ethernet port does not seem to be working properly, make sure that the port in question is configured properly and is not administratively shut down. If you have a working console connection, perform the following steps:
  - At the router prompt, enter **show int fast0/0/0**. If the port is administratively down, enter these commands to enable it:

```
router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.
router(config)# int fast0/0/0
router(config-if)# no shut
router(config-if)# exit
router(config)# exit
```
  - Check that the Ethernet port in question has a valid IP address assigned to it.

**Note**

The Cisco uBR10012 router also has an internal Ethernet interface, Ethernet0/0/0, which PRE processors and line cards use to transfer packets between cards. This interface is not user-configurable, although you can see the configuration and run-time information using the **show interface** command.

For more information about configuring Ethernet ports, refer to the *Cisco uBR10012 Router Software Configuration Guide* at the following URL:

<http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/configuration/guide/scg.html>

If the cable, connections, power, and configuration all check out, and you still cannot connect to the Ethernet port on the module, you probably need to replace the PRE. Contact the Cisco TAC for further assistance.

## Troubleshooting the Console Port Serial Connection

If the terminal connected to the Cisco uBR10012 router console port appears frozen or fails to work properly, check for the following problems:

- Check the console cable and make sure it is properly connected to the correct console port on the PRE, and to your terminal equipment at the other end.
- Verify that you are using the right type of cable and adapter. For additional information about cable pin-outs, refer to the “[Connecting the Console Port and Auxiliary Port](#)” section on page 3-55.
- To be sure the cable is not defective or broken, replace the cable with another high quality cable if possible.
- Check that your terminal equipment is working properly and configured with the correct settings for the console port. The default console port settings are:
  - 9600 baud
  - 8 data bits
  - 1 stop bit

- No parity
- No flow control
- Check the LEDs on the PRE to make sure that it is powered up properly.
- If the cable, connections, power, and terminal settings all check out and you still cannot connect to the console port on the module, you probably need to replace the PRE. Contact the Cisco TAC for further assistance. See the [“Obtaining Documentation and Submitting a Service Request”](#) section on page xvi.

## Identifying Startup Problems

Startup problems are commonly due to the source power or to a line card that is not properly seated in the router. Although an overtemperature condition is unlikely at initial startup, the environmental monitoring functions are included in this chapter because they also monitor internal voltages.

When you start up the router for the first time, observe the startup sequence described in the [“Powering On the System”](#) section on page 3-66. This provides a detailed description of a normal startup sequence.

LEDs indicate all system states in the startup sequence. By checking the state of the LEDs, you can determine when and where the system failed in the startup sequence. Use the following descriptions to isolate the problem to a subsystem, and then proceed to the appropriate sections to try to resolve the problem.

When you start up the system by turning the power supply switch to the on (I) position, the following should occur:

1. Fans—the fans start operating. The FAN OK LED on the fan assembly module turns green. You should be able to feel the air being taken in at the bottom front of the router and blown out at the top rear of the router.

If not, proceed to the [“Troubleshooting the Cooling Subsystem”](#) section on page 4-14.

2. DC PEM—the POWER LED on each DC PEM turns green to indicate that the PEM is connected to an active DC power source and is supplying power to the chassis.
  - If the FAULT LED is illuminated (yellow), it indicates that the PEM is connected to an active DC power source but is not providing power to the chassis.
  - If the MISWIRE LED is illuminated (yellow), it indicates that the wires from the DC power source to this DC PEM are reversed.
  - Proceed to the [“Troubleshooting the Power Subsystem”](#) section on page 4-7.

3. PREs—the FAIL LED on the PRE modules briefly lights during the power-on sequence and then it turns off. If the FAIL LED remains on, try removing and reseating the PRE module, and verify that the card is fully inserted and that both locking levers are fully down in the locked position.

If the FAIL LED remains on, make a note of the failure code that appears in the PRE module’s LCD screen and call TAC for instructions.

4. Line cards—Verify the line card “Enabled” LEDs.

Each line card has an enabled LED that goes on initially at power-on and then goes off. The LED then goes on and remains on when the corresponding port is enabled and configured for operations.

If an enabled LED fails to go on at initial power-on, or if the LED fails to go on and remain on after the port is enabled and configured, proceed to the [“Troubleshooting the Cooling Subsystem”](#) section on page 4-14.

**Note**

The slot 0 and slot 1 LEDs only go on when the PC media card slot is being accessed by the system. These LEDs remain off during normal operation of the router and do not indicate startup problems.

- The initial system banner displays on the console screen.

If it is not displayed, see the “[Connecting Network Management Cables](#)” section on page 3-58 to verify that the terminal is set up correctly and that it is properly connected to the router’s console port.

## Troubleshooting the Power Subsystem

The AC power entry modules, DC power entry modules, or an AC power shelf combined with the DC power modules are used to power on the Cisco uBR10012 router.

### Troubleshooting the AC Power Subsystem

The following troubleshooting steps are applicable to both the AC PEM (UBR10-PWR-AC= and UBR10-PWR-AC-PLUS=) modules.

Use the following steps to isolate a problem with the AC power subsystem.

- Use the **show environment** command to display the general health of the power system.

```
Router# show environment
```

```
Temperature information:
```

```
Temperature normal: Inlet sensor measured at 30C/86F
Temperature normal: Outlet sensor measured at 40C/104F
```

```
Voltage information:
```

```
RP Voltage readings :
```

| Channel  | Margin | ADC Value |
|----------|--------|-----------|
| 2.5v     | Normal | 2.47v     |
| 1.8v     | N/A    | 1.80v     |
| 1.5v     | Normal | 1.48v     |
| 1.8vFPGA | Normal | 1.78v     |
| 1.2v     | Normal | 1.18v     |
| 3.3v     | Normal | 3.26v     |

```
Fan: OK
Power Entry Module 0 type AC status: OK
Power Entry Module 0 Power: 3692w
Power Entry Module 0 Voltage: 71v
Power Entry Module 0 Power Last Successful Timestamp: 15:16:20 13 Dec 2012
Router#
```

**Note**

The **show environment** command provides accurate information on the AC PEM only when using Cisco IOS Release 12.2(4)XF1, 12.2(4)BC1a, or a later release. If using an earlier release, the **show environment** command does not correctly identify the AC PEM error messages. Starting Cisco IOS Release 12.2(33)SCG2 and later, the **show environment** command output has been modified to display the latest valid power and voltage values of the PEM module with timestamp.

**Step 2** Verify that the temperatures are within the valid operating ranges, and that the fan assembly and both AC PEM modules are present and OK.

a. If this is not the case, check for the following issues:

- Fan is reported MISSING—Insert the fan assembly or shut down the router immediately to avoid running the router beyond its operating temperature range.
- AC PEM is not listed—Verify that both AC PEMs are present, and if so, that each PEM is fully inserted into the chassis.
- The “Input/Output Voltage Fault” message indicates that the output voltage from one of the AC PEMs is not within the correct range. This can occur when the input AC voltage to the AC PEM is either too low or too high. Measure the input AC voltage, and if it is correct, the AC PEM has failed and should be replaced.




---

**Note** Wall input voltage for the AC PEM must be 200 - 240 VAC at 50/60Hz.

---

b. Verify if the UBR10-PWR-AC-PLUS= AC PEM **show environment** command output displays a DC PEM module instead of AC PEM.

```
Router# show environment
```

```
Temperature information:
```

```
Temperature normal: Inlet sensor measured at 31C/87F
Temperature normal: Outlet sensor measured at 35C/95F
```

```
Voltage information:
```

```
RP Voltage readings:
```

| Channel  | Margin | ADC Value |
|----------|--------|-----------|
| 2.5v     | Normal | 2.49v     |
| 1.8v     | N/A    | 1.81v     |
| 1.5v     | Normal | 1.49v     |
| 1.8vFPGA | Normal | 1.79v     |
| 1.2v     | Normal | 1.20v     |
| 3.3v     | Normal | 3.29v     |

```
Fan: OK
Power Entry Module 0 type DC status: OK // DC PEM is displayed //
Power Entry Module 1 type AC status: OK
Power Entry Module 0 Power Last Successful Timestamp: 15:16:20 13 Dec 2012
```

- Upgrade to a supported Cisco IOS Release and then press the PRODUCT ID LED/switch.
- Reload the software or physically remove the AC PEM module for at least 1 minute and then reinsert it.




---

**Note** The **show environment** command provides accurate information on the 3300 W AC PEM if the Cisco uBR10012 router is running a supported Cisco IOS Release. If using an earlier Cisco IOS release, the **show environment** command will not correctly identify the error messages of the 3300 W AC PEM.

---

**Step 3** Verify if the AC power cables are installed into the AC PEM receptacles and the facility power source is turned on. The AC power enable switch is set to the Standby (0) position.

a. Check if the AC PEM is receiving power.

- The V1 POWER and V2 POWER LEDs on the UBR10-PWR-AC-PLUS= AC PEM should illuminate (green).

If these LEDs are not illuminated, check the external wiring and facility power source. If the fans are working and are audible, it indicates that the AC PEM is receiving power, so there could be a possibility that the LEDs are not working.

- The FAULT LED should illuminate (yellow).

If this LED is not illuminated, there could be a possibility that the LED is not working, therefore the LED cannot indicate a valid fault on the PEM.

- b. If the above LEDs do not illuminate but you are confident that PEM is receiving power, you can proceed to power on the PEM, see *AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*. Ensure that the POWER LED is not illuminated (green). If this LED is illuminated, the AC PEM should be replaced. See the “[Obtaining Documentation and Submitting a Service Request](#)” section on page xvi.

**Step 4** Verify if the UBR10-PWR-AC-PLUS= AC PEM is powered on, and the V1 POWER and V2 POWER LEDs are illuminated (unless they may not be working, as above). The AC power enable switch on the AC PEM is set to the ENABLE (I) position.

- a. The FAULT LED should stop illuminating. If it remains illuminated, the AC PEM should be replaced because this is a valid fault. See the “[Obtaining Documentation and Submitting a Service Request](#)” section on page xvi.
- b. The POWER LED should illuminate (green). If this LED does not illuminate, and the FAULT LED is not illuminated, there might be a possibility that the POWER LED is not working. You may need to verify if the PEM is providing valid power to the system by checking the AC PEM voltage and current using the Cisco IOS Release running on the router. Contact technical support for assistance, see the “[Obtaining Documentation and Submitting a Service Request](#)” section on page xvi.

**Step 5** The FAULT LED is illuminated (yellow).

- a. The FAULT LED illuminates when the PEM module detects an over-voltage or over-current condition, or when the PRE issues the command to shut down the PEM module (this could occur due to overheating). Ensure that none of these conditions exist in the system, and then try to switch the PEM module off and switch it on again.
- b. If another PEM module exists in the system that powers up the chassis, and the FAULT LED is not illuminated on that module, then ensure that the PRE does not issue the command to shut down the PEM module.
- c. If the problem persists, try another working unit. Else, see the “[Obtaining Documentation and Submitting a Service Request](#)” section on page xvi.

**Step 6** If none of the above suggestions correct the problem, the AC PEM could be faulty. Contact a service representative for further instructions. See the “[Obtaining Documentation and Submitting a Service Request](#)” section on page xvi.

## Troubleshooting the DC Power Subsystem

The following troubleshooting steps are applicable to both the DC PEM (UBR10-PWR-DC= and UBR10-PWR-DC-PLUS=) modules.

Use the following steps to isolate a problem with the DC power subsystem.

**Step 1** The DC-input power cables are installed into the DC PEM terminal blocks and the facility power source is turned on. The DC power enable switch is set to the Standby (0) position.

Check if the DC PEM is receiving power.

a. The MISWIRE LED should not be illuminated. If it is illuminated (yellow), it indicates that the DC-input power cables are reversed, or one DC-input power cable was probably not connected. Correct the situation by reconnecting the power cables see, [“Connecting DC Power to the Cisco uBR10012 Router” section on page 3-39](#).

b. The V1 POWER and V2 POWER LEDs on the UBR10-PWR-DC-PLUS= DC PEM should illuminate (green).

If these LEDs are not illuminated, check the external wiring and facility power source. If the fans are working and are audible, it indicates that the DC PEM is receiving power, so there could be a possibility that the LEDs are not working.

c. The FAULT LED should illuminate (yellow).

If this LED is not illuminated, there could be a possibility that the LED is not working, therefore the LED cannot indicate a valid fault on the PEM.

If the above LEDs do not illuminate but you are confident that PEM is receiving power, you can proceed to power on the PEM. Ensure that the POWER LED is not illuminated (green). If this LED is illuminated, the DC PEM should be replaced. See the [“Obtaining Documentation and Submitting a Service Request” section on page -xvi](#).

**Step 2** The UBR10-PWR-DC-PLUS= DC PEM is powered on, and the V1 POWER and V2 POWER LEDs are illuminated (unless they may not be working, as above). The DC power enable switch on the DC PEM is set to the ENABLE (I) position.

a. The FAULT LED should stop illuminating. If it remains illuminated, the DC PEM should be replaced because this is a valid fault. See the [“Obtaining Documentation and Submitting a Service Request” section on page -xvi](#).

b. The POWER LED should illuminate (green). If this LED does not illuminate, and the FAULT LED is not illuminated, there might be a possibility that the POWER LED is not working. You may need to verify if the PEM is providing valid power to the system by checking the DC PEM voltage and current using the Cisco IOS Release running on the router. Contact technical support for assistance, see the [“Obtaining Documentation and Submitting a Service Request” section on page -xvi](#).

**Step 3** The FAULT LED is illuminated (yellow).

a. The FAULT LED illuminates when the PEM module detects an over-voltage or over-current condition, or when the PRE issues the command to shut down the PEM module (this could occur due to overheating). Ensure that none of these conditions exist in the system, and then try to switch the PEM module off and switch it on again.

b. If another PEM module exists in the system that powers up the chassis, and the FAULT LED is not illuminated on that module, then ensure that the PRE does not issue the command to shut down the PEM module.

c. If the problem persists, try another working unit. Else, see the [“Obtaining Documentation and Submitting a Service Request” section on page -xvi](#).

**Step 4** The MISWIRE LED is illuminated (yellow).

If the MISWIRE LED is illuminated, the -48/-60 VDC and return (RTN+) wires are reversed. Ensure that the facility power source is turned off immediately, see [“Connecting DC Power to the Cisco uBR10012 Router” section on page 3-39](#) to reconnect the wires correctly before powering on the PEM module.

**Step 5** The **show environment** command output on the UBR10-PWR-DC-PLUS= DC PEM module (shown below) displays AC PEM instead of DC PEM.

```
Router# show environment

Temperature information:
 Temperature normal: Inlet sensor measured at 31C/87F
 Temperature normal: Outlet sensor measured at 35C/95F

Voltage information:
 RP Voltage readings:
 Channel Margin ADC Value

 2.5v Normal 2.49v
 1.8v N/A 1.81v
 1.5v Normal 1.49v
 1.8vFPGA Normal 1.79v
 1.2v Normal 1.20v
 3.3v Normal 3.29v

Fan: OK
Power Entry Module 0 type AC status: OK // AC PEM is displayed //
Power Entry Module 1 type DC status: OK
Power Entry Module 0 Power Last Successful Timestamp: 15:16:20 13 Dec 2012
```

Try one of the following:

- Upgrade to a supported Cisco IOS Release and then press the PRODUCT ID LED/switch.
- Reload the software or physically remove the DC PEM module for at least 1 minute and then reinsert it.

**Step 6** Use the **show environment** command to display the general health of the power system:

```
Router# show environment

Temperature normal: chassis inlet measured at 29C/84F
Temperature normal: chassis core measured at 42C/107F
Fan: OK
Power Entry Module 0 type DC status: OK
Power Entry Module 1 type DC status: OK
Power Entry Module 0 Power Last Successful Timestamp: 15:16:20 13 Dec 2012
Router#
```



**Note**

Starting Cisco IOS Release 12.2(33)SCG2 and later, the **show environment** command output has been modified to display the latest valid power and voltage values of the PEM module with timestamp.

Verify that the temperatures are within the valid operating ranges, and that the fan assembly and both DC PEM modules are present and OK. If this is not the case, check for the following actions:

- Fan is reported MISSING—Insert the fan assembly or shut down the router immediately to avoid running the router beyond its operating temperature range.
- DC PEM is not listed—Verify that both DC PEMs are present, and if so, that each PEM is fully inserted into the chassis.
- An “External AC Supply Fault” message indicates that one of the power modules in the external power supply is reporting either a fault, an over-temperature condition, or is missing. Check the LEDs on the front panels of the power modules on the external power supply to discover which module has the fault.

**Note**

When using the external AC-input power shelf, the **show environment** command provides information on whether a power module in the power shelf is missing, is reporting a fault, is experiencing an over-temperature condition, or is not receiving AC-input power. For information on the external AC-input power shelf and on connecting it to the DC PEM, see [Cisco uBR10012 Universal Broadband Router Hardware Installation Guide](#).

- Step 7** Check to see if the DC power source supplying the proper power to the DC PEMs? (If you are using the 2400W AC-input power shelf, look to verify that the AC OK and DC OK LEDs are illuminated for each of the AC power supplies.)
- If no, and if the DC power source is connected to a valid power outlet, troubleshoot the DC power source.
  - If yes, turn off the DC power source and remove the DC PEM from the chassis. Verify that the DC power source is correctly wired to the terminal blocks underneath each PEM. See the “[Connecting DC Power to the Cisco uBR10012 Router](#)” section on page 3-39 for details.
- Step 8** If none of the above suggestions correct the problem, the DC PEM could be faulty. Contact a service representative for further instructions. See the “[Obtaining Documentation and Submitting a Service Request](#)” section on page xvi.

## Troubleshooting the 2400 W AC-Input Power Shelf

Check the following to isolate a problem to the AC-input power shelf.

- Step 1** Check to see which version of the PEM you have in the chassis.
- If the Cisco uBR10012 router is running Cisco IOS Release 12.2(4)XF or a later release, you can use the **show environment** command to monitor the AC-input power shelf.
 

```
Router# show environment
Temperature normal: chassis inlet measured at 29C/84F
Temperature normal: chassis core measured at 42C/107F
Fan: OK
Power Entry Module 0 type DC status: OK
Power Entry Module 1 type DC status: OK

Router#
```
  - If the DC PEM status is either “External AC Supply Fault” or “Input/Output Voltage Fault,” a problem exists with the AC-input power shelf.
    - The “External AC Supply Fault” message indicates that one of the power modules is reporting either a fault, an over-temperature condition, or is missing. Check the LEDs on the front panels of the power modules on the external power supply to discover which module has the fault.
    - If the “Input/Output Voltage Fault” message indicates that one of the power modules is not receiving AC-input power then, check the LEDs on each power module, check that each power module is plugged into an AC-input power outlet, and that those outlets are providing power.
- Step 2** Verify that the DC and AC OK LEDs are illuminated.
- If yes, then the power shelf is operational.
  - If not, do the following:



- Make sure that the AC power cord is correctly plugged in to both the AC-output wall outlet and in to the back of the AC-input power shelf. (A separate power cord is used for each power supply.)
  - Make sure that the AC power supply is properly inserted, seated, and locked. If necessary, remove the AC power supply and reinsert it.
  - Check the external AC power source.
  - Swap the AC power supply with one of the others. If the failure follows the power supply, replace the power supply. If the failure remains in that particular power bay, double-check the external AC power source and the power cord connections; if they are correct, contact the Cisco TAC for additional troubleshooting information.
- c. If only DC OK LED is not illuminated, then check the wiring to the Cisco uBR10012 router DC-input terminal blocks.
- Step 3** Check to see if the FAULT LED is illuminated (yellow), if it is then:
- Check that the external AC power source is supplying consistent AC voltage at the proper levels, without spikes or brownouts.
  - Flip the circuit-breaker for the external AC power source.
  - Replace the power supply with a known good replacement.
- Step 4** If none of these measures work, contact a service representative for instructions. See the [“Obtaining Documentation and Submitting a Service Request”](#) section on page xvi.
- 

## Troubleshooting the Processor Subsystem

The processor subsystem on the Cisco uBR10012 router consists of the performance routing engine (PRE) modules and the timing, communication, and control plus (TCC+) cards. At system startup, the following sequence should appear on the primary PRE.

1. The FAIL LED briefly comes on (yellow), turn off, and the STATUS LED starts flashing (yellow).
2. A series of messages appear on the PRE alphanumeric display indicating the progress of the boot-up sequence.
3. Upon successful completion of the boot-up sequence, the message IOS RUN appears on the alphanumeric display.
4. The STATUS LED comes on (green) to indicate this is the primary PRE.

The sequence on the redundant PRE is similar, except that the STATUS LED remains OFF and the messages on the alphanumeric display are slightly different. The final message upon a successful boot-up sequence is IOS STBY to indicate that this is the redundant PRE operating in stand-by mode.

Use the following procedure to troubleshoot the PRE modules.

---

- Step 1** Check the following if a problem appears on one of the PRE modules.
- a. Did the STATUS LED on the primary PRE light solid (green) at the end of the boot-up sequence?
  - b. If no, check the other LEDs on other modules in the chassis. If no other LEDs are lit, check for a problem in the power subsystem, as described in the [“Troubleshooting the Power Subsystem”](#) section on page 4-7.

- c. If no, and no other LEDs on the PRE are lit but LEDs on other modules are lit, remove the PRE from the slot, check for any bent or broken pins on the backplane connectors, and reinsert it, ensuring it makes solid contact with the backplane and is securely locked in by firmly closing both locking levers.
  - d. If no, but the FAIL LED is lit (yellow), remove the PRE and reinsert it. If that fails, insert a new PRE. If that fails, contact TAC for assistance.
- Step 2** Repeat the above steps for the redundant PRE, except that its STATUS LED should be OFF and its alphanumeric display should read IOS STBY if it is operating correctly.
- a. If both PREs are operating correctly, check the Power LEDs on each TCC+ card. Are the POWER LEDs on each TCC+ card lighted (green)?
  - b. If no, remove the TCC+ card and reinsert it, making it sure it firmly connects to the backplane and that both captive screws are tightly connected.
  - c. If yes, proceed to the next step.
- Step 3** Verify the Status LEDs on the TCC+ card.
- a. Is the STATUS LED on the primary TCC+ on (solid green) indicating that it is the primary card?
  - b. Is the STATUS LED on the secondary TCC+ flashing (green) indicating that it is the redundant card?
  - c. If no, verify that the version of Cisco IOS on the router supports the TCC+ card.
- Step 4** Contact TAC for assistance if necessary. See the [“Obtaining Documentation and Submitting a Service Request”](#) section on page xvi.
- 

## Troubleshooting the Cooling Subsystem

The following troubleshooting steps are applicable to both the fan assembly (UBR10-FAN-ASSY= and UBR10012-FAN-PLUS=) modules.

Check the following to help isolate a problem with the cooling system.

- Step 1** When you start up the system, do the fans start operating?
- When the fans are operating, you should be able to hear them. You should also be able to feel air being drawn in at the bottom front and expelled at the top rear of the chassis.
- a. Check for fan failure by checking the fan status LEDs and running the **show environment** command.
 

```
Router# show environment

Temperature normal: chassis inlet measured at 29C/84F
Temperature normal: chassis core measured at 42C/107F
Fan: OK
Power Entry Module 0 type DC status: OK
Power Entry Module 1 type DC status: OK
Power Entry Module 0 Power Last Successful Timestamp: 15:16:20 13 Dec 2012
Router#
```
  - b. Ensure that no alarms are triggered on the fan assembly module.
  - c. Check if there is sufficient ventilation on the chassis intake and chassis exhaust.
  - d. Verify if the ambient temperature is within the specified range.

If the problem persists, see the [“Obtaining Documentation and Submitting a Service Request”](#) section on page -xvi.

**Step 2** Are the two LEDs —SINGLE FAN FAIL and MULTI FAN FAIL—illuminated (yellow)?

Remove the fan assembly module and reinsert it. If this does not help, examine the LED that is illuminated. Else see, [“Obtaining Documentation and Submitting a Service Request”](#) section on page -xvi.

**Step 3** Are the following messages displayed?

These messages indicate that the system has detected a critical over-temperature condition or out-of-tolerance power inside the chassis.

Queued messages:

```
00:01:19:%ENVM-4-ENVWARN:+2.5 V measured at +2.59
00:01:19:%ENVM-4-ENVWARN:+5.15 V measured at +5.31

00:00:19:%ENVM-2-ENVCRIT:chassis core measured at 31C/87F
00:00:19:%ENVM-2-ENVCRIT:chassis inlet measured at 27C/80F
00:00:19:%ENVM-2-ENVCRIT:chassis outlet 1 measured at 30C/86F
00:00:19:%ENVM-2-ENVCRIT:chassis outlet 2 measured at 30C/86F
```

Although an over-temperature condition is unlikely at initial startup, ensure that heated exhaust air from other equipment is not entering the inlet vent of the router and that there is sufficient clearance around the sides of the chassis to allow cooling air to flow.



**Note**

The message could also indicate a faulty component or temperature sensor. Use the **show environment** or **show environment table** command to display the internal chassis environment.

**Step 4** Is the PRODUCT ID LED/switch on fan assembly module illuminated (green) and a FAN-MISSING alarm is randomly being triggered?

If you are running a Cisco IOS Release that does not support the PRODUCT ID LED/switch feature, then ensure that the PRODUCT ID LED/switch is not pressed and is not illuminated. Upgrade to a supported Cisco IOS Release on the chassis.



**Note**

If you cannot upgrade to a supported Cisco IOS Release, then ensure that the PRODUCT ID LED/switch is not pressed and not illuminated (green).

If you are running a Cisco IOS Release that supports this feature, but the FAN-MISSING alarm is still being triggered, then follow the steps below to clear the alarm so that the software recognizes the fan module:

- a. Ensure that the PRODUCT ID LED/switch is pressed and illuminated (green).
- b. Remove the fan assembly module.
- c. Wait for 1 minute and reinsert the fan assembly module.

If the alarm is still being triggered, and the software still does not recognize the fan, then the fan may be faulty, you may have to replace the fan module.

If none of the above solves the problem, see the [“Obtaining Documentation and Submitting a Service Request”](#) section on page -xvi.

If you experience trouble with the startup, and the issue is not resolved with these procedures, manually power off the router and contact a service representative for assistance and further instructions, see the “[Obtaining Documentation and Submitting a Service Request](#)” section on page -xvi.

---

## Troubleshooting the Line Cards

Check the following to help isolate a problem to a line card.

- 
- Step 1** Verify that *all* the “Enabled” LEDs are on.  
If yes, the system is operational.
- Step 2** Check to see if *any* “Enabled” LEDs are off.
- a. If the enabled LED on a line card is off, first verify that the line card has been enabled and configured for operations. The enabled LED remains off when a line card has not been configured and enabled.
  - b. If a port has been enabled but its corresponding enabled LED is still off, reseal the line card in its slot (you do not have to turn off the system power when removing or replacing line card). After the system reinitializes the interfaces, the enabled LED on the line card should go on.
  - c. If the enabled LED remains off after the above checks, it is likely that the system has detected a processor hardware failure. Contact a service representative for instructions. See the “[Obtaining Documentation and Submitting a Service Request](#)” section on page xvi.
- Step 3** For all fiber optic connections, verify that the connections are clean. See *Cleaning and Checking the Bulkhead Optical Connectors* and *Cleaning and Inspecting the Fiber Optic Connections* at the following URL:
- [http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field\\_replaceable\\_units/ub\\_oc48.html](http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub_oc48.html)

**Note**

Refer to the FRU documentation for the different cards at the following URL:

[http://www.cisco.com/en/US/products/hw/cable/ps2209/prod\\_installation\\_guides\\_list.html](http://www.cisco.com/en/US/products/hw/cable/ps2209/prod_installation_guides_list.html)

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# Troubleshooting the HHGE Installation

To troubleshoot the HHGE installation, follow the instructions in [Table 4-2](#).

**Table 4-2** Line Card Installation Troubleshooting

| Symptom                                                                                                                                                               | Possible Cause                                                                                                                                                                                                                                                                                                                                                            | Corrective Action                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Error message appears on the console every time the line card requests an image download. The error message is echoed and the PRE2 will not load the line card image. | <ol style="list-style-type: none"> <li>1. HHGE card is inserted in slot 1 or slot 2.</li> </ol>                                                                                                                                                                                                                                                                           | <ol style="list-style-type: none"> <li>1. Remove the HHGE from the illegal slot and place the card in any of the following slots: <ul style="list-style-type: none"> <li>• 3/0/0 or 3/1/0</li> <li>• 4/0/0 or 4/1/0.</li> </ul> </li> </ol>            |
| The PRE2 software shuts down the card. The reset line is asserted and the running configuration is updated with this slot in the shutdown state.                      | <ol style="list-style-type: none"> <li>1. HHGE card is inserted in slot 1 or slot 2, subslot 1.</li> </ol>                                                                                                                                                                                                                                                                | <ol style="list-style-type: none"> <li>1. Remove the line card from the illegal slot and place it in slot 3 or slot 4.</li> <li>2. Use the <b>no hardware module shut</b> command to reset the slot<br/><code>no hardware 2/0/0 shut</code></li> </ol> |
| Power entry modules (PEMs), fans, and other line cards do not operate                                                                                                 | <ol style="list-style-type: none"> <li>1. Disconnected power cord.</li> <li>2. Power switch is in the Off position.</li> </ol>                                                                                                                                                                                                                                            | <ol style="list-style-type: none"> <li>1. Check that all power cords are properly connected to both the Cisco uBR10012 system and at the power connection end.</li> <li>2. Set the PEM power switches to the On position.</li> </ol>                   |
| The yellow FAIL LED does not light during portions of the POST                                                                                                        | <ol style="list-style-type: none"> <li>1. The line card is not properly seated.</li> <li>2. Bad line card slot or backplane connector.</li> </ol>                                                                                                                                                                                                                         | <ol style="list-style-type: none"> <li>1. Be sure the ejector levers are fully closed and that the captive screws have been tightened.</li> <li>2. Remove the line card and install it in another chassis slot.</li> </ol>                             |
| The yellow FAIL LED blinks                                                                                                                                            | <ol style="list-style-type: none"> <li>1. The SFP GBIC has been rejected because: <ul style="list-style-type: none"> <li>– An internal fault is detected.</li> <li>– Not a Gigabit Ethernet SFP.</li> <li>– Not a Cisco SFP.</li> <li>– Two SFPs with identical serial numbers are present in the system.</li> <li>– There is a hardware shut down</li> </ul> </li> </ol> | <ol style="list-style-type: none"> <li>1. Replace with a Cisco SFP GBIC.</li> </ol>                                                                                                                                                                    |

**Table 4-2** *Line Card Installation Troubleshooting (continued)*

| <b>Symptom</b>                                                        | <b>Possible Cause</b>                                                                                                                                                                                                                                                                                                                               | <b>Corrective Action</b>                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The green LINK LED does not light when you plug in the Ethernet cable | <ol style="list-style-type: none"> <li>1. No Ethernet connection to upstream device.</li> <li>2. The SFP GBIC was not fully inserted or seated properly.</li> <li>3. Negotiation is not configured properly.</li> <li>4. Hardware shut down for that port.</li> <li>5. Improper SFP GBIC (FAIL LED should blink).</li> <li>6. Bad cable.</li> </ol> | <ol style="list-style-type: none"> <li>1. Make sure the upstream device has an active Ethernet connection.</li> <li>2. Reinstall the SFP GBIC.</li> <li>3. Reconfigure negotiation.</li> <li>4. Enable the port.</li> <li>5. Replace with a Cisco SFP GBIC.</li> <li>6. Replace the cable.</li> </ol> |
| The green LINK LED is on, but does not pass traffic                   | <ol style="list-style-type: none"> <li>1. Negotiation is off, but set to on at the remote end.</li> <li>2. Internal loopback is enabled.</li> </ol>                                                                                                                                                                                                 | <ol style="list-style-type: none"> <li>1. Set local and remote negotiation settings to the same value.</li> <li>2. Disable loopback.</li> <li>3. ARP incomplete</li> <li>4. IP address not configured</li> </ol>                                                                                      |



## Maintaining the Cisco uBR10012 Router

---

The Cisco uBR10012 universal broadband router is configured to your order and ready for installation when it arrives. After you install the system, you may have to perform specific maintenance procedures to ensure the router is operating properly. These procedures can include routine maintenance such as replacing the filter, upgrading system components, or replacing components with field replaceable units (FRUs).

This chapter contains the information necessary to perform the following maintenance operations for the Cisco uBR10012 router:

- [Shutting Down the System, page 5-2](#)
- [Removing and Replacing the Front Cover, page 5-2](#)
- [Replacing the Air Filter, page 5-4](#)
- [Removing and Replacing the Fan Assembly Module, page 5-6](#)
- [Removing and Replacing DC Power Entry Modules, page 5-7](#)
- [Connecting Alarm Indicators, page 5-7](#)
- [Removing and Replacing AC PEM Modules, page 5-9](#)
- [Removing and Replacing the PRE Module, page 5-10](#)
- [Removing and Installing a PC Media Card, page 5-16](#)
- [Removing and Replacing a Timing, Communication, and Control Plus Card, page 5-18](#)
- [Removing and Replacing a Network Line Card, page 5-21](#)
- [Removing the Half-Height Gigabit Ethernet Line Card and the Slot Splitter, page 5-27](#)
- [Replacing the Slot Splitter and Half-Height Gigabit Ethernet Line Card, page 5-32](#)
- [Removing and Replacing an SFP Module, page 5-38](#)
- [Upgrading to a Half-Height Gigabit Ethernet Line Card, page 5-41](#)



### Tip

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Before beginning any FRU procedure, be sure you are familiar with the safety precautions outlined in [Chapter 2, “Preparing for Installation.”](#)

---

System components fall into two categories: hot-swappable components that do not require you to power off the system before replacing them, and those components that do require you to power off the system before you replace them. For example, all line cards are hot-swappable and can be replaced without powering off the system, but you must power off the system before replacing a single power entry module (PEM) or a single performance routing engine (PRE).

**Caution**

Cisco recommends that you create a duplicate PC media card that contains the current boot software image and the current software configuration. You can use the backup card to quickly recover from a major system failure. You can also use a backup card to load a new PRE module and avoid the time-consuming reconfiguration process. For instructions to create a backup PC media card, refer to the [Cisco uBR10012 Router Software Configuration Guide](#).

## Shutting Down the System

Although most components in the Cisco uBR10012 router are hot-swappable, you may have to shut down the system under certain circumstances. Use the following procedure to shut down the system.

- 
- Step 1** Notify appropriate personnel that you plan to shut down the system and that the shutdown results in total loss of service. *Appropriate personnel* includes the regional alarm or network monitoring center, central office personnel, and key customers.
- Step 2** Before you shut down the router, use the **copy** command to save any configuration changes to the NVRAM, and also, if you want, to a PC media card. For instructions on using the **copy** command, see [Cisco uBR10012 Universal Broadband Router Software Configuration Guide](#).
- Step 3** Power down the system by setting the power switch on all PEMs to the Standby (0) position.
- Step 4** If you are also using the optional AC-input power shelf, also disconnect the AC power cord for each of the AC-input power modules from the power outlet.
- 

**Warning**

**This unit has more than one power supply connection; all connections must be removed completely to completely remove power from the unit.** Statement 102

---

## Required Maintenance Tools

The only tools required to perform the maintenance procedures described in this chapter are:

- A Number 2 Phillips screwdriver
- A flat-blade screwdriver
- An electrostatic discharge (ESD) grounding strap

## Removing and Replacing the Front Cover

The Cisco uBR10012 router is equipped with a plastic front cover that ensures proper airflow through the system and protects the cables and connectors from damage. The following procedures describe how to remove and replace the front cover.

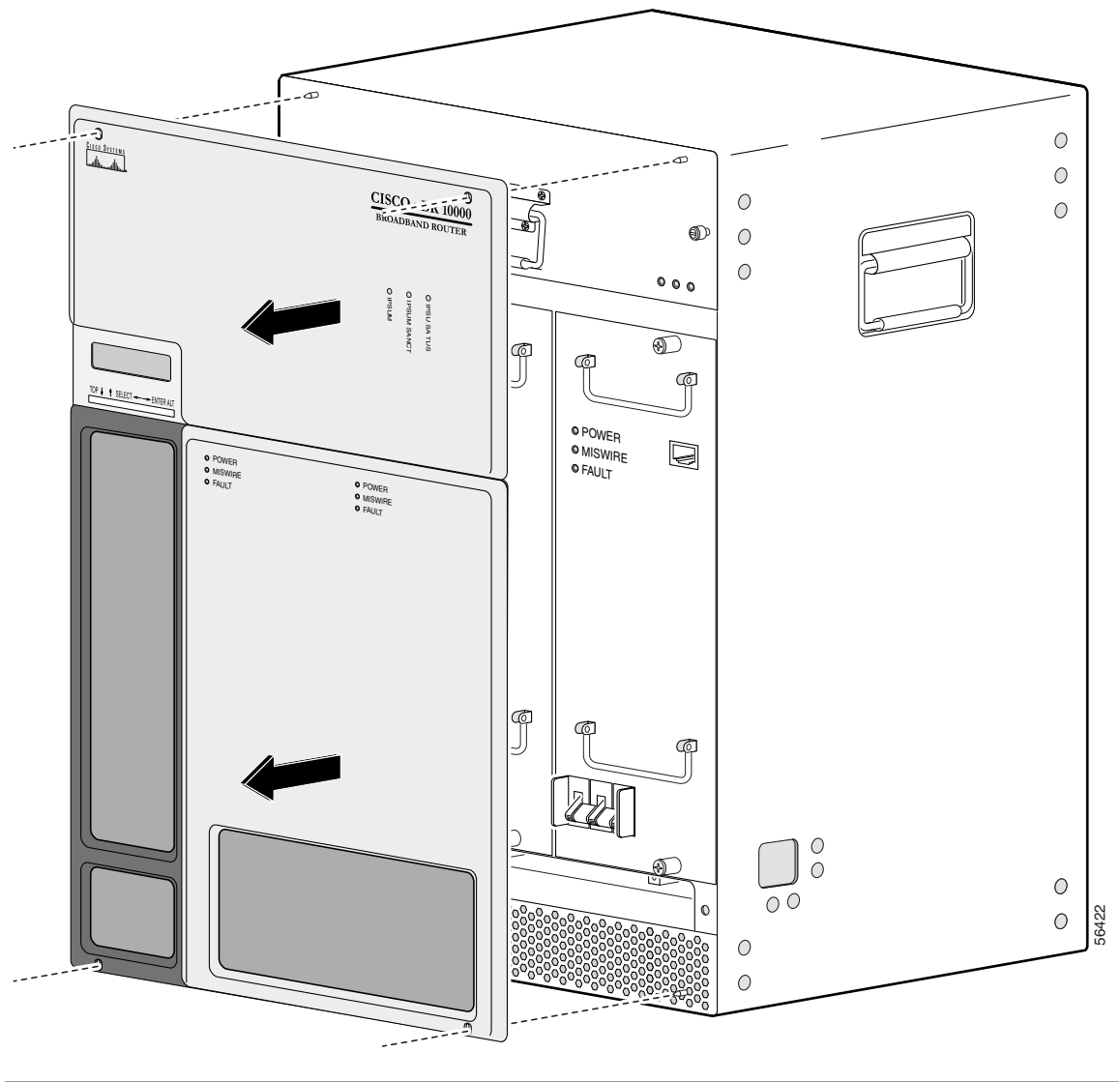


## Removing the Front Cover

Use the following procedure to remove the front cover from the chassis.

- Step 1** Remove the cover by lifting it up slightly and then pulling it toward you (see [Figure 5-1](#)).

**Figure 5-1** Removing the Front Cover

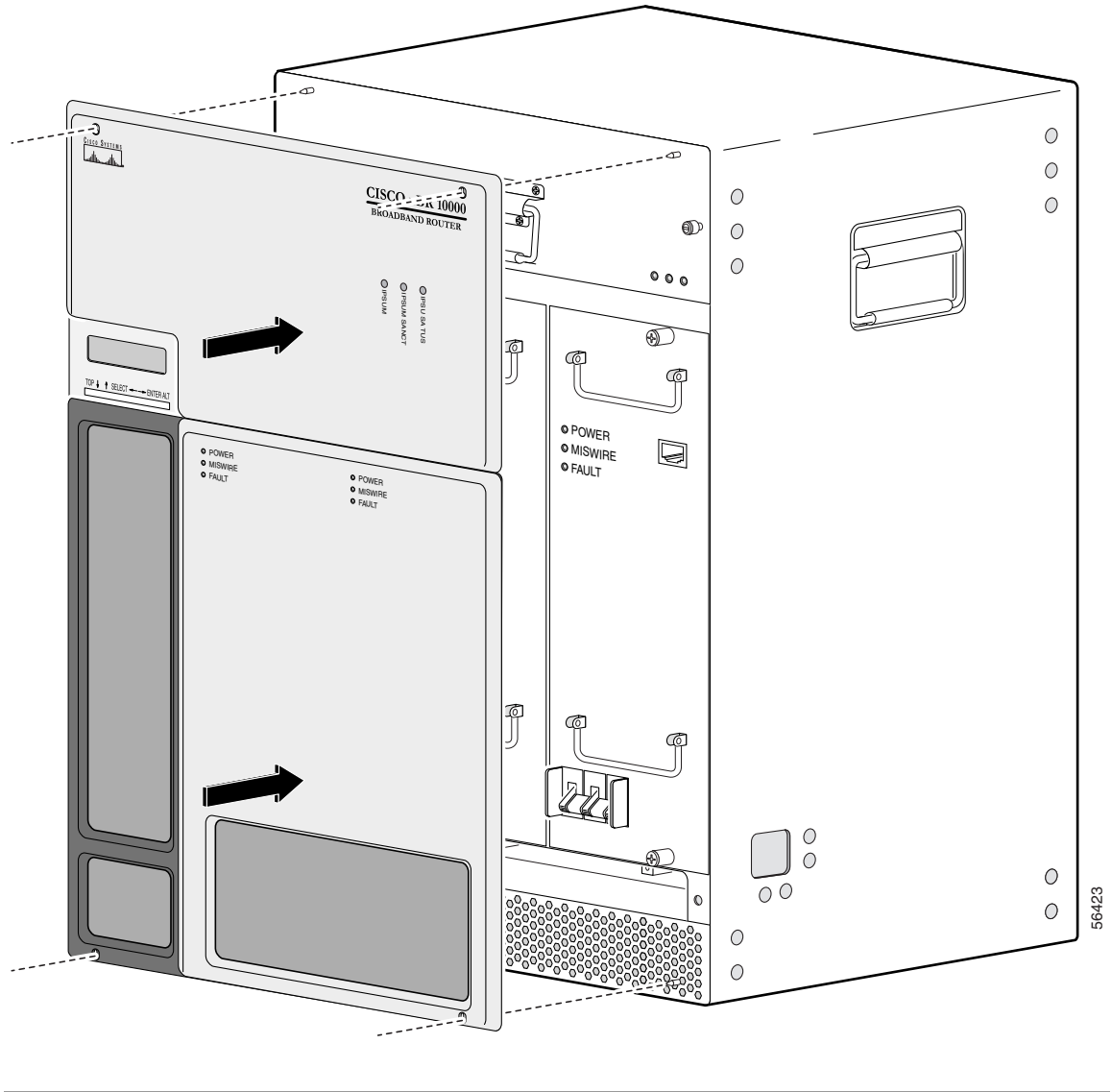


## Replacing the Front Cover

Use the following procedure to replace the front cover on the chassis.

- Step 1** Slide the cover onto the four corner posts of the chassis and then push down so that the posts are seated in the grooves above the cover holes (see [Figure 5-2](#)).

**Figure 5-2** Attaching the Cover to the Chassis



## Replacing the Air Filter

If the air filter is dirty or clogged, the fan assembly module could have a problem providing sufficient cooling airflow throughout the chassis, causing the system to overheat. To prevent a potential overheating problem, you should replace the air filter approximately every 6 to 12 months, depending on how clean and dust-free your operating environment is normally. In certain environments where the air quality is poor, you may have to replace the filter more frequently.

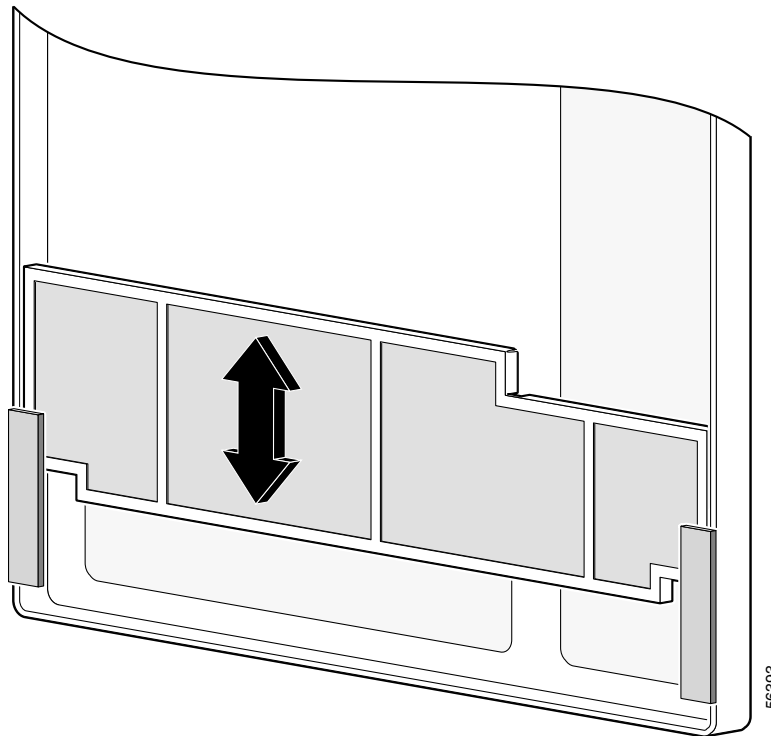
**Note**

The product order number for a replacement air filter is UBR10-FAN-FILTER=.

Use the following procedure to replace the air filter:

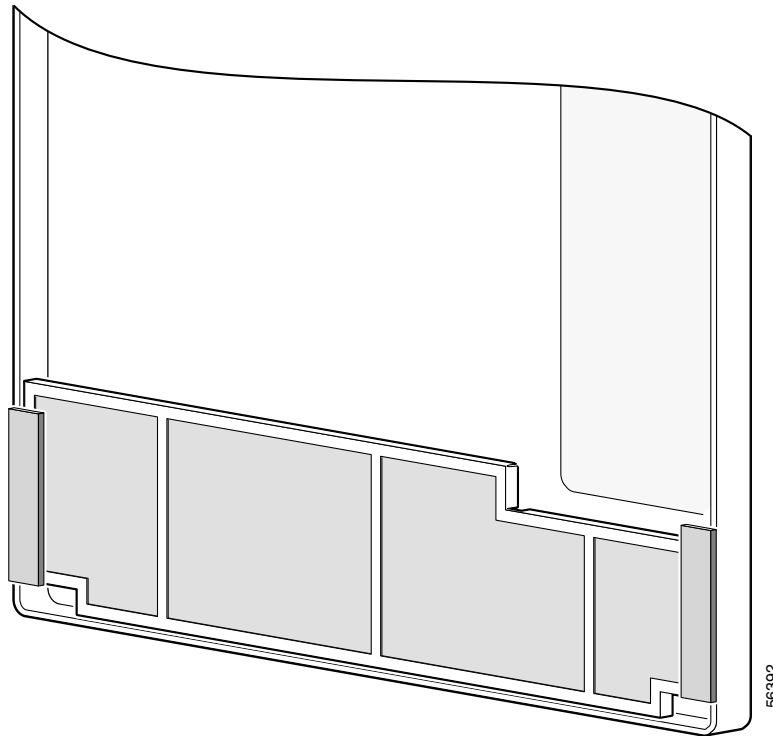
- Step 1** Remove the front cover (see “[Removing the Front Cover](#)” section on page 5-3).
- Step 2** Slide the air filter out of its slot.
- Step 3** Discard the old filter.

**Figure 5-3** *Removing and Inserting the Air Filter*



- Step 4** Position the new air filter above the tabs on the inside of the front cover and slide it down into the slot. When fully inserted, it should appear as shown in [Figure 5-4](#).

**Figure 5-4** Air Filter Inserted into the Front Cover



**Step 5** Replace the front cover (see [“Replacing the Front Cover”](#)).

## Removing and Replacing the Fan Assembly Module



### Caution

The Cisco uBR10012 chassis should not be run without a working fan assembly module for more than three minutes. To prevent the possibility of the system overheating, be sure that the replacement fan assembly module is out of its box and packaging, so it is ready to install as soon as the defective module is removed.

The fan assembly module does not need to be replaced when it is operating normally. However, if either of the two failure LEDs come on, the fan assembly module should be replaced:

- **SINGLE FAN FAILURE**—This yellow LED indicates that one of the four fans in the module has failed. The module can still provide enough cooling to safely operate the Cisco uBR10012 chassis, but it might begin operating the fans in its high-speed mode to do so. If this LED lights, the fan assembly module should be replaced as soon as is conveniently possible.
- **MULTIPLE FAN FAILURE**—This yellow LED indicates that two or more fans in the module have failed, and that the module is no longer able to consistently cool the Cisco uBR10012 chassis. To prevent overheating the chassis and possible damage to the line cards and other modules, the fan assembly module should be replaced immediately.

If the failure LEDs—SINGLE FAN FAILURE and MULTIPLE FAN FAILURE—are illuminated, remove and reinsert the fan assembly module. If the failure LEDs are still illuminated, replace the fan assembly module. The fan assembly module supports hot-swapping and can be replaced without interrupting system operation.

For more information about removing and replacing the fan assembly module, see [Cisco uBR10012 Universal Broadband Router Fan Assembly Module](#).

## Removing and Replacing DC Power Entry Modules

The Cisco uBR10012 router is shipped with two DC power entry modules (PEM) that provide a redundant power supply to the system. One DC PEM can provide sufficient power for a fully configured chassis, so that if one DC PEM fails, the other automatically begins providing power for the entire system. However, the system should not be run for an extended period time with only one DC PEM. If a DC PEM fails, install a replacement DC PEM as soon as possible.



### Note

You do not need to shut down the Cisco uBR10012 router to replace a redundant DC PEM. And, if you are replacing both DC PEMs, you can replace one, bring it online, and then replace the other one to avoid shutting down the entire system.

The DC PEM is operating correctly when its POWER LED lights (green). Replace a DC PEM if either of the PEM failure LEDs light (yellow):

- MISWIRE—This LED indicates that the wires connecting the PEM to DC power source were wired incorrectly. The DC PEM therefore needs to be removed so that the wiring can be corrected. After the wiring has been corrected, the same DC PEM can be reinserted. See “[Connecting Alarm Indicators](#)” section on page 5-7 for more information.
- FAULT—This LED indicates that the DC power source is supplying power but that the DC PEM is not providing power to the system.ced.



### Warning

**Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position.** Statement 7

For more information on removing and replacing the DC PEM module, see [DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For more information on removing and replacing the 3300 W DC PEM, see [3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

## Connecting Alarm Indicators

The Cisco uBR10012 router provides relay contacts for optional (customer-supplied) audible or visual alarm indicators. Relay contacts are provided for three levels of severity:

- Minor—This is an informational alarm and does not affect the system operation.
- Major—A condition that affects system operation and should be investigated as soon as possible.
- Critical—A condition that affects system operation and requires immediate attention.

If you did not connect the alarm indicators when you originally installed the Cisco uBR10012 chassis, use the following procedure to connect an alarm indicator to the system. For safety and convenience reasons, you need to remove power from the DC PEM on the right side (DC PEM “B”) and remove that DC PEM for easier access to the alarm indicators terminal block.

For more information on removing and replacing the DC PEM module, see *DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*.

For more information on removing and replacing the 3300 W DC PEM, see *3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*.

## Attaching the Alarm Wires

For each alarm indicator being connected (minor, major, or critical), use two wires that are long enough to reach between the Cisco uBR10012 chassis and the alarm indicator equipment. Use the gauge of wire required by the audible or visual alarm indicator equipment you are using (14 AWG maximum gauge).



### Warning

**Use copper conductors only.** Statement 1025



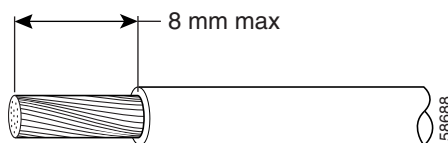
### Caution

The alarm contacts on the Cisco uBR10012 router are only relays and do not provide any power from the unit. These relays are rated for 60 VDC, 1 A maximum—ensure that the connected alarm equipment does not exceed these voltage and current ratings.

### Step 1

For each pair of wires, strip not more than 0.3 inches (8 mm) of insulation off of the ends of each wire (see [Figure 5-5](#)).

**Figure 5-5 Stripping Insulation**



### Step 2

Connect one end of each pair of alarm indicator wires to the alarm terminal block as follows:

- a. Connect one lead to the common (COM) terminal.
- b. If you are wiring the router in *series* with other equipment for the alarm indicators, wire the other lead to the normally closed (NC) terminal.
- c. If you are wiring the router in *parallel* with other equipment for the alarm indicators, wire the other lead to the normally open (NO) terminal.

[Figure 5-6](#) shows the wiring configuration for normally open (NO) alarm relays.

### Step 3

Connect the other end of this pair of alarm indicator wires to the appropriate connectors on the alarm indicator equipment. Route these cables through the square hole on the bottom right side of the chassis, as you face the front of the chassis.

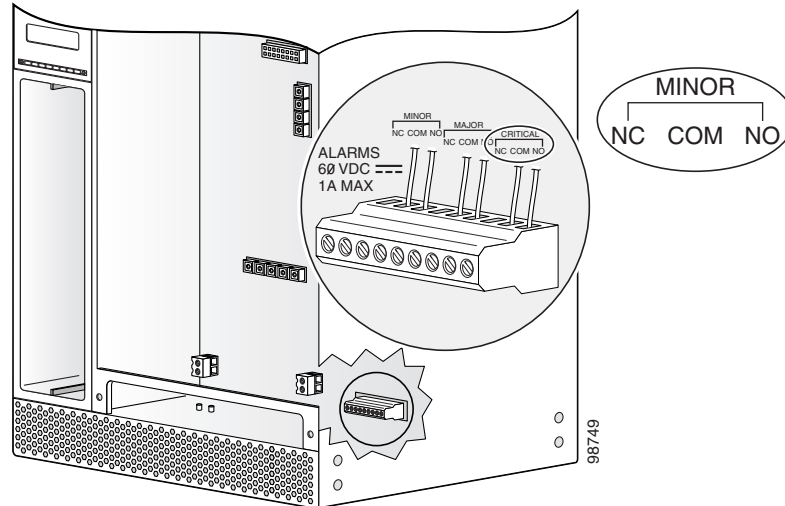
### Step 4

Repeat steps [2](#) through [3](#) for the remaining alarm indicators.

### Step 5

Secure the cabling to the chassis by feeding a tie wrap through one of the round holes next to the large hole on the side of the chassis. Then use the tie wrap to bind the cables to the chassis.

Figure 5-6 Alarm Terminal Block Connections



## Removing and Replacing AC PEM Modules

The Cisco uBR10012 router ships with two AC power entry modules (PEMs). In this redundant system, (2 power supplies), one AC PEM provides sufficient power for a fully configured chassis. If one AC PEM fails, the other automatically begins providing power for the entire router, without impacting system operations. However, even though one AC PEM provides sufficient power for a fully configured Cisco uBR10012 chassis, the system should not be run for extended periods of time with only one AC PEM. Always install the replacement AC PEM as soon as possible and order a spare for backup.



### Caution

For proper airflow, cooling, and safety, do not remove the failed unit until the replacement unit is available for installation.



### Caution

The Cisco uBR10012 router supports using either the AC PEM or the DC PEM, but it does not support mixing AC and DC PEMs. Both PEMs must be either AC PEMs or DC PEMs.

The AC PEMs use standard 200–240 VAC (50/60 Hz) input power obtained through power receptacles on the front panel of each PEM. The two AC PEMs convert the AC power to provide filtered, redundant, and load shared DC power to the Cisco uBR10012 chassis.



### Caution

The AC PEMs cannot be used with a 100–120 VAC input power source.



### Tip

For fully redundant power protection, use either an uninterruptible power supply (UPS) or a separate AC-input power source for each AC PEM.

**Note**

You do not need to shut down the Cisco uBR10012 router to replace a redundant AC PEM. If you are replacing both AC PEMs, you can replace one, bring it online, and then replace the other one to avoid shutting down the system.

For information on removing and replacing the AC PEM, see [AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

For information on removing and replacing the 3300 W AC PEM, see [3300 W AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router](#).

## Removing and Replacing the PRE Module

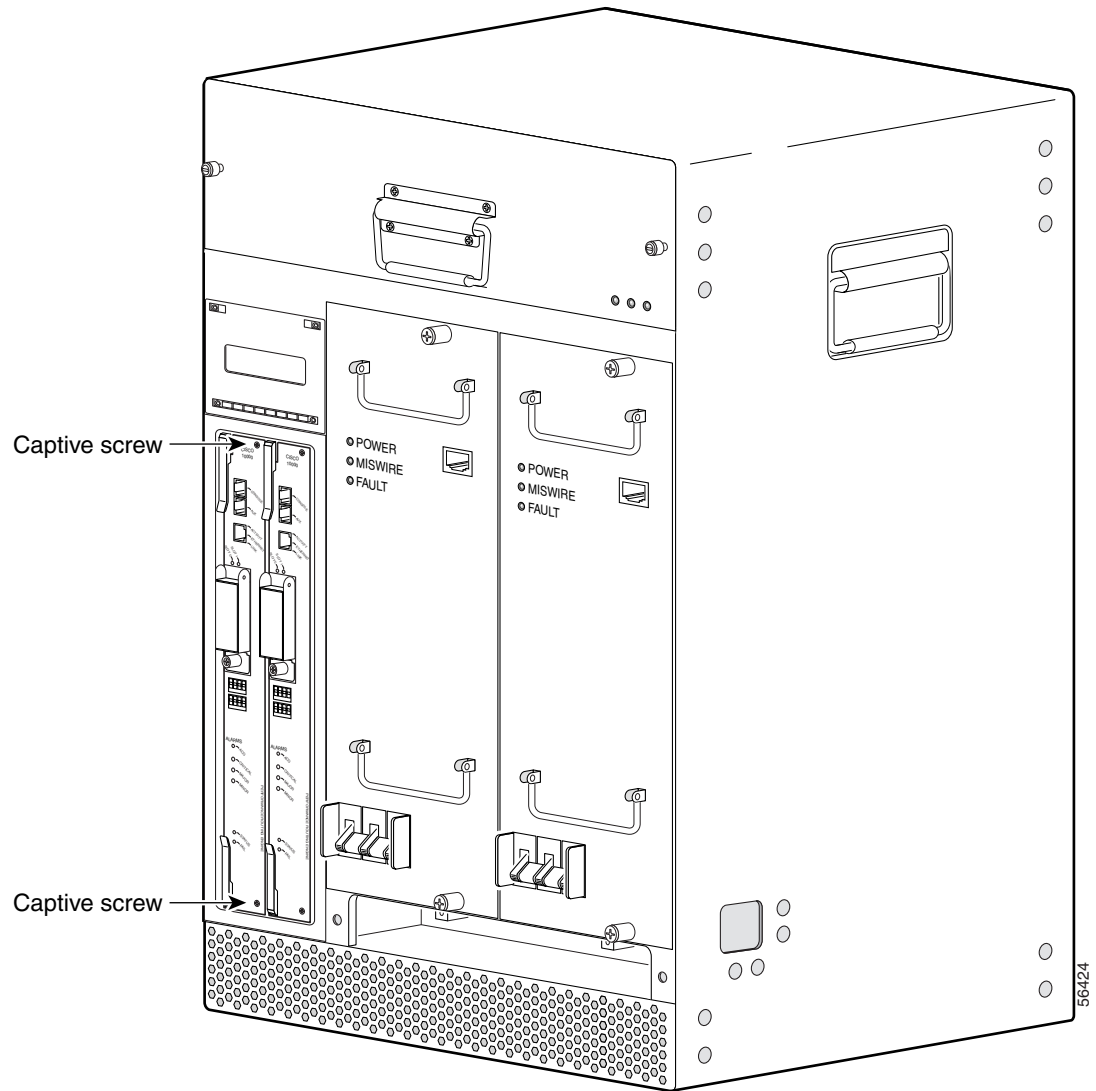
It is not necessary to configure the PRE module if you are installing or replacing a second PRE. The system automatically downloads the necessary configuration information from the primary PRE.

### Removing the PRE Module

Use the following procedure to install a new PRE module, or to replace an existing PRE module.

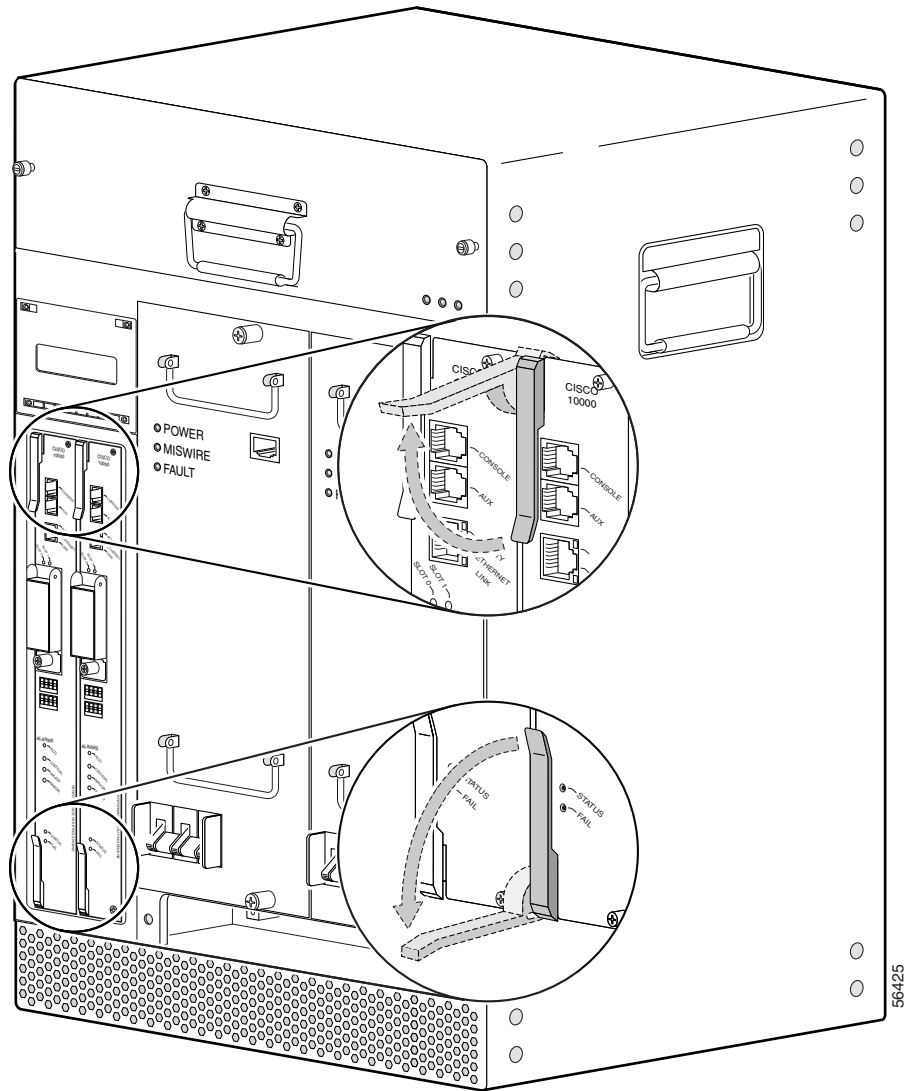
- Step 1** Be sure you are properly grounded.
- Step 2** If necessary, remove the blank cover from the PRE module slot and discard.
- Step 3** Disconnect any interface cables from the PRE module if necessary.
- Step 4** Remove the PC media card from the PRE module (see the [“Removing and Installing a PC Media Card”](#) section on page 5-16).
- Step 5** Unscrew the top and bottom captive screws on the PRE module (see [Figure 5-7](#)).



**Figure 5-7** Loosening the Captive Screws

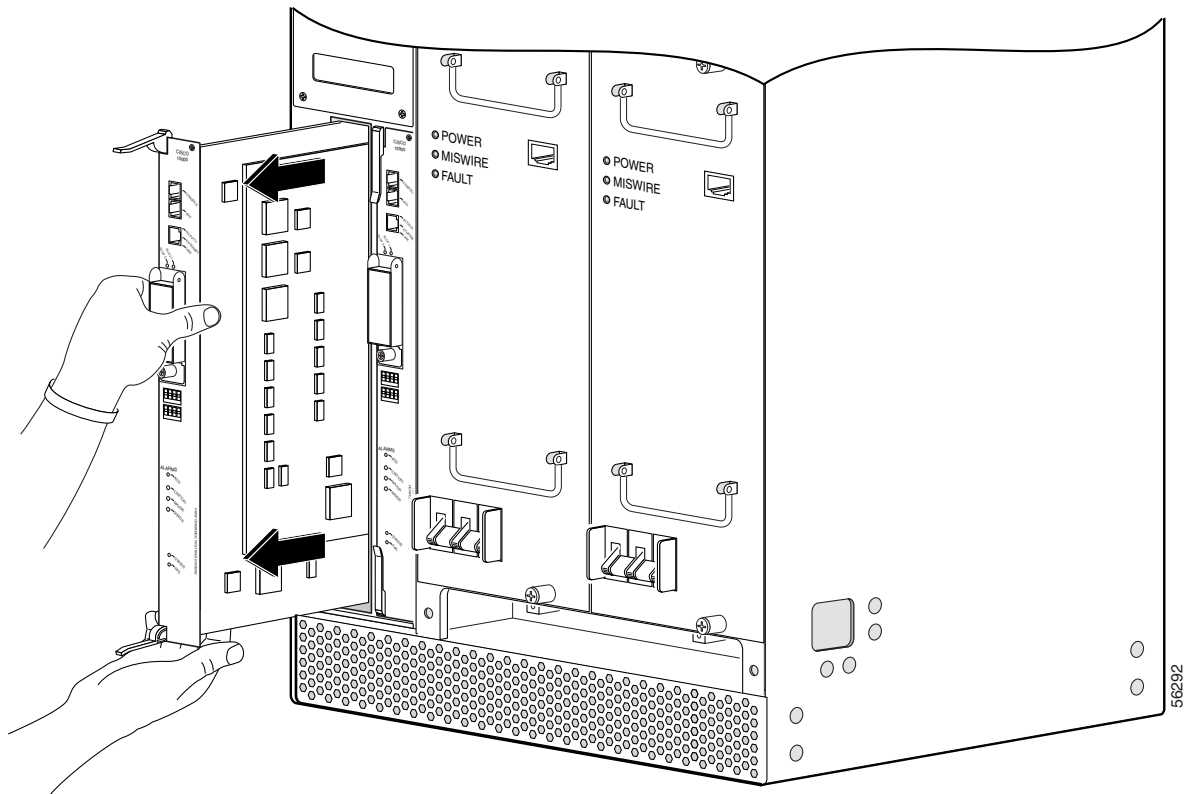
- Step 6** Simultaneously pivot both ejector levers away from each other to disengage the PRE module from the backplane (see [Figure 5-8](#)).

**Figure 5-8** Opening the Ejector Levers



**Step 7** Slide the PRE module out of the slot and place it on an antistatic surface, or in an antistatic bag (see [Figure 5-9](#)).

Figure 5-9 Removing the PRE Module from the Chassis



**Step 8** If you are installing a new or replacement PRE module, proceed to the next step. Otherwise, install a blank cover over the slot and screw down its captive screws to conclude this procedure.

**Note**

For proper cooling and airflow, a blank PRE module cover should always be installed when a second PRE module is not installed.

The product order number for the blank PRE module cover is ESR-PRE-COVER=.

**Warning**

**Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.** Statement 1029

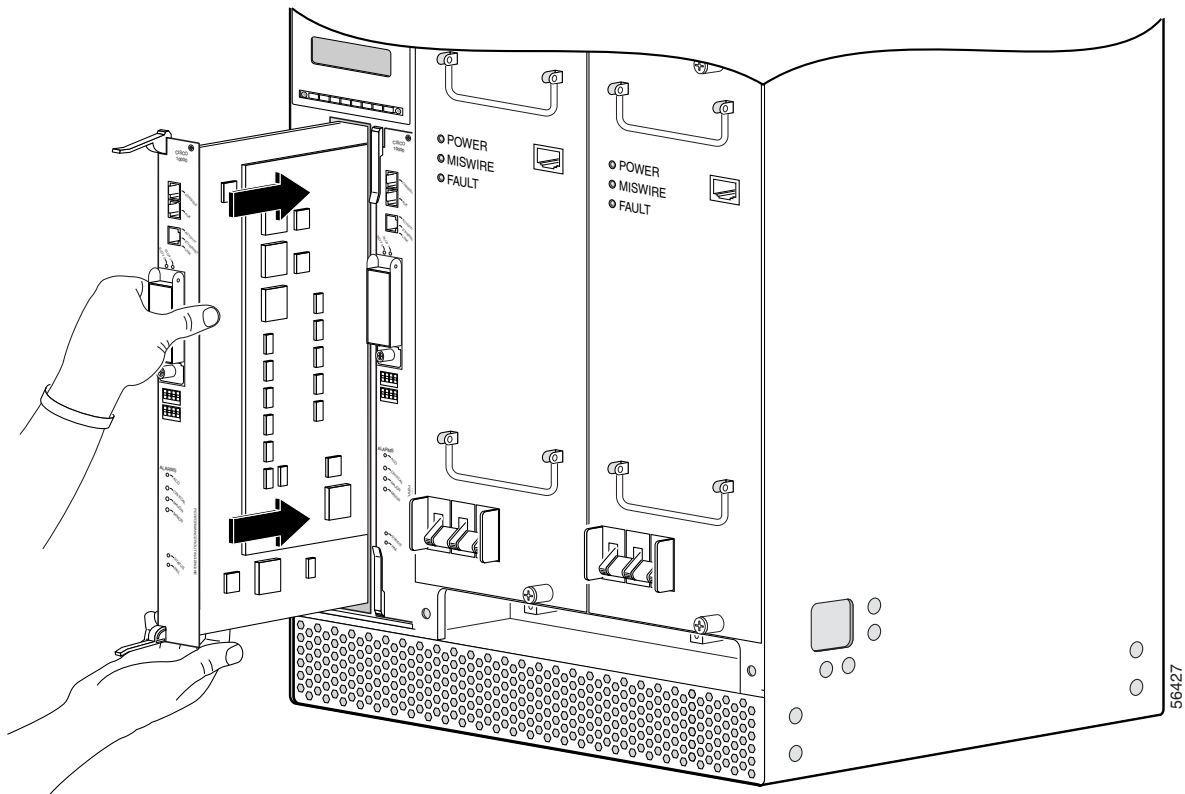
## Replacing the PRE Module

When replacing a PRE1 module with a PRE2 module, you must also install EMI gaskets and RF absorber material, for more information, go to the following URL:

[http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field\\_replaceable\\_units/pre2gkit.html](http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/pre2gkit.html)

- 
- Step 1** Grasp the faceplate of the new PRE module with one hand and place your other hand under the card carrier (to support the weight of the module) and position the card in front of the card cage slot.
- Step 2** Carefully align the upper and lower edges of the PRE module with the upper and lower guides in the chassis, and slide the module into the slot until you can feel it begin to seat in the backplane connectors (see [Figure 5-10](#)).

**Figure 5-10** Inserting the PRE Module in the Chassis

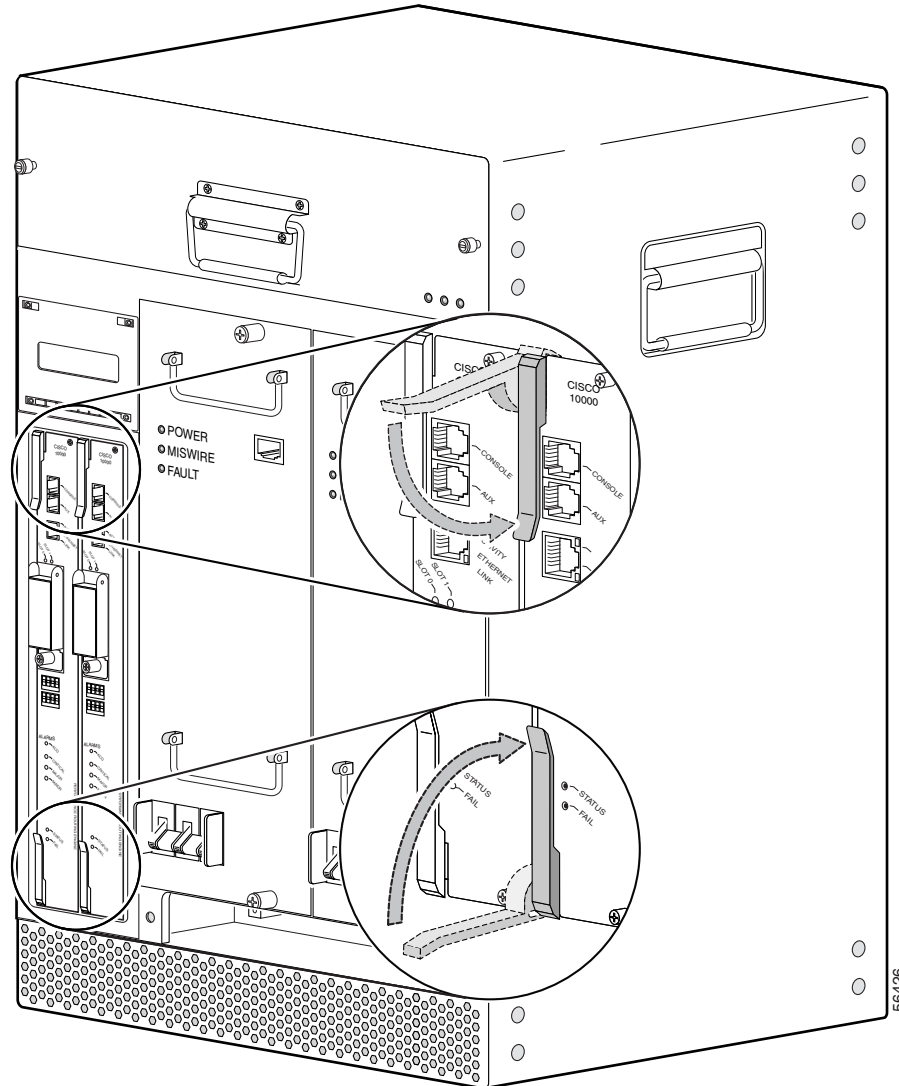


- Step 3** Simultaneously pivot both ejector levers toward each other (until they are parallel to the faceplate) to firmly seat the PRE module in the backplane (see [Figure 5-11](#)).
- Step 4** Secure the PRE module in the chassis by tightening the top and bottom captive screws (see [Figure 5-7](#)).



**Caution** Always tighten the captive screws on each newly installed PRE module. These screws prevent accidental removal and provide proper grounding for electromagnetic interference (EMI) shielding.

Figure 5-11 Closing the Ejector Levers



- Step 5** When fully inserted, the PRE module cycles through its power-on self-test. The FAIL LED stays on briefly (about 5 to 6 seconds) and then shuts off. If the FAIL LED remains on or is flashing, go to the [“Troubleshooting Installation Problems”](#) section on page 4-3.
- Step 6** Reconnect any interface cables to the PRE module if necessary. Route the cables through the square hole in the front left side on the chassis.
- Step 7** Install the PC media card in the PRE module, if necessary (see the [Removing and Installing a PC Media Card](#)).

# Removing and Installing a PC Media Card

Use the following procedure to remove and install a PC media card.

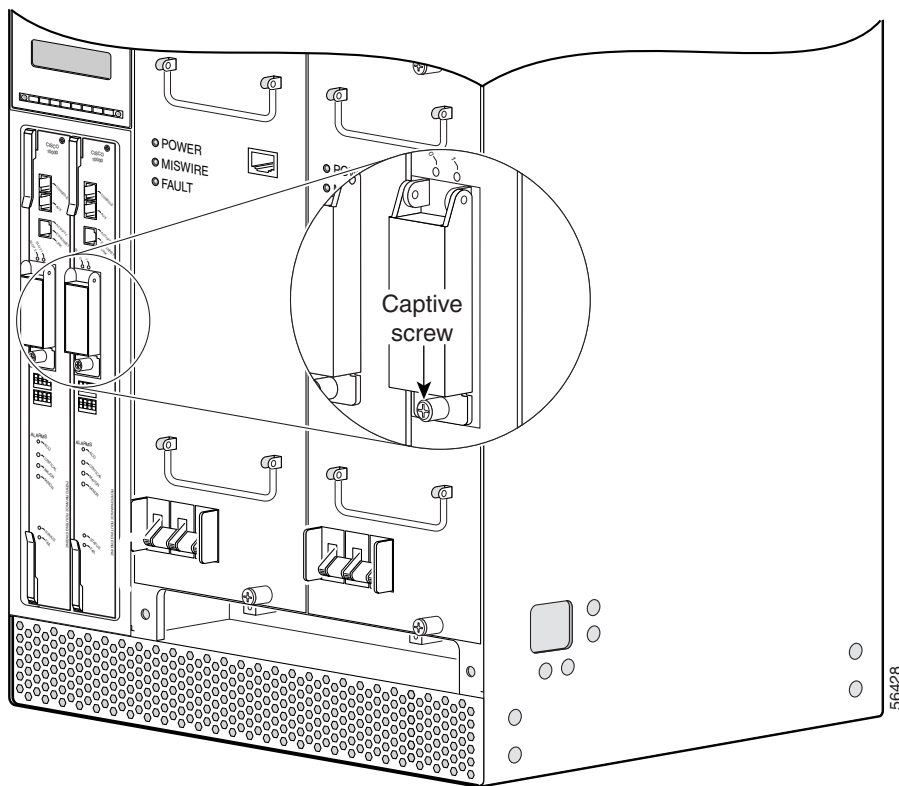


## Note

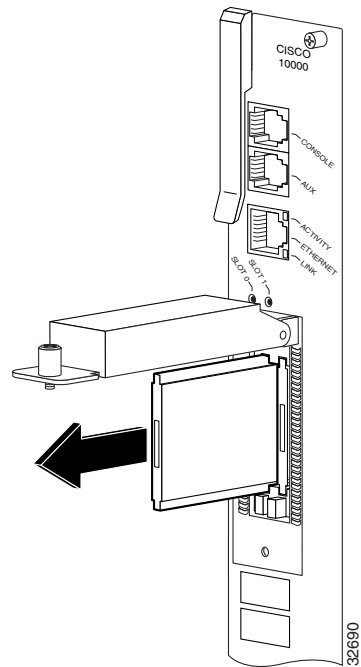
The Cisco uBR10012 router uses PC media cards that are a minimum of 64 MB in size. For information about formatting media cards and disks, see the [“Formatting PC Media Cards”](#) section on page 3-71.

- Step 1** Loosen the captive screw on the PC media card cover on the PRE (see [Figure 5-12](#)).

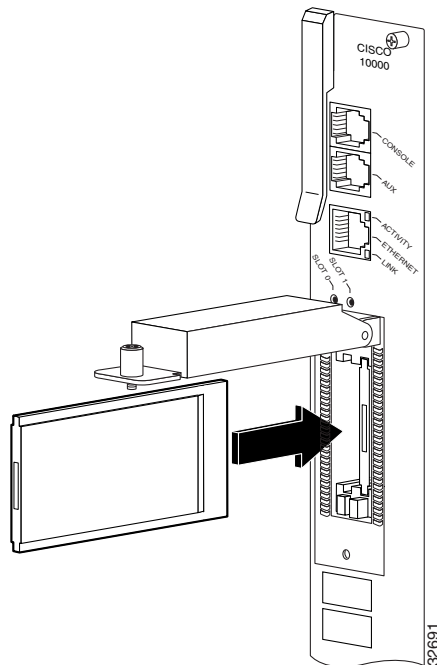
**Figure 5-12** PC Media Card Cover Captive Screws



- Step 2** Lift the cover, push the proper eject button, and pull the Flash card out of its slot (see [Figure 5-13](#)).

**Figure 5-13** Removing the PC Media Card

**Step 3** Insert the new PC media card into one of the card slots on the PRE (see [Figure 5-14](#)).

**Figure 5-14** Inserting the PC Media Card

**Step 4** Close the cover and tighten the captive screw to maintain proper EMI emissions levels (see [Figure 5-12](#)).

# Removing and Replacing a Timing, Communication, and Control Plus Card

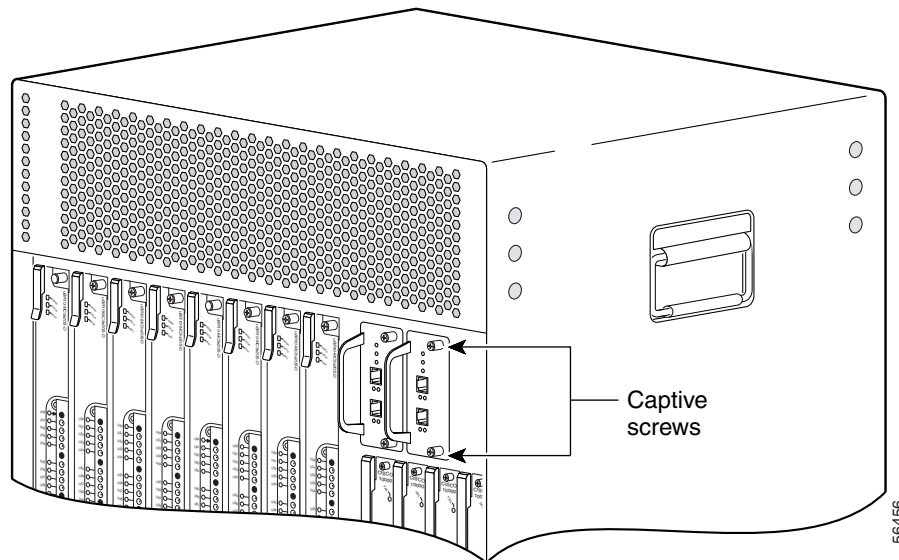
Use the following procedure to install a new Timing, Communication, and Control Plus (TCC+) card or to replace an existing TCC+ card. If two TCC+ cards are installed for redundant operation, one of the cards can be removed and replaced without interrupting system operations.


**Note**

The product order number for the TCC+ card is UBR10-TCC+=

- Step 1** Attach an antistatic wrist strap to your wrist and to a bare metal, unpainted surface on the chassis or frame.
- Step 2** Face the back of the Cisco uBR10012 chassis. If necessary, clear aside enough interface and power cables to allow sufficient space to work.
- Step 3** If installing a new TCC+ card, remove the blank slot cover and discard, and then proceed to step 8. Otherwise, disconnect the clock cables from the TCC+ card being replaced.
- Step 4** Loosen the top and bottom captive screws on the TCC+ card (see [Figure 5-15](#)).

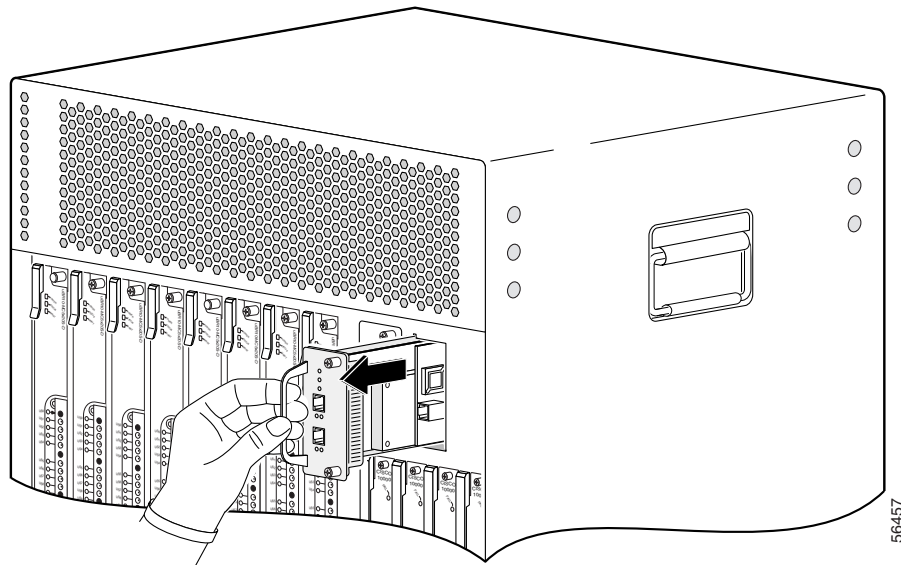
**Figure 5-15** TCC+ Card Captive Screws



- Step 5** Verify that the maintenance LED is lighted on the TCC+ card you are removing. This LED indicates that the card can be removed from the chassis without interrupting systems operations.
- Step 6** Using the handle, pull the TCC+ card out of the slot and place it on an antistatic surface, or in an antistatic bag (see [Figure 5-16](#)).



Figure 5-16 Removing the TCC+ card



- Step 7** If you are installing a replacement card, proceed to the next step. Otherwise, install a blank cover over the slot and screw down its captive screws to conclude this procedure.

**Note**

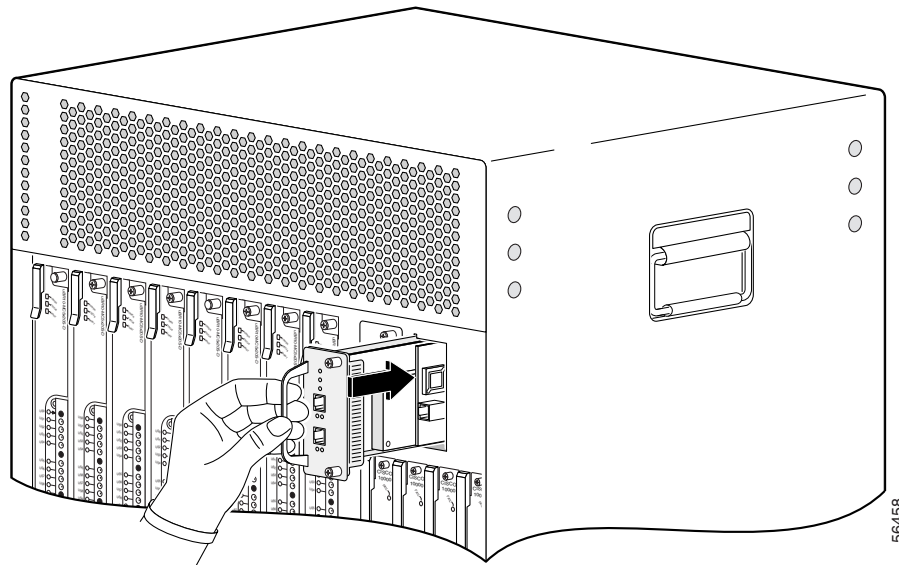
For proper cooling and airflow, a cover must always be installed in a blank TCC+ card slot. The product order number for the blank TCC+ card cover is UBR10-TCC+-COVER=.

**Warning**

**Blank faceplates (filler panels) serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards and faceplates are in place.** Statement 1029

- Step 8** Pick up the replacement TCC+ card and position it in front of the card cage slot.
- Step 9** Carefully align the upper and lower edges of the line card with the upper and lower guides in the chassis, and slide the line card into the slot so that it firmly seats in the backplane connectors (see [Figure 5-17](#)).

Figure 5-17 Inserting the TCC+ Card



**Step 10** Secure the line card in the chassis by tightening the top and bottom captive screws (see [Figure 5-15](#)).

**Caution**

Always tighten the captive screws on each TCC+ card. These screws prevent accidental removal and provide proper grounding for electromagnetic interference (EMI) shielding.

**Step 11** When fully inserted, the TCC+ card cycles through its power-on self-test. The Power LED lights (green) and the Status LED then briefly lights (yellow). If this is the primary (or only) TCC+ card, the Status LED then lights a solid green. On the backup TCC+ card, the Status LED should start flashing green after a few moments. If these LEDs do not operate as described, go to the [“Troubleshooting Installation Problems”](#) section on page 4-3.

**Step 12** Connect the clock cables to the TCC+ card.

**Caution**

The TCC+ card can connect only to a national clock source such as a GPS receiver or Building Integrated Timing Supply (BITS) clock. The Cisco uBR10012 router does not support directly connecting the RJ-45 connectors on the TCC+ cards to an outside plant line or telco-provided T1/E1 clock source. You can use an outside or telco-provided T1/E1 clock source only by connecting the source to the TCC+ cards using a CSU/DSU or other equipment that is approved to FCC part 68 and ANSI/UL1950 for the connection to the Public Switched Telephone Network (PSTN).

**Note**

It is not necessary to configure the TCC+ card if you are installing a replacement card in the same slot. The system automatically downloads the necessary configuration information from the PRE module.

**Step 13** Configure the TCC+ card if necessary (see the [“Formatting PC Media Cards”](#) section on page 3-71).

## Removing and Replacing a Network Line Card

Use the following procedure to install a new network line card, or to remove or replace an existing network line card in the Cisco uBR10012 chassis. The following cards are supported:

- Cisco OC-12/STS12c/STM4 POS (UBR10-OC12/P-SMI=)
- Cisco uBR10-SRP-OC12SML-DPT WAN (UBR10-SRP-OC12SML=)
- Cisco Single Port Gigabit Ethernet line card (UBR10-1GE=)
- Cisco uBR10012 OC-48 DPT/POS interface module



Tip

To prevent alarms from activating, you can administratively shut down a line card before hot-swapping it. Otherwise, inform the network administrator that this portion of the network will be temporarily interrupted.

## Removing the Network Line Card



Warning

**Class 1 laser product.** Statement 1008



Warning

**Invisible laser radiation present.** Statement 1016



Warning

**Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures.** Statement 1056

**Warning Statement for Sweden**



Warning

**Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.** Statement 1036

**Warning Statement for Finland**



Warning

**Alleviätes ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.** Statement 1035

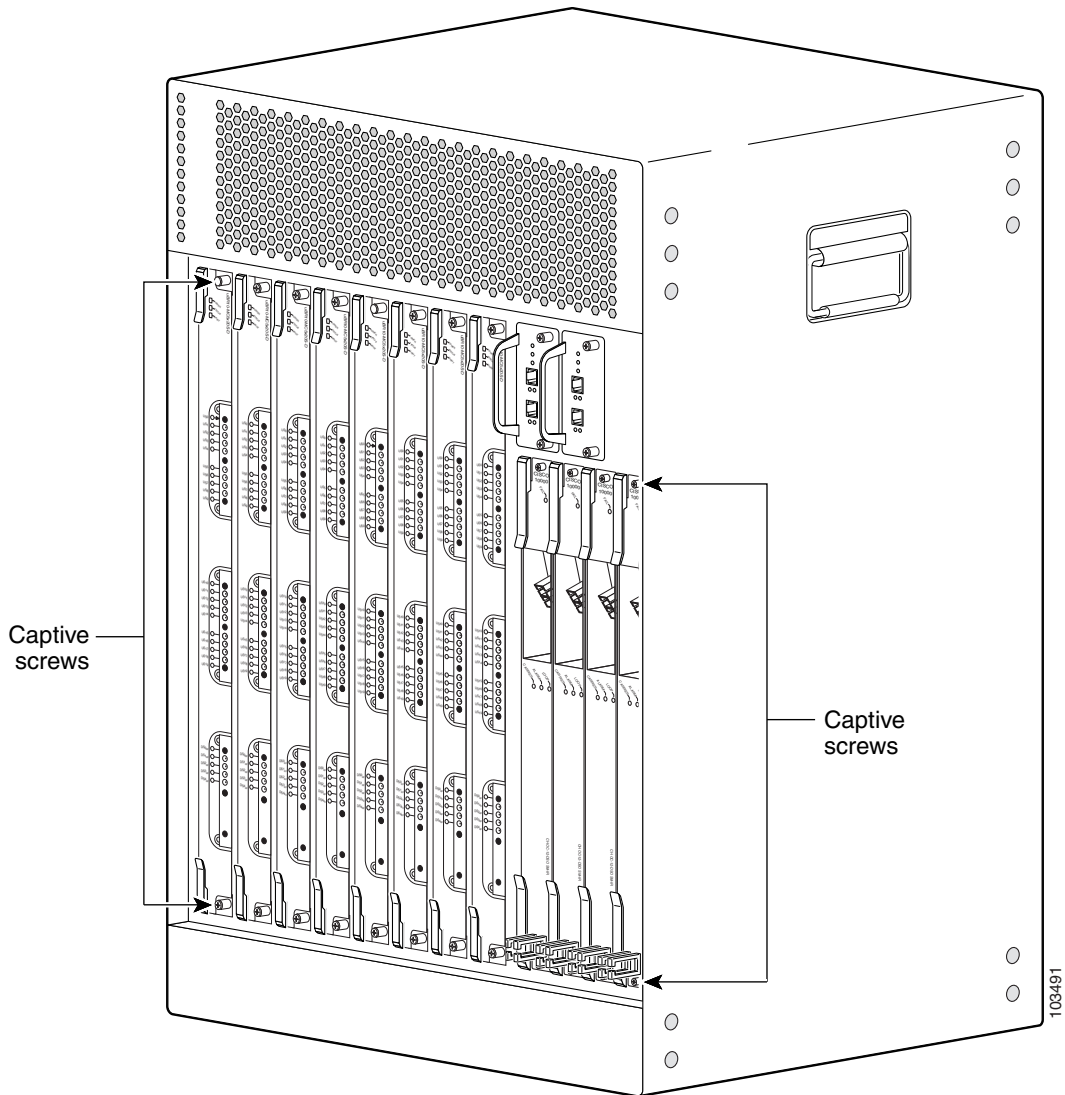
**Step 1**

Attach an antistatic wrist strap to your wrist and to a bare metal surface on the chassis or frame.

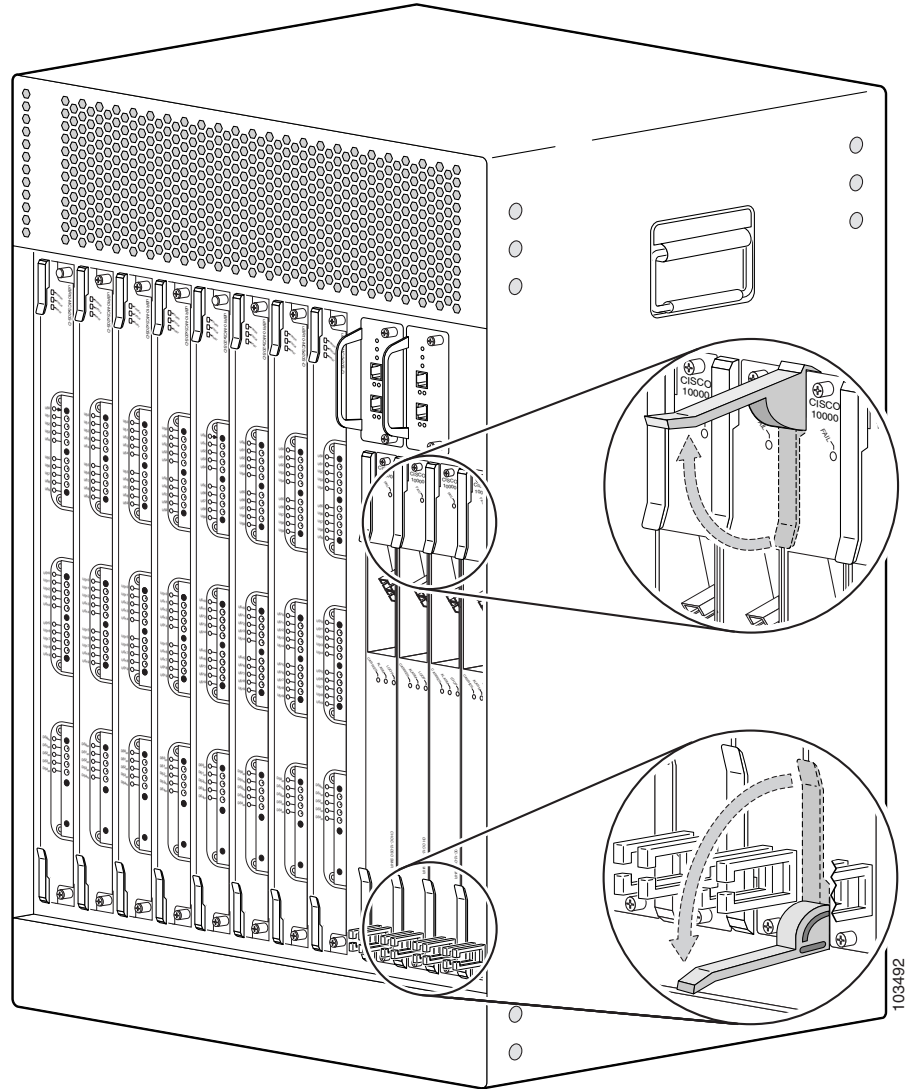
**Step 2**

Face the back of the Cisco uBR10012 chassis. Clear aside enough interface and power cables to allow sufficient space to work.

Figure 5-18 Loosening the Captive Screws

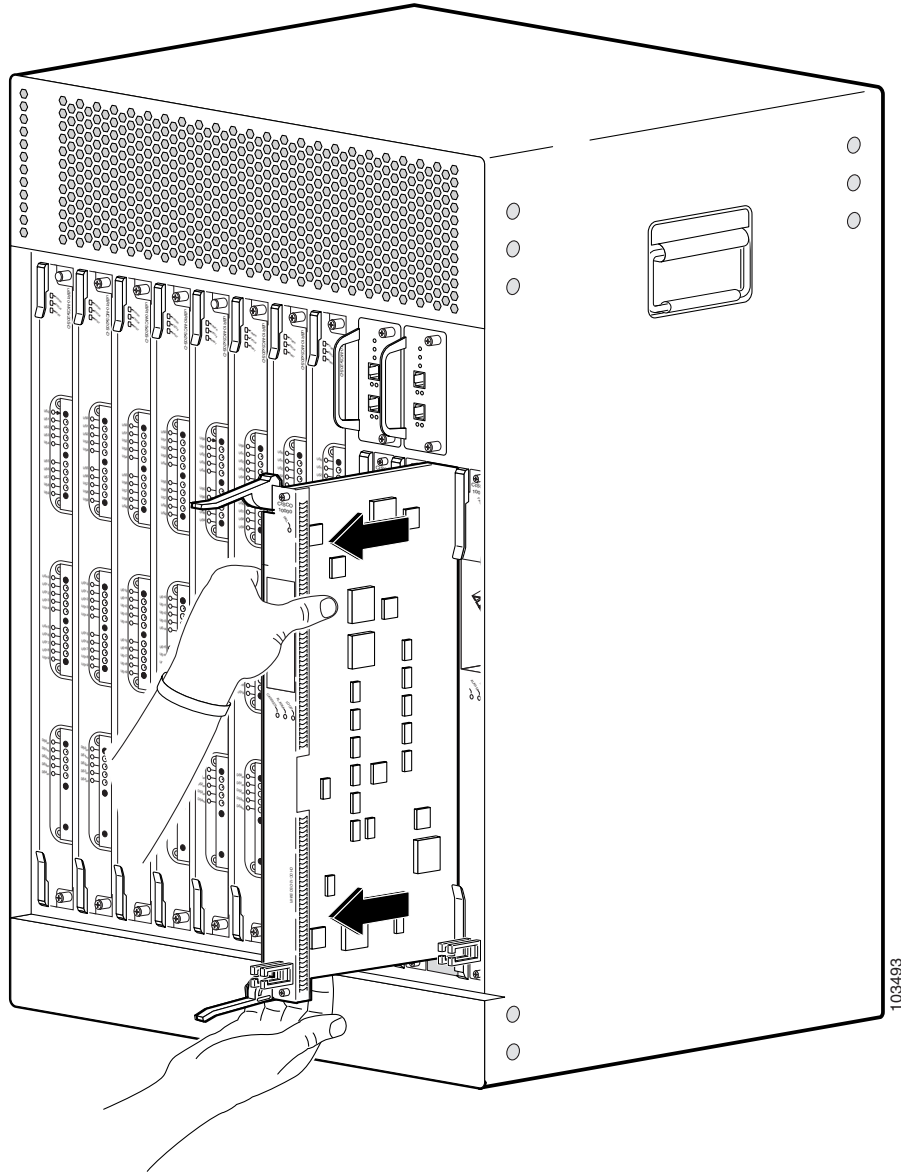


- Step 3** If installing a new line card in a blank slot, remove the blank slot cover and discard. Otherwise, disconnect the cables from the network line card.
- Step 4** Unscrew the top and bottom captive screws on the card (see [Figure 5-18](#)).
- Step 5** Simultaneously pivot both ejector levers away from each other to disengage the line card from the backplane (see [Figure 5-19](#)).

**Figure 5-19** Opening the Ejector Levers

**Step 6** Slide the card out of the slot and place it on an antistatic surface, or in an antistatic bag (see [Figure 5-20](#)).

Figure 5-20 Removing the Network Line Card



**Step 7** If you are installing a new or replacement card, proceed to the next step. Otherwise, install a blank cover over the slot and screw down its captive screws to conclude this procedure.



**Warning**

**Blank faceplates (filler panels) serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards and faceplates are in place.** Statement 1029

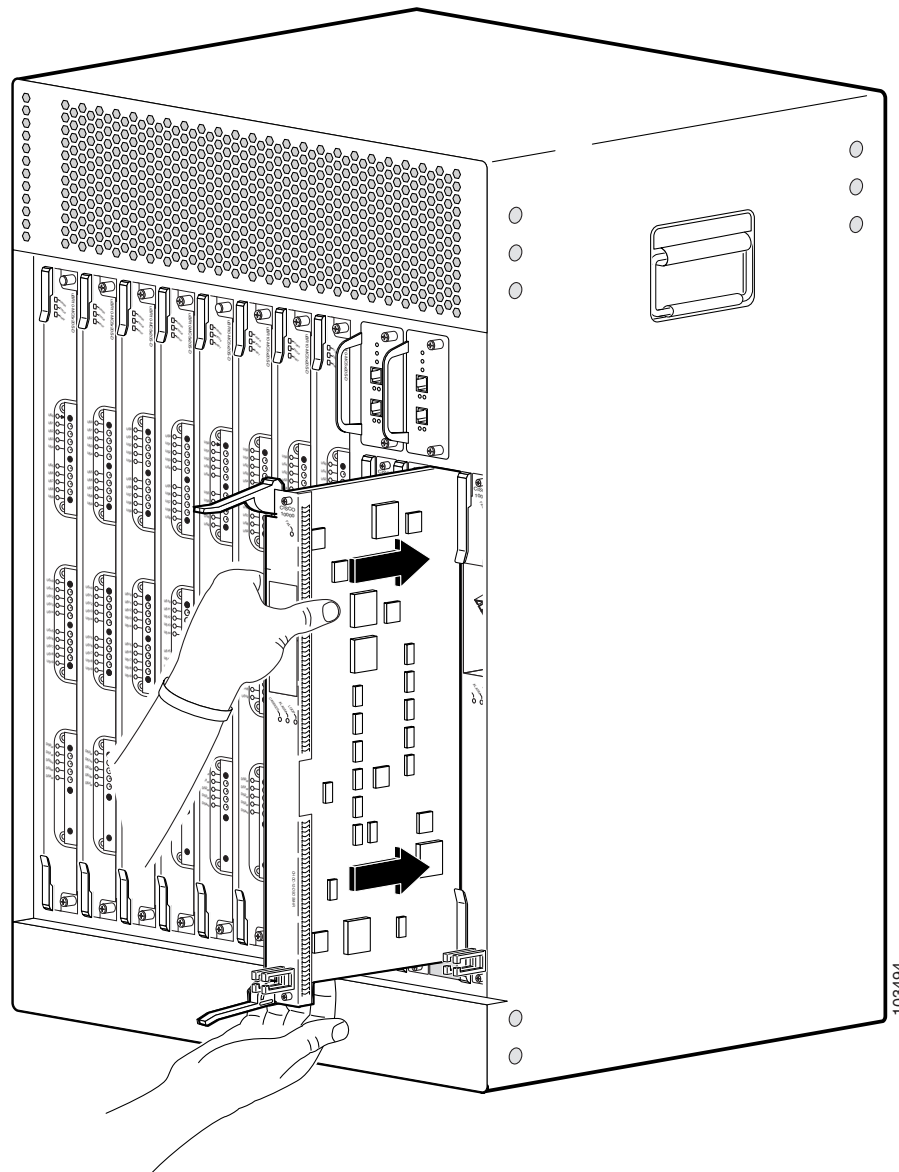
## Installing the Network Line Card

**Note**

For proper cooling and airflow, a blank card cover must always be installed in a blank line card slot. The product order number for the blank card cover is ESR-LC-Cover=.

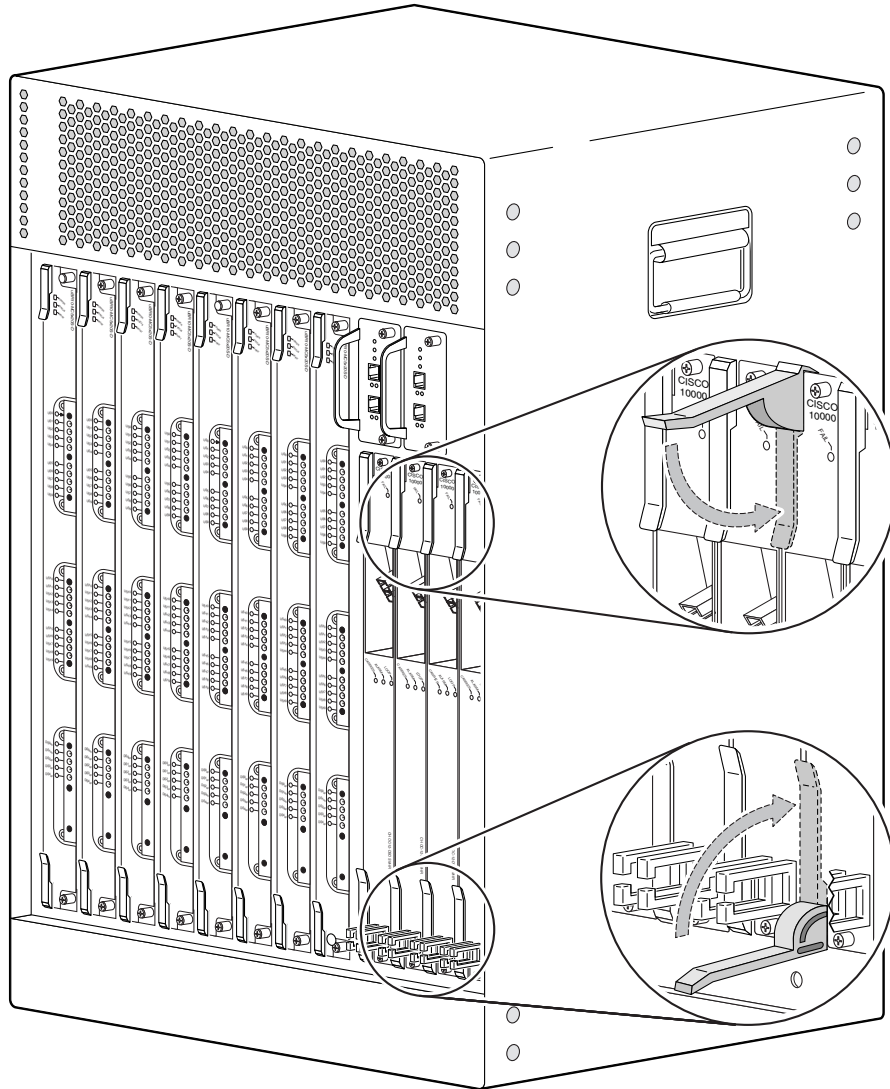
- Step 1** Grasp the faceplate of the new card with one hand and place your other hand under the card carrier (to support the weight of the card) and position the card in front of the card cage slot.
- Step 2** Carefully align the upper and lower edges of the line card with the upper and lower guides in the chassis, and slide the line card into the slot until you can feel it begin to seat in the backplane connectors (see [Figure 5-21](#)).

**Figure 5-21** Inserting the Network Line Card



- Step 3** Simultaneously pivot both ejector levers toward each other (until they are parallel to the faceplate) to firmly seat the card in the backplane (see [Figure 5-22](#)).

**Figure 5-22** Closing the Ejector Levers



- Step 4** Secure the network line card in the chassis by tightening the top and bottom captive screws (see [Figure 5-18](#)).



To ensure that there is adequate space for additional line cards, always tighten the captive screws on each newly installed line card *before* you insert any additional line cards. These screws prevent accidental removal and provide proper grounding for electromagnetic interference (EMI) shielding.



- Step 5** When fully inserted, the card cycles through its power-on self-test. The Fail LED stays on briefly (about 5 to 6 seconds) and then shuts off. If the Fail LED remains on or is flashing, go to the “[Troubleshooting the Line Cards](#)” section on page 4-16.
- Step 6** Reconnect any network interface cables to the card.
- Step 7** Configure the network line card if necessary (see the “[Formatting PC Media Cards](#)” section on page 3-71, or refer to the *Cisco uBR10012 Router Software Configuration Guide*, for information about configuring the card).



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**Note** It is not necessary to configure the network card if you are installing a replacement card in the same slot. The system automatically downloads the necessary configuration information from the PRE module.

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## Removing the Half-Height Gigabit Ethernet Line Card and the Slot Splitter

This section describes how to properly remove and replace HHGE line cards and the slot splitter from the chassis. This section includes the following tasks:

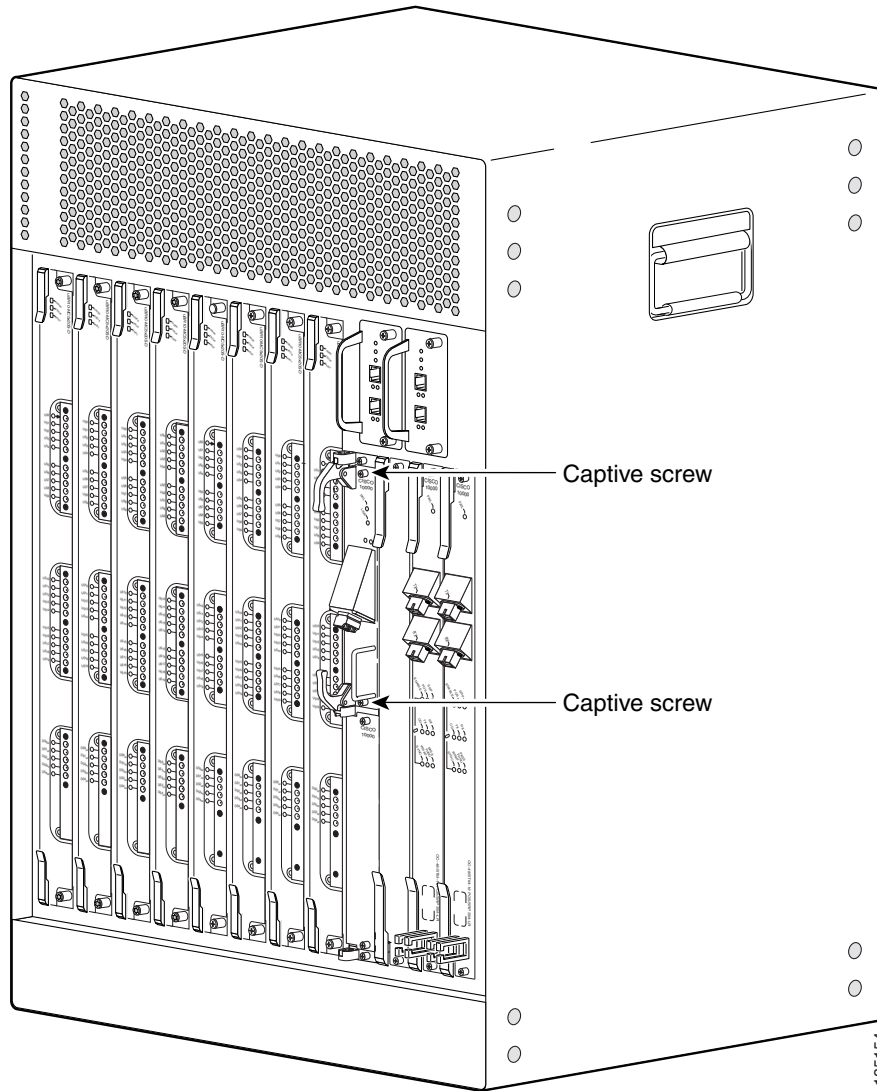
- [Removing a Half-Height Gigabit Ethernet Line Card, page 5-27](#)
- [Removing the Slot Splitter, page 5-30](#)

### Removing a Half-Height Gigabit Ethernet Line Card

Use the following procedure to remove the HHGE line card from the slot splitter:

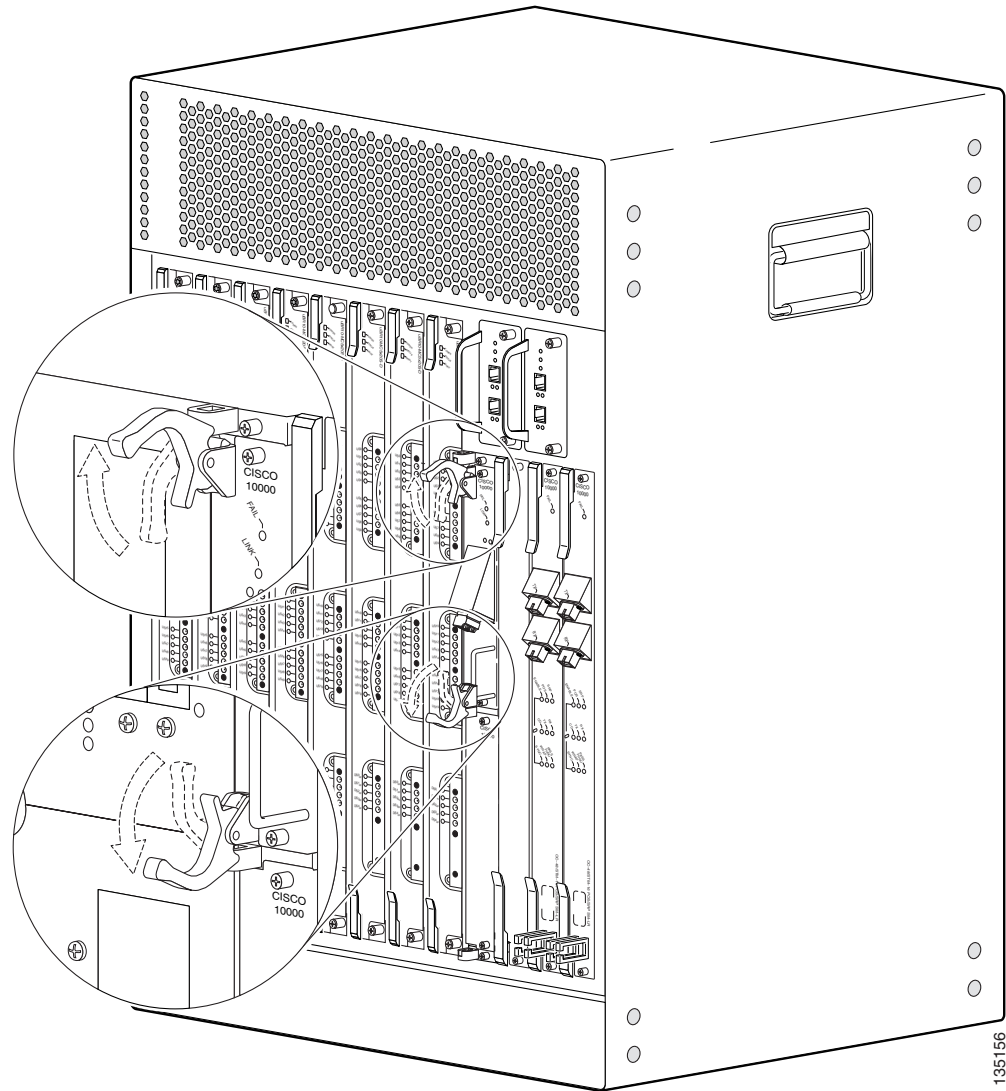
- 
- Step 1** Verify that you are properly grounded.
- Step 2** Disconnect any network cables connected to the line card port.

Figure 5-23 Captive Screw Locations



- Step 3** Loosen the top and bottom captive screws until they disengage and spring away from the face plate (Figure 5-23).
- Step 4** Simultaneously pivot both ejector levers away from each other to disengage the line card from the backplane (Figure 5-24).
- Step 5** Slide the line card out of the slot splitter and place it on an antistatic surface or in an antistatic bag.
- Step 6** If you are not installing a replacement line card, install a blank faceplate in the slot.

Figure 5-24 Opening the Ejector Levers



135156

**Caution**

Do not operate the system unless all slots contain a line card or a blank faceplate. Always install a full-slot blank faceplate into an empty slot. Half-height blank faceplates do not have air dams, and the empty slot will rob cooling air from the other slots. A slot splitter with one half-height line card and one blank faceplate is allowed.

**Warning**

**Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.**

Statement 1029

## Removing the Slot Splitter

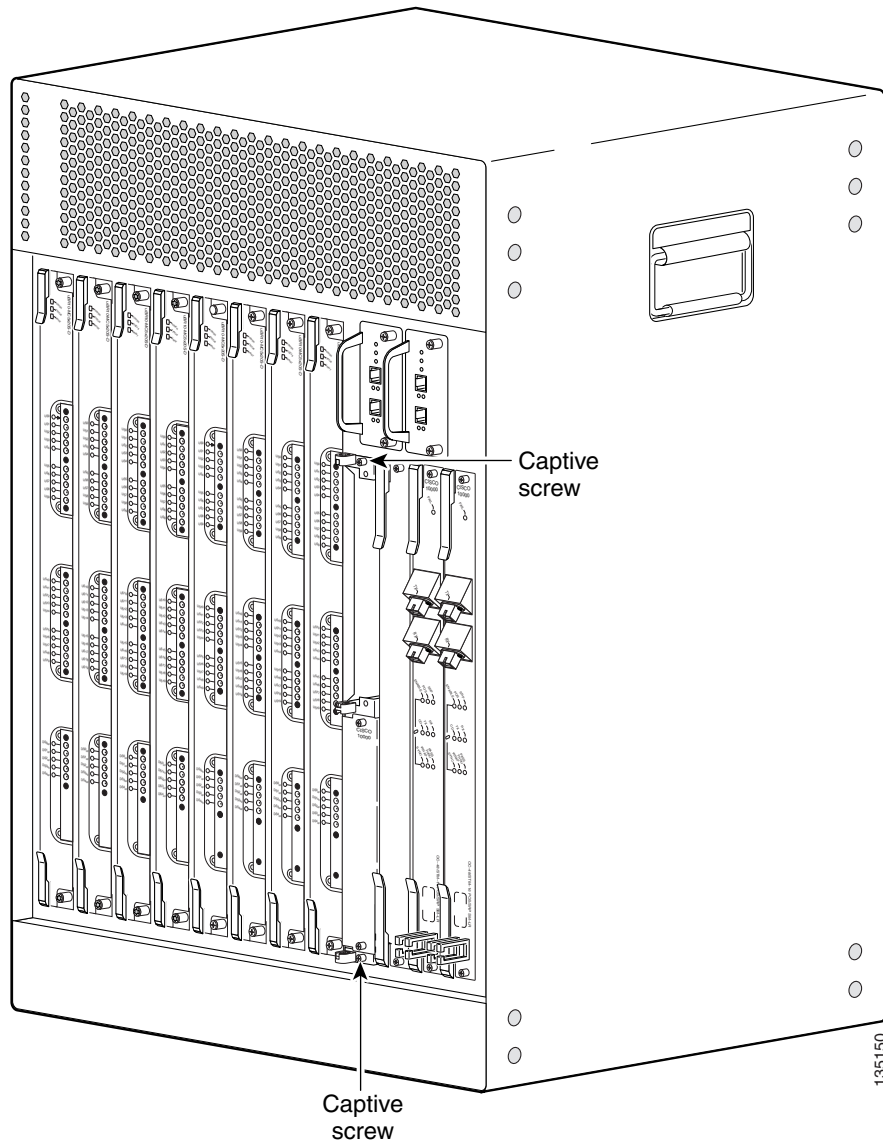
Use the following procedure to remove a slot splitter from the chassis:

- Step 1** Attach an antistatic wrist strap to your wrist and to the ESD socket on the chassis, or to a bare metal surface on the chassis or frame).
- Step 2** Remove any line cards from the splitter according to the [“Removing a Half-Height Gigabit Ethernet Line Card”](#) section on page 5-27.

The slot splitter does not have ejector levers to disengage cards from the backplane, so you must remove any line cards before you remove the splitter.

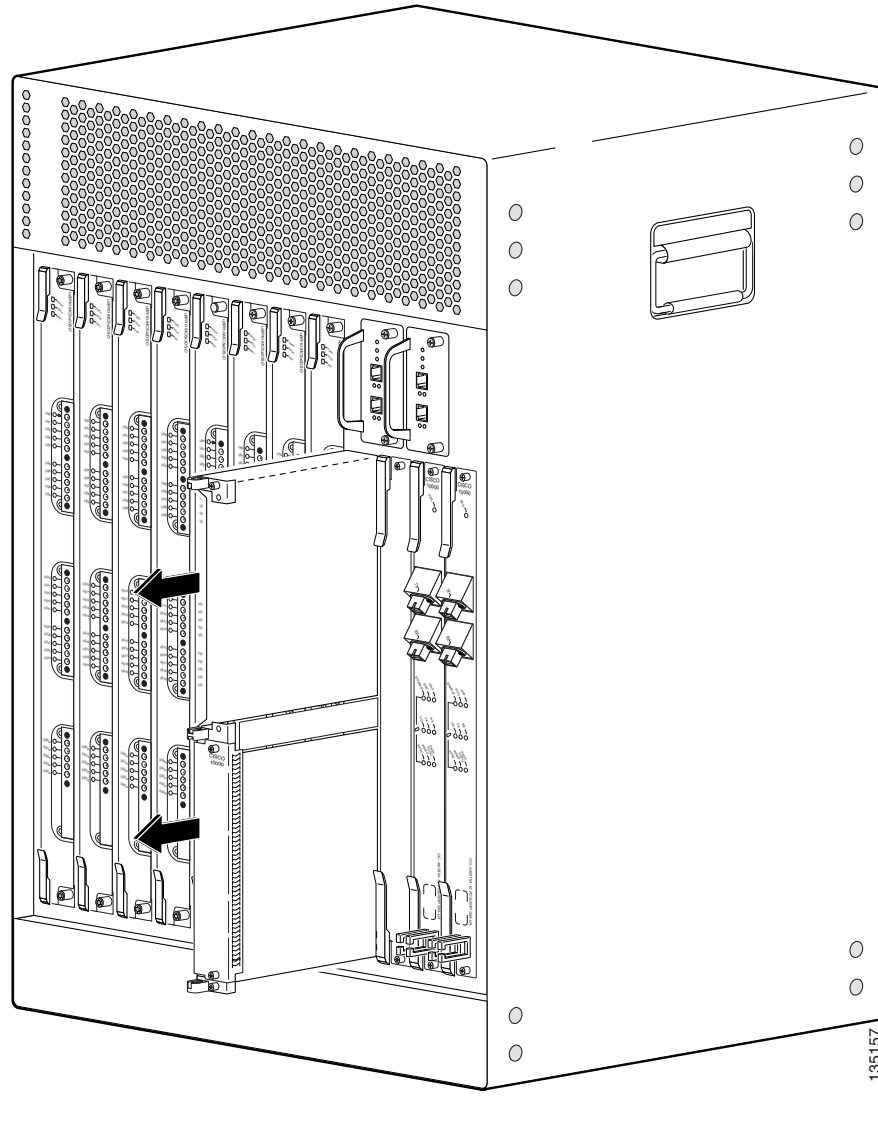
- Step 3** Loosen the top and bottom captive screws on the slot splitter ([Figure 5-25](#)).

**Figure 5-25** Captive Screw Locations



- Step 4** Slide the splitter out of the slot (Figure 5-26).
- Step 5** If you are not installing a replacement splitter or a line card, install a full-slot blank faceplate in the slot.

**Figure 5-26** Removing the Slot Splitter



# Replacing the Slot Splitter and Half-Height Gigabit Ethernet Line Card

This section describes how to install the line card in the Cisco uBR10012 router. This section includes the following tasks:

- [Installing the Slot Splitter, page 5-32](#)
- [Installing the Half-Height Gigabit Ethernet Line Card, page 5-35](#)

**Caution**

You must use slot 3 or slot 4 when installing the slot splitter and HHGE line card in the Cisco uBR10012 router, using slot 1 or slot 2 will cause the router to shut down those slots.

**Caution**

Do not install two half-height blank faceplates into the same slot in the slot splitter. Instead, install a full-slot blank faceplate into the slot. The half-height blank faceplates do not have air dams, and the empty slot will rob cooling air from the other slots. A slot splitter with one half-height line card and one blank faceplate is allowed.

**Caution**

Do not install a line card into the slot splitter before installing the splitter into the chassis. The slot splitter does not have ejector levers that allow you to seat the line card in the backplane.

## Installing the Slot Splitter

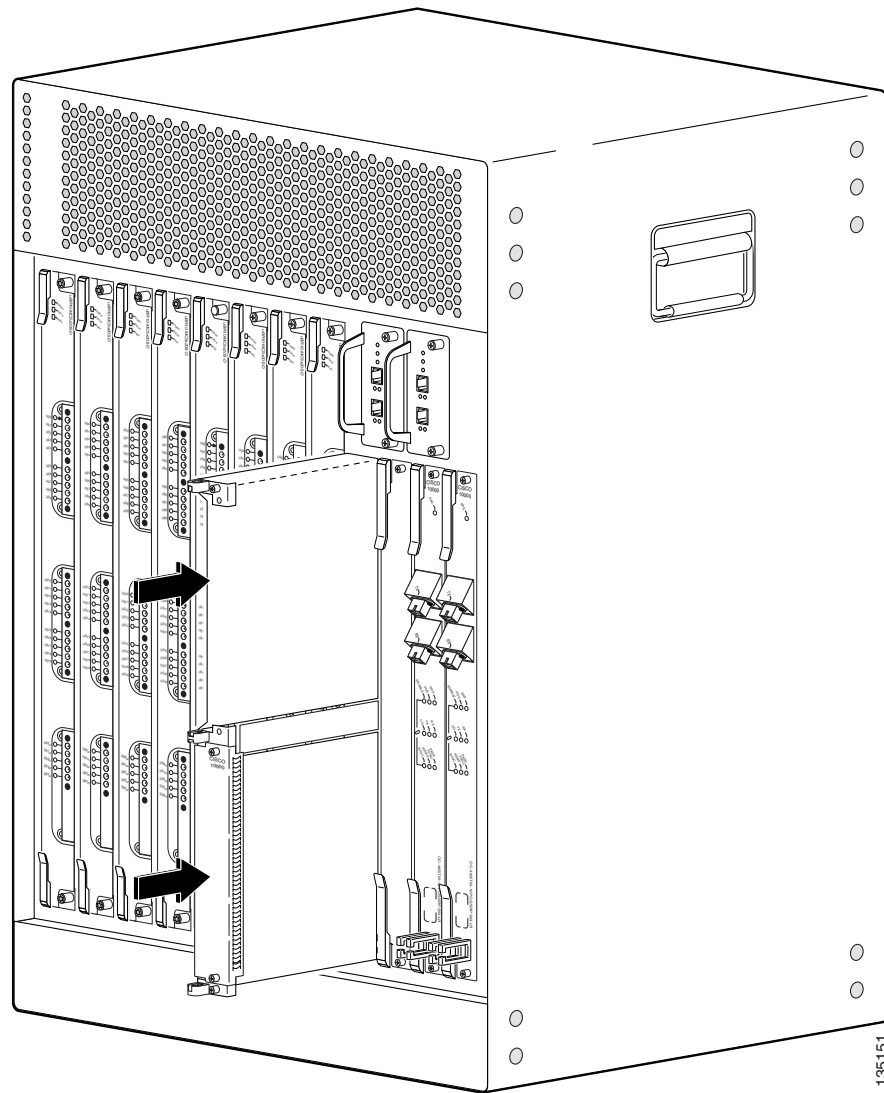
You must install the half-height line card into a slot that contains a slot splitter, which can hold two half-height line cards. If both slots of the slot splitter are not used, then you must install a blank faceplate in the empty slot.

Follow these steps to install a slot splitter into slot 3 or slot 4 of the Cisco uBR10012 chassis.

**Step 1**

Attach an antistatic wrist strap to your wrist and to an ESD socket on the chassis, or to a bare metal surface on the chassis or frame ([Figure 5-21](#)).

Figure 5-27 Inserting the Slot Splitter

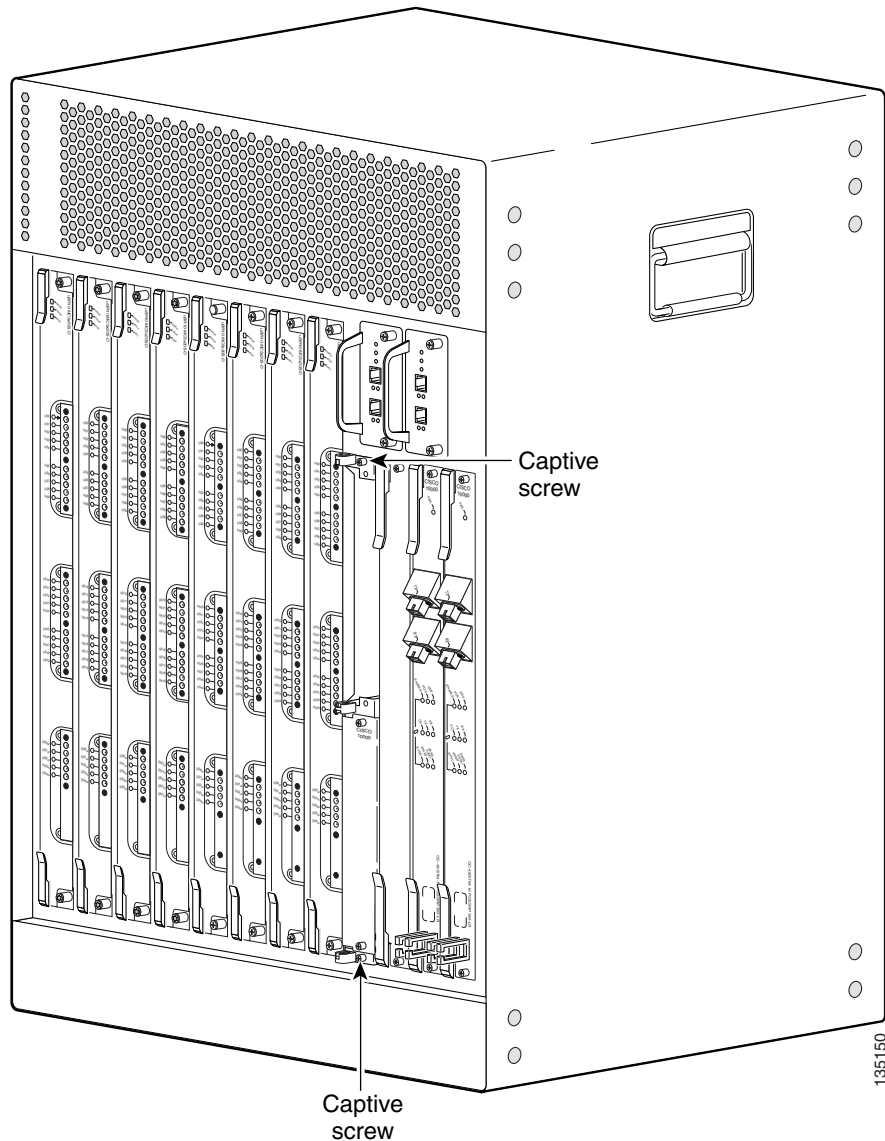


- Step 2** Grasp the front of the slot splitter with one hand and place your other hand under the splitter. Position the splitter in front of the card cage slot.
- Step 3** Carefully align the upper and lower edges of the slot splitter with the upper and lower guides in the chassis, and slide the splitter into the slot until the front is flush with the chassis.



**Note** The slot splitter shown in [Figure 5-21](#) has one open slot (top) and one slot with a slot cover (bottom).

Figure 5-28 Captive Screw Locations



**Step 4** Secure the slot splitter to the chassis by tightening the top and bottom captive screws (Figure 5-28).



**Warning**

**Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.**

Statement 1029



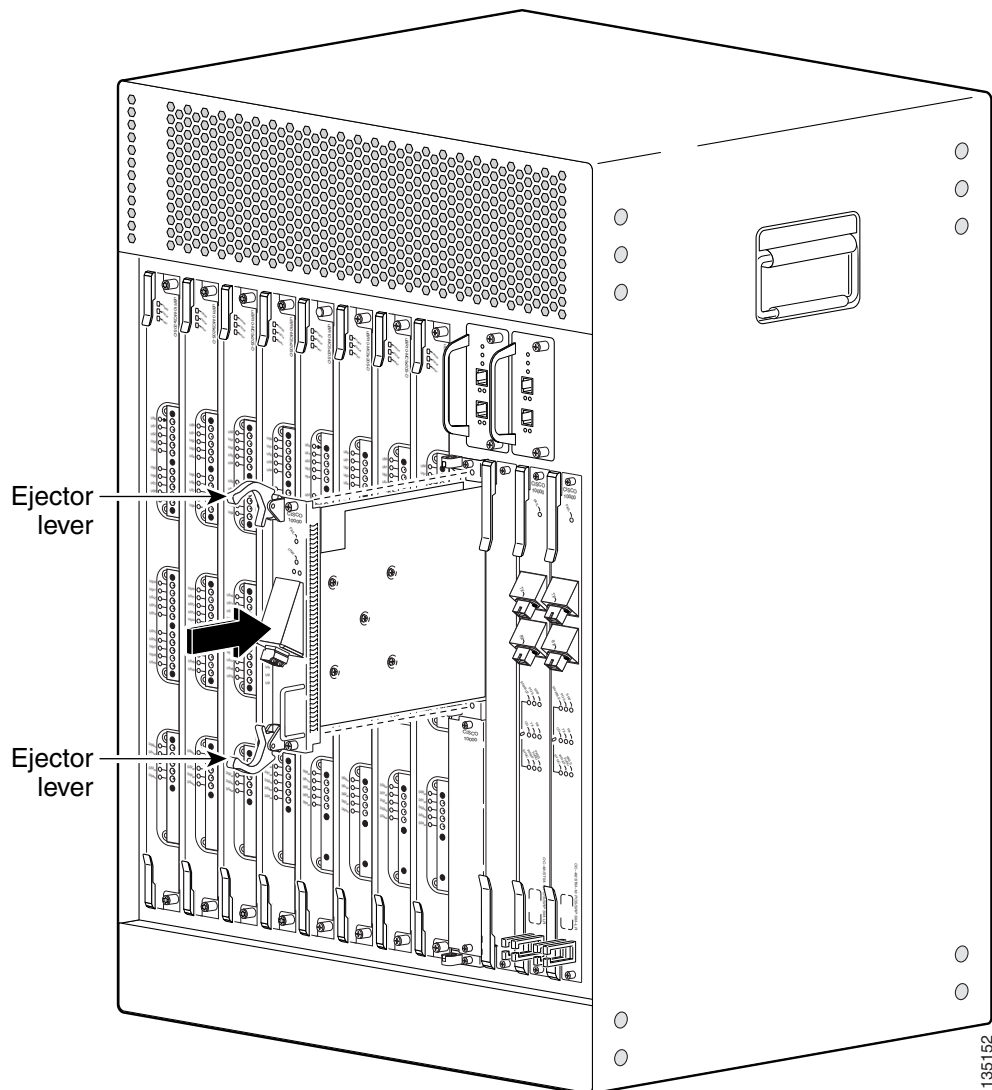
## Installing the Half-Height Gigabit Ethernet Line Card

Use the following procedure to install a HHGE line card into an installed slot splitter. See the [“Installing the Slot Splitter”](#) section on page 5-32 to install the slot splitter.

If you are replacing a line card, see the [“Removing a Half-Height Gigabit Ethernet Line Card”](#) section on page 5-27 before you begin this procedure.

- Step 1** Attach an antistatic wrist strap to your wrist and to an ESD socket on the chassis, or to a bare metal surface on the chassis or frame.

**Figure 5-29** Inserting the Line Card

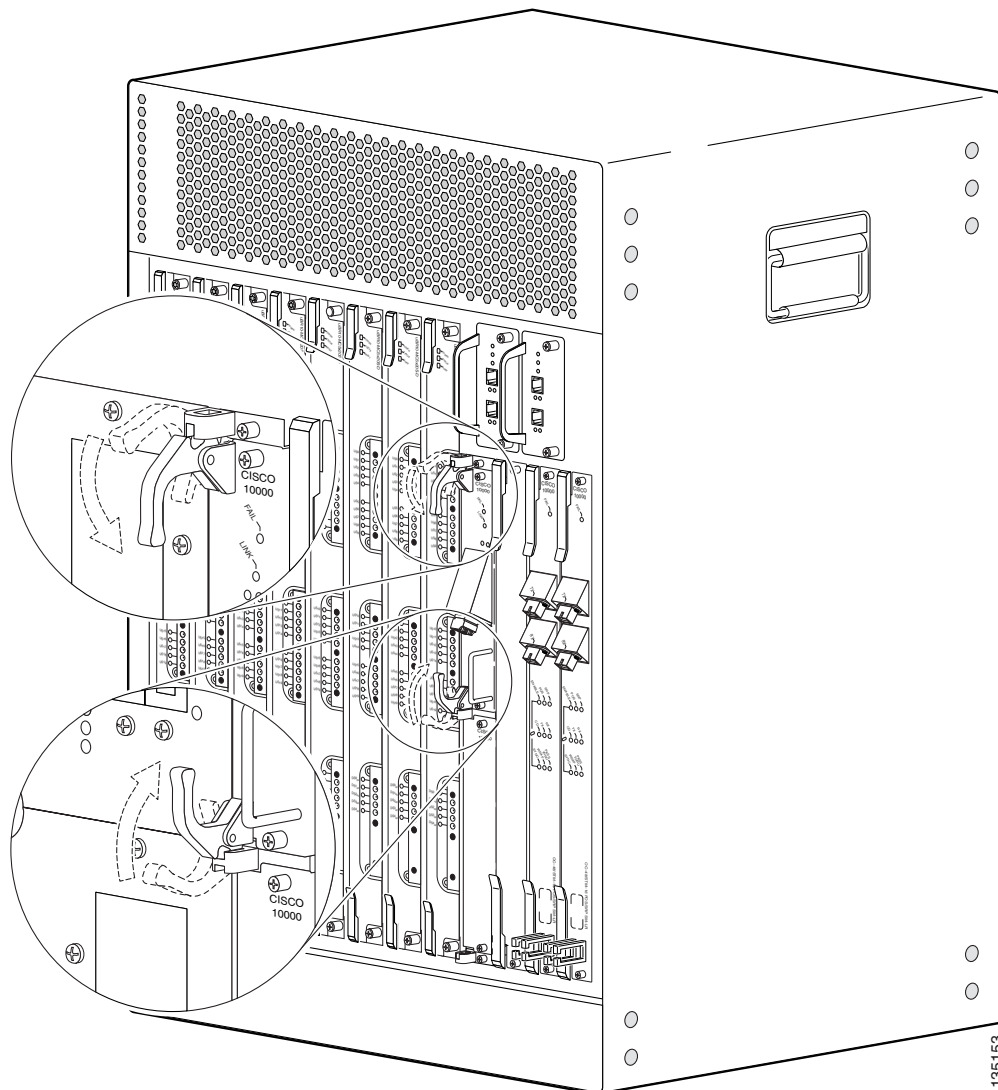


- Step 2** Grasp the faceplate of the line card with one hand and place your other hand under the card carrier (to support the weight of the card). Position the card in front of the slot splitter.
- Step 3** Carefully align the upper and lower edges of the line card with the upper and lower guides in the slot splitter, and slide the line card about half-way into the splitter.

- Step 4** Be sure the ejectors are in the open position (as shown) and continue to push the line card into the splitter until you can feel it begin to seat in the backplane connectors.
- Step 5** Verify that the captive screws are properly aligned with the captive screw holes in the splitter. If the captive screws are not properly aligned, the card will not seat properly in the backplane.
- Step 6** Simultaneously pivot both ejector levers toward each other (until they are parallel to the faceplate) to firmly seat the card in the backplane ([Figure 5-22](#)).

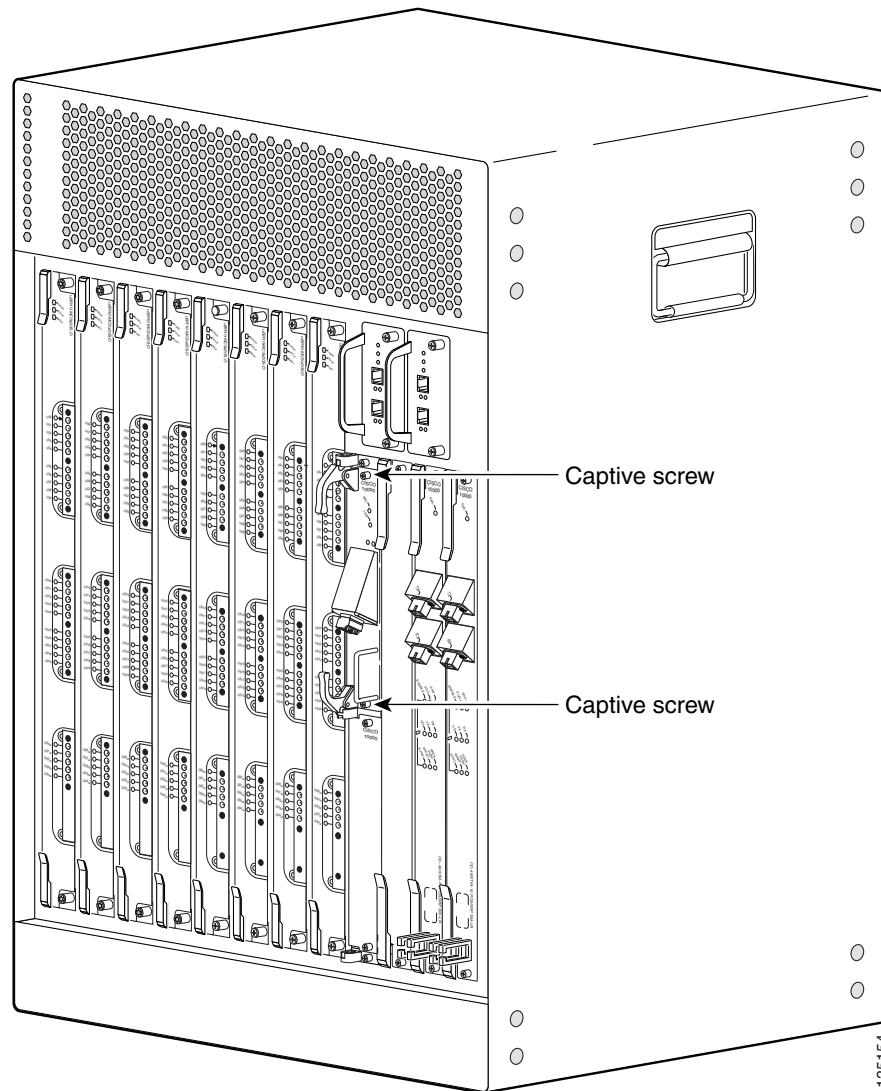
The line card cycles through its power-on self-test. The FAIL LED lights during portions of the POST (Power-On Self Test), but remains off after POST on a properly working line card. If the FAIL LED remains on, go to the [“Troubleshooting the HHGE Installation”](#) section on page 4-17.

**Figure 5-30** Closing the Ejector Levers



135153

Figure 5-31 Captive Screw Locations



**Step 7** Secure the line card in the slot splitter by tightening the top and bottom captive screws (Figure 5-31).

**Caution**

To ensure that there is adequate space for additional line cards, always tighten the captive screws on each newly installed line card *before* you insert any additional line cards. These screws prevent accidental removal and provide proper grounding for electromagnetic interference (EMI) shielding.

# Removing and Replacing an SFP Module

Your HHGE line card is shipped with an SFP module installed. Use the procedures in this section if you need to change the SFP module:

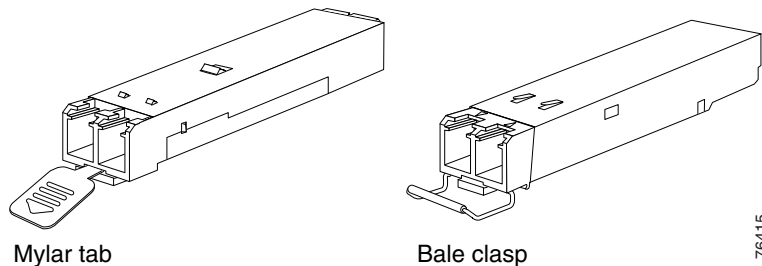
- [Removing an SFP Module, page 5-38](#)
- [Inserting an SFP Module, page 5-40](#)

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

## Types of SFP Modules

SFP modules from different manufacturers provide different methods for freeing the locking pin and removing the SFP module. [Figure 5-32](#) shows two available module types.

**Figure 5-32 Mylar Tab SFP Module and Bale Clasp SFP Module**



- Mylar Tab SFP—Pulling the mylar tab simultaneously releases the locking pin and pulls the SFP module out of its receptacle.
- Bale Clasp SFP—Opening the bale clasp releases the locking pin so you can remove the SFP module from its receptacle.

## Removing an SFP Module

Use the following procedure to remove an SFP module from the HHGE line card.



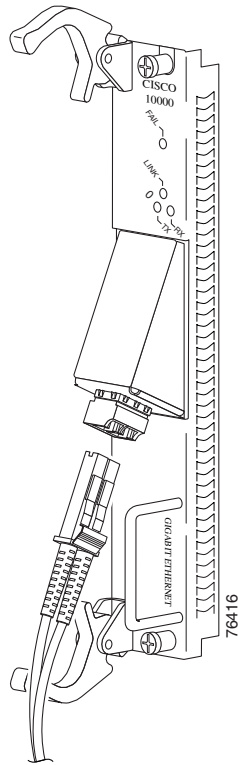
### Note

You can remove an SFP module while the system is powered on, but the interface shuts down.

### Step 1

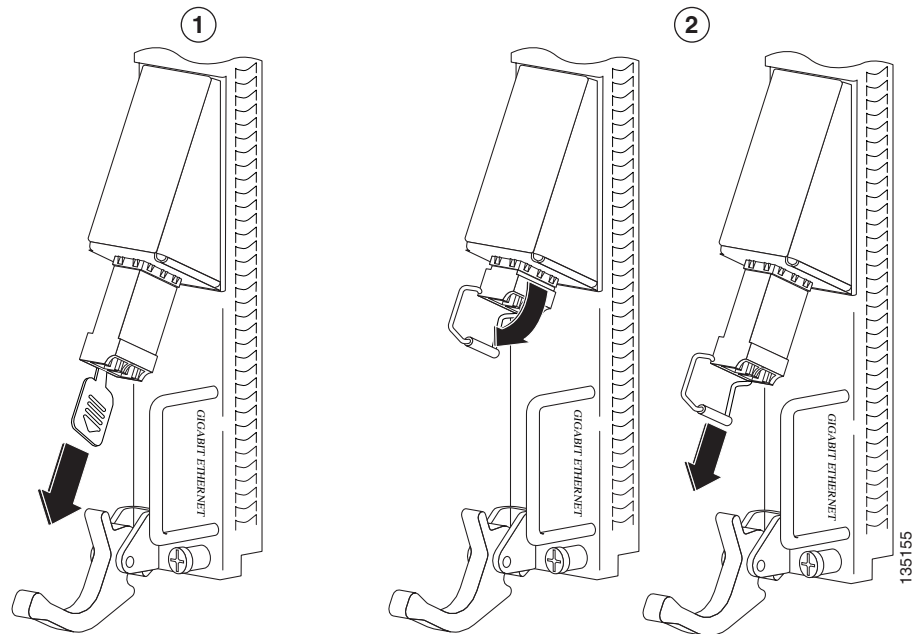
Attach an antistatic wrist strap to your wrist and to an ESD socket on the chassis, or to a bare metal surface on the chassis or frame.

**Figure 5-33** *Disconnecting the LC-type Fiber-Optic Cable*



**Step 2** Disconnect the fiber-optic cable connector from the SFP module (Figure 5-33). Note which cable connector plug is TX and which is RX for reattachment.

**Figure 5-34** *Removing an SFP Module*



- Step 3** Unlock and remove the SFP module as follows:
- Mylar Tab SFP Modules—Gently, but firmly pull the plastic tab to free the locking pin and remove the SFP module (Figure 5-34).



**Caution** Do not twist the Mylar tab when you remove the SFP module. Twisting the tab may disconnect it from the module.

- Bale Clasp Modules—Open the bale clasp to release the locking pin and remove the SFP module (Figure 5-34).

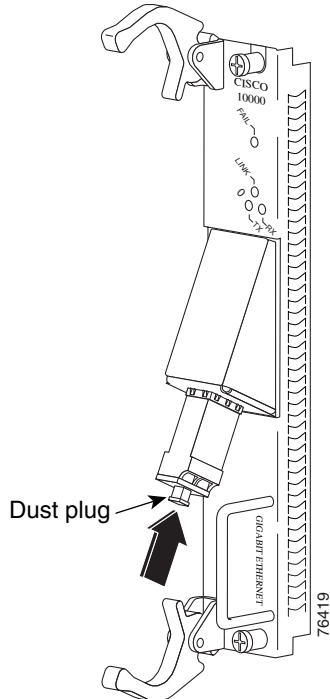
- Step 4** Insert a dust plug into the optical ports of the removed SFP module to keep the optical interfaces clean, and place the module in an antistatic bag or other protective environment.

## Inserting an SFP Module

Use the following procedure to insert an SFP module into the HHGE line card.

- Step 1** Attach an antistatic wrist strap to your wrist and to an ESD socket on the chassis, or to a bare metal surface on the chassis or frame.

**Figure 5-35** Inserting the SFP Module



- Step 2** Gently insert the SFP module into the line card port until the edge connector is fully seated in the connector. You will hear a click as the triangular pin on the bottom of the SFP module snaps into place (Figure 5-35).
- Step 3** Remove the dust plug from the SFP module optical ports and plug the LC-type fiber-optic cable connector into the SFP module (see Figure 5-35).
- 

## Upgrading to a Half-Height Gigabit Ethernet Line Card

This section provides instructions for upgrading from two full height Gigabit Ethernet line cards to half-height Gigabit Ethernet line cards.

**Note**

Verify that you have a PRE2 installed in the router and that you are using the latest IOS software, IOS software release 12.3(13)BC or later.

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To upgrade from the full-height GigE line card to the HHGE line card, perform the following steps:

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- Step 1** Verify traffic is passing through slot 3 and slot 4.
- Step 2** Administratively shut down the line card in slot 3 and let traffic reroute through slot 4.
- Step 3** Remove the full height line card in slot 3.
- Step 4** Install the slot splitter into slot 3.
- Step 5** Install the half height card in the slot splitter 3/0/0 or slot 3/1/0.
- Step 6** Configure and bring up the ethernet card in slot 3/0/0 or slot 3/1/0.

Refer to *Configuring the Half-Height Gigabit Ethernet Line Card for the Cisco uBR10012 Universal Broadband Router* at the following URL:

[http://www.cisco.com/en/US/docs/interfaces\\_modules/cable/line\\_cards/ubr\\_hh\\_ge/configuration/guide/hhgefml0.html](http://www.cisco.com/en/US/docs/interfaces_modules/cable/line_cards/ubr_hh_ge/configuration/guide/hhgefml0.html)

- Step 7** Repeat this procedure for the GigE line card in slot 4.
- 

## Removing and Replacing a Cable Interface Line Card

Use the following procedure to install a new cable interface line card, or to remove or replace an existing cable interface line card in the Cisco uBR10012 chassis. The following cable interface line cards are supported:

- Cisco uBR10-MC5X20S/U, UBR10-MC5X20S=, UBR10-MC5X20U=
- Cisco UBR-MC20X20V, UBR-MC20X20V-20D=, UBR-MC20X20V-5D=, UBR-MC20X20V-0D=
- Cisco uBR-MC3GX60V, uBR-MC3GX60V=

**Tip**

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To prevent alarms from activating, you must administratively shut down a cable interface line card before hot-swapping it. Otherwise, inform the network administrator that this portion of the network will be temporarily interrupted. If the maintenance LED is lighted, you can remove the line card without affecting systems operations.

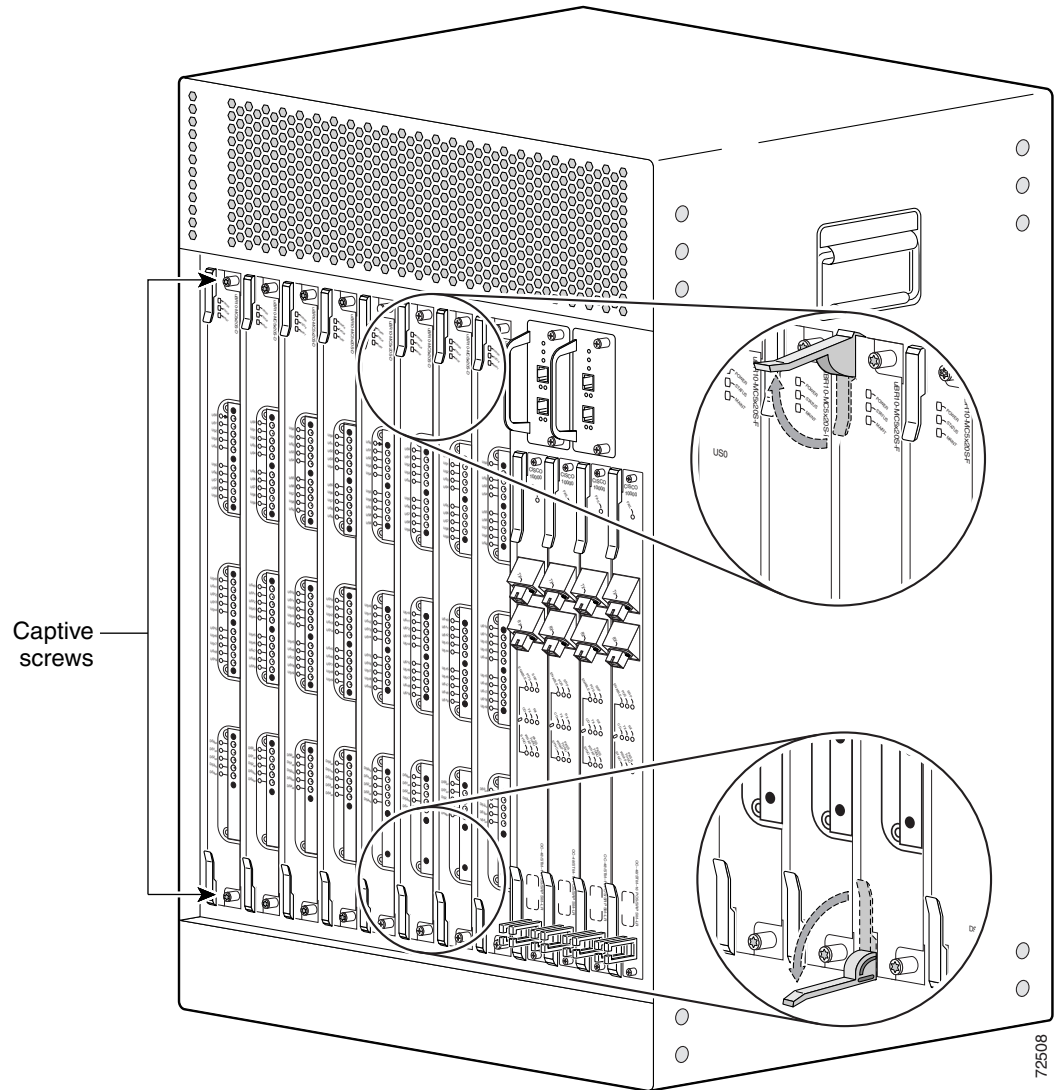
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## Removing the Cable Interface Line Card

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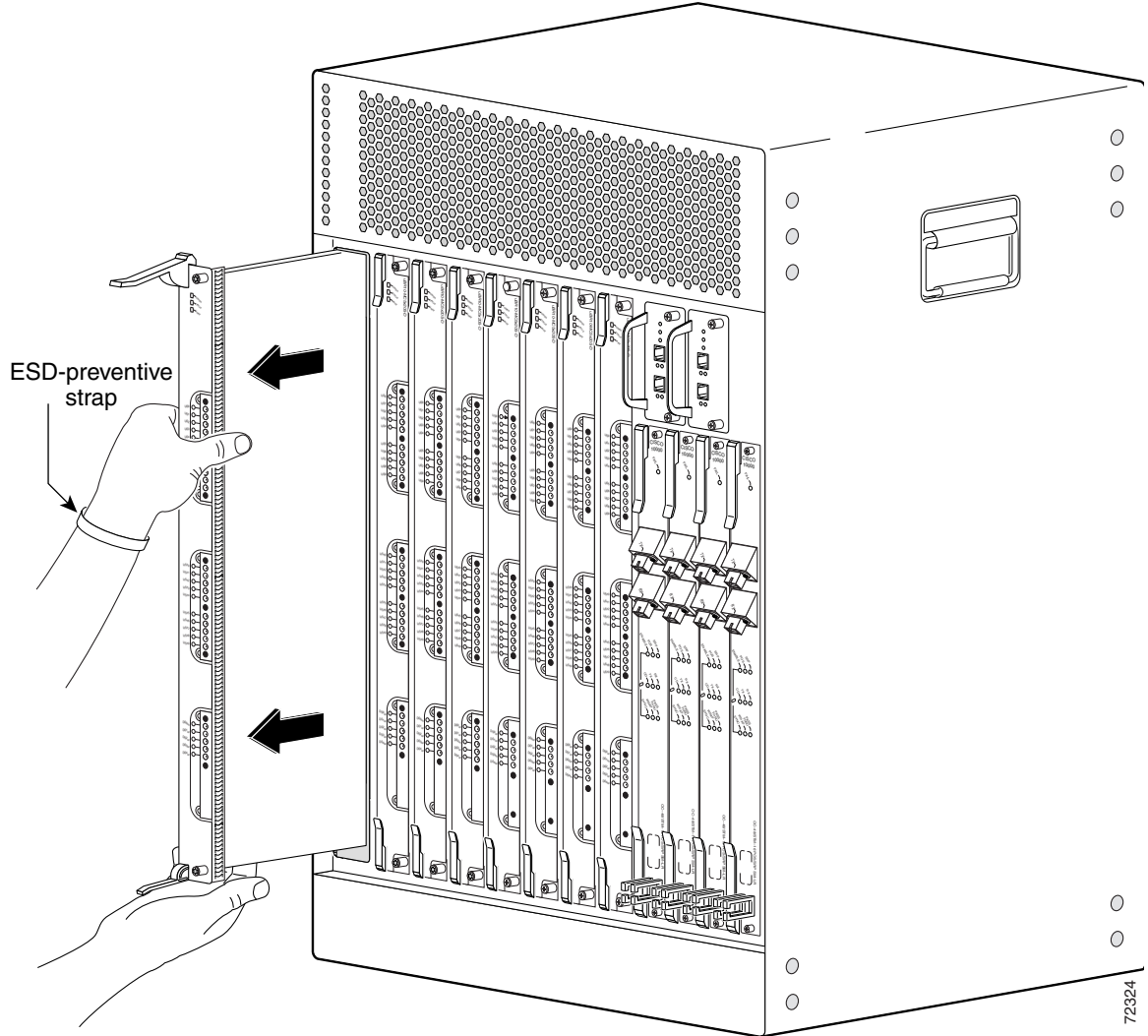
- Step 1** Attach an antistatic wrist strap to your wrist and to a bare metal, unpainted surface on the chassis or frame.
- Step 2** Face the back of the Cisco uBR10012 chassis. Clear aside enough interface and power cables to allow sufficient space to work.
- Step 3** If installing a new cable interface line card in a blank slot, remove the blank slot cover and discard. Otherwise, disconnect all coaxial cables from the cable interface line card being replaced or removed.
- Step 4** Unscrew the top and bottom captive screws on the cable interface line card (see [Figure 5-36](#)).



**Figure 5-36** Captive Screws, Ejector Levers

- Step 5** Simultaneously pivot both ejector levers away from each other to disengage the cable interface line card from the backplane.
- Step 6** Slide the cable interface line card out of the slot and place it on an antistatic surface, or in an antistatic bag (see [Figure 5-37](#)).

Figure 5-37 Removing the Cable Interface Line Card



**Step 7** If you are installing a new or replacement cable interface line card, proceed to the next step. Otherwise, install a blank cover over the slot and screw down its captive screws to conclude this procedure.

**Note**

For proper cooling and airflow, a blank cable interface line card cover must always be installed in a blank line card slot.

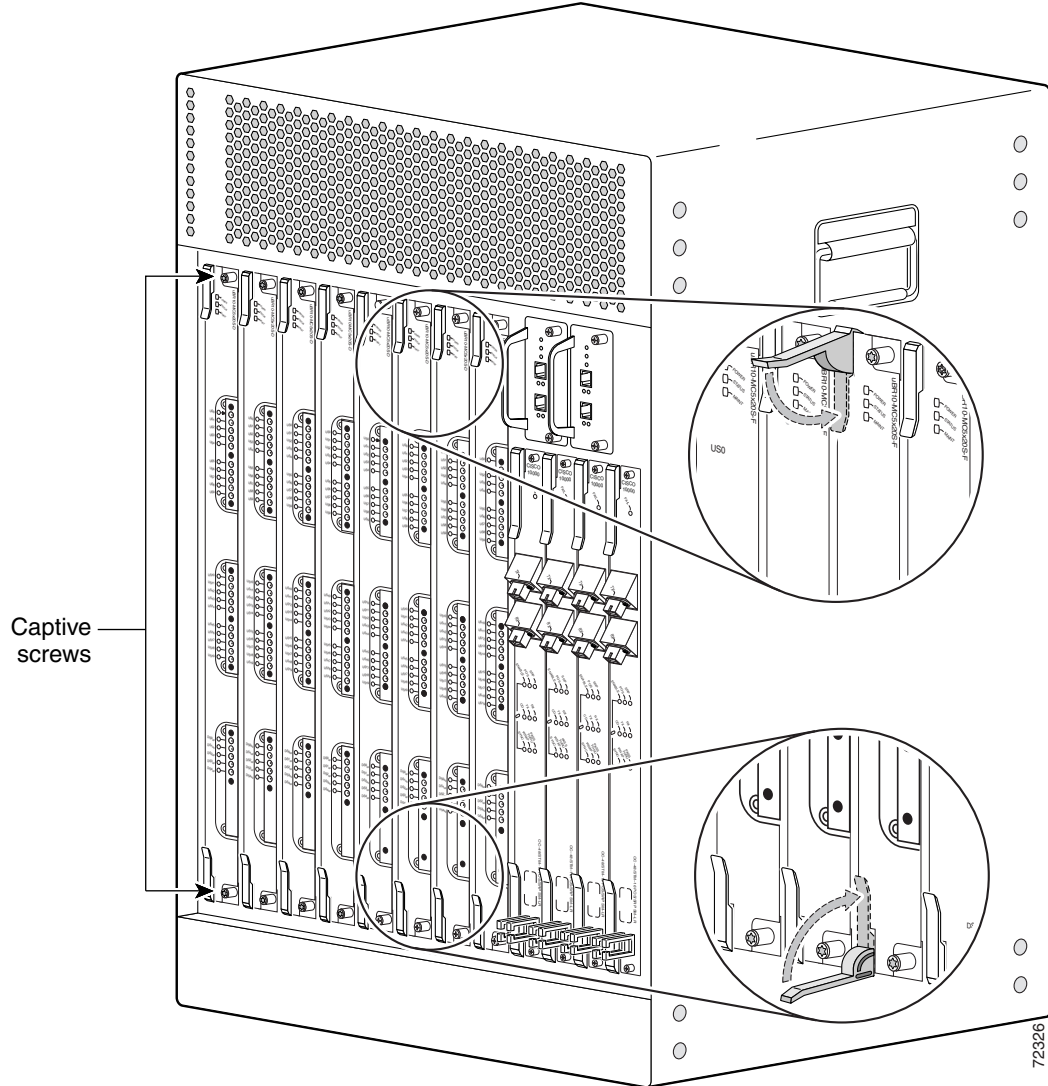
The product order number for the blank cable interface line card cover is UBR10-MC-Cover=.

**Warning**

**Blank faceplates (filler panels) serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards and faceplates are in place.** Statement 1029



Figure 5-39 Closing the Ejector Levers



**Step 4** Secure the cable interface line card in the chassis by tightening the top and bottom captive screws (see [Figure 5-36](#)).



**Tip**

If you are installing more than one card, wait until all the cards are installed before tightening the captive screws.



**Tip**

Captive screws prevent accidental removal and provide proper grounding for electromagnetic interference (EMI) shielding.

**Step 5** When fully inserted, the cable interface line card cycles through its power-on self-test. The POWER LED lights (green) and the STATUS LED lights (yellow). If the card is operating correctly, the STATUS LED then starts lighting green. If these LEDs do not operate as described, see the [“Troubleshooting the Line Cards”](#) section on page 4-16.

- Step 6** Connect all downstream and upstream coaxial cables to the cable interface line card as necessary.
- Step 7** Configure the cable interface line card if necessary (refer to the [Cisco uBR10012 Router Software Configuration Guide](#) for information about configuring the line card).



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**Note** It is not necessary to configure the cable interface line card if you are installing a replacement card in the identical slot. The system automatically downloads the necessary configuration information from the PRE.

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# Technical Specifications

This appendix provides specifications information about the Cisco uBR10012 router, router components, and cards used in the router.

- [Cisco uBR10012 Chassis and Chassis Components, page A-1](#)
- [Network Uplink Cards and Cable Interface Line Cards, page A-8](#)

## Cisco uBR10012 Chassis and Chassis Components

[Table A-1](#) lists the physical specifications for the Cisco uBR10012 universal broadband router and its components.

**Table A-1** Cisco uBR10012 Router and Router Components Physical Specifications

| Description               | Specifications                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chassis specifications    | <ul style="list-style-type: none"> <li>• Weight: 235 lb (106.6 kg) fully configured chassis</li> <li>• Height: 31.25 in. (79.4 cm)—18 Rack Units (RU)</li> <li>• Width: 17.2 in. (43.7 cm)</li> <li>• Depth: 22.75 in. (57.8 cm)</li> <li>• Mounting: 19 in. rack mountable (front or rear), 2 units per 7 ft. rack</li> </ul> <p><b>Note</b> Mounting in 23 in. racks is possible with optional third-party hardware.</p> |
| Temperature range         | <ul style="list-style-type: none"> <li>• Operating: 41°F to 104°F (5 to 40°C)</li> <li>• Storage: -40°F to 158°F (-40 to 70°C)</li> </ul>                                                                                                                                                                                                                                                                                  |
| Relative humidity         | <ul style="list-style-type: none"> <li>• Operating—nominal: 5% to 85%</li> <li>• Storage: 5% to 95% percent</li> </ul>                                                                                                                                                                                                                                                                                                     |
| Operating altitude        | -197 to 13,123 ft. (-60 to 4000 m)                                                                                                                                                                                                                                                                                                                                                                                         |
| Airflow                   | <p>280 cfm<sup>1</sup> (approximately) through the system fan assembly module (low speed, normal operating temperatures, with clean air filter)</p> <p>450 cfm (approximately) through the system fan assembly module (high speed, chassis temperature at air outlet exceeds 40°C, with clean air filter)</p>                                                                                                              |
| Operating vibrations      | 5 to 200 Hz, 1 g (1 octave/min), 200 to 500 Hz, 2 g (1 octave/min)                                                                                                                                                                                                                                                                                                                                                         |
| Chassis power consumption | Not to exceed 2400 W <sup>2</sup> (8189btu <sup>3</sup> )                                                                                                                                                                                                                                                                                                                                                                  |

Table A-1 Cisco uBR10012 Router and Router Components Physical Specifications (continued)

| Description                                                                                                                                                                                                  | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>DC Power entry modules (PEM)— 34-1651-04, 34-1651-05</p> <p>Power supply monitoring cable</p> <p>Supports two separate input feeds (–48 to –60VDC) by means of built-in two-position terminal blocks.</p> | <p>Part Number: UBR10-PWR-DC (Primary)</p> <p>Part Number: UBR10-PWR-MON-CAB<br/>Part Number: UBR10-PWR-MON-CAB= (Spare)</p> <ul style="list-style-type: none"> <li>• Dimensions           <ul style="list-style-type: none"> <li>Height: 19.25 in (48.894 cm)</li> <li>Width: 6 in. (15.24 cm)</li> <li>Depth: 5 in. (12.4 cm)</li> </ul> </li> <li>• Weight: 10 lbs. (4.54 kg)</li> <li>• Temperature range           <ul style="list-style-type: none"> <li>Operating: 41° F to 104° F (5° C to 40° C)</li> <li>Storage: -40° F to 158° F (-40° C to 70° C)</li> </ul> </li> </ul> <p>The Power output, DC input voltage and DC input current vary for the Cisco DC PEM entry modules. See <a href="#">Table 2-2 on page 2-8</a>.</p>                                                                                                                                                                                                                                                        |
| <p>DC Power entry modules (PEM)—341-0388-01</p>                                                                                                                                                              | <p>Part Number: UBR10-PWR-DC-PLUS (Primary)<br/>Part Number: UBR10-PWR-DC-PLUS= (Spare)</p> <ul style="list-style-type: none"> <li>• Dimensions:           <ul style="list-style-type: none"> <li>Height: 19.25 in. (48.894 cm)</li> <li>Width: 6 in. (15.24 cm)</li> <li>Depth: 5 in. (12.4 cm)</li> </ul> </li> <li>• Weight: 16 lbs. (7.25 kg)</li> <li>• DC-input Voltage: –48 to –60 VDC nominal<br/>–40.5 to –72 VDC minimum to maximum</li> <li>• DC-input Current Connections: 50 A + 50 A</li> <li>• Power Output: 3300 W maximum</li> <li>• Temperature range:           <ul style="list-style-type: none"> <li>Operating: 41° F to 104° F (5° C to 40° C)</li> <li>Storage: -40° F to 158° F (-40° C to 70° C)</li> </ul> </li> <li>• Relative Humidity:           <ul style="list-style-type: none"> <li>Operating: 5% to 85%, non-condensing</li> <li>Storage: 5% to 95%, non-condensing</li> </ul> </li> <li>• Operating Altitude: –197 to 13,693 feet (–60 to 4000 m)</li> </ul> |



**Table A-1** Cisco uBR10012 Router and Router Components Physical Specifications (continued)

| Description                                                                           | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Power entry modules (PEM) 34-1966-02<br><br>100—120 VAC operation is not supported | Part Number: UBR10-PWR-AC (Primary)<br>Part Number: UBR10-PWR-AC= (Spare) <ul style="list-style-type: none"> <li>• Dimensions:               <ul style="list-style-type: none"> <li>Height: 19.25 in. (48.89 cm)</li> <li>Width: 6 in. (15.24 cm)</li> <li>Depth: 5 in. (12.4 cm)</li> </ul> </li> <li>• Weight: 14.7 lbs (6.65 kg)</li> <li>• AC input voltage rating: 200-240 VAC @ 50/60Hz</li> <li>• AC operating voltage rating: 180-255 VAC @ 50/60Hz</li> <li>• AC input power connections: 13 A</li> <li>• DC output voltage: 54 VDC maximum</li> <li>• DC output current: 45.3 A maximum</li> <li>• Power output: 2650W maximum</li> <li>• Temperature range:               <ul style="list-style-type: none"> <li>Operating: 23 to 122 F (-5 to 50 C)</li> <li>Storage: -13 to 158 F (-25 to 70 C)</li> </ul> </li> </ul> |

**Table A-1** Cisco uBR10012 Router and Router Components Physical Specifications (continued)

| Description                                                                            | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Power entry modules (PEM) 341-0387-01<br><br>100—120 VAC operation is not supported | Part Number: UBR10-PWR-AC-PLUS (Primary)<br>Part Number: UBR10-PWR-AC-PLUS= (Spare) <ul style="list-style-type: none"> <li>• Dimensions:               <ul style="list-style-type: none"> <li>Height: 19.4 in. (49.3 cm)</li> <li>Width: 6 in. (15.2 cm)</li> <li>Depth: 5 in. (12.7 cm)</li> </ul> </li> <li>• Weight: 19 lbs (8.64 kg)</li> <li>• AC input voltage rating: 200-240 VAC @ 50 or 60Hz</li> <li>• AC operating voltage rating: 180-255 VAC @ 50 or 60Hz</li> <li>• AC input power connections: 13 A + 13 A</li> <li>• DC output voltage:               <ul style="list-style-type: none"> <li>57.5 VDC nominal</li> <li>59.0 VDC maximum</li> </ul> </li> <li>• DC output current:               <ul style="list-style-type: none"> <li>58 A nominal</li> <li>59 A maximum</li> </ul> </li> <li>• Power output: 3300 W maximum</li> <li>• Temperature range:               <ul style="list-style-type: none"> <li>Operating: 41° to 104°F (5° to 40°C)</li> <li>Storage: -40° to 158°F (-40° to 70°C)</li> </ul> </li> <li>• Relative Humidity:               <ul style="list-style-type: none"> <li>Operating: 5% to 85%, non-condensing</li> <li>Storage: 5% to 95%, non-condensing</li> </ul> </li> <li>• Operating Altitude: -197 to 13,693 feet (-60 to 4000 m)</li> </ul> |

Table A-1 Cisco uBR10012 Router and Router Components Physical Specifications (continued)

| Description                                                       | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC power shelf<br>2400W AC-input power shelf<br>and DC PEM bundle | UBR10-PWR-AC-EXT=<br><ul style="list-style-type: none"> <li>• Chassis dimensions               <ul style="list-style-type: none"> <li>Height: 3.46 in. (87.9 cm)</li> <li>Width: 19 in. (482.26 cm)</li> <li>Depth: 12.00 in. (304.2 cm)</li> <li>Mounting: 19-inch rack mountable (2 rack units)</li> </ul> </li> <li>• Weight               <ul style="list-style-type: none"> <li>Shelf only: 7 lb. (3.2 kg)</li> <li>Each power module only: 7 lb. (3.2 kg)</li> <li>Fully configured shelf: 28 lb. (12.8 kg)</li> </ul> </li> <li>• AC-input voltage and frequency: 100,120 to 200,240 VAC, 50/60 Hz</li> <li>• AC voltage and current:               <ul style="list-style-type: none"> <li>110 VAC at 15A maximum with power factor correction (PFC)</li> <li>240 VAC at 7.4 A maximum with power factor correction (PFC)</li> </ul> </li> <li>• AC power cable receptacle: IEC-320 15A receptacle that accepts right-angle cords</li> <li>• Temperature range:               <ul style="list-style-type: none"> <li>Operating: 41 F to 104 F (5 C to 40 C)</li> <li>Storage: -40 F to 158 F (-40 C to 70 C)</li> </ul> </li> </ul> |
| Visual alarm indicator relay contacts                             | Rated for a maximum of 60 VDC and 1 A.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Timing, Communication, and Control Plus (TCC+) Card               | Part Number: UBR10-TCC+-T1<br><ul style="list-style-type: none"> <li>• Power consumption: 40 W<sup>2</sup> (136.5 BTU<sup>3</sup>) per hour</li> <li>• Weight: 1.5 lb (0.5636 kg)</li> <li>• Height: 4.73 in (12.01 cm)</li> <li>• Depth: 10.00 in (25.4 cm)</li> <li>• Width: 1.55 in (3.937 cm)</li> <li>• MTBF: 431,348 hours</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| DOCSIS Timing & Control Card (DTCC)                               | Part Number: UBR10-DTCC<br><ul style="list-style-type: none"> <li>• Power consumption: 12 Watts (40.94 BTU<sup>1</sup> per hour)</li> <li>• Weight: 1.5 lb. (.68 kg)</li> <li>• Height: 4.73 in. (12.0142 cm)</li> <li>• Depth: 10 in. (25.4 cm)</li> <li>• Width: 1.548 in. (3.93192 cm)</li> <li>• MTBF: 431,348 hours</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

Table A-1 Cisco uBR10012 Router and Router Components Physical Specifications (continued)

| Description         | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fan assembly module | Part Number: UBR10-FAN-ASSY (Primary)<br>Part Number: UBR10-FAN-ASSY= (Spare) <ul style="list-style-type: none"> <li>• Product number (cable): UBR10-FAN-CAB=</li> <li>• Power consumption: 250 W<sup>2</sup>—4 amps, not to exceed 6 amps at startup (1365 BTU<sup>3</sup>) per hour</li> <li>• Weight: 30 lb (13.61 kg)</li> <li>• Height: 5.60 in. (14.22 cm)<br/>Depth: 16.15 in. (41.02 cm)<br/>Width: 19.00 in. (48.26 cm)</li> <li>• Temperature range:<br/>Operating: 41° to 104°F (5° to 40°C)<br/>Storage: -40° to 158°F (-40° to 70°C)</li> <li>• Relative humidity:<br/>Operating: 5% to 85%<br/>Storage: 5% to 95%</li> <li>• Operating altitude: -197 to 13,123 ft (-60 to 4000 m)</li> </ul>                                |
| Fan assembly module | Part Number: UBR10012-FAN-PLUS (Primary)<br>Part Number: UBR10012-FAN-PLUS= (Spare) <ul style="list-style-type: none"> <li>• Product number (cable): UBR10-FAN-CAB=</li> <li>• Power consumption: 224 W max (4 amps, not to exceed 6 amps at startup)Weight: 22 lbs (10 kg)</li> <li>• Height: 5.85 in. (14.9 cm)<br/>Width: 17 in. (43.2 cm)<br/>Depth: 20 in. (50.8 cm)</li> <li>• Acoustic: Sound Power (dB [re 1E-12] watts) &lt; 78 dB up to 80.6°F (27°C)</li> <li>• Temperature range:<br/>Operating: 41° to 104°F (5° to 40°C)<br/>Storage: -40° to 158°F (-40° to 70°C)</li> <li>• Relative humidity:<br/>Operating: 5% to 85%<br/>Storage: 5% to 95%</li> <li>• Operating altitude: -197 to 13,123 ft (-60 to 4000 m)</li> </ul> |

Table A-1 Cisco uBR10012 Router and Router Components Physical Specifications (continued)

| Description                      | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LCD module                       | Part number: module-UBR10-DSPL=<br>Part number: cable-UBR10-DSPL-CAB=<br><ul style="list-style-type: none"> <li>• Power consumption: 2W<sup>2</sup> (6.824 BTU<sup>3</sup>) per hour</li> <li>• Weight: 0.4 lb (0.1814 kg)</li> <li>• Height: 4.0 in. (10.16 cm)<br/>               Depth: 4.8 in. (12.19 cm)<br/>               Width: 1.4 in. (3.56 cm)</li> <li>• MTBF: module-231,576 hours</li> <li>• MTBF: cable-N/A</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Performance routing engine (PRE) | PRE1 modules:<br><ul style="list-style-type: none"> <li>• ESR-PRE1 (Primary and redundant)<br/>               ESR-PRE1= (Spare)</li> </ul> PRE2 modules<br><ul style="list-style-type: none"> <li>• ESR-PRE2 (Primary and redundant)<br/>               ESR-PRE2/R= (Spare)</li> </ul> PRE4 modules<br><ul style="list-style-type: none"> <li>• ESR-PRE4 (Primary and redundant)<br/>               ESR-PRE4/R= (Spare)</li> </ul> Max per chassis: 2<br>Power consumption:<br><ul style="list-style-type: none"> <li>• PRE and PRE1: 80 Watts (273 BTU per hour)<br/>               PRE2: 200 Watts (682.4 BTU<sup>1</sup> per hour)<br/>               PRE4: 210 Watts (716.5 BTU<sup>1</sup> per hour)</li> </ul> Weight:<br><ul style="list-style-type: none"> <li>• PRE and PRE1: 7.5 lb (3.41 kg)<br/>               PRE2: 8.45 lb (3.84 kg)<br/>               PRE4: 9.0 lb (4.09 kg)</li> <li>• Height: 16.0 in. (40.64 cm)<br/>               Depth: 9.97 in. (25.32 cm)<br/>               Width: 1.91 in. (4.84 cm)</li> </ul> MTBF:<br><ul style="list-style-type: none"> <li>• PRE and PRE1: 116,904 hours<br/>               PRE2: 122,426 hours<br/>               PRE4: 106,574 hours</li> </ul> Three interface ports:<br><ul style="list-style-type: none"> <li>• RJ-45 IEEE 802.3 Ethernet 100Base-T<br/>               RJ-45 auxiliary (AUX) port for modem access<br/>               RJ-45 console (CON) port for terminal access</li> </ul> |

**Table A-1** Cisco uBR10012 Router and Router Components Physical Specifications (continued)

| Description                    | Specifications                                                                                                                                                           |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PRE PC media card options      | <ul style="list-style-type: none"> <li>Slot 0, Slot 1</li> </ul>                                                                                                         |
| PRE4 CompactFlash Disk options | <ul style="list-style-type: none"> <li>Disk0<br/>512 MB—Part Number: ESR-PRE-CF-512MB(=)<br/>1 GB—Part Number: ESR-PRE-CF-1GB(=)</li> </ul>                              |
| PRE DRAM memory options        | <ul style="list-style-type: none"> <li>40 MB—Part Number: ESR-PRE-MEM-FD40<br/>128 MB—Part Number: ESR-PRE-MEM-FD128<br/>512 MB—Part Number: ESR-PRE-MEM-512M</li> </ul> |

1. cfm = Cubic feet per minute
2. W = Watts
3. BTU = British thermal units

## Network Uplink Cards and Cable Interface Line Cards

Table A-2 lists the physical specifications for the cards used with the Cisco uBR10012 router.

**Table A-2** Cards Used in the uBR10012 Router

| Description                      | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cisco Gigabit Ethernet line card | <ul style="list-style-type: none"> <li>UBR10-1GE and UBR10-1GE=</li> <li>Power consumption: 25 W<sup>1</sup> (85.3 BTU<sup>2</sup>)</li> <li>Weight: 4.75 lb (2.16 kg)</li> <li>Height: 16.0 in. (40.64 cm)<br/>Depth: 9.97 in. (25.32 cm)<br/>Width: 1.12 in. (2.83 cm)</li> <li>MTBF: 183,4431 hours</li> </ul> <p><b>Gigabit Ethernet Converter (GBIC) Types:</b></p> <ul style="list-style-type: none"> <li>1000Base-SX (SFP-GE-S), multimode</li> <li>1000Base-LX/LH (SFP-GE-L), single mode</li> <li>1000Base-ZX (GLC-ZX-SM), single-mode</li> </ul> |

Table A-2 Cards Used in the uBR10012 Router (continued)

| Description                                   | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cisco Half-Height Gigabit Ethernet line card  | <ul style="list-style-type: none"> <li>• ESR-HH-1GE and ESR-HH-1GE=</li> <li>• Power consumption:15.98 W (54.53 BTU<sup>2</sup>)</li> <li>• Weight: 2 lb (0.9 kg)</li> <li>• Height: 7.8 in. (19.8 cm)<br/>Depth: 11.0 in. (27.9 cm)<br/>Width: 1.3 in. (3.3 cm)</li> <li>• MTBF: 449,330 hours</li> </ul> <p><b>Gigabit Ethernet Converter (GBIC) Types:</b></p> <ul style="list-style-type: none"> <li>• 1000Base-SX (SFP-GE-S)</li> <li>• 1000Base-LX/LH (SFP-GE-L)</li> <li>• 1000Base-ZX (GLC-ZX-SM)</li> <li>• 1000Base-T (GLC-T)</li> </ul> |
| Slot splitter card                            | <ul style="list-style-type: none"> <li>• ESR-HH-CARRIER</li> <li>• Weight: 2.28 lb (1.05 kg)</li> <li>• Height: 16.0 in. (40.64 cm)<br/>Depth: 10.50 in. (26.67 cm)<br/>Width: 1.80 in. (3.00 cm)</li> </ul>                                                                                                                                                                                                                                                                                                                                       |
| Half-height slot blank cover                  | <ul style="list-style-type: none"> <li>• ESR-HH-COVER</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Full-height slot blank cover                  | <ul style="list-style-type: none"> <li>• ESR-COVER</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| SFP optical power budget—1000Base-SX GBIC     | <ul style="list-style-type: none"> <li>• Power budget: 7.5 dB</li> <li>• Transmit power: -9.5 to 0 dBm</li> <li>• Receive power: -17 to 0 dBm</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                           |
| SFP optical power budget—1000Base-LX/LH GBIC  | <ul style="list-style-type: none"> <li>• Power budget: 7.5 dB (multimode fiber), 8 dB (single mode)</li> <li>• Transmit power: -11.5 to -3 dBm (multimode fiber), -11 to -3 dBm (single mode)</li> <li>• Receive power: -19 to -3 dBm (multimode and single mode fiber)</li> </ul>                                                                                                                                                                                                                                                                 |
| SFP optical power budget—1000Base-ZX GBIC     | <ul style="list-style-type: none"> <li>• Power budget: 23 dB</li> <li>• Transmit power: 0 to 4.77 dBm</li> <li>• Receive power: -23 to 0 dBm</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                            |
| Cisco OC-12 Packet Over SONET (POS) line card | <ul style="list-style-type: none"> <li>• UBR10-1OC12/P-SMI, UBR10-1OC12/P-SMI=</li> <li>• Power: 28W<sup>1</sup> (95.54 BTU<sup>2</sup>)</li> <li>• Weight: 4.75 lb (2.16 kg)</li> <li>• Height: 16.0 in. (40.64 cm)<br/>Depth: 9.97 in. (25.32 cm)<br/>Width: 1.12 in. (2.83 cm)</li> <li>• MTBF:329,349 hours</li> </ul>                                                                                                                                                                                                                         |

Table A-2 Cards Used in the uBR10012 Router (continued)

| Description                                                                                                                 | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cisco OC12SML-DPT WAN line card                                                                                             | <ul style="list-style-type: none"> <li>• USB-SRP-OC12SML, USB-SRP-OC12SML=</li> <li>• Power consumption: 110 W<sup>1</sup> (375.3 BTU<sup>2</sup>)</li> <li>• Weight: 6 lb (2.72 kg)</li> <li>• Height: 16 in. (40.64 cm)<br/>Depth: 10.56 in. (26.82 cm)<br/>Width: 2.38 in. (6.05 cm)</li> <li>• MTBF: 153,624 hours</li> </ul>                                                                                                                                                                                             |
| Cisco uBR10012-OC48 DPT/POS interface module<br><br>Single-mode, short-reach modules<br><br>Single-mode, long-reach modules | <ul style="list-style-type: none"> <li>• Spares (2)—UBR10-SRP-OC48SMS=<br/>Spare (1)—ESR1048/P/SRPMS=</li> <li>• Spares (2)—UBR10-SRP-OC48SML=<br/>Spare (1)—ESR1048/P/SRPML=</li> <li>• Power consumption: 28 W<sup>1</sup> (95.54 BTU<sup>2</sup>)</li> <li>• Weight: 4.75 lb (2.16 kg)</li> <li>• Height: 16 in. (40.64 cm)<br/>Depth: 9.87 in. (25.32 cm)<br/>Width: 1.12 in. (2.83 cm)</li> </ul> <p><b>MTBF:</b></p> <ul style="list-style-type: none"> <li>• SMS—216,018 hours</li> <li>• SML—215,068 hours</li> </ul> |
| Cisco uBR10-MC5X20S/U cable interface line cards                                                                            | <ul style="list-style-type: none"> <li>• Cisco UBR10-MC5X20S=</li> <li>• Cisco UBR10-MC5X20U=</li> <li>• Power consumption: 185W<sup>1</sup> (631.2 BTU<sup>2</sup>/hr)</li> <li>• Weight: 16 lb (7.26 kg)</li> <li>• Width: 1.36 in (3.55 cm)<br/>Height: 20 in. (50.80 cm)<br/>Depth: 16 in. (10.64 cm)</li> <li>• Cisco UBR10-MC5X20S MTBF: 38, 922 hours</li> <li>• Cisco UBR10-MC5X20U MTBF: 40,256 hours</li> </ul>                                                                                                     |
| Cisco UBR-MC20X20V cable interface line card                                                                                | <ul style="list-style-type: none"> <li>• UBR-MC20X20V-20D=</li> <li>• UBR-MC20X20V-5D=</li> <li>• UBR-MC20X20V-0D=</li> <li>• Power consumption: 250W<sup>1</sup> (853 BTU/hr<sup>2</sup>)</li> <li>• Weight: 16 lb (7.26 kg)</li> <li>• Width: 1.36 in (3.45 cm)<br/>Height: 20 in. (50.80 cm)<br/>Depth: 16 in. (40.64 cm)</li> <li>• MTBF: Supports 5 9s availability</li> </ul>                                                                                                                                           |



Table A-2 Cards Used in the uBR10012 Router (continued)

| Description                                                                                                                                                                                                                                                                                                                                                                                    | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cisco uBR-MC3GX60V cable interface line card                                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>• UBR-MC3GX60V=</li> <li>• Power consumption: 246W (839 BTU/hr)</li> <li>• Weight: 11.6 lb (5.26 kg)</li> <li>• Width: 1.38 in (3.50 cm)<br/>Height: 21.5 in. (54.61 cm)<br/>Depth: 17 in. (43.18 cm)</li> <li>• MTBF: Supports 5 9s availability</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Cable kit (3m MCX to F cables)<br>Cable kit with pre configured cables<br>Cable extraction tool<br>Universal cable holder<br><br>MCX connector strip tool<br>F connector strip tool<br>MCX connector crimper tool<br>F connector crimper tool<br>MCX fixed pin connector<br>F connector<br>MCX connector to F connector adapter<br>75-ohm precision miniature video cable<br><br>Shrink tubing | <ul style="list-style-type: none"> <li>• PN-74-2984-01, White Sands Engineering (or Asheridge Communications Limited)<sup>2</sup></li> <li>• PN-74-2984-01-DNS, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• RTOOLWSE, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-133-8447-026, Johnson Components<sup>3</sup><br/>PN-29-4442-02, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-CPT-7538-125, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-CPT-753, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-C47-10120, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-ACT-270, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-MCXFP, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-ASFP, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-53140137, White Sands Engineering (or Asheridge Communications Limited)</li> <li>• PN-YR46940/WS940, Belden<sup>4</sup>, single strand bonded foil 1855A type</li> <li>• Size: 1/4 inch<br/>Shrink ratio: 2:1<br/>Recovered wall thickness: 0.025 inch<br/>Inside diameter after recovery: 0.125 inch</li> </ul> |

1. W = Watts

2. Whitesands Engineering at the following URL: <http://www.whitesandsengineering.com/> (Asheridge Communications Limited is the European and Middle Eastern partner for White Sands Engineering and their URL is <http://www.ashcatv.com>)3. Johnson Components at the following URL: <http://www.johnsoncomponents.com/>4. Belden Electronics division at the following URL: <http://www.belden.com/>

# SIP and SPA

Table A-3 lists the SPAs used with the Cisco uBR10012 router.

**Table A-3** SPA used with the Cisco uBR10012 router

| Description                               | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cisco 6 Gbps Wideband Shared Port Adapter | <ul style="list-style-type: none"> <li>• Part number: Effective with Cisco IOS Release 12.2(33)SCI1, the part number is SPA-UBR10-DS-6G</li> </ul> <p><b>Note</b> In Cisco IOS Release 12.2(33)SCI, the part number is SPA-UBR10-DS-HD and the field programmable device (FPD) image of the Cisco 3 Gbps Wideband Shared Port Adapter must be upgraded to use it as Cisco 6 Gbps Wideband Shared Port Adapter.</p> <ul style="list-style-type: none"> <li>• Per port bandwidth: 6 Gbps</li> <li>• Number of ports: 1+1 redundant</li> <li>• Total bandwidth: 6 Gbps</li> <li>• Power consumption: 30</li> <li>• MTBF: 1,240,020 hours</li> </ul> <p><b>SFP+ Modules</b></p> <ul style="list-style-type: none"> <li>• SFP-10G-SR-X</li> <li>• SFP-10G-LR-X</li> </ul> |
| Cisco 3 Gbps Wideband Shared Port Adapter | <ul style="list-style-type: none"> <li>• Part number: SPA-UBR10-DS-HD</li> <li>• Per port bandwidth: 1 Gbps</li> <li>• Number of ports: 3</li> <li>• Total bandwidth: 3 Gbps</li> <li>• Power consumption: 30</li> <li>• MTBF: 1,240,020 hours</li> </ul> <p><b>SFP and SFP+ Modules</b></p> <ul style="list-style-type: none"> <li>• GLC-SX-MMD</li> <li>• GLC-LH-SMD</li> <li>• GLC-ZX-SMD</li> <li>• SFP-GE-T</li> <li>• SFP-10G-SR-X</li> <li>• SFP-10G-LR-X</li> </ul>                                                                                                                                                                                                                                                                                          |

Table A-3 SPA used with the Cisco uBR10012 router

| Description                    | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cisco Wideband SPA             | <ul style="list-style-type: none"> <li>• Part Number: SPA-24XDS-SFP</li> <li>• Per port Bandwidth: 1 Gbps</li> <li>• Number of ports: 1+1 redundant</li> <li>• Total Bandwidth: 1 Gbps</li> <li>• Power consumption: 20</li> <li>• MTBF: 500,000 hours</li> </ul> <p><b>SFP Modules</b></p> <ul style="list-style-type: none"> <li>• GLC-SX-MM</li> <li>• GLC-LH-SM</li> <li>• GLC-ZX-SM</li> </ul>                                                                  |
| 1-Port 10-Gigabit Ethernet SPA | <ul style="list-style-type: none"> <li>• Part Number: SPA-1X10GE-L-V2</li> <li>• Per port Bandwidth: 10 Gbps</li> <li>• Number of ports: 1</li> <li>• Total Bandwidth: 10 Gbps</li> <li>• Power consumption: 25</li> <li>• MTBF: 411, 892 hours</li> </ul> <p><b>SFP Modules</b></p> <ul style="list-style-type: none"> <li>• XFP-10GLR-OC192SR</li> <li>• XFP-10GER-OC192IR</li> <li>• XFP-10GZR LR-2</li> <li>• XFP-10G-MM-SR</li> <li>• DWDM-XFP-xx.xx</li> </ul> |
| 5-Port Gigabit Ethernet SPA    | <ul style="list-style-type: none"> <li>• Part Number: SPA-5X1GE-V2</li> <li>• Per port Bandwidth: 1 Gbps</li> <li>• Number of ports: 5</li> <li>• Total Bandwidth: 1 Gbps</li> <li>• Power consumption: 18.1</li> <li>• MTBF: 674,351 hours</li> </ul> <p><b>SFP Modules</b></p> <ul style="list-style-type: none"> <li>• SFP-GE-T</li> <li>• SFP-GE-S</li> <li>• SFP-GE-L</li> <li>• SFP-GE-Z</li> </ul>                                                            |

Table A-4 lists the SIPs used with the Cisco uBR10012 router

**Table A-4** SIP used with the Cisco uBR10012 router

| Description        | Specification                                                                                                                                                                                                                                                                                                   |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cisco Wideband SIP | <ul style="list-style-type: none"> <li>• Part Number: UBR10-2XDS-SIP</li> <li>• Power consumption: 115</li> <li>• Weight: 10 lb (4.54 kg)</li> <li>• MTBF: 380,625 hours</li> </ul>                                                                                                                             |
| Cisco SIP-600      | <ul style="list-style-type: none"> <li>• Part Number: 10000-SIP-600</li> <li>• Power consumption: 160<sup>2</sup></li> <li>• Weight: 10 lb (4.6 kg)</li> <li>• Height: 16 inches (41.5 cm)</li> <li>Width: 2.44 inches (6.32 cm)</li> <li>Depth: 10.4 inches (27 cm)</li> <li>• MTBF: 280, 449 hours</li> </ul> |



## Cable Specifications

This appendix provides the following cabling and pinout information for the Cisco uBR10012 routers.

- [Coaxial Cables, page B-1](#)
- [Console and Auxiliary Port Cables and Pinouts, page B-2](#)
- [Fast Ethernet Port Cables and Pinouts, page B-5](#)
- [Connecting a Cable to an RJ-45 Connector, page B-7](#)
- [Fiber-Optic Cables and Connectors, page B-8](#)



**Note**

This appendix specifies pinouts only for the pins used. Pins not listed in the tables are not connected.

For more information about cables and connectors, refer to the *Cabling Guide for Console and AUX Ports* at the following URL:

[http://www.cisco.com/en/US/products/hw/routers/ps332/products\\_tech\\_note09186a0080094ce6.shtml](http://www.cisco.com/en/US/products/hw/routers/ps332/products_tech_note09186a0080094ce6.shtml)

## Coaxial Cables

The coaxial cable used to connect the Cisco uBR10012 universal broadband routers at the headend should be very high-quality cable.

Cisco recommends that you use a headend-grade coaxial cable or a quad-shield coaxial cable to connect the cable modem cards to the HFC network. The center conductor must be straight and extend 1/8 in. (3.2 mm) beyond the end of the connector, and the connector should be securely crimped to the cable. The following headend cables are recommended:

- 59-series cable (preferred)—20 AWG (0.032 in./0.81 mm diameter) silver plated, copper-clad, steel center conductor; bonded foil inner shield; 95% braid second shield; non-bonded foil third shield; 95% braid fourth shield.
- 59-series quad shield—20 AWG (0.032 in./0.81 mm diameter) copper-clad steel center conductor; bonded foil inner shield; 53% braid second shield; non-bonded foil third shield; 34%-35% braid fourth shield.
- 6-series quad shield—18 AWG (0.0359 in./0.91 mm diameter) copper-clad steel center conductor; bonded foil inner shield; 60% braid second shield; non-bonded foil third shield; 40%-42% braid fourth shield.

**Note**

Any of the three of the coaxial cables listed can be used to connect a Cisco cable interface card to the HFC network; however, the consistent use of 59-series cable is preferred. If you connect an 59-series cable to a cable interface card that was previously connected using 6-series cable, the difference in the center connector diameter might cause intermittent connectivity loss.

If you use different types of coaxial cable, the following problems can appear:

- Damage to Cisco uBR10012 router cable interface card connectors—Cable interface card connectors are designed for 59-series or 6-series cable and connectors. Larger cables can damage the connectors.
- Poor return loss—High quality cable and correct connectors help to ensure an optimal return loss of 16 dB or more.

**Caution**

Poorly shielded coaxial cable may result in undesired signal leakage (egress), interference from over-the-air signals (ingress), or crosstalk between cables in close physical proximity.

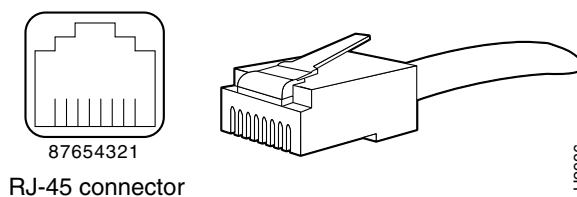
## Console and Auxiliary Port Cables and Pinouts

The router arrives with a console and auxiliary cable kit, which contains the cable and adapters you need to connect a console (an ASCII terminal or PC running terminal emulation software) or modem to the router. The console and auxiliary cable kit includes:

- RJ-45-to-RJ-45 rollover cable
- RJ-45-to-DB-9 female data terminal equipment (DTE) adapter labeled TERMINAL
- RJ-45-to-DB-25 male data communications equipment (DCE) adapter labeled MODEM

Figure B-1 shows the RJ-45 cable connector.

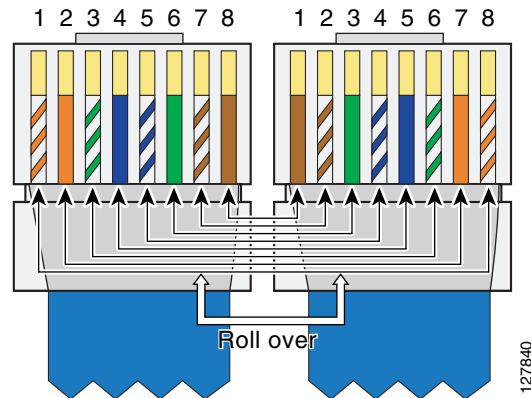
**Figure B-1** RJ-45 Plug and Receptacle



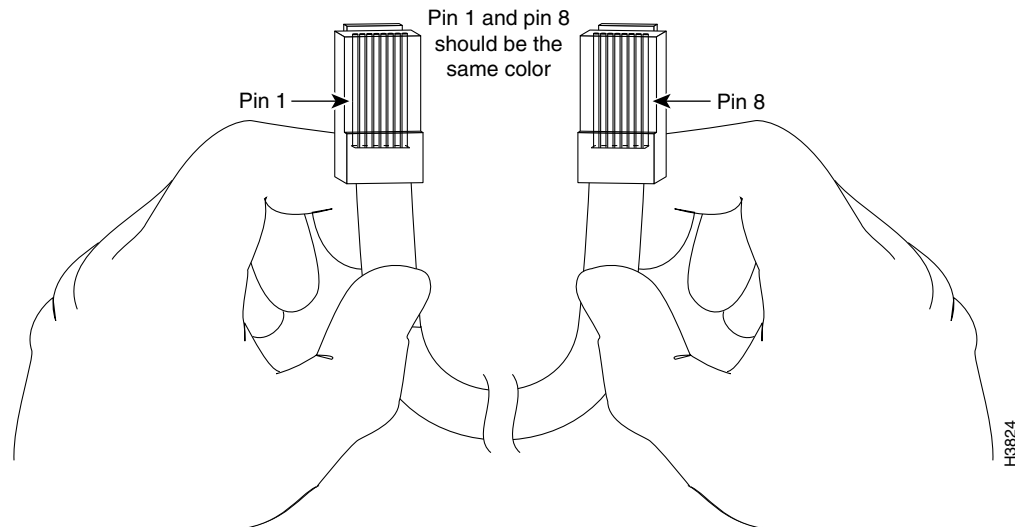
## How to Identify an RJ-45 Rollover Cable

You can identify a rollover cable by holding the two ends of the cable next to each other, with the tab at the back. The wire connected to the pin on the outside of the left hand plug should be the same color as the wire connected to the pin on the right hand plug, as shown in [Figure B-3](#).

**Figure B-2 Rollover Cable**



**Figure B-3 RJ-45 Rollover Cable Identification**



The colored wires at one connector are in the reverse order at the other connector (reverses pins 1 and 8, 2 and 7, 3 and 6, 4 and 5, 5 and 4, 6 and 3, 7 and 2, 8 and 1).

A straight-through cable wires are in the same sequence at both ends of the cable.



**Note**

If your cable was purchased from Cisco Systems, pin 8 is white.

## Console Port Cables and Pinouts

Use the RJ-45-to-RJ-45 rollover cable and RJ-45-to-DB-9 female DTE adapter (labeled TERMINAL) to connect the console port to a PC running terminal emulation software. [Table B-1](#) lists the signals and pinouts for the asynchronous serial console port, the RJ-45-to-RJ-45 rollover cable, and the RJ-45-to-DB-9 female DTE adapter.

**Table B-1** Console Port Signaling and Cabling Using a DB-9 Adapter

| Console Port (DTE) | RJ-45-to-RJ-45 Rollover Cable |           | RJ-45-to-DB-9 Terminal Adapter | Console Device |
|--------------------|-------------------------------|-----------|--------------------------------|----------------|
|                    | RJ-45 Pin                     | RJ-45 Pin | DB-9 Pin                       |                |
| Signal             |                               |           |                                | Signal         |
| RTS                | 1 <sup>1</sup>                | 8         | 8                              | CTS            |
| DTR                | 2                             | 7         | 6                              | DSR            |
| TxD                | 3                             | 6         | 2                              | RxD            |
| GND                | 4                             | 5         | 5                              | GND            |
| GND                | 5                             | 4         | 5                              | GND            |
| RxD                | 6                             | 3         | 3                              | TxD            |
| DSR                | 7                             | 2         | 4                              | DTR            |
| CTS                | 8 <sup>1</sup>                | 1         | 7                              | RTS            |

1. Pin 1 is connected internally to pin 8.

## Auxiliary Port Cables and Pinouts

Use the RJ-45-to-RJ-45 rollover cable and RJ-45-to-DB-25 male DCE adapter (labeled MODEM) to connect the auxiliary port to a modem. [Table B-2](#) lists the signals and pinouts for the asynchronous serial auxiliary port, the RJ-45-to-RJ-45 rollover cable, and the RJ-45-to-DB-25 male DCE adapter (labeled MODEM).

**Table B-2** Auxiliary Port Signaling

| AUX Port (DTE) | RJ-45-to-RJ-45 Rollover Cable |           | RJ-45-to-DB-25 Modem Adapter | Modem (DCE) |
|----------------|-------------------------------|-----------|------------------------------|-------------|
|                | RJ-45 Pin                     | RJ-45 Pin | DB-25 Pin                    |             |
| Signal         |                               |           |                              | Signal      |
| RTS            | 1                             | 8         | 4                            | RTS         |
| DTR            | 2                             | 7         | 20                           | DTR         |
| TxD            | 3                             | 6         | 3                            | TxD         |
| GND            | 4                             | 5         | 7                            | GND         |
| GND            | 5                             | 4         | 7                            | GND         |
| RxD            | 6                             | 3         | 2                            | RxD         |
| DSR            | 7                             | 2         | 8                            | DCD         |
| CTS            | 8                             | 1         | 5                            | CTS         |



# Fast Ethernet Port Cables and Pinouts

The 10Base-T/100Base-TX Fast Ethernet ports support IEEE 802.3 and IEEE 802.3u specifications for 10-Mbps and 100-Mbps transmission over unshielded twisted-pair (UTP) cables. Each Fast Ethernet port on the router has an RJ-45 connector to attach to Category 3 or Category 5 UTP cables.

- Use a Category 3 UTP crossover cable when connecting 10Base-T port to a hub.
- Use a Category 3 UTP straight-through cable when connecting to a PC or other Ethernet device.
- Use a Category 5 UTP crossover cable when connecting 100Base-TX to a hub.
- Use a Category 5 UTP straight-through cable when connecting to a PC or other Ethernet device.



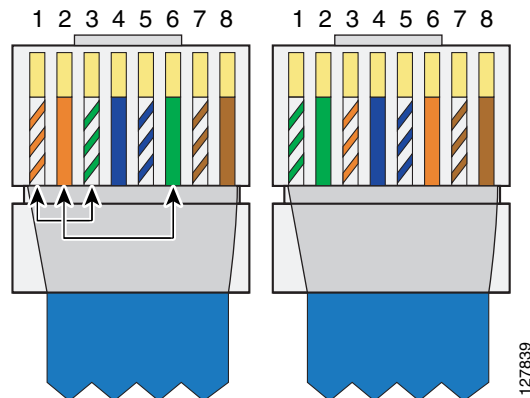
**Note**

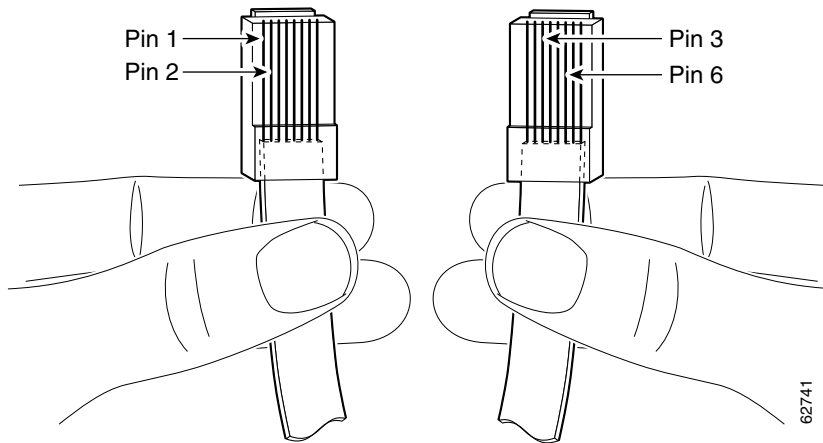
Cisco Systems does not supply Category 3 or Category 5 UTP RJ-45 cables; these cables are available commercially.

## How to Identify an RJ-45 Crossover Cable

You can identify a crossover cable by comparing the two modular ends of the cable. Hold the cables side-by-side with the tab at the back. The first (far left) colored wire (pin 1) at one end of the cable is the third colored wire (pin 3) at the other end of the cable. The second colored wire (pin 2) at one end of the cable is the sixth colored wire (pin 6) at the other end of the cable. See [Figure B-4](#).

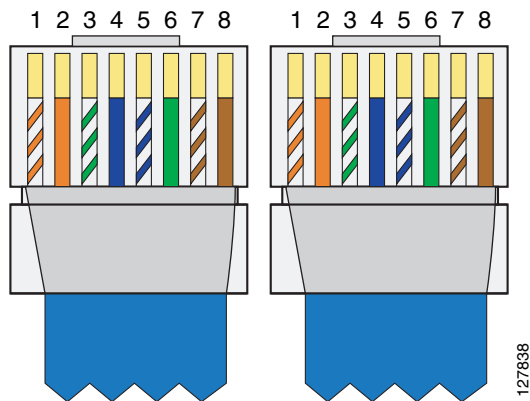
**Figure B-4** Crossover Cable

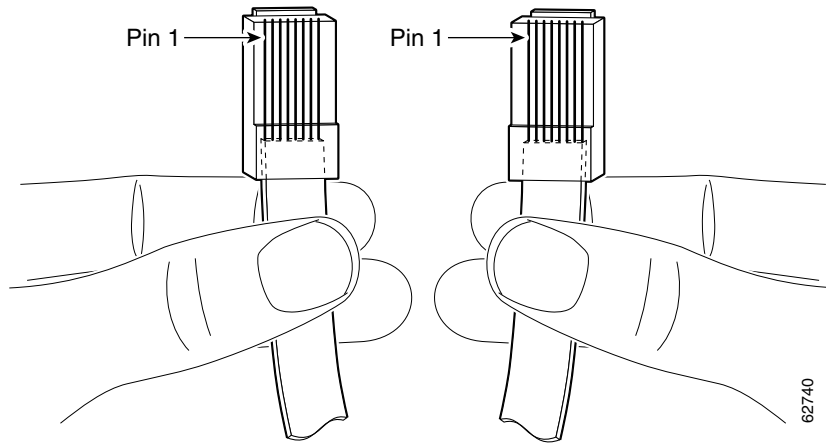


**Figure B-5** *RJ-45 Crossover Cable Identification*

## How to Identify an RJ-45 Straight-Through Cable

You can identify a Straight-through cable by comparing the two modular ends of the cable. Hold the cables side-by-side with the tab at the back. A straight-through cable wires are in the same sequence at both ends of the cable. See [Figure B-6](#).

**Figure B-6** *Straight-through Cable*

**Figure B-7 RJ-45 Straight-Through Cable Identification****Note**

If your cable was purchased from Cisco Systems, pin 1 is white.

Table B-3 lists the pinouts for the two Fast Ethernet ports.

**Table B-3 10Base-T RJ-45 Connector Pinouts**

| RJ-45 Pin | Description | RJ-45 Pin | Description |
|-----------|-------------|-----------|-------------|
| 1         | Tx+         | 3         | Rx+         |
| 2         | Tx-         | 6         | Rx-         |

## Connecting a Cable to an RJ-45 Connector

Use the following information to build your own cables with RJ45 connectors.

**Tools**

- Category 3 cable or Category 5 cable
- RJ45 connectors
- Wire stripping tool
- Crimping tool—for the RJ45 connector

**Step 1**

Use the wire stripper to cut the outer jacket of the wire about 1 inch to 1.5 inches from the end of the cable.

**Caution**

When cutting the cable jacket, make sure that you do not damage the wires in the jacket.

**Step 2**

Arrange the wires in the order that you want to install them into the RJ45 connector.

**Note**

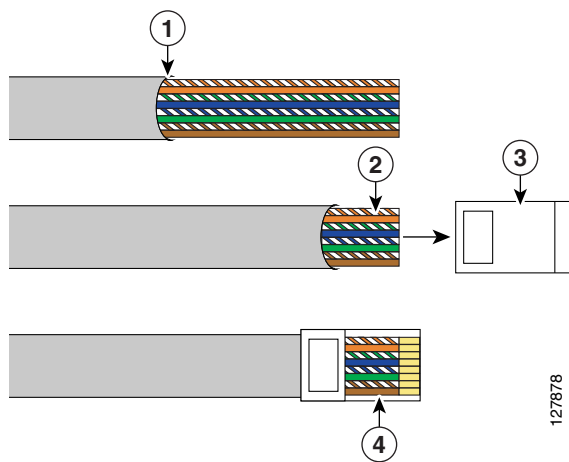
The order of the wires is dependant on what type of connection you are making: crossover, rollover, or straight-through.

- Step 3** After arranging the wires in the correct order, cut them back so there is about 1/2 inch available to install in the connector.
- Step 4** Push the cable into the connector so that the jacket is past the plastic wedge at the rear of the connector and the wires are at the end of the connector underneath the gold crimping pins. Make sure each wire goes into the appropriate location.
- Step 5** Use your crimping tool to crimp the cable. Check your connection by tugging slightly on the cable. Recrimp as necessary.



**Note** When you use the crimping tool, the plastic wedge is pressed into the cable jacket to hold the cable in place and the crimping pins are pushed down into the wires in the connector channels.

**Figure B-8** Installing Cable in an RJ45 Connector



|          |                                     |          |                                   |
|----------|-------------------------------------|----------|-----------------------------------|
| <b>1</b> | Jacket cut here                     | <b>3</b> | RJ45 connector                    |
| <b>2</b> | Wire cut to one half inch in length | <b>4</b> | Cable installed in RJ45 connector |

## Fiber-Optic Cables and Connectors

The following warnings apply when you work with fiber-optic cables and ports.



**Warning**

**Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.** Statement 1051



**Warning**

**Laser radiation is present when the system is open and interlocks are bypassed.** Statement 1009

  
Warning

**Class 1 laser product** Statement 1008

  
Warning

**Class 1 LED product** Statement 1027

Use a single-mode or multimode fiber-optic interface cable to connect your Cisco uBR10012 router to another router or switch.

In general, multimode cables are gray or orange, and single-mode cables are yellow.

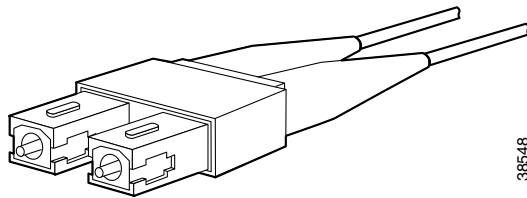


Note

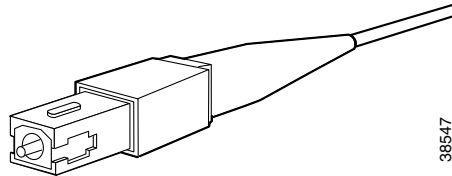
Single-mode and multimode fiber-optic cables are not available from Cisco Systems, Inc.

For SONET or SDH single-mode and multimode fiber-optic connections, use one duplex SC-type connector ([Figure B-9](#)) or two simplex SC-type connectors. (See [Figure B-10](#).)

**Figure B-9 Duplex SC Cable Connector**

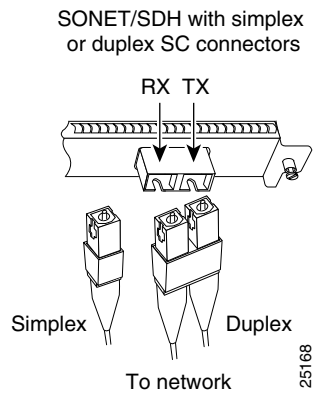


**Figure B-10 Simplex SC Cable Connector**



Attach either one duplex fiber cable or two simplex fiber cables between the DPT port adapter and the device to which the DPT port adapter is connected.

Observe the receive (RX) and transmit (TX) cable relationship shown in [Figure B-11](#).

**Figure B-11 Attaching Simplex or Duplex Fiber-Optic Cables**



## Frequency Allocation

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This appendix provides information on broadcast and cable television NTSC and PAL/SECAM standards and frequencies used around the world.

There are three standards for transmitting video. They are defined by the method of encoding color onto a monochrome signal. The methods are defined as:

- **NTSC**—National Television System Committee.  
NTSC is the current standard used for analog television in the United States and elsewhere. NTSC supports color television transmission in a 6 MHz channel bandwidth and has 525 interlaced scan lines. Two fields are interlaced to make one frame with a frame rate of 29.97 frames per second and a field rate of 59.94 fields per second. A fraction (~8%) of the available bandwidth is used for signal synchronization between the transmitter and the receiver giving an effective resolution of 640x480. The aspect ratio, or ratio of picture width to picture height, is 4:3.
- **PAL**—Phase Alternating Line.  
PAL is a composite color system similar to NTSC. In PAL, however, the color difference signals alternate phase at the horizontal line rate. PAL video consists of a 625-line frame, a frame rate of 25 Hz, and a field rate of 50 Hz. As with NTSC, ~8% of the available bandwidth is used for synchronization yielding an effective resolution of 768x576. The aspect ratio is 4:3. The PAL standard and its variants are used primarily in Europe, China, Asia, Africa, Australia, Brazil, and Argentina.
- **SECAM**—SEquential Couleur Avec Memoire.  
SECAM is a color television broadcasting system using 625 picture lines and a 50-hertz (Hz) field rate, in which the two color-difference signals are transmitted sequentially instead of simultaneously.

General NTSC information is covered in [Table C-4](#) and [Table C-5](#). General PAL/SECAM information is covered in [Table C-7](#). Use the information in [Table C-1](#), [Table C-2](#), and [Table C-3](#) to compare analog television standards used around the world.

Check these Web sites for more information about world-wide frequency allocation.

<http://www.blondertongue.com/CATV-Broadband-Reference-Literature>

<http://www.geo-orbit.org/sizepgs/ntscp.html#anchor1016493>

<http://www.acterna.com>

<http://www.apple.com>

<http://www.c-cor.com>

<http://www.atxincorporated.com>

<http://www.alkenmrs.com>

# Standards Comparisons

The following tables (Table C-1, Table C-2, and Table C-3) include data from Recommendation ITU-R BT.470.6, Conventional Television Systems (1998) and provide a comparison of the different standards.

**Table C-1** Analog Television System Baseband Video Parameters

|                              | <b>M</b>                                | <b>N</b> | <b>B, B1, D1, G</b> | <b>H</b> | <b>I</b> | <b>D, K</b> | <b>K1</b> | <b>L</b> |
|------------------------------|-----------------------------------------|----------|---------------------|----------|----------|-------------|-----------|----------|
| <b>Lines per frame</b>       | 525                                     | 625      | 625                 | 625      | 625      | 625         | 625       | 625      |
| <b>Field rate (Hz)</b>       | Monochrome: 60<br>Color: 59.94          | 50       | 50                  | 50       | 50       | 50          | 50        | 50       |
| <b>Horizontal rate (Hz)</b>  | Monochrome: 15,750<br>Color: 15,734.264 | 15,625   | 15,625              | 15,625   | 15,625   | 15,625      | 15,625    | 15,625   |
| <b>Video bandwidth (Mhz)</b> | 4.2                                     | 4.2      | 5                   | 5        | 5.5      | 6           | 6         | 6        |

**Table C-2** Analog Television Chrominance Subcarrier Frequencies

|                                              | <b>M/NTSC</b>     | <b>M/PAL</b>         | <b>B, B1, D, D1, G, H, K, N/PAL</b> | <b>I/PAL</b>        | <b>B, D, G, H, K, K1, L/SECAM</b>                                      | <b>N/PAL<sup>1</sup></b> |
|----------------------------------------------|-------------------|----------------------|-------------------------------------|---------------------|------------------------------------------------------------------------|--------------------------|
| <b>Chrominance subcarrier frequency (Hz)</b> | 3,579,545<br>± 10 | 3,575,611.49<br>± 10 | 4,433,618.75<br>± 5                 | 4,433,618.75<br>± 1 | $f_{OR} = 4,406,250$<br>± 2,000<br><br>$f_{OB} = 4,250,000$<br>± 2,000 | 3,582,056.25<br>± 5      |

1. This value applies to the combination N/PAL used in Argentina.

**Table C-3** Analog Television System RF Parameters

|                                                                    | <b>M</b> | <b>N</b> | <b>B, B1, G</b> | <b>H</b> | <b>I</b> | <b>D, D1, K</b> | <b>K1</b> | <b>L</b> |
|--------------------------------------------------------------------|----------|----------|-----------------|----------|----------|-----------------|-----------|----------|
| <b>Channel bandwidth at RF (MHz)</b>                               | 6        | 6        | B=7<br>B1, G=8  | 8        | 8        | 8               | 8         | 8        |
| <b>Frequency separation between visual and aural carrier (MHz)</b> | 4.5      | 4.5      | 5.5             | 5.5      | 5.9996   | 6.5             | 6.5       | 6.5      |



# NTSC Cable Television Channels and Relative Frequencies

Table C-4 provides information on the NTSC frequency map for standard 6-MHz channels in North, Central, and South America as well as parts of Asia. Table C-5 lists NTSC assignments for Japan.

**Table C-4** NTSC Cable Television Channels and Relative Frequencies

| Channel No. <sup>1</sup> | Channel No., EIA | Bandwidth (MHz) | Visual Carrier (MHz) | Center Freq. | Aural Carrier (MHz) | Incrementally Related Carrier |          | Harmonically Related Carrier                |          |
|--------------------------|------------------|-----------------|----------------------|--------------|---------------------|-------------------------------|----------|---------------------------------------------|----------|
|                          |                  |                 |                      |              |                     | Visual                        | Aural    | Visual                                      | Aural    |
| T-7                      | none             | 5.75-11.75      | 7                    | 8.75         | 11.5                | N/A                           | N/A      | N/A                                         | N/A      |
| T-8                      | none             | 11.75-17.75     | 13                   | 14.75        | 17.5                | N/A                           | N/A      | N/A                                         | N/A      |
| T-9                      | none             | 17.75-23.75     | 19                   | 10.75        | 23.5                | N/A                           | N/A      | N/A                                         | N/A      |
| T-10                     | none             | 23.75-29.75     | 25                   | 26.75        | 29.5                | N/A                           | N/A      | N/A                                         | N/A      |
| T-11                     | none             | 29.75-35.75     | 31                   | 32.75        | 35.5                | N/A                           | N/A      | N/A                                         | N/A      |
| T-12                     | none             | 35.75-41.75     | 37                   | 38.75        | 41.5                | N/A                           | N/A      | N/A                                         | N/A      |
| T-13                     | none             | 41.75-47.75     | 43                   | 44.75        | 47.5                | N/A                           | N/A      | N/A                                         | N/A      |
| TV-IF                    | none             | 40.0-46.0       | 45.75                | 44.0         | 41.25               | N/A                           | N/A      | N/A                                         | N/A      |
| 2                        | 2                | 54.0-60.0       | 55.25                | 57.0         | 59.75               | 55.2625                       | 59.7625  | 54.0027                                     | 58.5027  |
| 3                        | 3                | 60.0-66.0       | 61.25                | 63.0         | 65.75               | 61.2625                       | 65.7625  | 60.0030                                     | 64.5030  |
| 4                        | 4                | 66.0-72.0       | 67.25                | 69.0         | 71.75               | 67.2625                       | 71.7625  | 66.0033                                     | 70.5030  |
| 5                        | 5                | 76.0-82.0       | 77.25                | 79.0         | 81.75               | 79.2625                       | 83.7625  | 78.0039                                     | 82.5039  |
| 6                        | 6                | 82.0-88.0       | 83.25                | 85.0         | 87.75               | 85.2625                       | 89.7625  | 84.0042                                     | 88.5042  |
|                          | FM               | 88.0-108.0      |                      |              |                     |                               |          |                                             |          |
| A-5                      | 95               | 90.0-96.0       | 91.25                | 93.0         | 95.75               | 91.2625                       | 95.7625  | 90.0045                                     | 94.5045  |
| A-4                      | 96               | 96.0-102.0      | 97.25                | 99.0         | 101.75              | 97.2625                       | 101.7625 | 96.0048                                     | 100.5048 |
| A-3                      | 97               | 102.0-108.0     | 103.25               | 105.0        | 107.75              | 103.2625                      | 107.7625 | 102.0051                                    | 106.5051 |
| A-2                      | 98 <sup>2</sup>  | 108.0-114.0     | 109.25               | 111.0        | 113.75              | 109.2750                      | 113.7750 | Cannot lock to comb                         |          |
| A-1                      | 99 <sup>2</sup>  | 114.0-120.0     | 115.25               | 117.0        | 119.75              | 115.2750                      | 119.7750 | Reference channel, Refer to FCC regulations |          |
| A                        | 14 <sup>2</sup>  | 120.0-126.0     | 121.25               | 123.0        | 125.75              | 121.2625                      | 125.7625 | 120.0060                                    | 124.5060 |
| B                        | 15 <sup>2</sup>  | 126.0-132.0     | 127.25               | 129.0        | 131.75              | 127.2625                      | 131.7625 | 126.0063                                    | 130.5063 |
| C                        | 16 <sup>2</sup>  | 132.0-138.0     | 133.25               | 135.0        | 137.75              | 133.2625                      | 137.7625 | 132.0066                                    | 136.5066 |
| D                        | 17               | 138.0-144.0     | 139.25               | 141.0        | 143.75              | 139.2625                      | 143.7625 | 138.0069                                    | 142.5069 |
| E                        | 18               | 144.0-150.0     | 145.25               | 147.0        | 149.75              | 145.2625                      | 149.7625 | 144.0072                                    | 148.5072 |
| F                        | 19               | 150.0-156.0     | 151.25               | 153.0        | 155.75              | 151.2625                      | 155.7625 | 150.0075                                    | 154.5075 |
| G                        | 20               | 156.0-162.0     | 157.25               | 159.0        | 161.75              | 157.2625                      | 161.7625 | 156.0078                                    | 160.5078 |
| H                        | 21               | 162.0-168.0     | 163.25               | 165.0        | 167.75              | 163.2625                      | 167.7625 | 162.0081                                    | 166.5081 |
| I                        | 22               | 168.0-174.0     | 169.25               | 171.0        | 173.75              | 169.2625                      | 173.7625 | 168.0084                                    | 172.5084 |
| 7                        | 7                | 174.0-180.0     | 175.25               | 177.0        | 179.75              | 175.2625                      | 179.7625 | 174.0087                                    | 178.5087 |

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

| Channel No. <sup>1</sup> | Channel No., EIA | Bandwidth (MHz) | Visual Carrier (MHz) | Center Freq. | Aural Carrier (MHz) | Incrementally Related Carrier |          | Harmonically Related Carrier |          |
|--------------------------|------------------|-----------------|----------------------|--------------|---------------------|-------------------------------|----------|------------------------------|----------|
|                          |                  |                 |                      |              |                     | Visual                        | Aural    | Visual                       | Aural    |
| 8                        | 8                | 180.0-186.0     | 181.25               | 183.0        | 185.75              | 181.2625                      | 185.7625 | 180.0090                     | 184.5090 |
| 9                        | 9                | 186.0-192.0     | 187.25               | 189.0        | 191.75              | 187.2625                      | 191.7625 | 186.0093                     | 190.5093 |
| 10                       | 10               | 192.0-198.0     | 193.25               | 195.0        | 197.75              | 193.2625                      | 197.7625 | 192.0096                     | 196.5096 |
| 11                       | 11               | 198.0-204.0     | 199.25               | 201.0        | 203.75              | 199.2625                      | 203.7625 | 198.0099                     | 202.5099 |
| 12                       | 12               | 204.0-210.0     | 205.25               | 207.0        | 209.75              | 205.2625                      | 209.7625 | 204.0102                     | 208.5102 |
| 13                       | 13               | 210.0-216.0     | 211.25               | 213.0        | 215.75              | 211.2625                      | 215.7625 | 210.0105                     | 214.5105 |
| J                        | 23               | 216.0-222.0     | 217.25               | 219.0        | 221.75              | 217.2625                      | 211.7625 | 216.0108                     | 220.5108 |
| K                        | 24 <sup>2</sup>  | 222.0-228.0     | 223.25               | 225.0        | 227.75              | 223.2625                      | 227.7625 | 222.0111                     | 226.5111 |
| L                        | 25 <sup>2</sup>  | 228.0-234.0     | 229.25               | 231.0        | 233.75              | 229.2625                      | 233.7625 | 228.0114                     | 232.5114 |
| M                        | 26 <sup>2</sup>  | 234.0-240.0     | 235.25               | 237.0        | 239.75              | 235.2625                      | 239.7625 | 234.0117                     | 238.5117 |
| N                        | 27 <sup>2</sup>  | 240.0-246.0     | 241.25               | 243.0        | 245.75              | 241.2625                      | 245.7625 | 240.0120                     | 244.5120 |
| O                        | 28 <sup>2</sup>  | 246.0-252.0     | 247.25               | 249.0        | 251.75              | 247.2625                      | 251.7625 | 246.0123                     | 250.5123 |
| P                        | 29 <sup>2</sup>  | 252.0-258.0     | 253.25               | 255.0        | 257.75              | 253.2625                      | 257.7625 | 252.0126                     | 256.5126 |
| Q                        | 30 <sup>2</sup>  | 258.0-264.0     | 259.25               | 261.0        | 263.75              | 259.2625                      | 263.7625 | 258.0129                     | 262.5129 |
| R                        | 31 <sup>2</sup>  | 264.0-270.0     | 265.25               | 267.0        | 269.75              | 265.2625                      | 269.7625 | 264.0132                     | 268.5132 |
| S                        | 32 <sup>2</sup>  | 270.0-276.0     | 271.25               | 273.0        | 275.75              | 271.2625                      | 275.7625 | 270.0135                     | 274.5135 |
| T                        | 33 <sup>2</sup>  | 276.0-282.0     | 277.25               | 279.0        | 281.75              | 277.2625                      | 281.7625 | 276.0138                     | 270.5138 |
| U                        | 34 <sup>2</sup>  | 282.0-288.0     | 283.25               | 285.0        | 287.75              | 283.2625                      | 287.7625 | 282.0141                     | 286.5141 |
| V                        | 35 <sup>2</sup>  | 288.0-294.0     | 289.25               | 291.0        | 293.75              | 289.2625                      | 293.7625 | 288.0144                     | 292.5144 |
| W                        | 36 <sup>2</sup>  | 294.0-300.0     | 295.25               | 297.0        | 299.75              | 295.2625                      | 299.7625 | 294.0147                     | 298.5147 |
| AA                       | 37 <sup>2</sup>  | 300.0-306.0     | 301.25               | 303.0        | 305.75              | 301.2625                      | 305.7625 | 300.0150                     | 304.5150 |
| BB                       | 38 <sup>2</sup>  | 306.0-312.0     | 307.25               | 309.0        | 311.75              | 307.2625                      | 311.7625 | 306.0153                     | 310.5153 |
| CC                       | 39 <sup>2</sup>  | 312.0-318.0     | 313.25               | 315.0        | 317.75              | 313.2625                      | 317.7625 | 312.0156                     | 316.5156 |
| DD                       | 40 <sup>2</sup>  | 318.0-324.0     | 319.25               | 321.0        | 323.75              | 319.2625                      | 323.7625 | 318.0159                     | 322.5159 |
| EE                       | 41 <sup>2</sup>  | 324.0-330.0     | 325.25               | 327.0        | 329.75              | 325.2625                      | 329.7625 | 324.0162                     | 328.5162 |
| FF                       | 42 <sup>2</sup>  | 330.0-336.0     | 331.25               | 333.0        | 335.75              | 331.2625                      | 335.7625 | 330.0165                     | 334.5165 |
| GG                       | 43 <sup>2</sup>  | 336.0-342.0     | 337.25               | 339.0        | 341.75              | 337.2625                      | 341.7625 | 336.0168                     | 340.5168 |
| HH                       | 44 <sup>2</sup>  | 342.0-348.0     | 343.25               | 345.0        | 347.75              | 343.2625                      | 347.7625 | 342.0171                     | 346.5171 |
| II                       | 45 <sup>2</sup>  | 348.0-354.0     | 349.25               | 351.0        | 353.75              | 349.2625                      | 353.7625 | 348.0174                     | 352.5174 |
| JJ                       | 46 <sup>2</sup>  | 354.0-360.0     | 355.25               | 357.0        | 359.75              | 355.2625                      | 359.7625 | 354.0177                     | 358.5177 |
| KK                       | 47 <sup>2</sup>  | 360.0-366.0     | 361.25               | 363.0        | 365.75              | 361.2625                      | 365.7625 | 360.0180                     | 364.5180 |
| LL                       | 48 <sup>2</sup>  | 366.0-372.0     | 367.25               | 369.0        | 371.75              | 367.2625                      | 371.7625 | 366.0183                     | 370.5183 |
| MM                       | 49 <sup>2</sup>  | 372.0-378.0     | 373.25               | 375.0        | 377.75              | 373.2625                      | 377.7625 | 372.0186                     | 376.5186 |
| NN                       | 50 <sup>2</sup>  | 378.0-384.0     | 379.25               | 381.0        | 383.75              | 379.2625                      | 383.7625 | 378.0189                     | 382.5189 |
| OO                       | 51 <sup>2</sup>  | 384.0-390.0     | 385.25               | 387.0        | 389.75              | 385.2625                      | 389.7625 | 384.0192                     | 388.5192 |

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

| Channel No. <sup>1</sup> | Channel No., EIA | Bandwidth (MHz) | Visual Carrier (MHz) | Center Freq. | Aural Carrier (MHz) | Incrementally Related Carrier |          | Harmonically Related Carrier |          |
|--------------------------|------------------|-----------------|----------------------|--------------|---------------------|-------------------------------|----------|------------------------------|----------|
|                          |                  |                 |                      |              |                     | Visual                        | Aural    | Visual                       | Aural    |
| PP                       | 52 <sup>2</sup>  | 390.0-396.0     | 391.25               | 393.0        | 395.75              | 391.2625                      | 395.7625 | 390.0195                     | 394.5195 |
| QQ                       | 53 <sup>2</sup>  | 396.0-402.0     | 397.25               | 399.0        | 401.75              | 397.2625                      | 401.7625 | 396.0198                     | 400.5198 |
| RR                       | 54               | 402.0-408.0     | 403.25               | 405.0        | 407.75              | 403.2625                      | 407.7625 | 402.0201                     | 406.5201 |
| SS                       | 55               | 408.0-414.0     | 409.25               | 411.0        | 413.75              | 409.2625                      | 413.7625 | 408.0204                     | 412.5204 |
| TT                       | 56               | 414.0-420.0     | 415.25               | 417.0        | 419.75              | 415.2625                      | 419.7625 | 414.0207                     | 418.5207 |
| UU                       | 57               | 420.0-426.0     | 421.25               | 423.0        | 425.75              | 421.2625                      | 425.7625 | 420.0210                     | 424.5210 |
| VV                       | 58               | 426.0-432.0     | 427.25               | 429.0        | 431.75              | 427.2625                      | 431.7625 | 426.0213                     | 430.5213 |
| WW                       | 59               | 432.0-438.0     | 433.25               | 435.0        | 437.75              | 433.2625                      | 437.7625 | 432.0216                     | 436.5216 |
| XX                       | 60               | 438.0-444.0     | 439.25               | 441.0        | 443.75              | 439.2625                      | 443.7625 | 438.0219                     | 442.5219 |
| YY                       | 61               | 444.0-450.0     | 445.25               | 447.0        | 449.75              | 445.2625                      | 449.7625 | 444.0222                     | 448.5222 |
| ZZ                       | 62               | 450.0-456.0     | 451.25               | 453.0        | 455.75              | 451.2625                      | 455.7625 | 450.0225                     | 454.5225 |
|                          | 63               | 456.0-462.0     | 457.25               | 459.0        | 461.75              | 457.2625                      | 461.7625 | 456.0228                     | 460.5228 |
|                          | 64               | 462.0-468.0     | 463.25               | 465.0        | 467.75              | 463.2625                      | 467.7625 | 462.0231                     | 466.5231 |
|                          | 65               | 468.0-474.0     | 469.25               | 471.0        | 473.75              | 469.2625                      | 473.7625 | 468.0234                     | 472.5234 |
|                          | 66               | 474.0-480.0     | 475.25               | 477.0        | 479.75              | 475.2625                      | 479.7625 | 474.0237                     | 478.5237 |
|                          | 67               | 480.0-486.0     | 481.25               | 483.0        | 485.75              | 481.2625                      | 485.7625 | 480.0240                     | 484.5240 |
|                          | 68               | 486.0-492.0     | 487.25               | 489.0        | 491.75              | 487.2625                      | 491.7625 | 486.0243                     | 490.5243 |
|                          | 69               | 492.0-498.0     | 493.25               | 495.0        | 497.75              | 493.2625                      | 497.7625 | 492.0246                     | 496.5246 |
|                          | 70               | 498.0-504.0     | 499.25               | 501.0        | 503.75              | 499.2625                      | 503.7625 | 498.0249                     | 502.5249 |
|                          | 71               | 504.0-510.0     | 505.25               | 507.0        | 509.75              | 505.2625                      | 509.7625 | 504.0252                     | 508.5252 |
|                          | 72               | 510.0-516.0     | 511.25               | 513.0        | 515.75              | 511.2625                      | 515.7625 | 510.0255                     | 514.5255 |
|                          | 73               | 516.0-522.0     | 517.25               | 519.0        | 521.75              | 517.2625                      | 521.7625 | 516.0258                     | 520.5258 |
|                          | 74               | 522.0-528.0     | 523.25               | 525.0        | 527.75              | 523.2625                      | 527.7625 | 522.0261                     | 526.5261 |
|                          | 75               | 528.0-534.0     | 529.25               | 531.0        | 533.75              | 529.2625                      | 533.7625 | 528.0264                     | 532.5264 |
|                          | 76               | 534.0-540.0     | 535.25               | 537.0        | 539.75              | 535.2625                      | 539.7625 | 534.0267                     | 538.5267 |
|                          | 77               | 540.0-546.0     | 541.25               | 543.0        | 545.75              | 541.2625                      | 545.7625 | 540.0270                     | 544.5270 |
|                          | 78               | 546.0-552.0     | 547.25               | 549.0        | 551.75              | 547.2625                      | 551.7625 | 556.0273                     | 550.5273 |
|                          | 79               | 552.0-558.0     | 553.25               | 555.0        | 557.75              | 553.2625                      | 557.7625 | 552.0276                     | 556.5276 |
|                          | 80               | 558.0-564.0     | 559.25               | 561.0        | 563.75              | 559.2625                      | 563.7625 | 558.0279                     | 562.5279 |
|                          | 81               | 564.0-570.0     | 565.25               | 567.0        | 569.75              | 565.2625                      | 569.7625 | 564.0282                     | 568.5282 |
|                          | 82               | 570.0-576.0     | 571.25               | 573.0        | 575.75              | 571.2625                      | 575.7625 | 570.0285                     | 574.5285 |
|                          | 83               | 576.0-582.0     | 577.25               | 579.0        | 581.75              | 577.2625                      | 581.7625 | 576.0288                     | 580.5288 |
|                          | 84               | 582.0-588.0     | 583.25               | 585.0        | 587.75              | 583.2625                      | 587.7625 | 582.0291                     | 586.5291 |
|                          | 85               | 588.0-594.0     | 589.25               | 591.0        | 593.75              | 589.2625                      | 593.7625 | 588.0294                     | 592.5294 |
|                          | 86               | 594.0-600.0     | 595.25               | 597.0        | 599.75              | 595.2625                      | 599.7625 | 594.0297                     | 598.5297 |

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

| Channel No. <sup>1</sup> | Channel No., EIA | Bandwidth (MHz) | Visual Carrier (MHz) | Center Freq. | Aural Carrier (MHz) | Incrementally Related Carrier |          | Harmonically Related Carrier |          |
|--------------------------|------------------|-----------------|----------------------|--------------|---------------------|-------------------------------|----------|------------------------------|----------|
|                          |                  |                 |                      |              |                     | Visual                        | Aural    | Visual                       | Aural    |
|                          | 87               | 600.0-606.0     | 601.25               | 603.0        | 605.75              | 601.2625                      | 605.7625 | 600.0300                     | 604.5300 |
|                          | 88               | 606.0-612.0     | 607.25               | 609.0        | 611.75              | 607.2625                      | 611.7625 | 606.0303                     | 610.5303 |
|                          | 89               | 612.0-618.0     | 613.25               | 615.0        | 617.75              | 613.2625                      | 617.7625 | 612.0306                     | 616.5306 |
|                          | 90               | 618.0-624.0     | 619.25               | 621.0        | 623.75              | 619.2625                      | 623.7625 | 618.0309                     | 622.5309 |
|                          | 91               | 624.0-630.0     | 625.25               | 627.0        | 629.75              | 625.2625                      | 629.7625 | 624.0312                     | 628.5312 |
|                          | 92               | 630.0-636.0     | 631.25               | 633.0        | 635.75              | 631.2625                      | 635.7625 | 630.0315                     | 634.5315 |
|                          | 93               | 636.0-642.0     | 637.25               | 639.0        | 641.75              | 637.2625                      | 641.7625 | 636.0318                     | 640.5318 |
|                          | 94               | 642.0-648.0     | 643.25               | 645.0        | 647.75              | 643.2625                      | 647.7625 | 642.0321                     | 646.5321 |
|                          | 100              | 648.0-654.0     | 649.25               | 651.0        | 653.75              | 649.2625                      | 653.7625 | 648.0324                     | 652.5324 |
|                          | 101              | 654.0-660.0     | 655.25               | 657.0        | 659.75              | 655.2625                      | 659.7625 | 654.0327                     | 658.5327 |
|                          | 102              | 660.0-666.0     | 661.25               | 663.0        | 665.75              | 661.2625                      | 665.7625 | 660.0330                     | 664.5330 |
|                          | 103              | 666.0-672.0     | 667.25               | 669.0        | 671.75              | 667.2625                      | 671.7625 | 666.0333                     | 670.5333 |
|                          | 104              | 672.0-678.0     | 673.25               | 675.0        | 677.75              | 673.2625                      | 677.7625 | 672.0336                     | 676.5336 |
|                          | 105              | 678.0-684.0     | 679.25               | 681.0        | 683.75              | 679.2625                      | 683.7625 | 678.0339                     | 682.5339 |
|                          | 106              | 684.0-690.0     | 685.25               | 687.0        | 689.75              | 685.2625                      | 689.7625 | 684.0342                     | 688.5342 |
|                          | 107              | 690.0-696.0     | 691.25               | 693.0        | 695.75              | 691.2625                      | 695.7625 | 690.0345                     | 694.5345 |
|                          | 108              | 696.0-702.0     | 697.25               | 699.0        | 701.75              | 697.2625                      | 701.7625 | 696.0348                     | 700.5348 |
|                          | 109              | 702.0-708.0     | 703.25               | 705.0        | 707.75              | 703.2625                      | 707.7625 | 702.0351                     | 706.5351 |
|                          | 110              | 708.0-714.0     | 709.25               | 711.0        | 713.75              | 709.2625                      | 713.7625 | 708.0354                     | 712.5354 |
|                          | 111              | 714.0-720.0     | 715.25               | 717.0        | 719.75              | 715.2625                      | 719.7625 | 714.0357                     | 718.5357 |
|                          | 112              | 720.0-726.0     | 721.25               | 723.0        | 725.75              | 721.2625                      | 725.7625 | 720.0360                     | 724.5360 |
|                          | 113              | 726.0-732.0     | 727.25               | 729.0        | 731.75              | 727.2625                      | 731.7625 | 726.0363                     | 730.5363 |
|                          | 114              | 732.0-738.0     | 733.25               | 735.0        | 737.75              | 733.2625                      | 737.7625 | 732.0366                     | 736.5366 |
|                          | 115              | 738.0-744.0     | 739.25               | 741.0        | 743.75              | 739.2625                      | 743.7625 | 738.0369                     | 742.5369 |
|                          | 116              | 744.0-750.0     | 745.25               | 747.0        | 749.75              | 745.2625                      | 749.7625 | 744.0372                     | 748.5372 |
|                          | 117              | 750.0-756.0     | 751.25               | 753.0        | 755.75              | 751.2625                      | 755.7625 | 750.0375                     | 754.5375 |
|                          | 118              | 756.0-762.0     | 757.25               | 759.0        | 761.75              | 757.2625                      | 761.7625 | 756.0378                     | 760.5378 |
|                          | 119              | 762.0-768.0     | 763.25               | 765.0        | 767.75              | 763.2625                      | 767.7625 | 762.0381                     | 766.5381 |
|                          | 120              | 768.0-774.0     | 769.25               | 771.0        | 773.75              | 769.2625                      | 773.7625 | 768.0384                     | 772.5384 |
|                          | 121              | 774.0-780.0     | 775.25               | 777.0        | 779.75              | 775.2625                      | 779.7625 | 774.0387                     | 778.5387 |
|                          | 122              | 780.0-786.0     | 781.25               | 783.0        | 785.75              | 781.2625                      | 785.7625 | 780.0390                     | 784.5390 |
|                          | 123              | 786.0-792.0     | 787.25               | 789.0        | 791.75              | 787.2625                      | 791.7625 | 786.0393                     | 790.5393 |
|                          | 124              | 792.0-798.0     | 793.25               | 795.0        | 797.75              | 793.2625                      | 797.7625 | 792.0396                     | 796.5396 |
|                          | 125              | 798.0-804.0     | 799.25               | 801.0        | 803.75              | 799.2625                      | 803.7625 | 798.0399                     | 802.5399 |
|                          | 126              | 804.0-810.0     | 805.25               | 807.0        | 809.75              | 805.2625                      | 809.7625 | 804.0402                     | 808.5402 |

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

| Channel No. <sup>1</sup> | Channel No., EIA | Bandwidth (MHz) | Visual Carrier (MHz) | Center Freq. | Aural Carrier (MHz) | Incrementally Related Carrier |           | Harmonically Related Carrier |           |
|--------------------------|------------------|-----------------|----------------------|--------------|---------------------|-------------------------------|-----------|------------------------------|-----------|
|                          |                  |                 |                      |              |                     | Visual                        | Aural     | Visual                       | Aural     |
|                          | 127              | 810.0-816.0     | 811.25               | 813.0        | 815.75              | 811.2625                      | 815.7625  | 810.0405                     | 814.5405  |
|                          | 128              | 816.0-822.0     | 817.25               | 819.0        | 821.75              | 817.2625                      | 821.7625  | 816.0408                     | 820.5408  |
|                          | 129              | 822.0-828.0     | 823.25               | 825.0        | 827.75              | 823.2625                      | 827.7625  | 822.0411                     | 826.5411  |
|                          | 130              | 828.0-834.0     | 829.25               | 831.0        | 833.75              | 829.2625                      | 833.7625  | 828.0414                     | 832.5414  |
|                          | 131              | 834.0-840.0     | 835.25               | 837.0        | 839.75              | 835.2625                      | 839.7625  | 834.0417                     | 838.5417  |
|                          | 132              | 840.0-846.0     | 841.25               | 843.0        | 845.75              | 841.2625                      | 845.7625  | 840.0420                     | 844.5420  |
|                          | 133              | 846.0-852.0     | 847.25               | 849.0        | 851.75              | 847.2625                      | 851.7625  | 846.0423                     | 850.5423  |
|                          | 134              | 852.0-858.0     | 853.25               | 855.0        | 857.75              | 853.2625                      | 857.7625  | 852.0426                     | 856.5426  |
|                          | 135              | 858.0-864.0     | 859.25               | 861.0        | 863.75              | 859.2625                      | 863.7625  | 858.0429                     | 862.5429  |
|                          | 136              | 864.0-870.0     | 865.25               | 867.0        | 869.75              | 865.2625                      | 869.7625  | 864.0432                     | 868.5432  |
|                          | 137              | 870.0-876.0     | 871.25               | 873.0        | 875.75              | 871.2625                      | 875.7625  | 870.0435                     | 874.5435  |
|                          | 138              | 876.0-882.0     | 877.25               | 879.0        | 881.75              | 877.2625                      | 881.7625  | 876.0438                     | 880.5438  |
|                          | 139              | 882.0-888.0     | 883.25               | 885.0        | 887.75              | 883.2625                      | 887.7625  | 882.0441                     | 886.5441  |
|                          | 140              | 888.0-894.0     | 889.25               | 891.0        | 893.75              | 889.2625                      | 893.7625  | 888.0444                     | 892.5444  |
|                          | 141              | 894.0-900.0     | 895.25               | 897.0        | 899.75              | 895.2625                      | 899.7625  | 894.0447                     | 898.5447  |
|                          | 142              | 900.0-906.0     | 901.25               | 903.0        | 905.75              | 901.2625                      | 905.7625  | 900.0450                     | 904.5450  |
|                          | 143              | 906.0-912.0     | 907.25               | 909.0        | 911.75              | 907.2625                      | 911.7625  | 906.0453                     | 910.5453  |
|                          | 144              | 912.0-918.0     | 913.25               | 915.0        | 917.75              | 913.2625                      | 917.7625  | 912.0456                     | 916.5456  |
|                          | 145              | 918.0-924.0     | 919.25               | 921.0        | 923.75              | 919.2625                      | 923.7625  | 918.0459                     | 922.5459  |
|                          | 146              | 924.0-930.0     | 925.25               | 927.0        | 929.75              | 925.2625                      | 929.7625  | 924.0462                     | 928.5462  |
|                          | 147              | 930.0-936.0     | 931.25               | 933.0        | 935.75              | 931.2625                      | 935.7625  | 930.0465                     | 934.5465  |
|                          | 148              | 936.0-942.0     | 937.25               | 939.0        | 941.75              | 937.2625                      | 941.7625  | 936.0468                     | 940.5468  |
|                          | 149              | 942.0-948.0     | 943.25               | 945.0        | 947.75              | 943.2625                      | 947.7625  | 942.0471                     | 946.5471  |
|                          | 150              | 948.0-954.0     | 949.25               | 951.0        | 953.75              | 949.2625                      | 953.7625  | 948.0474                     | 952.5474  |
|                          | 151              | 954.0-960.0     | 955.25               | 957.0        | 959.75              | 955.2625                      | 959.7625  | 954.0477                     | 958.5477  |
|                          | 152              | 960.0-966.0     | 961.25               | 963.0        | 965.75              | 961.2625                      | 965.7625  | 960.0480                     | 964.5480  |
|                          | 153              | 966.0-972.0     | 967.25               | 969.0        | 971.75              | 967.2625                      | 971.7625  | 966.0483                     | 970.5483  |
|                          | 154              | 972.0-978.0     | 973.25               | 975.0        | 977.75              | 973.2625                      | 977.7625  | 972.0486                     | 976.5486  |
|                          | 155              | 978.0-984.0     | 979.25               | 981.0        | 983.75              | 979.2625                      | 983.7625  | 978.0489                     | 982.5489  |
|                          | 156              | 984.0-990.0     | 985.25               | 987.0        | 989.75              | 985.2625                      | 989.7625  | 984.0492                     | 988.5492  |
|                          | 157              | 990.0-996.0     | 991.25               | 993.0        | 995.75              | 991.2625                      | 995.7625  | 990.0495                     | 994.5495  |
|                          | 158              | 996.0-1002.0    | 997.25               | 999.0        | 1001.75             | 997.2625                      | 1001.7625 | 996.0498                     | 1000.5498 |

1. This column is for historical channel listings.

2. Aeronautical channels visual carrier frequency tolerance +/-5 kHz.

# NTSC (M) Cable Television Channel Frequencies for Japan

Japan uses NTSC (M) with different channel assignments.

**Table C-5 Japanese Channel Assignments**

| Channel Number | Bandwidth (MHz) | Visual Carrier (MHz) | Center Frequency | Aural Carrier (MHz) |
|----------------|-----------------|----------------------|------------------|---------------------|
| 1              | 90.0-96.0       | 91.25                | 93.00            | 95.75               |
| 2              | 96.0-102.0      | 97.25                | 99.00            | 101.75              |
| 3              | 102.0-108.0     | 103.25               | 105.00           | 107.75              |
| 4              | 170.0-176.0     | 171.25               | 173.00           | 175.75              |
| 5              | 176.0-182.0     | 177.25               | 179.00           | 181.75              |
| 6              | 182.0-188.0     | 183.25               | 185.00           | 187.75              |
| 7              | 188.0-194.0     | 189.25               | 191.00           | 193.75              |
| 8              | 192.0-198.0     | 193.25               | 195.00           | 197.75              |
| 9              | 198.0-204.0     | 199.25               | 201.00           | 203.75              |
| 10             | 204.0-210.0     | 205.25               | 207.00           | 209.75              |
| 11             | 210.0-216.0     | 211.25               | 213.00           | 215.75              |
| 12             | 216.0-222.0     | 217.25               | 219.00           | 221.75              |
| C13            | 108.0-114.0     | 109.25               | 111.00           | 113.75              |
| C14            | 114.0-120.0     | 115.25               | 117.00           | 119.75              |
| C15            | 120.0-126.0     | 121.25               | 123.00           | 125.75              |
| C16            | 126.0-132.0     | 125.25               | 129.00           | 131.75              |
| C17            | 132.0-138.0     | 133.25               | 135.00           | 137.75              |
| C18            | 138.0-144.0     | 139.25               | 141.00           | 143.75              |
| C19            | 144.0-150.0     | 145.25               | 147.00           | 149.75              |
| C20            | 150.0-156.0     | 151.25               | 153.00           | 155.75              |
| C21            | 156.0-162.0     | 157.25               | 159.00           | 161.75              |
| C22            | 164.0-170.0     | 165.25               | 167.00           | 169.75              |
| C23            | 222.0-228.0     | 223.25               | 225.00           | 227.75              |
| C24            | 230.0-236.0     | 231.25               | 233.00           | 235.75              |
| C25            | 236.0-242.0     | 237.25               | 239.00           | 241.75              |
| C26            | 242.0-248.0     | 243.25               | 245.00           | 247.75              |
| C27            | 248.0-254.0     | 249.25               | 251.00           | 253.75              |
| C28            | 254.0-258.0     | 253.25               | 257.00           | 257.75              |
| C29            | 258.0-264.0     | 259.25               | 261.00           | 263.75              |
| C30            | 264.0-270.0     | 265.25               | 267.00           | 269.75              |
| C31            | 270.0-276.0     | 271.25               | 273.00           | 275.75              |
| C32            | 276.0-282.0     | 277.25               | 279.00           | 281.75              |

Table C-5 Japanese Channel Assignments (continued)

| Channel Number | Bandwidth (MHz) | Visual Carrier (MHz) | Center Frequency | Aural Carrier (MHz) |
|----------------|-----------------|----------------------|------------------|---------------------|
| C33            | 282.0-288.0     | 283.25               | 285.00           | 287.75              |
| C34            | 288.0-294.0     | 289.25               | 291.00           | 293.75              |
| C35            | 294.0-300.0     | 295.25               | 297.00           | 299.75              |
| C36            | 300.0-306.0     | 301.25               | 303.00           | 305.75              |
| C37            | 306.0-312.0     | 307.25               | 309.00           | 311.75              |
| C38            | 312.0-318.0     | 313.25               | 315.00           | 317.75              |
| C39            | 318.0-324.0     | 319.25               | 321.00           | 323.75              |
| C40            | 324.0-330.0     | 325.25               | 327.00           | 329.75              |
| C41            | 330.0-336.0     | 331.25               | 333.00           | 335.75              |
| C42            | 336.0-342.0     | 337.25               | 339.00           | 341.75              |
| C43            | 342.0-348.0     | 343.25               | 345.00           | 347.75              |
| C44            | 348.0-354.0     | 349.25               | 351.00           | 353.75              |
| C45            | 354.0-360.0     | 355.25               | 357.00           | 359.75              |
| C46            | 360.0-366.0     | 361.25               | 363.00           | 365.75              |
| C47            | 366.0-372.0     | 367.25               | 369.00           | 371.75              |
| C48            | 372.0-378.0     | 373.25               | 375.00           | 377.75              |
| C49            | 378.0-384.0     | 379.25               | 381.00           | 383.75              |
| C50            | 384.0-390.0     | 385.25               | 387.00           | 389.75              |
| C51            | 390.0-396.0     | 391.25               | 393.00           | 395.75              |
| C52            | 396.0-402.0     | 397.25               | 399.00           | 401.75              |
| C53            | 402.0-408.0     | 403.25               | 405.00           | 407.75              |
| C54            | 408.0-414.0     | 409.25               | 411.00           | 413.75              |
| C55            | 414.0-420.0     | 415.25               | 417.00           | 419.75              |
| C56            | 420.0-426.0     | 421.25               | 423.00           | 425.75              |
| C57            | 426.0-432.0     | 427.25               | 429.00           | 431.75              |
| C58            | 432.0-438.0     | 433.25               | 435.00           | 437.75              |
| C59            | 438.0-444.0     | 439.25               | 441.00           | 443.75              |
| C60            | 444.0-450.0     | 445.25               | 447.00           | 449.75              |
| C61            | 450.0-456.0     | 451.25               | 453.00           | 455.75              |
| C62            | 456.0-462.0     | 457.25               | 459.00           | 461.75              |
| C63            | 462.0-468.0     | 463.25               | 465.00           | 467.75              |

# NTSC Cable Television Channel Frequencies for the Republic of Korea

Korea uses NTSC (VHF, UHF) with different channel assignments.

**Table C-6** Korean Channel Assignments

| Channel Number | Bandwidth (MHz) | Visual Carrier (MHz) | Center Frequency | Aural Carrier (MHz) | Usage       |
|----------------|-----------------|----------------------|------------------|---------------------|-------------|
|                | 5.75-41.75      |                      |                  |                     | Return path |
| 2              | 54.0-60.0       | 55.25                | 57.00            | 59.75               | CATV        |
| 3              | 60.0-66.0       | 61.25                | 63.00            | 65.75               |             |
| 4              | 66.0-72.0       | 67.25                | 69.00            | 71.75               |             |
| 5              | 76.0-82.0       | 77.25                | 79.00            | 81.75               |             |
| 6              | 82.0-88.0       | 83.25                | 85.00            | 87.75               | Music band  |
|                | 88.0-108        |                      |                  |                     |             |



Table C-6 Korean Channel Assignments (continued)

| Channel Number  | Bandwidth (MHz) | Visual Carrier (MHz) | Center Frequency | Aural Carrier (MHz) | Usage |
|-----------------|-----------------|----------------------|------------------|---------------------|-------|
| 14              | 120.0-126.0     | 121.25               | 123.0            | 125.75              | CATV  |
| 15              | 126.0-132.0     | 127.25               | 129.0            | 131.75              |       |
| 16              | 132.0-138.0     | 133.25               | 135.0            | 137.75              |       |
| 17              | 138.0-144.0     | 139.25               | 141.0            | 143.75              |       |
| 18              | 144.0-150.0     | 145.25               | 147.0            | 149.75              |       |
| 19              | 150.0-156.0     | 151.25               | 153.0            | 155.75              |       |
| 20              | 156.0-162.0     | 157.25               | 159.0            | 161.75              |       |
| 21              | 162.0-168.0     | 163.25               | 165.0            | 167.75              |       |
| 22              | 168.0-174.0     | 169.25               | 171.0            | 173.75              |       |
| 7               | 174.0-180.0     | 175.25               | 177.0            | 179.75              |       |
| 8               | 180.0-186.0     | 181.25               | 183.0            | 185.75              |       |
| 9               | 186.0-192.0     | 187.25               | 189.0            | 191.75              |       |
| 10              | 192.0-198.0     | 193.25               | 195.0            | 197.75              |       |
| 11              | 198.0-204.0     | 199.25               | 201.0            | 203.75              |       |
| 12              | 204.0-210.0     | 205.25               | 207.0            | 209.75              |       |
| 13              | 210.0-216.0     | 211.25               | 213.0            | 215.75              |       |
| 23              | 216.0-222.0     | 217.25               | 219.0            | 221.75              |       |
| 24 <sup>1</sup> | 222.0-228.0     | 223.25               | 225.0            | 227.75              |       |
| 25 <sup>1</sup> | 228.0-234.0     | 229.25               | 231.0            | 233.75              |       |
| 26 <sup>1</sup> | 234.0-240.0     | 235.25               | 237.0            | 239.75              |       |
| 27 <sup>1</sup> | 240.0-246.0     | 241.25               | 243.0            | 245.75              |       |
| 28 <sup>1</sup> | 246.0-252.0     | 247.25               | 249.0            | 251.75              |       |
| 29 <sup>1</sup> | 252.0-258.0     | 253.25               | 255.0            | 257.75              |       |
| 30 <sup>1</sup> | 258.0-264.0     | 259.25               | 261.0            | 263.75              |       |
| 31 <sup>1</sup> | 264.0-270.0     | 265.25               | 267.0            | 269.75              |       |

Table C-6 Korean Channel Assignments (continued)

| Channel Number  | Bandwidth (MHz) | Visual Carrier (MHz) | Center Frequency | Aural Carrier (MHz) | Usage |
|-----------------|-----------------|----------------------|------------------|---------------------|-------|
| 32 <sup>1</sup> | 270.0-276.0     | 271.25               | 273.0            | 275.75              | CATV  |
| 33 <sup>1</sup> | 276.0-282.0     | 277.25               | 279.0            | 281.75              |       |
| 34 <sup>1</sup> | 282.0-288.0     | 283.25               | 285.0            | 287.75              |       |
| 35 <sup>1</sup> | 288.0-294.0     | 289.25               | 291.0            | 293.75              |       |
| 36 <sup>1</sup> | 294.0-300.0     | 295.25               | 297.0            | 299.75              |       |
| 37 <sup>1</sup> | 300.0-306.0     | 301.25               | 303.0            | 305.75              |       |
| 38 <sup>1</sup> | 306.0-312.0     | 307.25               | 309.0            | 311.75              |       |
| 39 <sup>1</sup> | 312.0-318.0     | 313.25               | 315.0            | 317.75              |       |
| 40 <sup>1</sup> | 318.0-324.0     | 319.25               | 321.0            | 323.75              |       |
| 41 <sup>1</sup> | 324.0-330.0     | 325.25               | 327.0            | 329.75              |       |
| 42 <sup>1</sup> | 330.0-336.0     | 331.25               | 333.0            | 335.75              |       |
| 43 <sup>1</sup> | 336.0-342.0     | 337.25               | 339.0            | 341.75              |       |
| 44 <sup>1</sup> | 342.0-348.0     | 343.25               | 345.0            | 347.75              |       |
| 45 <sup>1</sup> | 348.0-354.0     | 349.25               | 351.0            | 353.75              |       |
| 46 <sup>1</sup> | 354.0-360.0     | 355.25               | 357.0            | 359.75              |       |
| 47 <sup>1</sup> | 360.0-366.0     | 361.25               | 363.0            | 365.75              |       |
| 48 <sup>1</sup> | 366.0-372.0     | 367.25               | 369.0            | 371.75              |       |
| 49 <sup>1</sup> | 372.0-378.0     | 373.25               | 375.0            | 377.75              |       |
| 50 <sup>1</sup> | 378.0-384.0     | 379.25               | 381.0            | 383.75              |       |
| 51 <sup>1</sup> | 384.0-390.0     | 385.25               | 387.0            | 389.75              |       |
| 52 <sup>1</sup> | 390.0-396.0     | 391.25               | 393.0            | 395.75              |       |
| 53 <sup>1</sup> | 396.0-402.0     | 397.25               | 399.0            | 401.75              |       |
| 54              | 402.0-408.0     | 403.25               | 405.0            | 407.75              |       |
| 55              | 408.0-414.0     | 409.25               | 411.0            | 413.75              |       |
| 56              | 414.0-420.0     | 415.25               | 417.0            | 419.75              |       |
| 57              | 420.0-426.0     | 421.25               | 423.0            | 425.75              |       |
| 58              | 426.0-432.0     | 427.25               | 429.0            | 431.75              |       |
| 59              | 432.0-438.0     | 433.25               | 435.0            | 437.75              |       |
| 60              | 438.0-444.0     | 439.25               | 441.0            | 443.75              |       |
| 61              | 444.0-450.0     | 445.25               | 447.0            | 449.75              |       |
| 62              | 450.0-456.0     | 451.25               | 453.0            | 455.75              |       |
| 63              | 456.0-462.0     | 457.25               | 459.0            | 461.75              |       |
| 64              | 462.0-468.0     | 463.25               | 465.0            | 467.75              |       |
| 65              | 468.0-474.0     | 469.25               | 471.0            | 473.75              |       |
| 66              | 474.0-480.0     | 475.25               | 477.0            | 479.75              |       |

Table C-6 Korean Channel Assignments (continued)

| Channel Number | Bandwidth (MHz) | Visual Carrier (MHz) | Center Frequency | Aural Carrier (MHz) | Usage |
|----------------|-----------------|----------------------|------------------|---------------------|-------|
| 67             | 480.0-486.0     | 481.25               | 483.0            | 485.75              | CATV  |
| 68             | 486.0-492.0     | 487.25               | 489.0            | 491.75              |       |
| 69             | 492.0-498.0     | 493.25               | 495.0            | 497.75              |       |
| 70             | 498.0-504.0     | 499.25               | 501.0            | 503.75              |       |
| 71             | 504.0-510.0     | 505.25               | 507.0            | 509.75              |       |
| 72             | 510.0-516.0     | 511.25               | 513.0            | 515.75              |       |
| 73             | 516.0-522.0     | 517.25               | 519.0            | 521.75              |       |
| 74             | 522.0-528.0     | 523.25               | 525.0            | 527.75              |       |
| 75             | 528.0-534.0     | 529.25               | 531.0            | 533.75              |       |
| 76             | 534.0-540.0     | 535.25               | 537.0            | 539.75              |       |
| 77             | 540.0-546.0     | 541.25               | 543.0            | 545.75              |       |
| 78             | 546.0-552.0     | 547.25               | 549.0            | 551.75              |       |
| 79             | 552.0-558.0     | 553.25               | 555.0            | 557.75              |       |
| 80             | 558.0-564.0     | 559.25               | 561.0            | 563.75              |       |
| 81             | 564.0-570.0     | 565.25               | 567.0            | 569.75              |       |
| 82             | 570.0-576.0     | 571.25               | 573.0            | 575.75              |       |
| 83             | 576.0-582.0     | 577.25               | 579.0            | 581.75              |       |
| 84             | 582.0-588.0     | 583.25               | 585.0            | 587.75              |       |
| 85             | 588.0-594.0     | 589.25               | 591.0            | 593.75              |       |
| 86             | 594.0-600.0     | 595.25               | 597.0            | 599.75              |       |
| 87             | 600.0-606.0     | 601.25               | 603.0            | 605.75              |       |
| 88             | 606.0-612.0     | 607.25               | 609.0            | 611.75              |       |
| 89             | 612.0-618.0     | 613.25               | 615.0            | 617.75              |       |
| 90             | 618.0-624.0     | 619.25               | 621.0            | 623.75              |       |
| 91             | 624.0-630.0     | 625.25               | 627.0            | 629.75              |       |
| 92             | 630.0-636.0     | 631.25               | 633.0            | 635.75              |       |
| 93             | 636.0-642.0     | 637.25               | 639.0            | 641.75              |       |
| 94             | 642.0-648.0     | 643.25               | 645.0            | 647.75              |       |
| 95             | 648.0-654.0     | 649.25               | 651.0            | 653.75              |       |
| 96             | 654.0-660.0     | 655.25               | 657.0            | 659.75              |       |
| 97             | 660.0-666.0     | 661.25               | 663.0            | 665.75              |       |
| 98             | 666.0-672.0     | 667.25               | 669.0            | 671.75              |       |
| 99             | 672.0-678.0     | 673.25               | 675.0            | 677.75              |       |
| 100            | 678.0-684.0     | 679.25               | 681.0            | 683.75              |       |
| 101            | 684.0-690.0     | 685.25               | 687.0            | 689.75              |       |

**Table C-6** Korean Channel Assignments (continued)

| Channel Number | Bandwidth (MHz) | Visual Carrier (MHz) | Center Frequency | Aural Carrier (MHz) | Usage |
|----------------|-----------------|----------------------|------------------|---------------------|-------|
| 102            | 690.0-696.0     | 691.25               | 693.0            | 695.75              | CATV  |
| 103            | 696.0-702.0     | 697.25               | 699.0            | 701.75              |       |
| 104            | 702.0-708.0     | 703.25               | 705.0            | 707.75              |       |
| 105            | 708.0-714.0     | 709.25               | 711.0            | 713.75              |       |
| 106            | 714.0-720.0     | 715.25               | 717.0            | 719.75              |       |
| 107            | 720.0-726.0     | 721.25               | 723.0            | 725.75              |       |
| 108            | 726.0-732.0     | 727.25               | 729.0            | 731.75              |       |
| 109            | 732.0-738.0     | 733.25               | 735.0            | 737.75              |       |
| 110            | 738.0-744.0     | 739.25               | 741.0            | 743.75              |       |
| 111            | 744.0-750.0     | 745.25               | 747.0            | 749.75              |       |

1. Aeronautical channels visual carrier frequency tolerance +/-5 kHz.

## PAL/SECAM Cable Television Channels and Relative Frequencies

[Table C-7](#) provides information on the Phase Alternating Line (PAL) and SEquential Couleur Avec Memoire (SECAM) frequency map for standard 7 and 8 MHz channel bands in Europe.

The FCS (reference subcarrier frequency) for color integration is different for different countries. As well, the channel/frequency designations is different for different countries. For a summary of the ITU designations for PAL/SECAM systems and Recommendation ITU-R BT.470.6 standards, refer to [Table C-1](#), [Table C-2](#), and [Table C-3](#). These tables provide general information that may help determine frequency allocations for specific countries. [Table C-7](#) is a frequency allocation table for PAL B and G locations. Also note that some countries use different schemes for VHF and UHF. [Table C-8](#) is a frequency allocation table for PAL D and K locations for the People's Republic of China.

More information can be found at the Web sites listed on page E-1.



### Note

The downstream frequency plan will include all center frequencies between 112 and 858 MHz on 250 kHz increments. It is up to the operator to decide which frequencies to use to meet national and network requirements

**Table C-7** Cable Television Channels and Relative Frequencies, PAL B and G

| Channel Number | Bandwidth (MHz) | Visual Carrier (MHz) | Aural Carrier (MHz) |
|----------------|-----------------|----------------------|---------------------|
| E2             | 47.0-54.0       | 48.25                | 53.75               |
| E3             | 54.0-61.0       | 55.25                | 60.75               |
| E4             | 61.0-68.0       | 62.25                | 67.75               |
| S3             | 118.0-125.0     | 119.25               | 124.75              |

**Table C-7** Cable Television Channels and Relative Frequencies, PAL B and G (continued)

| <b>Channel Number</b> | <b>Bandwidth (MHz)</b> | <b>Visual Carrier (MHz)</b> | <b>Aural Carrier (MHz)</b> |
|-----------------------|------------------------|-----------------------------|----------------------------|
| S4                    | 125.0-132.0            | 126.25                      | 131.75                     |
| S5                    | 132.0-139.0            | 133.25                      | 138.75                     |
| S6                    | 139.0-146.0            | 140.25                      | 145.75                     |
| S7                    | 146.0-153.0            | 147.25                      | 152.75                     |
| S8                    | 153.0-160.0            | 154.25                      | 159.75                     |
| S9                    | 160.0-167.0            | 161.25                      | 166.75                     |
| S10                   | 167.0-174.0            | 168.25                      | 173.75                     |
| E5                    | 174.0-181.0            | 175.25                      | 180.75                     |
| E6                    | 181.0-188.0            | 182.25                      | 187.75                     |
| E7                    | 188.0-195.0            | 189.25                      | 194.5                      |
| E8                    | 195.0-202.0            | 196.25                      | 201.75                     |
| E9                    | 202.0-209.0            | 203.25                      | 208.75                     |
| E10                   | 209.0-216.0            | 210.25                      | 215.75                     |
| E11                   | 216.0-223.0            | 217.25                      | 222.75                     |
| E12                   | 223.0-230.0            | 224.25                      | 229.75                     |
| S11                   | 230.0-237.0            | 231.25                      | 236.75                     |
| S12                   | 237.0-244.0            | 238.25                      | 243.75                     |
| S13                   | 244.0-251.0            | 245.25                      | 250.75                     |
| S14                   | 251.0-258.0            | 252.25                      | 257.75                     |
| S15                   | 258.0-265.0            | 259.25                      | 264.75                     |
| S16                   | 265.0-272.0            | 266.25                      | 271.75                     |
| S17                   | 272.0-279.0            | 273.25                      | 278.75                     |
| S18                   | 279.0-286.0            | 280.25                      | 285.75                     |
| S19                   | 286.0-293.0            | 287.25                      | 289.75                     |
| S20                   | 293.0-300.0            | 294.25                      | 299.75                     |
| S21                   | 302.0-310.0            | 303.25                      | 308.75                     |
| S22                   | 310.0-318.0            | 311.25                      | 316.75                     |
| S23                   | 318.0-326.0            | 319.25                      | 324.75                     |
| S24                   | 326.0-334.0            | 327.25                      | 332.75                     |
| S25                   | 334.0-342.0            | 335.25                      | 340.75                     |
| S26                   | 342.0-350.0            | 343.25                      | 348.75                     |
| S27                   | 350.0-358.0            | 351.25                      | 356.75                     |
| S28                   | 358.0-366.0            | 359.25                      | 364.75                     |
| S29                   | 366.0-374.0            | 367.25                      | 372.05                     |
| S30                   | 374.0-382.0            | 375.25                      | 380.75                     |

**Table C-7** Cable Television Channels and Relative Frequencies, PAL B and G (continued)

| <b>Channel Number</b> | <b>Bandwidth (MHz)</b> | <b>Visual Carrier (MHz)</b> | <b>Aural Carrier (MHz)</b> |
|-----------------------|------------------------|-----------------------------|----------------------------|
| S31                   | 382.0-390.0            | 383.25                      | 388.75                     |
| S32                   | 390.0-398.0            | 391.25                      | 396.75                     |
| S33                   | 398.0-406.0            | 399.25                      | 404.75                     |
| S34                   | 406.0-414.0            | 407.25                      | 412.75                     |
| S35                   | 414.0-422.0            | 415.25                      | 420.75                     |
| S36                   | 422.0-430.0            | 423.25                      | 428.75                     |
| S37                   | 430.0-438.0            | 431.25                      | 436.75                     |
| S38                   | 438.0-446.0            | 439.25                      | 444.75                     |
| S39                   | 446.0-454.0            | 447.25                      | 452.75                     |
| S40                   | 454.0-462.0            | 455.25                      | 460.75                     |
| S41                   | 462.0-470.0            | 463.25                      | 468.75                     |
| 21                    | 470.0-478.0            | 471.25                      | 476.75                     |
| 22                    | 478.0-486.0            | 479.25                      | 484.75                     |
| 23                    | 486.0-494.0            | 487.25                      | 492.75                     |
| 24                    | 494.0-502.0            | 495.25                      | 500.75                     |
| 25                    | 502.0-510.0            | 503.25                      | 508.75                     |
| 26                    | 510.0-518.0            | 511.25                      | 516.75                     |
| 27                    | 518.0-526.0            | 519.25                      | 524.75                     |
| 28                    | 526.0-534.0            | 527.25                      | 532.75                     |
| 29                    | 534.0-542.0            | 535.25                      | 540.75                     |
| 30                    | 542.0-550.0            | 543.25                      | 548.75                     |
| 31                    | 550.0-558.0            | 551.25                      | 556.75                     |
| 32                    | 558.0-566.0            | 559.25                      | 564.75                     |
| 33                    | 566.0-574.0            | 567.25                      | 572.75                     |
| 34                    | 574.0-582.0            | 575.25                      | 580.75                     |
| 35                    | 582.0-590.0            | 583.25                      | 588.75                     |
| 36                    | 590.0-598.0            | 591.25                      | 596.75                     |
| 37                    | 598.0-606.0            | 599.25                      | 604.75                     |
| 38                    | 606.0-614.0            | 607.25                      | 612.75                     |
| 39                    | 614.0-622.0            | 615.25                      | 620.75                     |
| 40                    | 622.0-630.0            | 623.25                      | 628.75                     |
| 41                    | 630.0-638.0            | 631.25                      | 636.75                     |
| 42                    | 638.0-646.0            | 639.25                      | 644.75                     |
| 43                    | 646.0-654.0            | 647.25                      | 652.75                     |
| 44                    | 654.0-662.0            | 655.25                      | 660.75                     |

**Table C-7** Cable Television Channels and Relative Frequencies, PAL B and G (continued)

| <b>Channel Number</b> | <b>Bandwidth (MHz)</b> | <b>Visual Carrier (MHz)</b> | <b>Aural Carrier (MHz)</b> |
|-----------------------|------------------------|-----------------------------|----------------------------|
| 45                    | 662.0-670.0            | 663.25                      | 668.75                     |
| 46                    | 670.0-678.0            | 671.25                      | 676.75                     |
| 47                    | 678.0-686.0            | 679.25                      | 684.75                     |
| 48                    | 686.0-694.0            | 687.25                      | 692.75                     |
| 49                    | 694.0-702.0            | 695.25                      | 700.75                     |
| 50                    | 702.0-710.0            | 703.25                      | 708.75                     |
| 51                    | 710.0-718.0            | 711.25                      | 716.75                     |
| 52                    | 718.0-726.0            | 719.25                      | 724.75                     |
| 53                    | 726.0-734.0            | 727.25                      | 732.75                     |
| 54                    | 734.0-742.0            | 735.25                      | 740.75                     |
| 55                    | 742.0-750.0            | 743.25                      | 748.75                     |
| 56                    | 750.0-758.0            | 751.25                      | 756.75                     |
| 57                    | 758.0-766.0            | 759.25                      | 764.75                     |
| 58                    | 766.0-774.0            | 767.25                      | 772.75                     |
| 59                    | 774.0-782.0            | 775.25                      | 780.75                     |
| 60                    | 782.0-790.0            | 783.25                      | 788.75                     |
| 61                    | 790.0-798.0            | 791.25                      | 796.75                     |
| 62                    | 798.0-806.0            | 799.25                      | 804.75                     |
| 63                    | 806.0-814.0            | 807.25                      | 812.75                     |
| 64                    | 814.0-822.0            | 815.25                      | 820.75                     |
| 65                    | 822.0-830.0            | 823.25                      | 828.75                     |
| 66                    | 830.0-838.0            | 831.25                      | 836.75                     |
| 67                    | 838.0-846.0            | 839.25                      | 844.75                     |
| 68                    | 846.0-854.0            | 847.25                      | 852.75                     |
| 69                    | 854.0-862.0            | 855.25                      | 860.75                     |

# PAL SECAM (D/K) Cable Television Channel Frequencies for the People's Republic of China


**Note**

The downstream frequency plan includes all center frequencies between 112 and 862 MHz in 250 kHz increments. It is up to the operator to decide which frequencies to use to meet national and network requirements

**Table C-8** Cable Television Channels and Relative Frequencies, PAL D and K

| Channel Number | Bandwidth (MHz) | Visual Carrier (MHz) | Aural Carrier (MHz) |
|----------------|-----------------|----------------------|---------------------|
| Z1             | 112.0-119.0     | 112.25               | 118.75              |
| Z2             | 120.0-127.0     | 120.25               | 126.75              |
| Z3             | 128.0-135.0     | 128.25               | 134.75              |
| Z4             | 136.0-143.0     | 136.25               | 142.75              |
| Z5             | 144.0-151.0     | 144.25               | 150.75              |
| Z6             | 152.0-159.0     | 152.25               | 158.75              |
| Z7             | 160.0-167.0     | 160.25               | 166.75              |
| DS6            | 168.0-175.0     | 168.25               | 174.75              |
| DS7            | 176.0-183.0     | 176.25               | 182.75              |
| DS8            | 184.0-191.0     | 184.25               | 190.75              |
| DS9            | 192.0-199.0     | 192.25               | 198.75              |
| DS10           | 200.0-207.0     | 200.25               | 206.75              |
| DS11           | 208.0-215.0     | 208.25               | 214.75              |
| DS12           | 216.0-223.0     | 216.25               | 222.5               |
| Z8             | 224.0-231.0     | 224.25               | 230.75              |
| Z9             | 232.0-239.0     | 232.25               | 238.75              |
| Z10            | 240.0-247.0     | 240.25               | 246.75              |
| Z11            | 248.0-255.0     | 248.25               | 254.75              |
| Z12            | 256.0-263.0     | 256.25               | 262.75              |
| Z13            | 264.0-271.0     | 264.25               | 270.75              |
| Z14            | 272.0-279.0     | 272.25               | 278.75              |
| Z15            | 280.0-287.0     | 280.25               | 286.75              |
| Z16            | 288.0-295.0     | 288.25               | 294.75              |
| Z17            | 296.0-303.0     | 296.25               | 302.75              |
| Z18            | 304.0-311.0     | 304.25               | 310.75              |
| Z19            | 312.0-319.0     | 312.25               | 318.75              |
| Z20            | 320.0-327.0     | 320.25               | 326.75              |
| Z21            | 328.0-335.0     | 328.25               | 334.75              |



**Table C-8** Cable Television Channels and Relative Frequencies, PAL D and K (continued)

| <b>Channel Number</b> | <b>Bandwidth (MHz)</b> | <b>Visual Carrier (MHz)</b> | <b>Aural Carrier (MHz)</b> |
|-----------------------|------------------------|-----------------------------|----------------------------|
| Z22                   | 336.0-343.0            | 336.25                      | 342.75                     |
| Z23                   | 344.0-351.0            | 344.25                      | 350.75                     |
| Z24                   | 352.0-359.0            | 352.25                      | 358.75                     |
| Z25                   | 362.0-367.0            | 362.25                      | 366.75                     |
| Z26                   | 368.0-375.0            | 368.25                      | 374.75                     |
| Z27                   | 376.0-383.0            | 376.25                      | 382.75                     |
| Z28                   | 384.0-391.0            | 384.25                      | 390.75                     |
| Z29                   | 393.0-399.0            | 392.25                      | 398.75                     |
| Z30                   | 400.0-407.0            | 400.25                      | 406.75                     |
| Z32                   | 408.0-415.0            | 408.25                      | 414.05                     |
| Z32                   | 416.0-423.0            | 416.25                      | 422.75                     |
| Z33                   | 424.0-431.0            | 424.25                      | 430.75                     |
| Z34                   | 432.0-439.0            | 432.25                      | 438.75                     |
| Z35                   | 440.0-447.0            | 440.25                      | 446.75                     |
| Z36                   | 448.0-455.0            | 448.25                      | 454.75                     |
| Z37                   | 456.0-463.0            | 456.25                      | 462.75                     |
| DS13                  | 471.0-478.0            | 471.25                      | 477.75                     |
| DS14                  | 479.0-486.0            | 479.25                      | 485.75                     |
| DS15                  | 487.0-494.0            | 487.25                      | 493.75                     |
| DS16                  | 495.0-502.0            | 495.25                      | 501.75                     |
| DS17                  | 503.0-510.0            | 503.25                      | 509.75                     |
| DS18                  | 511.0-518.0            | 511.25                      | 517.75                     |
| DS19                  | 519.0-526.0            | 519.25                      | 525.75                     |
| DS20                  | 527.0-534.0            | 527.25                      | 533.75                     |
| DS21                  | 535.0-542.0            | 535.25                      | 541.75                     |
| DS22                  | 543.0-550.0            | 543.25                      | 549.75                     |
| DS23                  | 551.0-558.0            | 551.25                      | 557.75                     |
| DS24                  | 559.0-566.0            | 559.25                      | 565.75                     |
| Z38                   | 567.0-574.0            | 567.25                      | 573.75                     |
| Z39                   | 575.0-582.0            | 575.25                      | 581.75                     |
| Z40                   | 583.0-590.0            | 583.25                      | 589.75                     |
| Z41                   | 591.0-598.0            | 591.25                      | 597.75                     |
| Z42                   | 599.0-606.0            | 599.25                      | 605.75                     |
| DS25                  | 607.0-614.0            | 607.25                      | 613.75                     |
| DS26                  | 615.0-622.0            | 615.25                      | 621.75                     |

**Table C-8** Cable Television Channels and Relative Frequencies, PAL D and K (continued)

| <b>Channel Number</b> | <b>Bandwidth (MHz)</b> | <b>Visual Carrier (MHz)</b> | <b>Aural Carrier (MHz)</b> |
|-----------------------|------------------------|-----------------------------|----------------------------|
| DS27                  | 623.0-630.0            | 623.25                      | 629.725                    |
| DS28                  | 631.0-638.0            | 631.25                      | 637.75                     |
| DS29                  | 639.0-646.0            | 639.25                      | 645.75                     |
| DS30                  | 647.0-654.0            | 647.25                      | 653.75                     |
| DS31                  | 655.0-662.0            | 655.25                      | 661.75                     |
| DS32                  | 663.0-670.0            | 663.25                      | 669.75                     |
| DS33                  | 671.0-678.0            | 671.25                      | 677.75                     |
| DS34                  | 679.0-686.0            | 679.25                      | 685.75                     |
| DS35                  | 687.0-694.0            | 687.25                      | 693.75                     |
| DS36                  | 695.0-702.0            | 695.25                      | 701.75                     |
| DS37                  | 703.0-710.0            | 703.25                      | 709.75                     |
| DS38                  | 711.0-718.0            | 711.25                      | 717.75                     |
| DS39                  | 719.0-726.0            | 719.25                      | 725.75                     |
| DS40                  | 727.0-730.0            | 727.25                      | 729.75                     |
| DS41                  | 735.0-742.0            | 735.25                      | 741.75                     |
| DS42                  | 743.0-750.0            | 743.25                      | 749.75                     |
| DS43                  | 751.0-758.0            | 751.25                      | 757.75                     |
| DS44                  | 759.0-766.0            | 759.25                      | 765.75                     |
| DS45                  | 767.0-774.0            | 767.25                      | 773.75                     |
| DS46                  | 775.0-782.0            | 775.25                      | 781.75                     |
| DS47                  | 783.0-790.0            | 783.25                      | 789.75                     |
| DS48                  | 791.0-798.0            | 791.25                      | 797.75                     |
| DS49                  | 799.0-806.0            | 799.25                      | 805.75                     |
| DS50                  | 807.0-814.0            | 807.25                      | 813.75                     |
| DS51                  | 815.0-822.0            | 815.25                      | 821.75                     |
| DS52                  | 823.0-730.0            | 823.25                      | 829.75                     |
| DS53                  | 831.0-838.0            | 831.25                      | 837.75                     |
| DS54                  | 839.0-846.0            | 839.25                      | 845.75                     |
| DS55                  | 847.0-854.0            | 847.25                      | 853.75                     |
| DS56                  | 855.0-862.0            | 855.25                      | 861.75                     |



## Manufacturers for Hardware Components

[Table D-1](#) and [Table D-2](#) provide contact information for manufacturers, web sites, and product offerings required to prepare and provision a North American cable headend site for two-way data.

[Table D-3](#) and [Table D-4](#) provide contact information for manufacturers, web sites, and product offerings required to prepare and provision a European cable headend site for two-way data.

[Table D-5](#) provides a list of parts and manufacturers used with the cable interface line card.

[Table D-6](#) provides a list manufacturers for the external AC-input power shelves that are used with the Cisco uBR10012 router.

### North American Channel Plans

**Table D-1** *Manufacturers for North American Headend Provisioning Requirements*

| Manufacturer <sup>1</sup>                                | Web Site or Phone Number                                                    | Products/Model                                                                              |
|----------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| <b>Upconverters</b>                                      |                                                                             |                                                                                             |
| Barco                                                    | <a href="http://www.barco.com">http://www.barco.com</a>                     | Gemini                                                                                      |
| Motorola <sup>2</sup>                                    | <a href="http://www.gi.com">http://www.gi.com</a>                           | CDCM2000                                                                                    |
| Scientific Atlanta                                       | <a href="http://www.sciatl.com">http://www.sciatl.com</a>                   | Continuum 9860, 9861                                                                        |
| Vecima Networks, Inc.                                    | <a href="http://www.vecima.com/">http://www.vecima.com/</a>                 | HD4040, MA4040                                                                              |
| <b>Diplex Filters</b>                                    |                                                                             |                                                                                             |
| Eagle Comtronics                                         | <a href="http://www.eaglecomtronics.com">http://www.eaglecomtronics.com</a> | Diplex filters                                                                              |
| Microwave Filter Company, Inc.                           | <a href="http://www.microwavefilter.com">http://www.microwavefilter.com</a> | Diplex filters                                                                              |
| PCI Technologies                                         | <a href="http://www.pci.com">http://www.pci.com</a>                         | Diplex filters                                                                              |
| Viewsonics                                               | <a href="http://www.viewsonics.com">http://www.viewsonics.com</a>           | Diplex filters                                                                              |
| <b>Coaxial Jumpers, Attenuators, Splitters, and Taps</b> |                                                                             |                                                                                             |
| Viewsonics                                               | <a href="http://www.viewsonics.com">http://www.viewsonics.com</a>           | Variable attenuators, Comb generators, Cisco uBR kit (splitter, diplex filter, attenuators) |
| Vecima Networks, Inc.                                    | <a href="http://www.vecima.com/">http://www.vecima.com/</a>                 | Cisco uBR kit (splitter, diplex filter, attenuators)                                        |

**Table D-1** *Manufacturers for North American Headend Provisioning Requirements (continued)*

| <b>Manufacturer<sup>1</sup></b> | <b>Web Site or Phone Number</b>                                                                                                                     | <b>Products/Model</b>  |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| White Sands Engineering, Inc    | <a href="http://www.whitesandsengineering.com">http://www.whitesandsengineering.com</a><br>1 800-jumpers or 602 581-0331                            | Coaxial jumpers        |
| <b>GPS Receivers</b>            |                                                                                                                                                     |                        |
| Agilent <sup>3</sup>            | <a href="http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng">http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng</a> | Agilent 85960B, 85961B |
| Symmetricom                     | <a href="http://www.symmetricom.com">http://www.symmetricom.com</a>                                                                                 | TS2500, TS2700, TS3000 |

1. The lead times for upconverters can run from 2 to 18 weeks. Contact the upconverter manufacturers listed above for current information on lead times.
2. Formerly General Instrument
3. Formerly Hewlett-Packard Test and Measurement Division.

In addition, Cisco recommends the following manufacturers, web sites, and product offerings for various measurement devices you will need to prepare and provision a North American cable headend site for two-way data.

**Table D-2** *Manufacturers for North American Headend Measurement Devices*

| <b>Manufacturer</b>                              | <b>Web Site or Phone Number</b>                                                                                                                     | <b>Products/Model</b> |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>Digital Signal Level Meters/QAM Analyzers</b> |                                                                                                                                                     |                       |
| Acterna                                          | <a href="http://www.acterna.com">http://www.acterna.com</a>                                                                                         | SDA-5000, w/Option 4B |
| Agilent <sup>1</sup>                             | <a href="http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng">http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng</a> | Agilent 8594Q, N1776A |
| Telsey <sup>2</sup>                              | <a href="http://www.telsey.it">http://www.telsey.it</a>                                                                                             | DMA120, DMA122        |
| Sencore                                          | <a href="http://www.sencore.com">http://www.sencore.com</a>                                                                                         | QAM-B970              |
| Sunrise Telecom <sup>3</sup>                     | <a href="http://www.sunrisetelecom.com">http://www.sunrisetelecom.com</a>                                                                           | CR1200R, AT2000RQ     |
| Trilithic                                        | <a href="http://www.trilithic.com">http://www.trilithic.com</a>                                                                                     | 860DSP w/Option QA1   |
| <b>Spectrum Analyzers</b>                        |                                                                                                                                                     |                       |
| Agilent                                          | <a href="http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng">http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng</a> | Agilent 8591C, N1776A |
| Tektronics                                       | <a href="http://www.tek.com">http://www.tek.com</a>                                                                                                 | 2715                  |
| Sunrise Telecom                                  | <a href="http://www.sunrisetelecom.com">http://www.sunrisetelecom.com</a>                                                                           | AT2000R               |
| <b>Vector Signal Analyzers</b>                   |                                                                                                                                                     |                       |
| Agilent                                          | <a href="http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng">http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng</a> | Agilent 89411A        |

1. Formerly Hewlett-Packard Test and Measurement Division.
2. Formerly Tektronics DMA division
3. Formerly Hukk Engineering and Avatron.

# European Channel Plans

**Table D-3** Manufacturers for European Headend Provisioning Requirements

| Manufacturer <sup>1</sup>                                | Web Site or Phone Number                                                                                                                            | Products/Model                                                                                                 |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>Upconverters</b>                                      |                                                                                                                                                     |                                                                                                                |
| Barco                                                    | <a href="http://www.barco.com">http://www.barco.com</a>                                                                                             | Gemini                                                                                                         |
| Motorola <sup>2</sup>                                    | <a href="http://www.gi.com">http://www.gi.com</a>                                                                                                   | CDCM2000                                                                                                       |
| Scientific Atlanta                                       | <a href="http://www.sciatl.com">http://www.sciatl.com</a>                                                                                           | Continuum                                                                                                      |
| Vecima Networks, Inc.                                    | <a href="http://www.vecima.com/">http://www.vecima.com/</a>                                                                                         | HD4040, MA4040                                                                                                 |
| <b>Diplex Filters</b>                                    |                                                                                                                                                     |                                                                                                                |
| Eagle Comtronics                                         | <a href="http://www.eaglecomtronics.com">http://www.eaglecomtronics.com</a>                                                                         | Diplex filters                                                                                                 |
| Microwave Filter Company, Inc.                           | <a href="http://www.microwavefilter.com">http://www.microwavefilter.com</a>                                                                         | Diplex filters                                                                                                 |
| PCI Technologies                                         | <a href="http://www.pci.com">http://www.pci.com</a>                                                                                                 | Diplex filters                                                                                                 |
| Viewsonics                                               | <a href="http://www.viewsonics.com">http://www.viewsonics.com</a>                                                                                   | Diplex filters                                                                                                 |
| <b>Coaxial Jumpers, Attenuators, Splitters, and Taps</b> |                                                                                                                                                     |                                                                                                                |
| Viewsonics                                               | <a href="http://www.viewsonics.com">http://www.viewsonics.com</a>                                                                                   | Variable attenuators,<br>Comb generators,<br>Cisco kit (splitter, diplex filter,<br>attenuators, coax jumpers) |
| Vecima Networks, Inc.                                    | <a href="http://www.vecima.com/">http://www.vecima.com/</a>                                                                                         | Cisco uBR kit (splitter, diplex filter,<br>attenuators)                                                        |
| White Sands Engineering, Inc                             | <a href="http://www.whitesandsengineering.com">http://www.whitesandsengineering.com</a><br>1 800-jumpers or 602 581-0331                            | Coaxial jumpers                                                                                                |
| <b>GPS Receivers</b>                                     |                                                                                                                                                     |                                                                                                                |
| Agilent <sup>3</sup>                                     | <a href="http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng">http://www.home.agilent.com/agilent/home.jsp?&amp;cc=IN&amp;lc=eng</a> | Agilent 85960B, 85961B                                                                                         |
| Symmetricom                                              | <a href="http://www.symmetricom.com">http://www.symmetricom.com</a>                                                                                 | TS2500, TS2700, TS3000                                                                                         |

1. The lead times for upconverters can run from 2 to 18 weeks. Contact the upconverter manufacturers listed above for current information on lead times.
2. Formerly General Instrument
3. Formerly Hewlett-Packard Test and Measurement Division.

In addition, Cisco recommends the following manufacturers, web sites, and product offerings for various measurement devices you will need to prepare and provision a European cable headend site for two-way data.

Table D-4 Manufacturers for European Headend Measurement Devices

| Manufacturer                                     | Web Site or Phone Number                                    | Products/Model        |
|--------------------------------------------------|-------------------------------------------------------------|-----------------------|
| <b>Digital Signal Level Meters/QAM Analysers</b> |                                                             |                       |
| Acterna                                          | http://www.acterna.com                                      | SDA-5000 w/Option 4B  |
| Agilent <sup>1</sup>                             | http://www.home.agilent.com/agilent/home.jspx?&cc=IN&lc=eng | Agilent 8594Q, N1776A |
| Sunrise Telecom <sup>2</sup>                     | http://www.sunrisetelecom.com                               | AT2000RQ              |
| Swires Research                                  | http://www.swire.com                                        | TVA 2000-Q            |
| Telsey <sup>3</sup>                              | http://www.telsey.it                                        | DMA121, DMA122        |
| Trilithic                                        | http://www.trilithic.com                                    | 860DSP w/Option QA1   |
| <b>Spectrum Analyzers</b>                        |                                                             |                       |
| Agilent                                          | http://www.home.agilent.com/agilent/home.jspx?&cc=IN&lc=eng | Agilent 8591C         |
| Tektronix                                        | http://www.tek.com                                          | 2715                  |
| Sunrise Telecom                                  | http://www.sunrisetelecom.com                               | AT2000R               |
| <b>Vector Signal Analyzers</b>                   |                                                             |                       |
| Agilent                                          | http://www.home.agilent.com/agilent/home.jspx?&cc=IN&lc=eng | Agilent 89411A        |

1. Formerly Hewlett-Packard Test and Measurement Division

2. Formerly Hukk Engineering and Avantron.

3. Formerly Tektronics DMA division

## Cable Kits and Tools

Table D-5 Tool Manufactures

| Manufacturer                                                                                                    | Web Site or Phone Number                                              | Products/Model                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Belden Electronics division                                                                                     | http://www.belden.com                                                 | 75-ohm precision miniature video cable                                                                                                                                                                                                                                                                                       |
| JohnsonComponents                                                                                               | http://www.johnsoncomponents.com                                      | Universal cable holder                                                                                                                                                                                                                                                                                                       |
| White Sands Engineering, Inc<br><b>Note</b> For a list of part numbers, see the FRU documentation. <sup>1</sup> | http://www.whitesandsengineering.com<br>1 800-jumpers or 602 581-0331 | Cable kit (3m MCX to F cables)<br>Cable kit with pre configured cables<br>Cable extraction tool<br>Universal cable holder<br>MCX connector strip tool<br>MCX connector crimper tool<br>MCX fixed pin connector<br>MCX connector to F connector adapter<br>F connector strip tool<br>F connector crimper tool<br>F connectors |

1. For cable interface line card documentation, see the following URL:

[www.cisco.com/en/US/products/hw/cable/ps2209/prod\\_installation\\_guides\\_list.html](http://www.cisco.com/en/US/products/hw/cable/ps2209/prod_installation_guides_list.html)

# External AC-Input Power Shelves

**Table D-6** AC-input Power Shelves Manufacturers

| <b>Manufacturer</b>  | <b>Web Site or Phone Number</b>                                       | <b>Products/Model</b>                            |
|----------------------|-----------------------------------------------------------------------|--------------------------------------------------|
| Lineage <sup>1</sup> | <a href="http://www.lineagepower.com">http://www.lineagepower.com</a> | Lineage Power AC-DC Power Supply<br>J85480S1 L30 |

1. For ordering, visit [www.arrow.com](http://www.arrow.com)







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## Symbols

- 1+1 APS** See [APS](#).
- 10Base-T** 10-Mbps baseband Ethernet specification using two pairs of twisted-pair cabling (Category 3, 4, or 5): one pair for transmitting data and the other for receiving data. 10Base-T, which is part of the IEEE 802.3 specification, has a distance limit of approximately 328 feet (100 meters) per segment. See also [IEEE 802.3](#) and [Ethernet](#).
- 100Base-T** 100-Mbps baseband Fast Ethernet specification using UTP wiring. Like the 10Base-T technology on which it is based, 100Base-T sends link pulses over the network segment when no traffic is present. However, these link pulses contain more information than those used in 10Base-T. The 100Base-T specification is based on the IEEE 802.3 standard. See also [10Base-T](#), [Fast Ethernet](#), and [IEEE 802.3](#).
- 1000Base-LX/LH** 1000-Mbps Gigabit Ethernet specification using two strands of multimode or single mode fiber-optic cable per link. To guarantee proper signal recovery, a 1000Base-LX/LH link cannot exceed 1804 feet (550 meters) in length over multimode fiber or 32,810 feet (10 km) in length over single mode fiber. Based on the IEEE 802.3 standard with reach over single mode fiber extended from 5 km to 10 km. See also [1000Base-SX](#), [1000Base-ZX](#), [Gigabit Ethernet](#), and [IEEE 802.3](#).
- 1000Base-SX** 1000-Mbps Gigabit Ethernet specification using two strands of multimode fiber-optic cable per link. To guarantee proper signal recovery, a 1000Base-SX link cannot exceed 1804 feet (550 meters) in length. The 1000Base-SX specification is based on the IEEE 802.3 standard. See also [1000Base-LX/LH](#), [1000Base-ZX](#), [Gigabit Ethernet](#), and [IEEE 802.3](#).
- 1000Base-T** 1000Base-T (GLC-T) SFP module connects a Cisco Gigabit Interface Converter (GBIC) port to Category 5 wiring via a standard RJ-45 interface. The maximum Category 5 wiring distance is 100 m. The module provides with an option of connecting to a backhaul network interface.
- 1000Base-X** 1000-Mbps Gigabit Ethernet specification that refers to the 1000Base-CX, 1000Base-SX, and 1000Base-LX standards for Gigabit Ethernet over fiber-optic cabling. The 1000Base-X specification is based on the IEEE 802.3 standard. See also [1000Base-SX](#), [1000Base-LX/LH](#), [1000Base-ZX](#), [Gigabit Ethernet](#), and [IEEE 802.3](#).
- 1000Base-ZX** 1000-Mbps Gigabit Ethernet specification using two strands of single mode fiber-optic cable per link. To guarantee proper signal recovery, a 1000Base-ZX link cannot be longer than 62.1 mi (100 km). This is a Cisco specification. See also [1000Base-SX](#), [1000Base-LX/LH](#), [Gigabit Ethernet](#), and [IEEE 802.3](#).
- 802.x** A set of IEEE standards for the definition of LAN protocols.

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**A**

- AAL** ATM adaptation layer. Service-dependent sublayer of the data link layer. The AAL accepts data from different applications and presents it to the ATM layer in the form of 48-byte ATM payload segments. AALs consist of two sublayers: the convergence sublayer and the segmentation and reassembly sublayer. Four types of AAL recommended by the ITU-T are AAL1, AAL2, AAL3/4, and AAL5; the Cisco uBR10012 uses AAL5.
- Access list** List kept by routers to control access to or from the router for a number of services. For example, access lists can be used to prevent packets with a certain IP address from leaving a particular interface on the router.
- Add drop Multiplexer** See [ADM](#).
- ADM** Add Drop Multiplexer. A multiplexer that allows a signal to be added into or dropped out of a SONET span. See also [SONET](#).
- Alarm** A status condition that shows that a module or port is experiencing an abnormal operating condition. See also [Critical alarm](#), [Major alarm](#), and [Minor alarm](#).
- Application-specific integrated circuit** See [ASIC](#).
- APS** Automatic Protection Switching. A SONET switching mechanism that achieves network resiliency by automatically switching from a primary circuit to a secondary circuit. This switching process occurs if the primary circuit fails or if the error rate on the primary line exceeds a set threshold. The Cisco 10000 ESR supports 1+1 APS, which provides permanent electrical bridging to the service and protection equipment, placed at both ends of the circuit.
- ASIC** Application-specific integrated circuit. A chip that is built for a specific application.
- Asynchronous Transfer Mode** See [ATM](#).
- ATM** Asynchronous Transfer Mode. International standard for cell relay in which multiple service types (such as voice, video, or data) are conveyed in fixed-length (53-byte) cells. Fixed-length cells allow cell processing to occur in hardware, thereby reducing transit delays. ATM is designed to take advantage of high-speed transmission media such as E3, SONET, and T3.
- Authentication** In security, the verification of the identity of a person or process.
- Automatic protection switching** See [APS](#).
- Alarm** A status condition that shows that a module or port is experiencing an abnormal operating condition. See also [Critical alarm](#), [Major alarm](#), and [Minor alarm](#).

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**B**

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|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Backplane</b>               | The circuit board at the back of the chassis that all components plug into. It provides the physical connection between an interface processor or line card, and the data and power distribution buses inside a chassis. |
| <b>Bellcore</b>                | Bell Communications Research. Former name of the organization that performs research and development on behalf of the Regional Bell Operating Companies (RBOCs). Bellcore is now called Telcordia.                       |
| <b>BER</b>                     | Bit error rate. The ratio of received bits that contain errors.                                                                                                                                                          |
| <b>BGP</b>                     | Border Gateway Protocol. An interdomain routing protocol that replaces EGP. BGP exchanges connection information with other BGP systems. It is defined by RFC 1163.                                                      |
| <b>Bit error rate</b>          | See <a href="#">BER</a> .                                                                                                                                                                                                |
| <b>Border Gateway Protocol</b> | See <a href="#">BGP</a> .                                                                                                                                                                                                |
| <b>Broadcast</b>               | Data packet that is sent to all nodes on a network. Broadcasts are identified by a broadcast address. Compare with <a href="#">Multicast</a> and <a href="#">Unicast</a> .                                               |

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**C**

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| <b>CCITT</b>                    | Consultative Committee for International Telegraph and Telephone. International organization responsible for the development of communications standards. Now called the ITU-T. (See <a href="#">ITU-T</a> .)                                                                                                                                                             |
| <b>CEF</b>                      | Cisco Express Forwarding. An advanced Layer 3 IP switching technology designed for high-performance, highly resilient Layer 3 IP backbone switching. CEF optimizes network performance and scalability for networks with large and dynamic traffic patterns, such as the Internet, on networks characterized by intensive Web-based applications or interactive sessions. |
| <b>Central Office</b>           | See <a href="#">CO</a> .                                                                                                                                                                                                                                                                                                                                                  |
| <b>Channel</b>                  | Communication path. Multiple channels can be multiplexed over a single cable in certain environments.                                                                                                                                                                                                                                                                     |
| <b>Cisco Express Forwarding</b> | See <a href="#">CEF</a> .                                                                                                                                                                                                                                                                                                                                                 |
| <b>Cisco IOS</b>                | Cisco system software that provides common functionality, scalability, and security for Cisco products. Cisco IOS allows centralized, integrated, and automated installation and management of internetworks, while ensuring support for a wide variety of protocols, media, services, and platforms.                                                                     |
| <b>Clear channel DS3</b>        | A framed DS3 signal which is not multiplexed from 28 DS1 signals. Sometimes referred to as unchannelized DS3.                                                                                                                                                                                                                                                             |
| <b>CLI</b>                      | Command line interface. Interface that allows the user to interact with the operating system by entering commands and optional arguments at the command prompt.                                                                                                                                                                                                           |

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|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO</b>                     | Central office. The local telephone company office to which all local loops in a given area connect and in which circuit switching of subscriber lines occurs.                                                                                                         |
| <b>Command Line Interface</b> | See <a href="#">CLI</a> .                                                                                                                                                                                                                                              |
| <b>Console</b>                | Data terminal equipment (DTE) through which commands are entered into a host.                                                                                                                                                                                          |
| <b>Critical alarm</b>         | An alarm condition that might affect most or all subscribers that connect to the reporting node. To obtain more information about a problem, use the <b>show facility-alarm status</b> command. See also <a href="#">Major alarm</a> and <a href="#">Minor alarm</a> . |

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## D

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|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data terminal equipment</b>      | See <a href="#">DTE</a> .                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>DCE</b>                          | Data circuit-terminating equipment (ITU-T expansion). Devices and connections of a communications network that comprise the network end of the user-to-network interface. The DCE provides a physical connection to the network, forwards traffic, and provides a clocking signal used to synchronize data transmission between DCE and DTE devices. Modems and interface cards are examples of DCE. Compare with <a href="#">DTE</a> . |
| <b>DRAM</b>                         | Dynamic random access memory. RAM that stores information in capacitors that must be periodically refreshed. Delays can occur because DRAMs are inaccessible to the processor when refreshing their contents. However, DRAMs are less complex and have greater capacity than SRAMs. See also <a href="#">SRAM</a> .                                                                                                                     |
| <b>DS0</b>                          | Digital signal level 0. Framing specification used in transmitting digital signals over a single channel at 64 kbps on a T1 facility. Compare with <a href="#">DS1</a> and <a href="#">DS3</a> .                                                                                                                                                                                                                                        |
| <b>DS1</b>                          | Digital signal level 1. Framing specification used in transmitting digital signals at 1.544 Mbps on a T1 facility (in the United States) or at 2.108 Mbps on an E1 facility (in Europe). Compare with <a href="#">DS0</a> and <a href="#">DS3</a> .                                                                                                                                                                                     |
| <b>DS3</b>                          | Digital signal level 3. Framing specification used for transmitting digital signals at 44.736 Mbps on a T3 facility. Compare with <a href="#">DS0</a> and <a href="#">DS1</a> .                                                                                                                                                                                                                                                         |
| <b>DSU</b>                          | Data Service Unit. Device used in digital transmission that adapts the physical interface on a DTE device to a transmission facility such as T1 or E1. The DSU is also responsible for such functions as signal timing. Often used with CSU, as in CSU/DSU.                                                                                                                                                                             |
| <b>DTE</b>                          | Data terminal equipment. Device at the user end of a user-network interface that serves as a data source, destination, or both. DTE connects to a data network through a DCE device (for example, a modem) and typically uses clocking signals generated by the DCE. DTE includes devices such as computers, protocol translators, and multiplexers.                                                                                    |
| <b>Dynamic random access memory</b> | See <a href="#">DRAM</a> .                                                                                                                                                                                                                                                                                                                                                                                                              |

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**E**

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| <b>E1</b>                           | Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. E1 lines can be leased for private use from common carriers. Compare with T1; see also DS1.                                                                                                |
| <b>Edge Services Router</b>         | See <a href="#">ESR</a> .                                                                                                                                                                                                                                                                                |
| <b>Electromagnetic interference</b> | See <a href="#">EMI</a> .                                                                                                                                                                                                                                                                                |
| <b>Electrostatic discharge</b>      | See <a href="#">ESD</a> .                                                                                                                                                                                                                                                                                |
| <b>EMI</b>                          | Electromagnetic interference. Interference by electromagnetic signals that can cause reduced data integrity and increased error rates on transmission channels.                                                                                                                                          |
| <b>EMP</b>                          | Electromagnetic pulse. Caused by lightning and other high-energy phenomena. Capable of coupling enough energy into unshielded conductors to destroy electronic devices.                                                                                                                                  |
| <b>ESD</b>                          | Electrostatic discharge. Discharge of stored static electricity that can damage electronic equipment and impair electrical circuitry, resulting in complete or intermittent failures.                                                                                                                    |
| <b>ESR</b>                          | Edge Services Router. A router that aggregates and routes traffic from thousands of low- and medium-bandwidth subscriber connections into a few high-bandwidth connections to the Internet core.                                                                                                         |
| <b>Ethernet</b>                     | Baseband LAN specification. Ethernet networks use CSMA/CD and run over a variety of cable types at 10 Mbps, 100 Mbps, and 1000 Mbps. Ethernet is similar to the IEEE 802.3 series of standards. See also <a href="#">Fast Ethernet</a> , <a href="#">Gigabit Ethernet</a> , <a href="#">IEEE 802.3</a> . |

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**F**

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| <b>Fast Ethernet</b>          | Any of a number of 100-Mbps Ethernet specifications. Fast Ethernet offers a speed increase 10 times that of the 10Base-T Ethernet specification, while preserving qualities such as frame format, MAC mechanisms, and MTU. Existing 10Base-T applications and network management tools can be used on Fast Ethernet networks. The Fast Ethernet specification is based on an extension to the IEEE 802.3 specification. Compare with <a href="#">Ethernet</a> and <a href="#">Gigabit Ethernet</a> . See also <a href="#">100Base-T</a> and <a href="#">IEEE 802.3</a> . |
| <b>Fiber-optic cable</b>      | Physical medium capable of conducting modulated light transmission. Compared with other transmission media, fiber-optic cable is more expensive, but it is not susceptible to electromagnetic interference and is capable of higher data rates. Sometimes called optical fiber.                                                                                                                                                                                                                                                                                          |
| <b>Field-replaceable unit</b> | See <a href="#">FRU</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Flash memory</b>           | Nonvolatile storage that can be electrically erased and reprogrammed so that software images can be stored, booted, and rewritten as necessary. Flash memory was developed by Intel and is licensed to other semiconductor companies.                                                                                                                                                                                                                                                                                                                                    |

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| <b>Frame Relay</b> | Industry-standard, switched data link layer protocol that handles multiple virtual circuits using HDLC encapsulation between connected devices. Frame Relay is more efficient than X.25, the protocol for which it is generally considered a replacement. |
| <b>FRU</b>         | Field replaceable unit. A component that can be removed from a network device and replaced in the field. Line cards, power modules, and fan modules are typically FRUs.                                                                                   |

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## G

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|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>GBIC</b>                        | Gigabit Ethernet converter. An interface module used by Gigabit Ethernet and Fibre Channel to convert the serial electrical signals to the transmission medium's physical layer signalling, which is typically optical. GBIC modules can be hot-swapped and contain ID and system information that a switch or router can use to determine the network device's capabilities. Different GBICs handle different types of fiber cable. See <a href="#">1000Base-LX/LH</a> , <a href="#">1000Base-SX</a> , and <a href="#">1000Base-ZX</a> . |
| <b>Gigabit Ethernet</b>            | Gigabit Ethernet. Ethernet running at a transmission speed of 1 billion bits per second.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Gigabit Interface Converter</b> | See <a href="#">GBIC</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

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## H

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|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HHGE</b>         | Half-Height Gigabit Ethernet                                                                                                                                                                                                                     |
| <b>Hot swapping</b> | Feature that permits the addition, replacement, or removal of cards without interrupting the system power, entering console commands, or causing other software or interfaces to shut down. Sometimes called online insertion and removal (OIR). |

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## I

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|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IEEE</b>                                              | Institute of Electrical and Electronics Engineers. Professional organization whose activities include the development of communications and network standards. IEEE LAN standards are the currently predominant LAN standards.                                                                                      |
| <b>IEEE 802.3</b>                                        | IEEE LAN protocol that specifies an implementation of the physical layer and the MAC sublayer of the data link layer. IEEE 802.3 uses CSMA/CD access at a variety of speeds over a variety of physical media. Extensions to the IEEE 802.3 standard specify implementations for Fast Ethernet and Gigabit Ethernet. |
| <b>Institute of Electrical and Electronics Engineers</b> | See <a href="#">IEEE</a> .                                                                                                                                                                                                                                                                                          |
| <b>Intermediate reach</b>                                | See <a href="#">IR</a> .                                                                                                                                                                                                                                                                                            |
| <b>Internet service provider</b>                         | See <a href="#">ISP</a> .                                                                                                                                                                                                                                                                                           |

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|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IOS</b>          | Internet Operating System. See <a href="#">Cisco IOS</a> .                                                                                                                                                                                                                                        |
| <b>IP</b>           | Internet Protocol. Network layer protocol in the TCP/IP stack offering a connectionless internetwork service. IP provides features for addressing, type-of-service specification, fragmentation and reassembly, and security. Defined in RFC 791.                                                 |
| <b>IP multicast</b> | Routing technique that allows IP traffic to be propagated from one source to a number of destinations or from many sources to many destinations. Rather than sending one packet to each destination, one packet is sent to a multicast group identified by a single IP destination group address. |
| <b>IR</b>           | Intermediate reach. SONET/SDH specification for transmit power and receive sensitivity that achieves a 9.3-mile (15-km) reach.                                                                                                                                                                    |
| <b>ISP</b>          | Internet Service Provider. A company that provides Internet access to other companies and individuals.                                                                                                                                                                                            |
| <b>ITU-T</b>        | International Telecommunication Union Telecommunication Standardization Sector. International body that develops worldwide standards for telecommunications technologies. The ITU-T carries out the functions of the former CCITT.                                                                |

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**L**

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|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LAN</b>                | Local-area network. High-speed, low-error data network covering a relatively small geographic area (up to a few thousand meters). LANs connect workstations, peripherals, terminals, and other devices in a single building or some other geographically limited area. LAN standards specify cabling and signaling at the physical and data link layers of the OSI model. Ethernet, FDDI, and Token Ring are widely used LAN technologies. Compare with <a href="#">MAN</a> and <a href="#">WAN</a> .                                                                                                                               |
| <b>Line card</b>          | Any I/O card that can be inserted in a modular chassis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>LMI</b>                | Local Management Interface. A set of enhancements to the basic Frame Relay specification. LMI includes support for a keepalive mechanism, which verifies that data is flowing; a multicast mechanism, which provides the network server with its local DLCI and the multicast DLCI; global addressing, which gives DLCIs global rather than local significance in Frame Relay networks; and a status mechanism, which provides an on-going status report on the DLCIs known to the switch. Known as LMT in ANSI terminology.                                                                                                        |
| <b>Local-area network</b> | See <a href="#">LAN</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Loopback test</b>      | A test in which signals are sent and then directed back toward their source from some point along the communications path. Loopback tests are often used to test network interface usability.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>LOS</b>                | Loss of signal. A SONET port status indicator that activates when an LOS defect occurs and does not clear throughout the alarm integration period, which is typically 2.5 seconds. An LOS defect occurs when the OC-3 port receives all zeros for 20 microseconds (+.3 ms). This occurrence begins the alarm integration period. If this period elapses without the detection of two consecutive frames in which there are no 20-ms periods of signal loss, the LOS indicator activates. The LOS indicator clears when an LOS defect is not detected for an interval equal to the alarm deactivation period (typically 10 seconds). |

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**M**

- M13** Generic term for equipment that multiplexes DS1s into DS3s. Sometimes used to describe a specific DS3 multiplex format. Some standards use this term to describe a synchronous multiplexing format also known as SYNTRAN. In many cases M13 does not refer to the SYNTRAN format, but instead refers to the format also known as M23.
- M23** A method of multiplexing four DS1 signals into a DS2 signal, then multiplexing seven DS2 signals into a DS3 signal.
- MAC** Media Access Control. Lower of the two sublayers of the data link layer defined by the IEEE. The MAC sublayer handles access to shared media.
- MAC address** Standardized data link layer address that is required for each port or device that connects to a LAN. Other devices in the network use these addresses to locate specific ports in the network, and to create and update routing tables and data structures. MAC addresses are 6 bytes long and are controlled by the IEEE. Also known as a hardware address, MAC-layer address, or physical address.
- Major alarm** One of a group of alarm conditions that are considered the second most severe of all reportable alarms. Major alarms affect several subscribers who connect to the reporting node. You can use the **show facility-alarm status** IOS command to obtain more information about the problem. See also [Critical alarm](#) and [Minor alarm](#).
- MAN** Metropolitan-area network. A network that spans a metropolitan area. Generally, a MAN spans a larger geographic area than a LAN, but a smaller geographic area than a WAN. Compare with [LAN](#) and [WAN](#).
- Management Information Base** See [MIB](#).
- Media Access Control** See [MAC](#).
- Metropolitan-area network** See [MAN](#).
- MIB** Management Information Base. Database of network management information that is used and maintained by a network management protocol such as SNMP or CMIP. The value of a MIB object can be changed or retrieved using SNMP or CMIP commands, usually through a GUI-based network management system. MIB objects are organized in a tree structure that includes public (standard) and private (proprietary) branches.
- Minor alarm** One of a group of alarm conditions that are considered the third most severe of all reportable alarms. Minor alarms affect a single or small number of subscribers who connect to the reporting node. You can use the **show facility-alarm status** IOS command to obtain more information about the problem. See also [Critical alarm](#) and [Major alarm](#).
- MLP** Multilink Point-to-Point Protocol. A method of splitting, recombining, and sequencing datagrams across multiple logical data links.
- MMF** Multimode fiber. Optical fiber supporting propagation of multiple frequencies of light. See also [Single-mode fiber](#).
- MPLS** Multiprotocol Label Switching. An emerging industry standard upon which tag switching is based.



|                                      |                                                                                                                                                                                                                               |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Multicast</b>                     | Single packets copied by the network and sent to a specific subset of network addresses. These addresses are specified in the Destination Address field. Compare with <a href="#">Broadcast</a> and <a href="#">Unicast</a> . |
| <b>Multilink Point-to-Point</b>      | See <a href="#">MLP</a> .                                                                                                                                                                                                     |
| <b>Multimode fiber</b>               | See <a href="#">MMF</a> .                                                                                                                                                                                                     |
| <b>Multiplexing</b>                  | An activity in which multiple logical signals are transmitted simultaneously across a single physical channel.                                                                                                                |
| <b>Multiprotocol Label Switching</b> | See <a href="#">MPLS</a> .                                                                                                                                                                                                    |

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## N

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|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NEBS</b>                               | Network Equipment Building Systems. The Telcordia (formerly Bellcore) requirements for equipment deployed in a central office environment. Covers spatial, hardware, crafts person interface, thermal, fire resistance, handling and transportation, earthquake and vibration, airborne contaminants, grounding, acoustical noise, illumination, EMC, and ESD requirements. |
| <b>Network Equipment Building Systems</b> | See <a href="#">NEBS</a> .                                                                                                                                                                                                                                                                                                                                                  |
| <b>Network termination unit</b>           | See <a href="#">NTU</a> .                                                                                                                                                                                                                                                                                                                                                   |
| <b>Nonvolatile RAM</b>                    | See <a href="#">NVRAM</a> .                                                                                                                                                                                                                                                                                                                                                 |
| <b>NTU</b>                                | Network terminating unit. The network equipment that connects directly to the data terminal equipment.                                                                                                                                                                                                                                                                      |
| <b>NVRAM</b>                              | Nonvolatile RAM. RAM that retains its contents when a unit is powered off.                                                                                                                                                                                                                                                                                                  |

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## O

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|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>OC</b>                           | Optical carrier. A series of physical protocols (OC-1, OC-2, OC-3, and so forth), defined for SONET optical signal transmissions. OC signal levels put STS frames onto fiber-optic lines at a variety of speeds. The base rate is 51.84 Mbps (OC-1); each signal level thereafter operates at a speed divisible by that number (thus, OC-3 runs at 155.52 Mbps). |
| <b>ODL</b>                          | Optical data link.                                                                                                                                                                                                                                                                                                                                               |
| <b>OIR</b>                          | Online insertion and removal. Feature that permits the addition, replacement, or removal of cards without interrupting the system power, entering console commands, or causing other software or interfaces to shut down. Same as hot-swapping.                                                                                                                  |
| <b>Online insertion and removal</b> | See <a href="#">OIR</a> .                                                                                                                                                                                                                                                                                                                                        |

**Optical carrier** See [OC](#).

**Optical fiber** See [Fiber-optic cable](#).

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## P

**Packet** Logical grouping of information that includes a header containing control information and (usually) user data. Packets are most often used to refer to network layer units of data. The terms datagram, frame, message, and segment are also used to describe logical information groupings at various layers of the OSI reference model and in various technology circles.

**Packet Over SONET** See [POS](#).

**Packet switching** Networking method in which nodes share bandwidth with each other by sending packets.

**Parallel Express Forwarding** See [PXF Network Processors](#).

**PCMCIA Flash disk card** A portable (credit-card size), nonvolatile storage device. PCMCIA flash disk cards use Flash technology to store data. PCMCIA stands for Personal Computer Memory Card International Association, which sets the standard for this technology. Also called PC card.

**PEM** Power entry module. A hardware module that distributes power to the chassis.

**Performance Routing Engine** See [PRE](#).

**Point of Presence** See [POP](#).

**Point-to-Point Protocol** See [PPP](#).

**POP** Point of presence. A physical location where an interexchange carrier installed equipment to interconnect with a local exchange carrier.

**POS** Packet Over SONET. A high-speed means of transmitting data over a SONET fiber-optic transmission system through a direct fiber connection to a data switch or router. POS is a point-to-point dedicated leased-line approach intended purely for high-speed data applications. POS allows a user organization to pass data in its native format, without the addition of any significant level of overhead in the form of signaling and control information.

**POST** Power-on self test. A set of hardware diagnostics that runs on a hardware device when that device is powered on.

**Power Entry Module** See [PEM](#).

**Power-on self test** See [POST](#).

**PPP** Point-to-Point Protocol. Provides router-to-router and host-to-network connections over synchronous and asynchronous circuits.

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|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PRE</b>                    | Performance routing engine. The central routing unit for the Cisco uBR10012 universal broadband router. The PRE performs all Layer 2 and Layer 3 packet manipulation related to routing and forwarding through the Cisco uBR10012 routers. Use dual PREs in a single chassis for redundancy. See also <a href="#">PXF Network Processors</a> . |
| <b>PXF Network Processors</b> | Parallel eXpress Forwarding network processors. A pair of programmable ASICs that perform parallel processing to support high performance Layer 3 forwarding.                                                                                                                                                                                  |

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## Q

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|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>QoS</b>                | Quality of service. A measure of performance for a transmission system that reflects its transmission quality and service availability.                                                                                                                                                                                                                                 |
| <b>QPPB</b>               | QoS Policy Propagation by BGP. A feature that classifies packets by IP precedence based on BGP community lists, BGP autonomous system paths, and access lists. After a packet is classified, other quality of service features such as committed access rate (CAR) and Weighted Random Early Detection (WRED) can specify and enforce policies to fit a business model. |
| <b>Quality of Service</b> | See <a href="#">QoS</a> .                                                                                                                                                                                                                                                                                                                                               |

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## R

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|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>RAM</b>                  | Random-access memory. Volatile memory that can be read and written by a microprocessor.                                                                                                                                                                                                                                                 |
| <b>Random Access Memory</b> | See <a href="#">RAM</a> .                                                                                                                                                                                                                                                                                                               |
| <b>Read only memory</b>     | See <a href="#">ROM</a> .                                                                                                                                                                                                                                                                                                               |
| <b>Redundancy</b>           | In internetworking, the duplication of devices, services, or connections so that, in the event of a failure, the redundant devices, services, or connections can perform the work of those that failed.                                                                                                                                 |
| <b>Remote monitoring</b>    | See <a href="#">RMON</a> .                                                                                                                                                                                                                                                                                                              |
| <b>Request for comments</b> | See <a href="#">RFC</a> .                                                                                                                                                                                                                                                                                                               |
| <b>RFC</b>                  | Request for comments. A document series used as the primary means for communicating information about the Internet. Some RFCs are designated by the IAB as Internet standards. Most RFCs document protocol specifications such as Telnet and FTP, but some are humorous or historical. RFCs are available online from numerous sources. |
| <b>RMON</b>                 | Remote Monitoring. MIB agent specification described in RFC 1271 that defines functions for the remote monitoring of networked devices. The RMON specification provides numerous monitoring, problem detection, and reporting capabilities.                                                                                             |
| <b>ROM</b>                  | Read only memory. Nonvolatile memory that can be read, but not written, by the microprocessor.                                                                                                                                                                                                                                          |

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**S**

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|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SAR</b>                                | Segmentation and reassembly. One of the two sublayers of the AAL common part convergence sublayer, responsible for dividing (at the source) and reassembling (at the destination) the protocol data units (PDUs) passed from the convergence sublayer. The SAR sublayer takes the PDUs processed by the convergence sublayer and, after dividing them into 48-byte pieces of payload data, passes them to the ATM layer for further processing. See also <a href="#">AAL</a> . |
| <b>SFP</b>                                | small formfactor pluggable (module) as in <a href="#">GBIC</a>                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Short reach</b>                        | See <a href="#">SR</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Simple Network Management Protocol</b> | See <a href="#">SNMP</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Single-mode fiber</b>                  | See <a href="#">SMF</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>SMF</b>                                | Single-mode fiber. Fiber-optic cabling with a narrow core that allows light to enter only at a single angle. Such cabling has higher bandwidth than multimode fiber, but requires a light source with a narrow spectral width (for example, a laser). Also called monomode fiber. See also <a href="#">Multimode fiber</a> .                                                                                                                                                   |
| <b>SNMP</b>                               | Simple Network Management Protocol. Network management protocol used almost exclusively in TCP/IP networks. SNMP provides a means to monitor and control network devices, and to manage configurations, statistics collection, performance, and security. See also <a href="#">SNMP2</a> .                                                                                                                                                                                     |
| <b>SNMP2</b>                              | SNMP Version 2. Version 2 of the network management protocol. SNMP2 supports centralized as well as distributed network management strategies, and includes improvements in the SMI, protocol operations, management architecture, and security. See also <a href="#">SNMP</a> .                                                                                                                                                                                               |
| <b>SONET</b>                              | Synchronous Optical Network. High-speed synchronous network specification developed by Bellcore and designed to run on optical fiber. STS-1 is the basic building block of SONET. It was approved as an international standard in 1988.                                                                                                                                                                                                                                        |
| <b>SR</b>                                 | Short reach. SONET/SDH specification for transmit power and receive sensitivity that achieves a 1.2-mile (2 km) reach.                                                                                                                                                                                                                                                                                                                                                         |
| <b>SRAM</b>                               | A type of RAM that retains its contents for as long as power is supplied. SRAM does not require constant refreshing, like DRAM. Compare with <a href="#">DRAM</a> .                                                                                                                                                                                                                                                                                                            |
| <b>Subrate DS3</b>                        | A generic term to describe a process in which the bandwidth of a clear channel DS3 is limited to a lower rate. Several proprietary formats exist.                                                                                                                                                                                                                                                                                                                              |
| <b>Synchronous Optical Network</b>        | See <a href="#">SONET</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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**T**

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| <b>T1</b> | Digital WAN carrier facility. T1 transmits DS1-formatted data at 1.544 Mbps through the telephone switching network. |
|-----------|----------------------------------------------------------------------------------------------------------------------|

|                                                              |                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>T3</b>                                                    | Digital WAN carrier facility. T3 transmits DS3-formatted data at 44.736 Mbps through the telephone switching network.                                                                                                                                                                                                                                           |
| <b>TAC</b>                                                   | A Cisco Technical Assistance Center. There are four TACs worldwide.                                                                                                                                                                                                                                                                                             |
| <b>TACACS</b>                                                | Terminal Access Controller Access Control System. Authentication protocol, developed by the DDN community, that provides remote access authentication and related services, such as event logging. User passwords are administered in a central database rather than in individual routers, providing an easily scalable network security solution.             |
| <b>TACACS+</b>                                               | Terminal Access Controller Access Control System Plus. Proprietary Cisco enhancement to Terminal Access Controller Access Control System (TACACS). Provides additional support for authentication, authorization, and accounting.                                                                                                                               |
| <b>TCC+</b>                                                  | See Timing, Communication, and Control Plus (TCC+) card.                                                                                                                                                                                                                                                                                                        |
| <b>TDM</b>                                                   | Time-division multiplexing. A technique in which information from multiple channels can be allocated bandwidth on a single wire based on preassigned time slots. Bandwidth is allocated to each channel regardless of whether the station has data to transmit.                                                                                                 |
| <b>Telcordia</b>                                             | Organization that performs research and development on behalf of the Regional Bell Operating Companies (RBOCs). Formerly called Bellcore.                                                                                                                                                                                                                       |
| <b>TELNET</b>                                                | Standard terminal emulation protocol in the TCP/IP protocol stack. Telnet is used for remote terminal connection, enabling users to log in to remote systems and use resources as if they were connected to a local system. Telnet is defined in RFC 854.                                                                                                       |
| <b>Terminal Access Controller Access Control System Plus</b> | See <a href="#">TACACS+</a> .                                                                                                                                                                                                                                                                                                                                   |
| <b>TFTP</b>                                                  | Trivial File Transfer Protocol. Simplified version of FTP that allows files to be transferred from one computer to another over a network.                                                                                                                                                                                                                      |
| <b>Time-division multiplexing</b>                            | See <a href="#">TDM</a> .                                                                                                                                                                                                                                                                                                                                       |
| <b>Timing, Communication, and Control Plus</b>               | The Timing, Communication, and Control Plus (TCC+) card in the Cisco uBR10012 chassis monitors the cable interface line cards and power supply usage, controls the LCD display on the front panel, and provides inputs for an external reference clock that is synced to a Stratum 1 source.                                                                    |
| <b>Traffic management</b>                                    | A technique for avoiding congestion and shaping and policing traffic. It allows links to operate at high levels of utilization by scaling back lower-priority, delay-tolerant traffic at the edge of the network when congestion begins to occur.                                                                                                               |
| <b>Traffic shaping</b>                                       | Use of queues to limit surges that can congest a network. Data is buffered and then sent into the network in regulated amounts to ensure that the traffic will fit within the promised traffic envelope for the particular connection. Traffic shaping is used in ATM, Frame Relay, and other types of networks. Also known as metering, shaping, or smoothing. |

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**U**

**UBR** See [Universal Broadband Router](#).

**Unchannelized DS3** See [Clear channel DS3](#).

**Unicast** A message sent to a single network destination. Compare with [Broadcast](#) and [Multicast](#).

**Universal Broadband Router** A Cisco Cable Modem Termination System (CMTS) and carrier-class router that provides broadband high-speed data, broadband entertainment, and IP telephony solutions over a coaxial cable network.

**Utility Card** Another name used in the software screens for the Timing, Communication, and Control Plus (TCC+) card.

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**V**

**Virtual Private Network** See [VPN](#).

**VLAN** Virtual LAN. A group of devices on one or more LANs that are configured (using management software) so that they can communicate as if they were attached to the same wire, when in fact they are located on a number of different LAN segments. Because VLANs are based on logical instead of physical connections, they are extremely flexible.

**VoIP** Voice over IP. Voice over IP enables a router to carry voice traffic (for example, telephone calls and faxes) over an IP network.

**VPN** Virtual private network. A secure, end-to-end private network constructed over a third-party or public network such as the Internet.

**VT-*n*** Virtual tributary level *n*. The SONET format for mapping a lower-rate signal into a SONET payload. For example, VT-1.5 is used to transport a DS1 signal. See also [DS1](#) and [SONET](#).

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**W**

**WAN** Wide-area network. A data communications network that serves users across a broad geographic area and often uses transmission devices provided by a common carrier (such as a telephone company or service provider).

**Weighted Fair Queuing** See [WFQ](#).

**Weighted Random Early Detection** See [WRED](#).

**WFQ** Weighted Fair Queuing. Congestion management algorithm that identifies conversations (in the form of traffic streams), separates packets that belong to each conversation, and ensures that capacity is shared fairly between these individual conversations. WFQ is an automatic way of stabilizing network behavior during congestion and results in better performance and fewer retransmissions.

**Wide-area network** See [WAN](#).

**WRED** Weighted Random Early Detection. RED uses an algorithm to randomly discard packets. The result of the drop is that the source detects the dropped traffic and slows its transmission. WRED combines the capabilities of the RED algorithm with IP precedence. This combination provides for preferential traffic handling for higher-priority packets. It can selectively discard lower-priority traffic when the interface starts to get congested and provide differentiated performance characteristics for different classes of service.

